LIFE SCIENCE

Supplemental Curriculum

Science Activities
in
English and Spanish

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This curriculum supplement represents a collaborative effort led by the New Mexico Museum of Natural History & Science that includes educators, scientists, and other professionals to provide teachers of English and Spanish-speaking students in grades K-8 with hands-on, auxiliary life science activities. The contents of this manual can be used as a framework to integrate inquiry-based activities into science teaching. This guide is part of the Museum's *Proyecto Futuro–Albuquerque* (Project Future) initiative, a multi-year collaboration between the New Mexico Museum of Natural History & Science and participating principals, teachers, parents, and students from the Albuquerque Public Schools. The New Mexico Museum of Natural History & Science has implemented *Proyecto Futuro* with the purpose of improving science and mathematics teaching and learning for elementary and middle school grades—by incorporating teacher professional development, bilingual curriculum materials, and family science workshops.

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INTRODUCTION

This supplemental life science curriculum is designed to be used in conjunction with other current science curricula and is intended to introduce K-8 students to biological concepts as well as encourage an interest in science in general. The activities in this manual were developed following local, state, and national science standards and benchmarks. Activities may be used to add inquiry-based and problem-solving approaches to the K-8 classroom; they are intended to give students hands-on experience with life science concepts while enhancing critical thinking skills.

General Layout

This supplemental curriculum begins with a general overview of life science. Subsequent sections of the curriculum are arranged in the hierarchical order of organisms used by taxonomists, beginning with fungi and continuing through invertebrates and vertebrates. The curriculum concludes with sections on the human body and ecology. The design of the curriculum includes a blend of elementary and middle school-level activities, indoor and outdoor activities, and activities that can be done individually, in small groups, or as a class. In many cases, there are suggestions for modifying the activities to different grade levels and to different classroom situations.

Activity Components

Considerable information is provided for the teacher within each activity. Please note that information that is provided primarily for the teacher's use is printed in English only. Information that the teacher may be distributing to students as well as key content and vocabulary is provided in both English and Spanish. Each section begins with background information, providing an overview of the content material for that section. Each of the activities contained in this supplemental curriculum contains the following components:

Purpose

The purpose is an overall description of the activity.

Materials

The materials section lists the materials needed to complete the activity.

Concepts (Also provided in Spanish.)

The concepts for each activity outline the principles students should learn while doing the activity.

Grades (Provided in the box at the top of each activity.)
The grades are a suggestion for what grade levels the activity may be appropriate for. With modifications, many activities can be used with older or younger students.

Group size (Provided in the box at the top of each activity.)
The group size is a suggestion for how to break up the class into groups for carrying out this activity and may be adjusted to fit the needs of the class and the teacher.

Time (Provided in the box at the top of each activity.)
Each activity includes an estimate of the time it will take to complete the activity. Some of the separate components of the activities can be completed over several days or weeks.

Safety
When there are safety issues, they will be listed in this section.

Vocabulary (Also provided in Spanish.)
Key words are listed in this section and highlighted throughout the text of the activity.

In Advance
This section describes the preparations you will need to make before introducing the activity.

Procedure
The procedure section is a step-by-step guide to presenting and conducting the activity.

Questions to Ask During the Activity (Also provided in Spanish.)
This section contains several questions to guide students' actions and thinking processes while doing the activity.

Why It Happens/More on the Topic (Also provided in Spanish.)
In this section you will find explanations of what is occurring during the activity. This section also might contain additional background information pertaining to the activity.

Modifications
The modifications section contains suggestions for how to change the activity for different grade levels or for different situations.

Extensions

The extensions section contains ideas for further investigation of the activity's topic.

References

The references are the sources of information used in the activity or additional resources that can be used by the teacher.

TEACHING TIPS

The *Proyecto Futuro* Life Science Curriculum is designed to provide educators with an assortment of flexible and stimulating activities. To maximize the effectiveness of the curriculum, review the following tips for integrating cooperative learning techniques, incorporating outdoor learning experiences, and working with all types of students.

Cooperative Learning

Many of the activities in the curriculum rely on cooperative learning principles. It has been shown that students can benefit from working in groups in several ways. Cooperative learning boasts academic achievement, helps students learn how to work together effectively, and increases the self-respect and self-direction of individual students. These improvements are particularly noticeable in students with limited English skills and in low achievers. The following tips will help you make the most of the cooperative learning strategy.

1. When assigning teams, be sure to include a diversity of learners. Consider achievement levels, language skills, learning styles, gender, and ethnicity.

2. Tell students that they should first try to solve problems and ask questions within their group before seeking help from the teacher.

3. Encourage students to work with their group, but also let them know that they are responsible for their own work.

4. Sometimes it will work best to assign roles within each group. Examples of roles include: the materials monitor to gather materials for the activity, a recorder to keep track of data and ideas, a reporter to report the group's findings to the class, a reader to read activity directions, and a time keeper to help the team complete tasks on time.

5. Establish and use a signal to gain attention of the class when necessary.

6. Monitor the groups throughout the activity to make sure they are on task and to assist with questions or problems. Your role should be as facilitator or consultant rather than instructor.

Teaching Outdoors

Teaching and working outdoors presents some different challenges from working indoors. The boundaries are not as clear, there are many background noises, and there are potential hazards. Here are some tips for making your outdoor excursion a safe and positive learning experience.

1. Discuss with students the importance of respecting plants and animals outdoors. Students should not touch unfamiliar plants or animals—they can be harmful. When observing or collecting plants and animals, students should disturb the area as little as possible. Rare plants or animals should not be collected.

2. Explain the activity and rules for working outside as much as possible before leaving the classroom. It will be harder for students to hear and to focus once you are outside.

3. Be sure to bring all the supplies you will need. It will not be easy to return to the classroom during the activity.

4. Once you are outside, identify the boundaries where students will be working. For instance, you may not want students to be out of view or playing on the playground equipment. Also consider directing students to areas where they will have the most success completing the activity.

5. Have a signal that can be used to get the attention of your students. Using a whistle, clapping your hands, or raising your arm are some possibilities.

Students with Special Needs

The activities in this curriculum can be modified to work with a variety of students. Here are some suggestions:

1. Try grouping a bilingual student with a student who has limited English proficiency. Write key words on the chalkboard—sometimes the words from different languages look similar when written. Use pictures, diagrams, and demonstrations to explain instructions when possible.

2. Students with visual impairments may be given oral instructions or a copy of the activity with enlarged print.

3. Students with mobility impairments may be paired with a non-disabled partner when necessary.

4. With gifted students, allow extra time for questions and further investigation.

TEACHER BACKGROUND INFORMATION

Scientific Inquiry: Observation and the Scientific Method

In many ways, your students are probably already experts at noticing things that adults pass by. But, while many kids will notice obvious characteristics of objects, observing in the life sciences will require them to hone their **observation** skills. All five senses will be needed: sight, hearing, taste, touch, and smell. And once their observations are made, they will need to analyze and describe them in greater detail. Observation is one of the most important scientific skills and the first step in the **scientific method**.

The scientific method is a set of steps used to systematically test ideas and find answers to questions. The steps of the scientific method include:

1) making an observation
2) formulating a **hypothesis**
3) designing and conducting an **experiment** to test the hypothesis
4) recording the results–often with a table or graph
5) forming a **conclusion**

[A simplified version of the steps in the scientific method for younger students is: Guess, Test, and Tell. Beginning with a problem, students propose a guess. Then they proceed to design a test for proving whether their guess is correct or not. After they have tested their guess, they tell the class their results.]

In some cases, an observation is made by chance. Other times, a scientist seeks more information by doing library research or by talking with others. Regardless of how the observations are made, a question eventually forms and the scientist can begin taking steps to find an answer. Examples of some biological questions are: "At what temperature do lizards become inactive?" "How fast do hummingbirds fly?" "What type of seed does a house finch like?"

The next step is to form a hypothesis based on the original observations. A hypothesis is a statement of a "best guess" answer to a question, or a prediction. It is important that the hypothesis is measurable. For example, after observing the feeder in your back yard, you might hypothesize that house finches like sunflower seeds. While we can't ask a finch which kind of seed it likes best, we can count the number and kind of seeds finches choose to eat at a feeder. So, a more testable hypothesis would be "house finches eat mostly sunflower seeds."

Next, the hypothesis is tested with an experiment. The easiest hypothesis to test is one with a "yes" or "no" answer or result. For example, you could give house finches sunflower seeds and another kind of seed, and then count how many of each kind the finches eat. The results of an experiment should either support or falsify the hypothesis. For example, if 80% of the seeds the house finches ate were sunflower seeds, the hypothesis would be supported in this case.

The experiment might not always provide an answer to the hypothesis, though. Sometimes new questions arise. Frequently one trial of the experiment is not enough. What if you conducted your experiment by observing only one house finch on one day? Would you be able to conclude that house finches eat mostly sunflower seeds? Probably not. But if you were to observe 20 house finches, you might be able to predict that other groups of house finches under the same conditions would also eat mostly sunflower seeds. Each time you conduct your experiment under the same conditions, it is referred to as a **replicate**.

When designing an experiment, it is also important to have a **control**. A control is the "measuring stick" that can be used as a comparison for experiment results. The control for the house finch study is a seed other than the sunflower seeds. If the only choice the house finch had was sunflower seeds (no control) it would be impossible to know whether house finches prefer sunflower seeds or just ate them when nothing else was available.

The **experimental variable** is the portion of the experiment that is used to test the hypothesis. It is important that there be only one difference between the variable and the control. If there is more than one variable, it's difficult to tell which variable caused the results. For example, if you provided the finches with three different kinds of seeds—small sunflower seeds, large sunflower seeds, and large thistle seeds—and they chose the small sunflower seeds, it would not be clear whether the size of the seed was more important than the kind of seed. It is important to make sure that all the conditions between the control and variable are equal except the one attribute being tested.

One of the most important features of a scientific experiment is that results can be duplicated each time the experiment is conducted. This helps ensure that the results are not just one-time, chance events. For instance, in the house finch experiment, it would be important to conduct the experiment under the same weather conditions, at the same time of year, in the same type of habitat, using the same type of feeders. The results of the experiment should be similar with each trial before a final conclusion can be made.

Finally, it is tempting to conclude that a hypothesis is “proven true” when the experiment results confirm the hypothesis. In science, however, results either support or falsify the hypothesis rather than prove it. It is always assumed that future experiments could change our ideas about what is true and what is false. For example, the same house finch experiment could be conducted during a different season of the year and we could find that house finches only prefer sunflower seeds in the summer, but not in the winter. This new data would only partially support the original hypothesis.

Often students are disappointed when their hypothesis is not supported by experiment results. But there are no wrong or right answers when an experiment is designed and conducted well. Some of the most important discoveries occur when an experiment generates more questions rather than supporting the original hypothesis. In fact, some of the most interesting scientific breakthroughs have been purely accidental! Emphasizing this point with students will give them the freedom to think more creatively, to ask questions, and to experiment without fear of “failure.”

Record Keeping and Journals

Scientists often keep records of their observations. Sometimes the records are in the form of numbers in a table, drawings in the margins of a page, or written thoughts about their research topic. Record keeping in all of its forms allows a scientist to discover patterns and make connections between separate observations. Keeping a science journal can do the same for your students. Journal writing during and after activities will help sharpen their writing, reading, and communication skills, and will help them discover patterns and connections as they work their way through the activities. Many of the activities in this curriculum provide a Student Activity Sheet for students to record their observations and data. Encourage your students to keep an ongoing journal where they can enter their thoughts on the activities they are doing in the classroom and how they apply to their “real world” experiences.

Introduction to
LIFE SCIENCE

BACKGROUND INFORMATION—LIFE SCIENCE

Characteristics of Living Things

Living things (**biotic**) have a number of characteristics that make them different from non-living (**abiotic**) things.

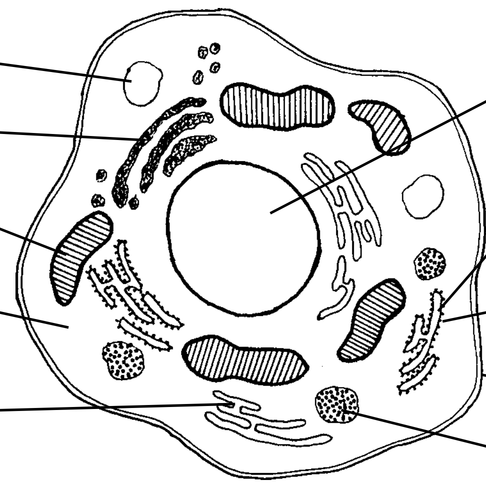
- They are made of one or more **cells**.
- Living things have structures that perform specific functions.
- Living things maintain an internal environment. The internal environment can be that of a single cell or that of an entire multi-cellular organism.
- Living things require and use energy. The energy is used to carry out life functions.
- Life functions of living things can include respiration, excretion, movement, and growth.
- Living things reproduce, passing along genetic information to future generations.
- Living things change over time, or evolve.

If an object does not have all these characteristics, it is not living. For example, light bulbs use energy and have an organized structure, but they do not move, respire, or reproduce. A marine sponge does not appear to move, but it does move during its early development and only later attaches itself to the sea floor or some other stationary object.

While all living things have these characteristics in common, there are seemingly infinite variations on the theme. These variations give us the enormous diversity of life on Earth today—perhaps between 10 and 100 million different **species**. To date, only about 1.4 million of these species have been identified.

The Cell

A cell is the smallest structural unit of life that is capable of functioning independently. In fact, cells are so small you could fit 9,000 of them, side by side, between the millimeter dashes on a ruler! Naturalists Robert Hooke and Anton van Leeuwenhoek were the first to view the microscopic world in the mid-1600s. It was Hooke who coined the term “cell” to describe the room-like partitions that he observed in cork through his microscope.



All living things are made up of one or more cells, but not all cells are the same. For example, protist cells are very different from human nerve cells, which are very different from blood cells. However, there are some basic similarities among all cells. These characteristics allow cells to carry out their basic functions of 1) interacting with their environment, 2) harnessing energy, and 3) digesting and storing food.

The **cell membrane** surrounds the outside of the cell. It is a thin layer made up of chemical compounds that act as a guard and gate to the inside of the cell. The cell membrane is **semi-permeable**, allowing only certain chemicals to enter or leave the cell.

The inside of the cell contains **cytoplasm**. Cytoplasm is a viscous fluid that acts as the cell's "blood" by transporting food and other chemicals from one part of the cell to the other. Other parts of the cell are also anchored to the cytoplasm. The **nucleus** and the **mitochondria** are two of the structures that can be found in the cytoplasm. The nucleus houses the genetic instructions (genes made up of DNA) for the cell. These genetic instructions determine the type of cell (nerve, blood, or protist) and how it will function. The mitochondria are the "power plants" for the cell, where food is turned into energy that the cell can use.

Lysosomes are another structure found in the cytoplasm. Lysosomes contain the enzymes used to break down food and discard waste products produced by chemical reactions in the cell. When the food is digested, the products are passed to the **vacuoles**. Vacuoles are also important in regulating water balance within the cell. For example, in plants, vacuoles help keep the plant stiff and rigid. When the vacuoles lose too much water, the plant wilts.

Change and Adaptation

Organization and order is one characteristic of living organisms, but change is the rule. Change occurs at several different biological levels. It occurs at the level of the individual organism, within groups of organisms, and within ecosystems. For instance, an individual organism changes as it grows and matures. A newborn wolf is different in shape, size, and behavior from that of an adult wolf. This kind of change is one part of the organism's **life cycle**. A life cycle is the combination of birth, growth, life, and death. Changes in individuals can be drastic, such as the complete changing of body form called **metamorphosis**. Metamorphosis occurs in butterflies and frogs, for example. Other changes are subtle, such as a ruby-throated hummingbird increasing its fat reserves for migration.

Change also takes place at the genetic level of individuals and their offspring. One type of genetic change is the process of **mutation**. A mutation is a change in the make up, or arrangement, of the genetic "instructions" for an organism. Sometimes mutations help an individual to survive better in its environment. Other mutations make it more difficult for an organism to survive. And still others are simply neutral and do not affect survival one way or another.

When an animal reproduces, another kind of genetic change takes place. This change occurs during **meiosis**, a type of cell division that occurs in sex cells. Parental genes, or traits, on the cells are halved when new sex cells are made. When a male and female reproduce, the halved male and female sex cells come together to form the offspring. That offspring displays a combination of physical traits from both parents. For example, you might have your mother's eye color and your father's curly hair. But, the combination of all the traits is different from either parent. Some traits may have been "hidden" in the parents' genetic makeup, but because of the "shuffling," those traits may show up in the offspring. In this way, change has occurred at the genetic level from one generation (the parents) to the next (the offspring).

Since organisms must reproduce in order for life to continue, survival and successful reproduction are paramount. If a mutation or trait helps an organism survive, the organism is more likely to reproduce and pass its genetic information to its offspring. If a mutation or trait is detrimental, the organism is less likely to survive and reproduce. Without reproduction and birth, the individual's genetic information will not be passed on. The more beneficial a trait is for survival and reproduction, the more likely that trait will persist in future generations. In other words, those traits are "selected" in the population. This process is called **natural selection** and results in **biological adaptation**. If an organism faces changes in its environment and a particular trait is selected, then the organism is said to have adapted to the environment. Biological adaptation occurs at the genetic level and requires at least one reproductive cycle. Over time, groups of organisms **evolve** because of natural selection and adaptation.

It is sometimes difficult to convey to students that natural selection and biological adaptation are not deliberate acts. However, teachers must be very careful to describe the evolutionary process accurately. Organisms do not "want" to adapt or "decide" to select certain genetic traits. Likewise, the environment does not "create" traits or characteristics at the genetic level. The environment is only the testing ground for the existing genetic characteristics of an individual.

Classification in the Life Sciences

Biologists have looked to the past to understand how today's organisms live and interact with each other and their environment. Biologists "map" these associations by first studying the similarities among modern organisms and fossils. By determining the age of the rocks where fossils are found, scientists have learned when in Earth's history different organisms lived. Fossil records show the order in which animals developed over millions of years. This information is represented in a historical time line of organisms, called a **geologic time line** (Table 1). Biologists use this information to study how modern organisms are related to one another and to help them organize and classify groups of organisms.

Now, imagine keeping track of 8,000 different kinds of birds or over 20,000 kinds of insects! What about classifying 1.4 million different types of living organisms? In order for biologists to make sense of all the different kinds of organisms, they group them with other similar organisms. In this way, biological information is organized much like a supermarket organizes its produce or a library organizes books. Scientific classification categorizes organisms into groups of similar organisms, but it also takes into account how those organisms are related to one another. Biologists who specialize in classification are called **taxonomists**.

Taxonomists group organisms into large, general categories called **kingdoms**. The kingdom concept is similar to categorizing library books into fiction and non-fiction.

Table 1—Geologic Time Line

ERA	PERIOD	MILLIONS OF YEARS AGO (APPROX.)	MAJOR EVOLUTIONARY EVENTS
Cenozoic	Quaternary	0 to 1.8	Humans evolve
	Tertiary	1.8 to 65	Mammals and birds dominant
Mesozoic	Cretaceous	65 to 144	First placental mammals Flowering plants dominant
	Jurassic	144 to 200	First birds First flowering plants
	Triassic	200 to 251	First mammals First dinosaurs
Paleozoic	Permian	251 to 295	Cone-bearing plants dominant
	Carboniferous	295 to 355	First reptiles First seed plants
	Devonian	355 to 410	First amphibians First seeds (plants)
	Silurian	410 to 435	First fossil plants First jawed fish
	Ordovician	435 to 500	Algae dominant First fungi
	Cambrian	500 to 540	First vertebrates Simple invertebrates
Precambrian	Precambrian	Before 540	Life diversifies Eukaryotes Prokaryotes Origin of Life

Table 2—Characteristics of the Four Kingdoms of Eukaryota

KINGDOM	MAJOR MODE OF FEEDING	MOTILITY (MOVEMENT)
Protista	Absorb, ingest, or photosynthesize	Both motile and non-motile
Fungi	Absorb	Generally non-motile
Plantae	Photosynthesize	Generally non-motile
Animalia	Ingest	All motile at some stage

There are currently four recognized kingdoms: protists (Protista), fungi (Fungi), plants (Plantae), and animals (Animalia) (Table 2). Older texts often include a fifth kingdom, the Monera, which includes bacteria. However, as biologists learned more about bacteria, they discovered they were very different from all other organisms—so different, that bacteria are now included in a new category called a domain. The three domains are the Bacteria domain; the Eukaryota domain, which includes four kingdoms (protists, fungi, plants, and animals); and a new domain, called Archaea, which includes bacteria-like organisms with a genetic makeup that is very different from bacteria.

Just as the fiction category in the library includes mysteries, westerns, and romantic novels, kingdoms also include other categories of organisms. Beneath the kingdom, the categories are arranged in descending order or in a hierarchy (Table 3). This means that the categories at each level contain all the organisms in the categories below. The top of the hierarchy contains larger groups of organisms that are similar, but not necessarily closely related. For example, humans, porcupines, and black bears are all mammals, but are only distantly related. They share the same categories at the top levels: kingdom Animalia, phylum Chordata and class Mammalia. But, humans belong to the Order Primates, porcupines belong to the Order Rodentia, and black bears belong to the Order Carnivora.

The increasingly smaller categories contain organisms that are more similar and more closely related. For example, wolves, bears, and cougars are all meat eaters and belong to the order Carnivora. Even more closely related are dogs, wolves, and coyotes,

Table 3—Hierarchy of Categories

SAMPLE ANIMALS	Bald Eagle	Humans	Porcupine	Black Bears	Crocodile (American)	Domestic Dogs
KINGDOM	Animalia	Animalia	Animalia	Animalia	Animalia	Animalia
PHYLUM	Chordata	Chordata	Chordata	Chordata	Chordata	Chordata
CLASS	Aves	Mammalia	Mammalia	Mammalia	Reptilia	Mammalia
ORDER	Falconi-formes	Primates	Rodentia	Carnivora	Crocodylia	Carnivora
FAMILY	Accipit-ridae	Hominidae	Erethi-zontidae	Ursidae	Crocodylidae	Canidae
GENUS	*Haliaeetus*	*Homo*	*Erethizon*	*Ursus*	*Crocodylus*	*Canis*
SPECIES	*leuco-cephalus*	*sapiens*	*dorsatum*	*americanus*	*acutus*	*familiaris*

which all belong to the genus Canis. This system of scientific classification helps biologists organize the vast quantity of organisms that have been identified. It also makes the huge job of sorting through and classifying the vast array of newly discovered organisms much easier!

Naming Species

When identifying each individual species, scientists use a naming system developed by Carolus Linnaeus in the 1700's. **Binomial nomenclature** is a system that uses two Latin names to identify the genus and species of each organism. These scientific names are used worldwide by scientists and they help eliminate the confusion sometimes caused when a species has multiple common names in several different languages. An organism's scientific name is always italicized or underlined. The genus name always begins with a capital letter, but the species name is always lower case. For example, the scientific name for humans is written: Homo sapiens or *Homo sapiens*. Homo is the name of the genus, and sapiens is the name of the species. These basic rules, once learned, make the exchange of information between biologists clear and concise.

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INFORMACIÓN BÁSICA—LAS CIENCIAS DE LA VIDA

Características de los seres vivos

Los seres vivos (**bióticos**) tienen varias características que los distinguen de los objetos no vivos (**abióticos**).

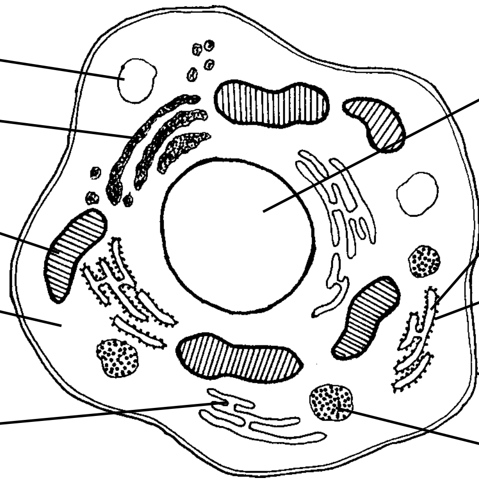
- Están compuestos por una o más **células.**
- Los seres vivos tienen estructuras que realizan funciones específicas.
- Los seres vivos tienen un medio interno. Este medio interno puede ser una sola célula o puede tratarse de un organismo multicelular.
- Los seres vivos necesitan y utilizan energía. Esta energía se usa para realizar funciones vitales.
- Las funciones vitales de los seres vivos abarcan, entre otras, la respiración, la excreción, el movimiento y el crecimiento.
- Los seres vivos se reproducen y pasan información genética a las generaciones futuras.
- Los seres vivos cambian o evolucionan a través del tiempo.

Si un objeto no tiene todas estas características, no se lo considera un ser vivo. Por ejemplo, una bombilla de luz usa energía y tiene una estructura organizada pero no se mueve, ni respira ni se reproduce. Una esponja de mar no parece moverse, pero en realidad se mueve durante la primera etapa de su desarrollo y sólo en una etapa posterior se adhiere al fondo del mar o a algún otro objeto estacionario.

Aunque todos los seres vivos tienen estas características en común, parece haber un número infinito de variaciones sobre el tema. De estas variaciones emana la enorme diversidad de tipos de vida que existen en la Tierra en la actualidad—quizás entre 10 y 100 millones de **especies** diferentes. Hasta ahora, se han identificado 1.4 millones de especies.

La célula

La célula es la unidad estructural viviente más pequeña que existe, capaz de funcionar independientemente. De hecho, las células son tan pequeñas que podrías ubicar 9,000 de ellas, una al lado de la otra, en el espacio que ocupa ¡un milímetro en una regla! Los naturalistas Robert Hooke y Anthony von Leeuvenhoek fueron los primeros en ver el mundo microscópico, a mediados de los años mil seiscientos. Hooke fue quien



acuñó el término “célula” (del latín *cellulla*: celdilla) para describir las pequeñas celdas que vio en un corcho a través de su microscopio.

Todos los seres vivos están compuestos de una o más células, pero no todas las células son iguales. Por ejemplo, las células de los protistas son muy diferentes de las células del sistema nervioso de los seres humanos y a la vez, muy diferentes de los glóbulos rojos. Sin embargo, existen similitudes entre todas las células. Estas características permiten a las células llevar a cabo sus funciones básicas 1) interactuar con el medio ambiente, 2) aprovechar energía, digerir y acumular alimentos.

La **membrana celular** rodea a la célula por afuera. Es una capa delgada formada por sustancias químicas que actúan como guardián y puerta de entrada hacia el interior de la célula. La membrana es **semipermeable** y sólo permite que cierto tipo de químicos entren o salgan de la célula.

El interior de la célula contiene **citoplasma**. El citoplasma es un fluido viscoso que actúa como si fuera la “sangre” de la célula, transporta alimentos y otras sustancias químicas de una parte de la célula a la otra. Otras partes de la célula también están ancladas al citoplasma. El **núcleo** y la **mitocondria** son dos de las estructuras que se encuentran en el citoplasma. La información genética (los genes están compuestos por ADN) está dentro del núcleo de la célula. Esta información genética determina qué tipo de célula será (nerviosa, sanguínea o protista) y cómo funcionará. La mitocondria es la “planta de energía” de la célula, donde los alimentos se transforman en la energía que usa la célula.

Otra estructura que se encuentra dentro del citoplasma son los **lisosomas**. Éstos contienen las enzimas que degradan los alimentos y eliminan los desechos producidos por las reacciones químicas dentro de la célula. Cuando los alimentos se digieren, los productos pasan a las **vacuolas**. Las vacuolas también son importantes para regular el agua dentro de la célula. Por ejemplo, las vacuolas de la planta la ayudan a que permanezca erguida y rígida. Cuando las vacuolas pierden mucha agua, la planta languidece.

Cambios y adaptaciones

Una de las características de los seres vivos es la organización y el orden, pero es el cambio lo que prevalece. El cambio ocurre a distintos niveles biológicos. Ocurre en organismos individuales, en grupos de seres vivos y en ecosistemas. Por ejemplo, un ser vivo cambia al crecer y madurar. Un lobo recién nacido tiene forma, tamaño y comportamiento diferentes de los de un lobo adulto. Este tipo de cambio es una de las partes del **ciclo vital** del organismo. El ciclo vital es una combinación de nacimiento, crecimiento, vida y muerte. Los cambios que sufren algunos individuos pueden parecer drásticos, por ejemplo la transformación total de la forma del cuerpo llamado **metamorfosis**. La metamorfosis ocurre en animales tales como las mariposas y las ranas. Hay otros cambios más sutiles, por ejemplo, el colibrí de pecho rojo que acumula reservas de grasa para utilizar durante el proceso migratorio.

Las transformaciones a nivel genético también ocurren en los individuos y en su progenie. Un tipo de cambio genético proviene de las **mutaciones**. Una mutación es un cambio en la organización o configuración de la "información" genética de un organismo. A veces las mutaciones ayudan a que un individuo pueda sobrevivir más facilmente en su medio ambiente. Otras mutaciones dificultan la supervivencia del organismo. Y, otras mutaciones son simplemente neutrales y no afectan la supervivencia de manera alguna.

Otro tipo de cambio genético ocurre con la reproducción de los animales. Este cambio se observa durante la **meiosis**, un cierto tipo de división celular que ocurre en las células sexuales. Los genes de los padres, es decir los rasgos que están impresos en las células se dividen por la mitad cuando se forman nuevas células sexuales. Cuando un macho y una hembra se reproducen, la mitad de las células sexuales masculinas y la mitad de las células femeninas se juntan para formar el nuevo ser. Ese nuevo ser tiene una combinación de características físicas de ambos padres. Por ejemplo, tú puedes tener el color de ojos de tu madre y el cabello rizado de tu padre. Pero, la combinación de todos estos rasgo será diferente a ambos padres. Algunos rasgos pudieron haber permanecido “escondidos” dentro de la estructura genética de los padres pero como se “mezclan” todos otra vez, es posible que resurjan en el nuevo ser. De esta manera, un cambio al nivel genético ocurre de generación (los padres) a generación (los hijos).

Ya que la mayoría de estos seres vivos se reproducen para que la vida continúe, la supervivencia y la reproducción exitosa tienen suprema importancia. Si alguna mutación o algún rasgo ayuda a que el ser vivo sobreviva, este organismo tiene más posibilidades de reproducirse y de pasar este rasgo genético a su progenie. Si esta mutación o rasgo genético es perjudicial, entonces el organismo tendrá menos posibilidades de sobrevivir y reproducirse. Sin reproducción y nacimiento, la información genética del individuo no pasará a otras generaciones. Cuanto más beneficioso sea el rasgo para la supervivencia y la reproducción, tanto más probable es que ese rasgo persista y se transmita a futuras generaciones. En otras palabras, esas son las características “seleccionadas” para esa población. Este proceso se llama **selección natural** y el resultado es la **adaptación biológica**. Si un ser vivo se enfrenta con cambios en el medio ambiente y “selecciona” esa característica en particular, entonces se dice que ese ser vivo se ha adaptado al medio ambiente. La adaptación biológica ocurre al nivel genético y requiere que, por lo menos, se produzca un ciclo reproductivo. A través del tiempo, los grupos de seres vivos **evolucionan** debido a la selección natural y a la adaptación.

A veces es fácil confundirse y pensar que la selección natural y la adaptación biológica son acciones deliberadas. Sin embargo, las maestras deben prestar atención y describir el proceso evolutivo con precisión. Los organismos ni “desean” ni “deciden” seleccionar determinados rasgos. De la misma manera, el medio ambiente no “crea” los rasgos o las características genéticas. El medio ambiente es sólo el lugar donde se prueban las características genéticas de cada individuo.

Ciencias de la vida: clasificación

Los biólogos estudian el pasado para entender cómo viven los organismos actuales y cómo interactúan entre ellos y con el medio ambiente. Los biólogos hacen “mapas” de estas asociaciones estudiando, primero, las similitudes entre organismos modernos y fósiles. Los científicos han aprendido en qué momento de la historia de la Tierra han habitado los diferentes organismos, fechando las rocas en donde se han encontrado dichos fósiles. La información recolectada sobre fósiles muestra el orden cronológico

Cuadro 1—Línea temporal geológica

ERA	PERÍODO	HACE CUÁNTOS MILLIONES DE AÑOS (APROX.)	PRINCIPALES ACONTECIMIENTOS EVOLUTIVOS
Cenozoica	Cuaternario	0–1.8	Aparece el ser humano
	Terciario	1.8–65	Los mamíferos y las aves dominan
Mesozoica	Cretácico	65–144	Primeros mamíferos con placenta, las plantas con flores dominan la flora
	Jurásico	144–200	Primeras aves Primeras plantas con flores
	Triásico	200–251	Primeros mamíferos Primeros dinosaurios
Paleozoica	Pérmico	251–295	Las plantas coníferas dominan la flora
	Carbonífero	295–355	Primeros reptiles Primeras plantas de semillas
	Devónico	355–410	Primeros anfibios Primeras semillas (plantas)
	Silúrico	410–435	Primeras plantas fosilizadas Primeros peces mandibulados
	Ordovícico	435–500	Dominan las algas Primeros hongos
	Cámbrico	540–540	Primeros vertebrados Invertebrados simples
Precámbrica	Precámbrico	Anterior a 540	La vida se diversifica Eucariotes Procariotes El orígen de la vida

Cuadro 2—Características de los cuatro reinos de los eucariota

REINO	FORMA DE ALIMENTACÍON	MOTILIDAD (MOVIMIENTO)
Protista	Absorción, ingestión o fotosíntesis	Tanto móvil como estacionario
Fungi	Absorción	Generalmente estacionario
Plantae	Fotosíntesis	Generalmente estacionario
Animalia	Ingestión	Todos móviles en alguna etapa

en que los animales se desarrollaron a través de millones de años. Esta información se puede ver en la línea histórica temporal de los seres vivos, o **línea geológica de tiempo** (Cuadro 1). Los biólogos utilizan esta información para estudiar la relación de los seres vivos modernos entre ellos y para organizar y clasificar los organismos en grupos.

Ahora, ¡imagínate llevar la cuenta de 8,000 especies diferentes de aves o de 20,000 tipos de insectos! ¡Y, piensa en clasificar 1.4 millones de seres vivos diferentes! Para que los biólogos puedan organizar y extraer información de todos los distintos tipos de organismos, los agrupan con otros seres vivos similares. De esta manera, la información biológica se organiza de manera parecida a la de los productos frescos en un supermercado o a la de los libros en una biblioteca. La clasificación científica ubica a los organismos en categorías con características similares, pero también toma en consideración la relación entre ellos. Los biólogos que se especializan en la clasificación de organismos se llaman **taxónomos.**

Los taxónomos agrupan a los organismos en categorías generales y amplias llamadas **reinos**. El concepto de reinos tiene similitud con la categorización de libros en las bibliotecas: literatura novelística y no novelística (historia, biografías, ensayos, etc.). Actualmente existen cuatro reinos reconocidos: protistas (Protista), hongos (Fungi), plantas (Plantae) y animales (Animalia) (Cuadro 2). Los textos más antiguos hablan de un quinto reino que incluye las bacterias, el reino Monera. Sin embargo, a medida que los biólogos descubrieron más sobre el tema, se dieron cuenta que las bacterias son muy diferentes de otros seres vivos—tan diferentes, que en la actualidad las bacterias se incluyen en una categoría llamada dominio. Los tres dominios son el Bacteriano, el Eucariota que incluye los cuatro reinos (protista, hongos, plantas y animales) y un nuevo dominio llamado Archaea, que se creó cuando se descubrieron organismos del tipo de las bacterias pero con una composición genética muy diferente a la de las bacterias.

De la misma manera que la categoría de novelas de la biblioteca incluye novelas policíacas, del lejano oeste y románticas, los reinos también incluyen categorías de seres vivos. Bajo el rótulo de reino, las categorías se organizan en orden de jerarquía descendente o ascendente (Cuadro 3). Esto significa que las categorías a cada nivel contienen todos los seres vivos de las categorías inferiores. El punto más alto de la jerarquía contiene grupos más amplios de seres vivos que son similares, pero no necesariamente relacionados. Por ejemplo, el ser humano, el puerco espín y el oso negro son todos mamíferos, pero no son parientes cercanos. Comparten las mismas categorías al nivel más alto de la jerarquía: reino Animalia, filo Chordata y clase Mammalia. Pero, el ser humano pertenece a la orden de los Primates, el puerco espín pertenece a la orden de los Rodentia y el oso negro pertenece a la orden de los Carnivora.

Las categorías se hacen cada vez más pequeñas y a medida que se reducen contienen seres vivos cada vez más similares y más relacionados. Por ejemplo, tanto los lobos, como los osos y los pumas comen carne y pertenecen a la orden de los Carnívora. Pero los perros, los lobos y los coyotes tienen una relación más cercana; todos pertenecen al género Canis. Este sistema de clasificación científica ayuda a que los biólogos organicen la amplia variedad de seres vivos que han identificado. ¡Además facilita el increíble trabajo de clasificar la gran gama de organismos que se siguen descubriendo!

Los nombres de las especies

Los científicos usan un sistema, inventado por Carolus Linnaeus en los años mil setecientos, que permite asignarle un nombre a cada una de las especies que identifican. La **nomenclatura binomial** es un sistema que utiliza dos nombres en latín para identificar el género y la especie de cada organismo. En el mundo de las ciencias se usan estos nombres científicos para evitar las confusiones que provienen de dar múltiples nombres comunes a cada especie en distintos idiomas. El nombre

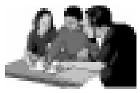
Cuadro 3—Jerarquías dentro de las categorías

EJEMPLO DE ANIMALES	Águila calva	Ser Humano	Puerco espín	Oso negro	Cocodrilo (americano)	Perros domésticos
REINO	Animalia	Animalia	Animalia	Animalia	Animalia	Animalia
FILO	Chordata	Chordata	Chordata	Chordata	Chordata	Chordata
CLASE	Aves	Mammalia	Mammalia	Mammalia	Reptilia	Mammalia
ORDEN	Falconi-formes	Primates	Rodentia	Carnivora	Crocodylia	Carnivora
FAMILIA	Accipit-ridae	Hominidae	Erethi-zontidae	Ursidae	Crocodylidae	Canidae
GÉNERO	*Haliaeetus*	*Homo*	*Erethizon*	*Ursus*	*Crocodylus*	*Canis*
ESPECIE	*leuco-cephalus*	*sapiens*	*dorsatum*	*americanus*	*acutus*	*familiaris*

científico de un ser vivo siempre se pone en letra cursiva o se subraya. El nombre del género siempre se escribe con mayúscula al principio pero el nombre de la especie se escribe con letra minúscula. Por ejemplo, el nombre científico para los seres humanos se escribe: Homo sapiens u *Homo sapiens*. Homo es el nombre del género y sapiens es el nombre de la especie. Una vez que se aprenden esas reglas básicas, el intercambio de información entre científicos resulta claro y conciso.

QUESTIONS, OBSERVATIONS, AND HYPOTHESES

Preguntas, observaciones e hipótesis

Grades		
3-8	*Whole Class*	*45–60 min.*

Purpose

Students will practice asking questions, observing a living organism, inferring how that organism lives, and developing hypotheses based on their observations.

Materials

Living organisms such as ants, toads, fish, crickets, or worms
Hand lenses (optional)
Rulers (optional)

Concepts

- Observation is an important scientific skill.
- The scientific method is a set of steps used to systematically test ideas and find answers to questions

Conceptos

- La observación es una técnica científica muy importante.
- El método científico es un conjunto de etapas que se usan sistemáticamente para comprobar ideas y para buscar respuestas.

Safety

Students should wash their hands after handling organisms.
Review school's procedures for handling animals in the classroom.

Vocabulary

Observation
Scientific question
Inference
Hypothesis

Vocabulario

Observación
Preguntas científicas
Inferencia
Hipótesis

In Advance

Obtain living organism(s) listed in materials section.

Procedure

1. Asking questions

Choose an object from the classroom—a particular table, chair, a poster on the wall, etc. The object you select should have a distinguishing characteristic or two, but there should be similar objects in the classroom.

Tell students that you are thinking of an object in the classroom. Have them take turns asking **questions** about the object. The questions should have "yes" or "no" answers that will help them guess what the object is. Younger students may need a hint if they are stumped.

Once the object is identified, point out that precise questions were needed in order to figure out what the object was. Scientists also need to ask precise questions to help them in their search for answers and to make careful **observations**.

2. Observing

Display or pass around organisms for students to observe. (If organisms are in short supply, have students take turns observing the organisms in small groups.) Students should write down or draw their observations about the organism's size, color, shape, and behavior on the Student Activity Sheet provided. When they are finished observing, review their observations as a group and collect the organisms.

3. Inferring

Next, ask students what they were not able to learn about the organisms by simply observing them. For example, could they tell what kind of food the animal eats? Does the animal sleep? How fast can the animal move? Where does the animal normally live? Does temperature affect the animal's activity level?

Explain the term "**infer**" to students. Inferring is making an assumption based on observations. For instance, based on the fact that worms have no legs, students might infer that worms can't move as fast as an animal with legs. Ask students what they can infer about the animal they observed. Write their responses on the chalk board or have them write their responses on the Student Activity Sheet.

4. Hypothesis

Tell students that scientists are frequently unable to learn all there is to know about an organism by simply observing it. Sometimes their observations and inferences are only the first step. Help students further develop their inferences into a **hypothesis**. Explain that a hypothesis is the best guess to a question. The hypothesis should be something that can be tested and the results of a test should show that the guess was correct or not. For example, one hypothesis about the worm might be that "crickets move faster than worms." To test that hypothesis, worms and crickets could race to a finish line. Write down some of the hypotheses that students develop on the chalk board. Older students can develop more hypothesis ideas and write them on the Student Activity Sheet.

5. Conclusion

Explain to students that scientists go through similar steps when studying a question or problem. They make observations, develop hypotheses, then create an experiment to gather more information about the hypothesis. Scientists go a little further by analyzing the experiment results and forming a conclusion. The whole process is called the "**scientific method**." You may want to write down the steps of the scientific method on the chalk board for students. (See Teacher Background Information at the beginning of this section.)

Next, ask students if they can think of a time when they naturally used the scientific method to figure something out. Have they ever watched a line of ants, then conducted an "experiment" to see what the ants would do if an obstacle was put in their path? Have they ever made a "hypothesis" about what their cat or dog would do with a new toy? Point out that while science may seem complicated at times, they have probably acted like scientists many times!

Questions to Ask During the Activity

1. Did you notice that your observations about the object needed to be more detailed as you made more guesses about the object in the classroom?

2. Where do you think your organism would live in the wild? Why?

3. How do you think the organism obtains food? What is your guess based on?

4. How do you think the organism might protect itself from danger? Why do you think so?

5. What kind of experiment could you design to test one of your hypotheses about the organism?

Preguntas sobre el tema de la actividad

1. ¿Has notado que tus observaciones sobre el objeto elegido tienen que ser muy detalladas para poder adivinar cuál es?

Preguntas (continuación)

2. ¿En qué lugar crees que el organismo que elegiste viviría si estuviera al aire libre? ¿Por qué?

3. ¿Cómo crees que ese ser vivo obtiene sus alimentos? ¿En qué basas tu suposición?

4. ¿Cómo crees que ese ser vivo se protege a sí mismo del peligro? ¿Por qué crees que lo hace de esa manera?

5. ¿Qué tipo de experimento puedes diseñar para comprobar una de tus hipótesis relacionadas con ese organismo?

Modifications

This activity can also be used for younger students (including K–2) by using procedure steps one through three only.

Extensions

Using one of the hypotheses developed by the class, have students design and conduct a simple experiment using the organisms they observed.

QUESTIONS, OBSERVATIONS, AND HYPOTHESES

Student Activity Sheet

Use the space below to write down your observations. You may want to draw a picture of what you see.

Size	
Color	
Shape	
Behavior	
Other	

QUESTIONS, OBSERVATIONS, AND HYPOTHESES
Student Activity Sheet

Use the space below to list your inferences about the organism. (In other words, what can you assume about the organism based on your observation.)

Use the space below to list your hypothesis about the organism. (In other words, what best guess can you form about the organism that you would be able to test with an experiment.)

PREGUNTAS, OBSERVACIONES E HIPÓTESIS
Actividades prácticas para el estudiante

Escribe tus observaciones en el espacio en blanco que aparece a continuación. Quizás prefieras hacer un dibujo de lo que observas.

Tamaño	
Color	
Forma	
Compor-tamiento	
Otras caracte-rísticas	

PREGUNTAS, OBSERVACIONES E HIPÓTESIS

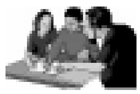
Actividades prácticas para el estudiante

Escribe tus inferencias acerca del organismo en el espacio que aparece a continuación. (En otras palabras, de acuerdo a tus observaciones, ¿qué supuestos puedes hacer acerca de ese organismo?)

Usa el espacio provisto a continuación para escribir tus hipótesis sobre ese organismo. (En otras palabras, ¿qué crees que sucederá con el organismo que usarás en tu experimento?)

WHAT IS A LIVING THING?

¿Qué es un ser vivo?

Grades		
3-8	*3–4*	*45–60 min.*

Purpose

Students will develop a definition of living and non-living things by observing common items. The definition will then be used to determine whether or not dry ice is a living thing.

Materials

A variety of living and non-living items (or pictures) such as: leaves, insects, small animals, rocks, paper, etc.
Dry ice—a 2”x2” chip is fine
Metal tongs
Pot holders
1 cup blue dishwashing liquid
10 cups water
Clear glass bowl or jar—at least 11-cup size
Ice chest (to carry dry ice)

Concepts

- Living things have characteristics that make them different than non-living things.
- An object must have *all* the characteristics in order to be considered a living thing.

Conceptos

- Los seres vivos u organismos tienen caracteristicas que los diferencian de los seres no vivos.
- Un objeto tiene que tener *todas* las caracteristicas para ser considerado un ser vivo.

Safety

DO NOT touch dry ice. Use potholders and tongs. Only the teacher should handle dry ice.

Vocabulary	***Vocabulario***
Abiotic	Abiótico
Biotic	Biótico

In Advance

Gather living and non-living items for students to examine. Obtain dry ice and materials for handling dry ice. Mix together dishwashing soap and 10 cups of water in a container large enough to accommodate the dry ice chunk.

Procedure

1. Observe

Organize students into groups of 3-4. Give each group several of the gathered items (or pictures) to examine. Tell students to look at the items and decide which items are living things (**biotic**) and which items are not living things (**abiotic**). When they are finished, have each group develop a list of characteristics that defines what a living thing is. Younger students may need help writing their list down.

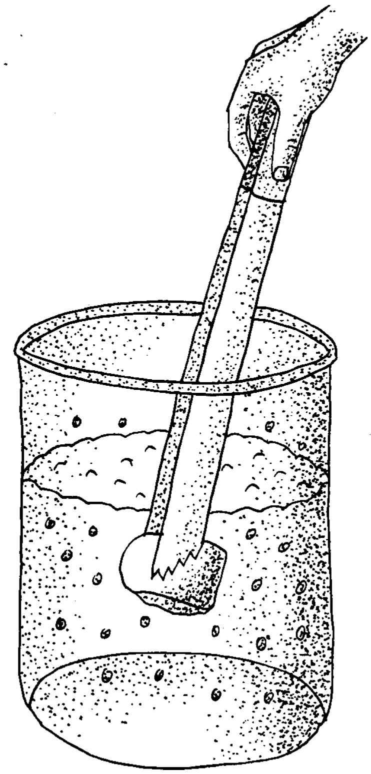
2. Discuss

Ask each group to share their findings with the class. Write a class list on the board and lead the class in a discussion of the characteristics on the board. Do all the responses describe *all* living things? Cross out the items that are not characteristics of all living things and add any characteristics not mentioned by the students. The definition should include only characteristics shared by *all* living things. (A list can be found in the background information for this section or in the "Why it Happens" section at the end of this activity.)

3. Bring out the "Thing"

Tell students that they have been selected to analyze a specimen brought back from Mars. Their assignment is to decide if the specimen is a living thing or not.

Carefully remove the dry ice from the ice chest with metal tongs. The specimen will "squeak" as you pick it up with the tongs. Place the "Thing" in the dishwashing soap and water. Explain that the "Thing" was found in this type of environment and seems to be more active in the blue liquid. Have students watch the specimen and observe what happens. The "Thing" will appear to make noise, move, grow, breathe (make bubbles), and respond to its environment. Put the "Thing" back into the ice chest.



4. Re-evaluate the Definition of a Living Thing

Is the "Thing" living? Discuss as a class how the characteristics of the "Thing" compared to their definition of a living thing. Did the "Thing" exhibit *all* the aspects of a living thing, according to their definition? Do they need to change their definition?

Questions to Ask During the Activity

1. Which aspects of the specimen were they unable to observe? (Reproduction, energy intake, adaptation.)

2. Do some non-living things have characteristics of living things? (Non-living things may exhibit one or two of the characteristics, such as movement or energy intake, but not all. For example, a light bulb requires and uses energy.)

3. How might you investigate the "Thing" further in relation to your definition? (Watch it over a longer period of time to observe energy intake and adaptation.)

Preguntas sobre el tema de la actividad

1. ¿Qué aspectos del espécimen no pudieron observar? (Reproducción, absorción de energía, adaptación.)

2. ¿Qué características de los seres vivos puede tener un organismo no vivo? (Los organismos no vivos pueden presentar una o dos características: movimiento o absorción de alimentos, pero no ambas. Por ejemplo, una bombilla de luz requiere y usa energía.)

3. ¿Qué tipo de investigación realizarías con "tu objeto" si quisieras profundizar más en relación con tu definición? (Puedes observarlo por un período más largo de tiempo para poder ver la absorción de energía y la adaptación).

Why It Happens/More on the Topic

The generally accepted characteristics of living things are:

Movement—plants bend towards the light, roots grow down, and stems grow up.
Responding to stimuli
Requiring energy from the environment
Excretion
Respiration
Made of one or more cells
Needs water
Reproduction and inheritance
Maintaining internal organization
Growth and development
Adapting to the environment

Dry ice is carbon dioxide in its solid form. Carbon dioxide is a solid at very cold temperatures and relatively low air pressure (like that found in higher elevations). When warmed above -108º F (-78º C), carbon dioxide changes directly from a solid to a gas. At this air pressure, there is no liquid phase. (Liquid carbon dioxide only exists at very high pressure produced in a laboratory.)

The dry ice "melts" in the relatively warm dishwashing liquid. Without the dishwashing liquid, the carbon dioxide gas that forms as the solid melts would not be visible. However, the gas is released from the solid into the liquid, making the gas observable as bubbles. There is a very large temperature difference between the dry ice and the tongs and the dishwashing liquid. The "melting" is very rapid and produces the squeaking noise as the solid changes to gas.

Algo más sobre el tema...

Las características generalmente aceptadas de los organismos vivos:

Movimiento—las plantas se inclinan buscando la luz, las raíces crecen hacia abajo y los tallos hacia arriba
Responden a los estímulos
Usan energía del medio ambiente
Excretan
Respiran
Formados por una o más células
Necesitan agua

Algo más sobre el tema (continuación)

Se reproducen y heredan
Mantienen una organización interna
Crecen y se desarrollan
Se adaptan al medio ambiente

El hielo seco es dióxido de carbono en forma sólida. El dióxido de carbono es un sólido a temperaturas muy frías y a presión relativamente baja (como la que existe en alturas elevadas.) Cuando la temperatura sube a más de -108º F (-78º C), el dióxido de carbono se transforma de materia sólida a gaseosa. A este nivel de presión, no existe una fase líquida. (El dióxido de carbono líquido se logra sólo en condiciones de muy alta presión producidas en laboratorios.)

El hielo seco se "derrite"en detergente para lavaplatos que es relativamente tibio. Sin este detergente para lavaplatos, no se vería el gas del dióxido de carbono que se forma al derretirse la materia sólida. Sin embargo, es posible observar el gas que se libera de la materia sólida al detergente líquido porque produce burbujas de gas. Hay mucha diferencia de temperatura entre el hielo seco y las pinzas y el detergente para lavaplatos. El "deshielo" ocurre con rapidez y cuando el sólido se transforma en gas se produce un chirrido.

Modifications

This activity can be done with younger students (including K-2); however, they will need more assistance with developing and using their definition of a living thing. The activity can be done as a class with teacher facilitation.

Extensions

Have students write a short description of an imaginary creature that has been recently discovered by scientists. Remind them to include all aspects of their definition of a living thing when describing this new creature. Encourage them to include the creature's habitat, unique features, and way of life.

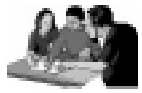
References

The New Mexico Museum of Natural History & Science. Proyecto Futuro Life Science Curriculum. 1st Ed. Albuquerque, NM, 1996.

Mader, Sylvia S., editor. Biology. 5th Ed. Dubuque, IA: Wm. C. Brown Publishers, 1996.

USING A MICROSCOPE

Uso del microscopio

Grades		
3–8	*2–3*	*60–90 min.**

Purpose

Students will learn how to use a light microscope, how to prepare a wet mount slide, and will observe a variety of cells under the microscope.

Materials

Light microscopes
Dissecting microscopes (for K–3 modifications)
Commercially-prepared slides
Slides and slip covers
Eye droppers
Banana peels, onion slices
Toothpicks
Q-tips cut in half

Concepts

- Microscopes are tools that can be used in science to observe objects more closely.
- Careful slide preparation and use of the microscope is important for safety and accurate viewing of objects.

Conceptos

- El microscopio es una herramienta que se puede utilizar en ciencias para observar objetos más de cerca.
- Es importante prestar atención cuando se usa el microscopio y preparar con cuidado el portaobjeto, no sólo por razones de seguridad, sino también para poder ver los objetos con precisión.

Safety

Broken glass should be carefully thrown away. Warn students that a microscope bulb is hot. Plastic slides are available for younger students.

** This activity can be done in two parts.*

Vocabulary

Eyepiece
Stage
Stage clip
Coarse adjustment knob
Fine adjustment knob
Body tube
Nosepiece
Objectives
Base
Light source
Diaphragm
Arm

Vocabulario

Ocular
Platina
Sujetador
Tornillo de ajuste grueso o macrométrico
Tornillo de ajuste fino o micrométrico
Tubo binocular
Portaobjetivo
Objetivos
Base
Fuente de luz
Diafragma
Brazo

In Advance

Gather materials. Make copies of the student activity sheets for each student.

Procedure

1. Demonstrate microscope use

Divide your class into groups according to the number of microscopes available. If possible, pair experienced students with students who have never used a microscope before.

Demonstrate how to carry and use the light microscope, using Student Activity Sheet 1 as a guide. As you explain each step, have students practice with their microscopes. Make sure that each student has an opportunity to practice before moving on to the next step.

2. Student practice

Pass out copies of Student Activity Sheet 1 and commercially-prepared slides. Have students follow the Activity Sheet as they view the slides. If you have a variety of slides, have students trade slides when they are finished. Be sure students are filling out the activity sheet as they go. Collect the slides once everyone has seen them.

3. Demonstrate wet slide mount preparation

Using Student Activity Sheet 2 as a guide, demonstrate how to prepare a wet mount slide. Be sure to emphasize that only one or two drops of water should be used on the slide. Also, show them how to put the cover slip onto the slide so they can avoid trapping air bubbles. (Have them touch the edge of the cover slide to the edge of the water drop, then gently lower the cover slide.)

4. Student Practice

Hand out copies of Student Activity Sheet 2. Using toothpicks, help students get a small sample of the onion and banana peel for their slide. With the cut end of a Q-tip, tell students to gently scrape the inside of their cheek. Have students follow the Student Activity Sheet to complete the activity. As a class, review the answers and discuss the observations students recorded on the activity sheet.

Questions to Ask During the Activity

1. If you are having trouble locating the object through the **eyepiece**, what should you check first? (Make sure you are using the shortest **objective**. Check to see that the object is directly beneath the lens.)

2. Why should you never focus downward? (You might push the objective through the slide and break it.)

3. The shorter objective will make things look how many times bigger than they really are? (100 times.)

4. The longer objective will make things look how many times bigger than they really are? (200 times.)

5. What other items might be interesting to look at through the microscope?

Preguntas sobre el tema de la actividad

1. Si te resulta difícil tratar de localizar un objeto a través del **ocular**, ¿qué debes revisar primero? (Asegúrate de que estás usando el **objetivo de menor aumento**. Asegúrate de que el objeto esté directamente debajo del lente.)

2. ¿Por qué debes evitar siempre enfocar directamente hacia abajo? (Podrías romper el portaobjeto con el objetivo.)

3. ¿Cuántas veces más grande se verán los objetos a través del objetivo de menor aumento? (100 veces)

4. ¿Cuántas veces más grande se verán los objetos a través del objetivo de mayor aumento? (200 veces)

5. ¿Qué otras cosas te interesaría ver a través del microscopio?

Modifications

Younger students (including K–2) can bring in several items from home or from the schoolyard to look at through dissecting scopes. Demonstrate how to use the dissecting scopes and then have students work in groups to look at their items through the microscope. If you have a light microscope available, show students how it can be used to look at their items. More mature students can help prepare a slide for the light microscope.

Extensions

Have students bring in a new item to look at through the microscope. Before they prepare the slide, have them predict what the item will look like under magnification. Students can draw a picture of their prediction and another picture after they look through the microscope. Was their prediction just a guess, or did they base their prediction on some prior knowledge?

References

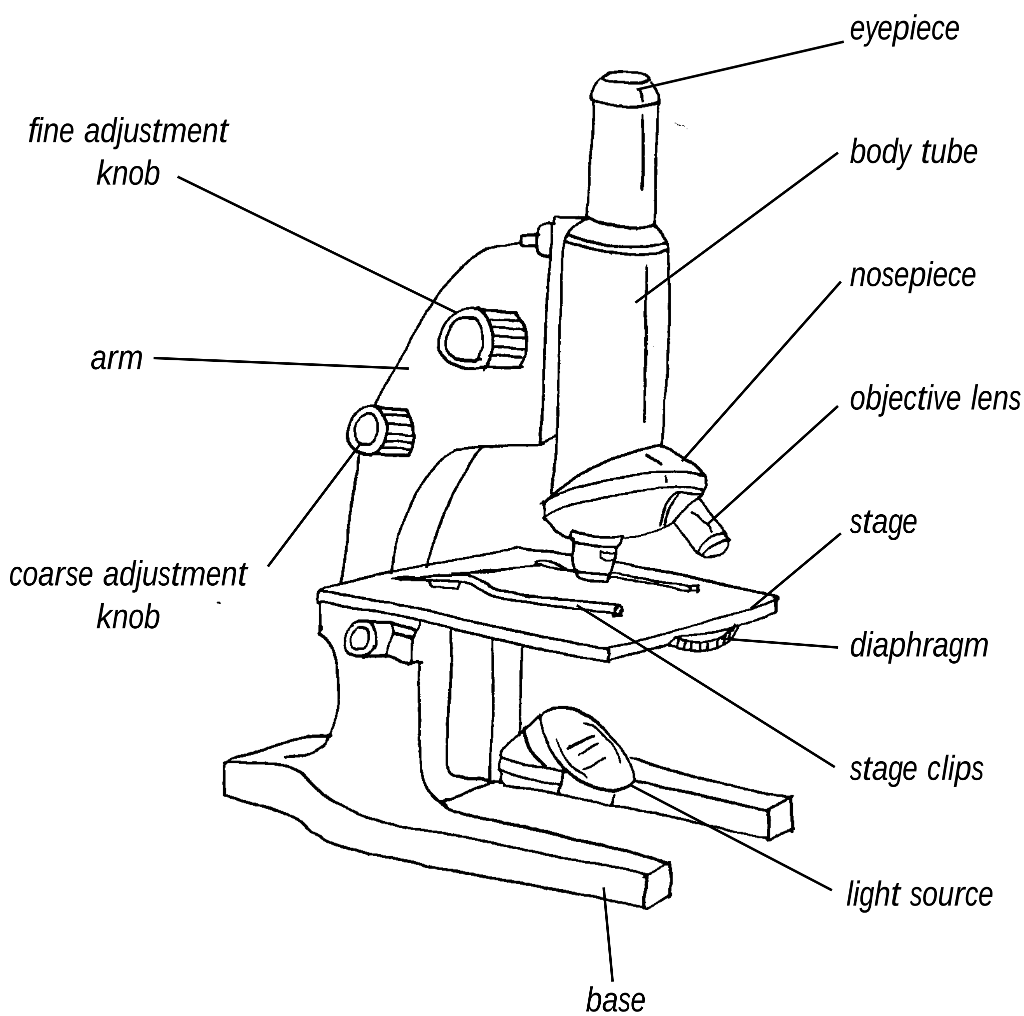
Mader, Sylvia S., Editor. Biology. 5th Edition. Dubuque, IA: Wm. C. Brown Publishers, 1996.

Heil, Discover Science. Glenview, IL: Scott, Foresman and Company, 1991.

Dykstra, Mary. The Amateur Zoologist: Explorations and Investigations. New York, NY: Franklin Watts, 1994.

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. 1st Edition. Albuquerque, NM, 1996.

Parts of a Microscope



What are the parts of a microscope? (in alphabetical order)

Arm – The arm supports the barrel or body tube, and is used to carry the microscope.

Base – The base is the bottom part of the microscope that is shaped like a horseshoe. To carry the microscope properly you should hold the arm in one hand and have your other hand under the base.

Body tube – This is a hollow tube through which light passes. It holds the lenses apart.

Coarse adjustment knob – This knob turns and is used to raise or lower the body tube to focus the microscope.

Diaphragm – The diaphragm changes the amount of light entering the body tube.

Eyepiece – The eyepiece is located at the top of the microscope. It holds the ocular lens.

Fine adjustment knob – This knob also raises or lowers the body tube. It is used to bring objects into sharp focus.

Light source – The light source sends light toward the hole in the stage. The light source can be an electric bulb built into the microscope or a mirror that reflects light into the microscope.

Nosepiece – The nosepiece holds the objective lenses.

Objective lens – Each lens has a different magnification power; there are several objective lenses.

Stage – The stage is where you place the object you are looking at.

Stage clips – The stage clips hold down the slide on the stage.

¿Cuáles son las partes del microscopio? (por orden alfabético)

Base – La base o pie es la parte inferior del microscopio y tiene la forma de una herradura. Para transportar el microscopio correctamente debes sostener el brazo con una mano y debes poner la otra debajo del pie.

Brazo – El brazo sostiene la barra o tubo binocular y se usa para transportar el microscopio.

Diafragma – El diafragma modifica la cantidad de luz que penetra en el tubo binocular.

Fuente de luz – La luz se proyecta directamente desde la fuente hacia el orificio de la platina. Esta fuente de luz puede ser una bombilla eléctrica integrada al microscopio o un espejo que refleje la luz dentro del mismo.

Objetivos intercambiables – Cada lente tiene un poder de magnificación diferente. Existen distintos tipos de objetivos intercambiables.

Ocular – El ocular se encuentra en la parte superior del microscopio. Dentro del ocular se encuentra el lente ocular.

Platina – En la platina se pone el objeto que quieres observar.

Portaobjetivo – El portaobjetivo sostiene los lentes objetivos intercambiables.

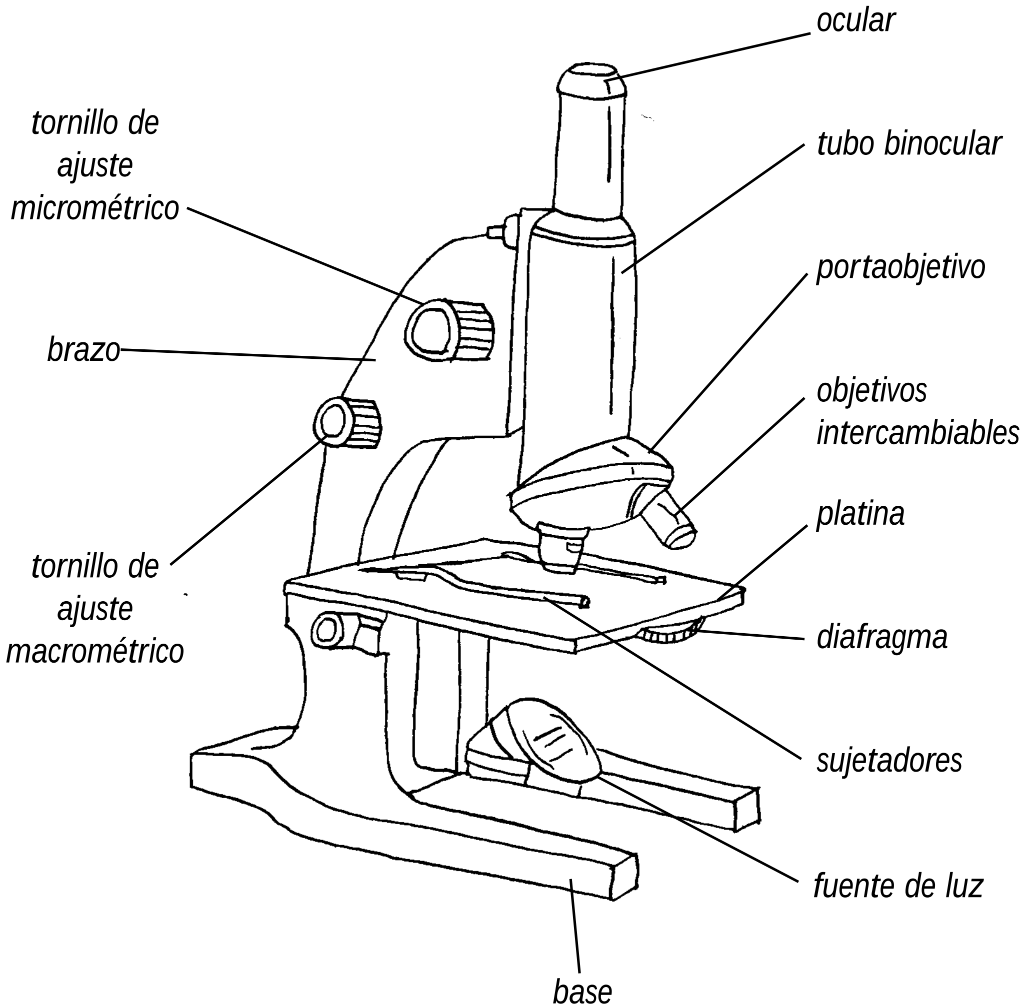
Sujetadores – Los sujetadores sostienen el portaobjeto sobre la platina.

Tornillo de ajuste macrométrico – Este tornillo gira y se utiliza para levantar o bajar el tubo binocular para enfocar el microscopio

Tornillo de ajuste micrométrico - Este tornillo también levanta y baja el tubo binocular. Se usa para enfocar los objetos con precisión.

Tubo binocular – Este es un tubo hueco a través del cual pasa la luz. Mantiene los lentes separados.

Partes del microscopio



EXAMINING THE MICROSCOPE
Student Activity Sheet 1

1. Look at your microscope and find the parts named on the diagram; become familiar with each part.

2. Insert the prepared slide.

3. Move the microscope so that the arm is turned toward you.

4. Turn the focusing knob slowly and watch how the objectives and eyepiece move.

5. Raise the objective as high as it will go.

6. Hold the arm of the microscope with one hand and turn the nosepiece slowly until one of the objectives snaps into place.

7. Look at the plate on the barrel. It will show 100X and 200X. This tells you that the shorter objective will magnify an object 100 times its real size, and that the longer objective will magnify the object 200 times its real size. (Note: The magnification will vary with the type of microscope.)

8. Draw and label pictures of the magnified items on the slides below.

MAKING WET SLIDES
Student Activity Sheet 2

1. Using the eye dropper, place a drop of water on your slide.

2. Place a piece of onion on the drop of water.

3. Touch the edge of the cover slide to the edge of the drop of water.

4. Lay the cover slip gently down over the drop of water and slide. This is called a wet mount.

5. Snap the shorter objective into place.

6. Look into the eyepiece with one eye, keeping your other eye closed.

7. If your microscope has a mirror, adjust it so the light is reflected upward. You should see a circle of light when you look into the eyepiece.

8. Put the slide on the stage and put the clips over the slide to hold it in place. The onion should be in the circle of light.

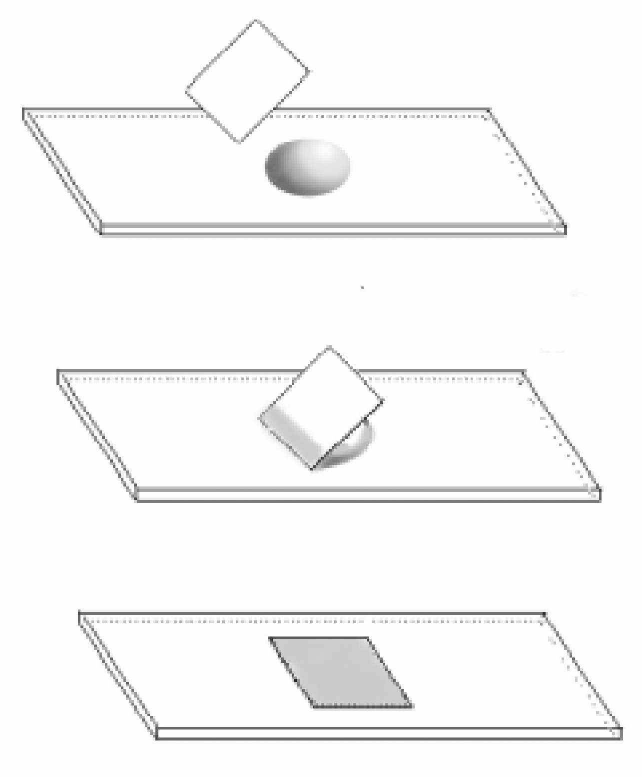
9. Look into the eyepiece and turn the knob slowly so that is moves upward. BE CAREFUL: If you turn the knob downward, you may force the objective into the slide and break it.

10. Move the slide slowly to the right and left. Notice how the image moves.

11. To look at the onion through the high power or longer objective, first turn the knob to raise the low power objective. Turn the nosepiece so that the high power objective is in place. Lower the objective until it is close to, but not touching, the slide. Focus by moving the objective slowly upward.

12. Repeat the steps above with the banana peel and the cheek cells you collected with the Q-tip.

MAKING WET SLIDES
Student Activity Sheet 2 (continued)



Questions

1. Draw what you saw when you looked at the onion with the shorter objective and record the magnification in the space provided.

Magnification: __________X

MAKING WET SLIDES
Student Activity Sheet 2 (continued)

2. Draw what you saw when you looked at the onion with the longer objective and record the magnification in the space provided.

Magnification: __________X

3. When you move the slide to the left, which way does the image move?

____

4. When you move the slide to the right, which way does the image move?

____

5. If you want to see an object in greater detail, which objective would you use?

____

INSPECCIÓN DEL MICROSCOPIO

Actividades prácticas para el estudiante—Hoja 1

1. Observa tu microscopio y busca las partes que aparecen en el diagrama. Familiarízate con cada una de las partes.

2. Coloca el portaobjetos con la preparación ya lista.

3. Mueve el microscopio de manera que el brazo gire hacia ti.

4. Gira el tornillo de enfoque despacio y observa cómo se mueven los objetivos y el ocular.

5. Levanta el objetivo hasta donde llegue.

6. Sostén el brazo del microscopio con una mano y gira el portaobjetivo lentamente hasta que uno de los objetivos se enganche en el lugar correcto.

7. Observa la placa del cilindro. Verás dos inscripciones: 100X y 200X. Esto indica que el lente más corto agrandará 100 veces el tamaño original del objeto (se lo llama objetivo de 100 aumentos) y que el lente más largo agrandará el objeto a 200 veces su tamaño original. (Nota: La magnitud de la amplificación varía según el modelo del microscopio.)

8. Dibuja y coloca los nombres de los objetos amplificados en los portaobjetos que siguen.

PREPARACIÓN PARA EL PORTAOBJETOS
Actividades prácticas para el estudiante—Hoja 2

1. Coloca una gota de agua sobre tu portaobjeto usando un gotero.

2. Coloca un pedazo de cebolla sobre la gota de agua.

3. Haz que la superficie del cubreobjeto toque la superficie de la gota de agua.

4. Deposita con mucho cuidado el cubreobjeto sobre la gota de agua y el portaobjeto. Esto se llama preparación.

5. Engancha el lente más corto en su lugar.

6. Mira a través del ocular con un ojo y mantén el otro ojo cerrado.

7. Si tu microscopio tiene un espejo, ajústalo para que la luz refleje hacia arriba. Cuando mires por el ocular, verás un círculo de luz.

8. Coloca el portaobjetos en la platina y ajusta los sujetadores para que no se mueva. La cebolla debe estar ubicada dentro del círculo de luz.

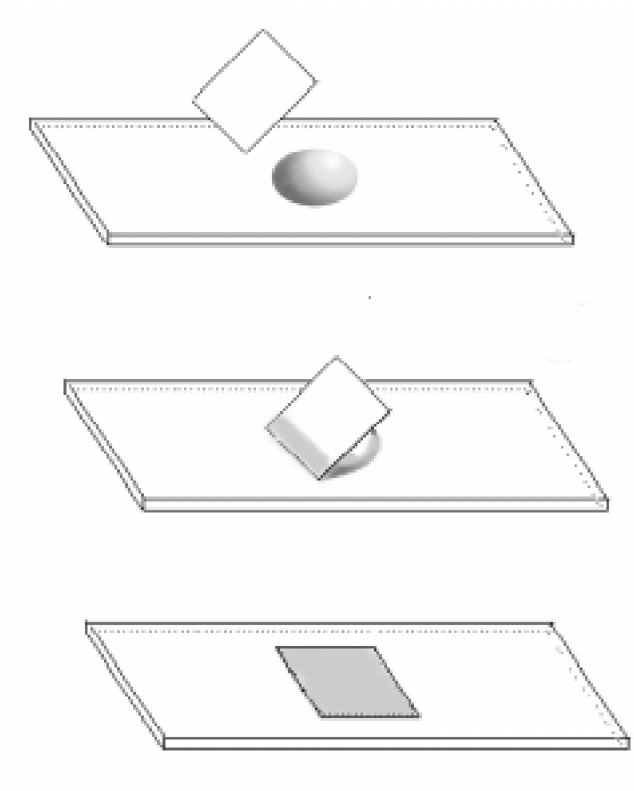
9. Mira a través del ocular y gira el tornillo lentamente para que se mueva hacia arriba. PRECAUCIÓN: si giras el tornillo hacia abajo podrías forzar el lente objetivo sobre el portaobjeto y romperlo.

10. Mueve el portaobjetos lentamente hacia la derecha y hacia la izquierda. Presta atención al movimiento de las imágenes.

11. Para ver la cebolla a través del lente de alta potencia u objetivo largo, primero debes girar el tornillo para levantar el objetivo de menos potencia. Gira el portaobjetivo para que el objetivo de alta potencia se enganche en su lugar. Mueve el objetivo hacia abajo hasta que esté cerca del portaobjeto, pero sin tocarlo. Para enfocar debes mover el objetivo lentamente hacia arriba.

12. Repite todos los pasos anteriores usando la cáscara de una banana y las células de la mejilla que obtuviste con un hisopo.

PREPARACIÓN PARA EL PORTAOBJETOS
Actividades prácticas para el estudiante—Hoja 2 (continuación)



Preguntas

1. Dibuja lo que observaste al mirar la cebolla con el objetivo de baja potencia y anota en el espacio en blanco, el nivel de aumento que usaste.

Objetivo de
__________X aumento

PREPARACIÓN PARA EL PORTAOBJETOS
Actividades prácticas para el estudiante - Hoja 2 (continuación)

2. Dibuja lo que observaste al mirar a la cebolla con el objetivo de alta potencia y anota en el espacio en blanco, el nivel de aumento que usaste.

Objetivo de
__________X aumento

3. Cuando mueves el portaobjeto hacia la izquierda, ¿hacia qué lado se mueve la imagen?

____

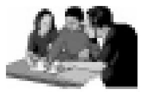
4. Cuando mueves el portaobjeto hacia la derecha, ¿hacia qué lado se mueve la imagen?

____

5. Si quieres ver un objeto más detalladamente, ¿qué lente usarías?

____

CELL DANCE
La danza de la célula

Grades		
2–6	Whole Class	45–60 min.

Purpose
Students will learn about the components of cells and how they function. Students will compare and contrast the characteristics of different types of cells.

Materials
Part 1

Cell Roll Cards
Signs for students to wear during cell dance (optional)

Part 2

Light microscope (optional)
Protozoa or single-celled plant cultures (or pond water)
Student Activity Sheet

Concepts
- Living things are made up of cells.
- Cells are made up of different structures.
- Each cell structure has a different role in the cell's functioning.
- Not all cells look alike.

Conceptos
- Los organismos vivos están compuestos por células.
- Las células tienen estructuras diferentes.
- Cada estructura dentro de la célula cumple una función específica.
- No todas las células se parecen.

Safety
Students shouldn't push or shove during Part 1. For Part 2, students need to know how to use a microscope and should wash hands after handling organisms. Review rules for handling live organisms.

Vocabulary

Cell
Cell membrane
Cytoplasm
Nucleus
Mitochondria
Vacuole

Vocabulario

Célula
Membrana celular
Citoplasma
Núcleo
Mitocondria
Vacuola

In Advance

Clear an open space in the classroom or find an open space outside the classroom. Obtain protozoa, single-celled plant cultures, or pond water. Set up microscopes and make copies of Student Activity Sheet.

Procedure

Part 1

1. Set up the Cell Dance

Begin by describing what a **cell** is to the class. Tell students they are all going to work together to create the parts of a cell and see how a cell functions. As you select students for different roles, write the names of the roles on the chalkboard.

Select about a third of the students to form a circle by linking elbows or holding hands in the open space. These students will be the **cell membrane**. Explain that the cell membrane surrounds the outside of the cell and regulates the flow of chemicals going in and out of the cell. Tell older students this property is called semi-permeable.

Next, select another third of the students to go into the center of the circle. These students represent the **cytoplasm**, a viscous fluid that fills the cell and helps move food and other chemicals to other parts of the cell.

Now, select several remaining students to be **vacuoles**. As they enter the center of the circle, explain that vacuoles store water and digested food products. A few more students can be **mitochondria**, the cell's "power plants." The mitochondria turn food into energy that the cell can use. Any remaining students can be chemicals.

You will be the **nucleus**, or "brains" of the cell during the first cell dance. The role can be turned over to a student if you have time to repeat the dance later. Tell students the nucleus will be orchestrating the cell functions. Remaining students will be chemicals that enter and leave the cell through the cell membrane.

For younger students, you may want to prepare labels or signs for each student to wear when they are given their roles. That will avoid confusion when the "cell dance" begins.

2. Cell dance

Begin the cell dance by instructing the students playing the cytoplasm to slowly "flow" around the inside of the circle. They should not push or shove, but gracefully move within the cell membrane.

Now it is time for you, the nucleus, to begin orchestrating the cell's functions. Use the following instructions as a guide:

- First, tell the students that only some "chemicals" will be allowed to enter the cell through the cell membrane. This time only "chemicals" wearing white on their clothing will be entering. When you say "go," **all** the chemicals should try to get into the cell, but only the ones wearing white should be let in by the students playing the cell membrane. Unselected chemicals will need to stay outside the cell. (They can be let in at a later time, if you choose).

- Explain that only some of the chemicals let in are food for the cell. This time students wearing red will be food the cell can use. When you say "go," the chemicals wearing red should go to a "mitochondria" student and link elbows. Tell students this represents how the food chemicals change into energy that the cell can use.

- Explain to students that once the food chemicals change into energy, they become waste products. Tell students that all the food chemicals have now changed into waste products and they should find a vacuole to link elbows with. This represents how the vacuole stores waste products and water.

- Finally, tell students that the waste products need to leave the cell, but the vacuoles stay behind in the cytoplasm. When you say "go," the waste products should unlink arms with the vacuoles and pass out of the cell membrane.

The whole dance can be repeated using different students in different roles or allowing different chemicals into the cell's membrane. Repeating the dance will help reinforce the concepts and vocabulary.

Part 2

1. Look at Real Cells

Pass out copies of the Student Activity Sheet. Give students a moment to look at the cell diagram.

Next, have students place one or two drops of the single-celled plant culture, protozoa, or pond water onto a slide and place the slide under a microscope. Students should look at the sample through the microscope and record the organism's size, shape, color, internal structures, and "behavior" in the spaces provided on their activity sheet. There is also space to make a diagram of what they view through the microscope. Be aware that pond water may have several different types of organisms.

To wrap up, discuss students' observations and drawings with the class. Note how important a detailed diagram can be in relating information to others and for recording observations accurately.

Questions to Ask During the Activity

1. How do you think cells can live as independent organisms? (The cell membrane surrounds the cell and protects it from its environment, much like skin. The nucleus also helps to control the cell's functions.)

2. In the real cells you observed, what is the substance that moves around inside the cell and helps the cell move through the water? (Cytoplasm.)

3. As the cells move in the water, some structures seem to disappear and reappear. Why do you think this happens? (The organisms are 3-dimensional. As they move across the slide, they twist and turn, causing certain structures to come in and out of focus.)

4. Do all the cells you observed look the same? What were some of the differences?

Preguntas sobre el tema de la actividad

1. ¿Por qué crees que las células pueden vivir como organismos independientes? (La membrana celular rodea a la célula y la protege del medio ambiente, parecido a lo que sucede con la piel. El núcleo también ayuda a controlar las funciones de la célula.)

2. Toma como ejemplo las células reales que has observado. ¿Cuál es el nombre de la sustancia que se mueve en el interior de la célula y que ayuda a la célula a moverse en el agua? (Citoplasma)

3. Cuando las células se mueven en el agua, algunas estructuras parecen desaparecer y luego reaparecen. ¿Por qué crees que sucede esto? (Los organismos son tridimensionales. Al desplazarse a través del portaobjetos, las células giran y se dan vueltas. Por eso, algunas estructuras están fuera del campo visual pero luego reaparecen.)

4. ¿Son iguales todas las células que has visto? ¿Cuáles son las diferencias?

Modifications

For younger students, you may want to prepare the slides of the plant culture, protozoa, or pond water and focus the microscopes. Younger students may find it easier to draw pictures of the cells they see.

Extensions

Provide students with books that have photographs of different cell types. Have them make drawings of the cells, particularly paying attention to the differences between the cells. Tell students to trade their drawings with another student and see if they can identify the cell types based on the drawing.

References

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Daniel, Lucy, Edward P. Ortleb, and Alton Briggs. Merrill Life Science, Teacher Wrap-Around Edition. Lake Forest, IL: Glencoe-Macmillan/McGraw-Hill, 1993.

CELL ROLL CARDS

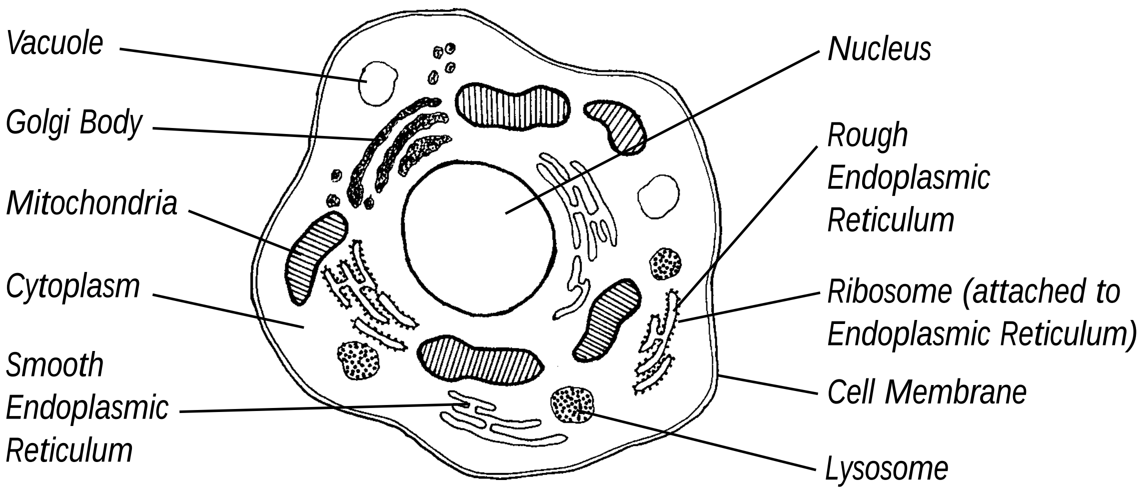
Cell Membrane The cell membrane surrounds the outside of the cell and regulates the flow of chemicals going in and out of the cell.
Cytoplasm The cytoplasm is a fluid that fills the cell and helps move food and other chemicals to other parts of the cell.
Vacuoles Vacuoles float around the cytoplasm, where they store water and digested food products.
Nucleus The nucleus is the "brain" of the cell. It directs the activities of the other cell structures.
Mitochondria The mitochondria are the cell's "power plants." They turn food into energy that the cell can use.

TARJETAS CON LOS NOMBRES DE LAS PARTES DE LA CÉLULA

Membrana celular La membrana celular rodea la parte exterior de la célula y regula el flujo de sustancias químicas que entran y salen de la célula.
Citoplasma El citoplasma es un fluido que ocupa el interior de la célula y que ayuda a que los alimentos y otros elementos químicos se muevan de un lugar a otro dentro de la célula.
Vacuolas Las vacuolas flotan alrededor del citoplasma, donde acumulan agua y alimentos digeridos
Núcleo El núcleo es el "cerebro" de la célula. Dirige las actividades de las otras estructuras celulares.
Mitocondrias Las mitocondrias son la "planta de energía" de la célula. Convierten los alimentos en la energía que utilizará esta planta.

THE CELL
Student Activity Sheet

The parts of a cell:



1. Using the chart below, describe the cell or cells you see in the microscope.

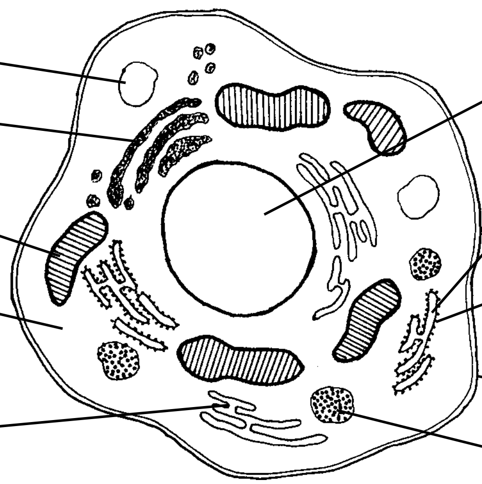
	CELL 1	**CELL 2**
Size		
Shape		
Color		
What is inside?		
What is it doing?		

THE CELL
Student Activity Sheet (continued)

2. Draw and label the cell or cells you see in the microscope. Be sure to include as much detail as possible.

LA CÉLULA
Actividades prácticas para el estudiante

Las partes de la célula:



1. Utiliza el cuadro que sigue para describir la célula o células que observaste a través del microscopio.

	CÉLULA 1	**CÉLULA 2**
Tamaño		
Forma		
Color		
¿Qué hay adentro?		
¿Qué está haciendo?		

LA CÉLULA
Actividades prácticas para el estudiante (continuación)

2. Dibuja y escribe el nombre de la célula o de las células que ves en tu microscopio. Incluye todos los detalles posibles.

LIFE CYCLES
Ciclo vital

Grades		
3–8	2–4	30 min. setup, 15 min./week for 1–4 mo.

Purpose

Students will learn about life cycles and metamorphosis by observing the larva (mealworm), pupa, and adult stages of a beetle named the Yellow Mealworm.

Materials

Mealworm larvae (from pet store or biological supply company)—5 per group
Clear jar or container with 2–3 air holes—1 per group
Grain (bran flour, corn meal, oatmeal)—enough to fill half of container
Apple or potato slice for moisture—1–2 per jar
Data sheets (provided)
Hand lens or dissecting microscope (optional)

Concepts

- Organisms have life cycles that include birth, growth, reproduction, and death.
- Some organisms go through a change in body form (metamorphosis) during their life cycle.

Conceptos

- Los seres vivos tienen un ciclo vital que incluye nacimiento, crecimiento, reproducción y muerte.
- Algunos seres vivos experimentan un cambio en la forma de sus cuerpos (metamorfosis) durante su ciclo vital.

Safety

Wash hands after handling organisms. Review rules for handling live organisms.

Vocabulary

Life cycle
Exoskeleton
Larva(e)
Pupa(e) or (s)
Nymph
Molt
Complete metamorphosis
Incomplete metamorphosis

Vocabulario

Ciclo vital
Exoesqueleto
Larva(s)
Pupa o capullo
Ninfa
Mudar
Metamorfosis completa
Metamorfosis incompleta

In Advance

Gather all materials (mealworms, jars, grain, apple or potato slices). Make a copy of the Student Activity Sheet for each student.

Procedure

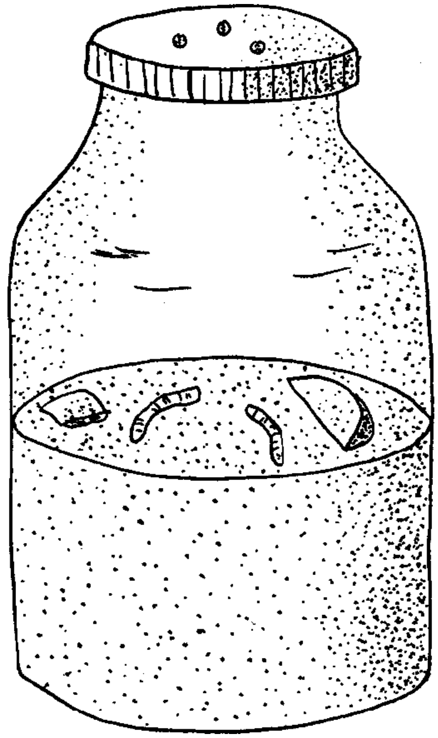
1. Introduce the activity

Begin by asking students if they know what a life cycle is. Explain that a life cycle is the process of change that an organism goes through during its lifetime. It includes birth, growth, reproduction and death. Organisms have different length life cycles and different ways of changing during those life cycles.

Tell students that some organisms go through dramatic changes during their life cycles. When an organism goes through a change of body form, it is called metamorphosis. Ask students if they can name a type of animal that goes through a metamorphosis. (Frogs and butterflies are good examples.) Using the "Why it Happens" section of this activity as a guide, explain the different types of metamorphosis in more detail. Tell students that over the next couple of months they will be observing the metamorphosis of the Yellow Mealworm.

2. Make the mealworm "homes"

Divide students into groups of 2-4. Give each student a copy of the Student Activity Sheet. Give each group a jar, some of the grain, and a piece of apple or potato. Tell students to fill their jars halfway with the grain and place the apple or potato slice in the jar. The apple or potato is for moisture. It will need to be replaced as it dries up or if it gets moldy. Finally, put the mealworm larvae into the jars. (The jars should be kept away from extreme temperatures.) Tell students the mealworms will eat the grain as



they grow and will also burrow into it. If the larvae have burrowed into the grain, students can see them by gently pouring the grain onto a clean white sheet of paper.

3. Observe the larvae

Using the Student Activity Sheet as a guide for observations, have students look at the larvae and record what they see. If you have hand lenses or dissecting microscopes available, students can use them to make their observations. They will be recording their observations weekly using the same Student Activity Sheet. The larval stage of the Yellow Mealworm should last from one to three months, depending on temperature (in warmer conditions this stage is shorter and in cooler conditions it is longer).

4. Observe the pupa

When the larvae are about to change into an adult beetle, they form a hard shell around them called the pupa. The larvae do not move around or feed while they are in the pupa. Students should observe the pupa stage and record their observations on the Student Activity Sheet.

The pupa stage of the metamorphosis should take from 10 to 20 days. Have students check their pupae more frequently around the two-week mark, so they won't miss seeing the adult beetles emerge from the pupa.

5. Observe the adult Yellow Mealworms

Have students look at the adult beetles (Yellow Mealworm) and write down their observations on the Student Activity Sheet. The adult beetles live about 5 to 10 days. During those days they mate, the female will lay about 300 eggs, and the life cycle will be completed.

6. Wrap up

Discuss the students' observations of the larvae, pupae, and adult beetles. Use the "Questions to Ask During the Activity" and "Why it Happens" sections to lead the discussion. For younger students, you may want to draw and label a picture of the life cycle of the Yellow Mealworm beetle on the chalkboard. Older students can use the information on their Student Activity Sheet to draw and label the life cycle themselves. The beetles can be taken home or saved for other activities.

Questions to Ask During the Activity

1. What are the tough yellow fragments that you find in the jar as your mealworms grow? Where did they come from? (As the mealworms grow larger, their tough outer "skin" or exoskeleton does not grow. They must shed or molt this old skin.)

2. What happens to the color of the pupa shell as it ages? Why do you think this happens? (It grows darker as the larva changes to an adult beetle inside.)

3. What do you think is the benefit of a life cycle that involves such different body forms? (Life cycles, like that of the Yellow Mealworm beetle, divide the "work." The larva eats and grows, and the adult can fly to a new home and reproduce.)

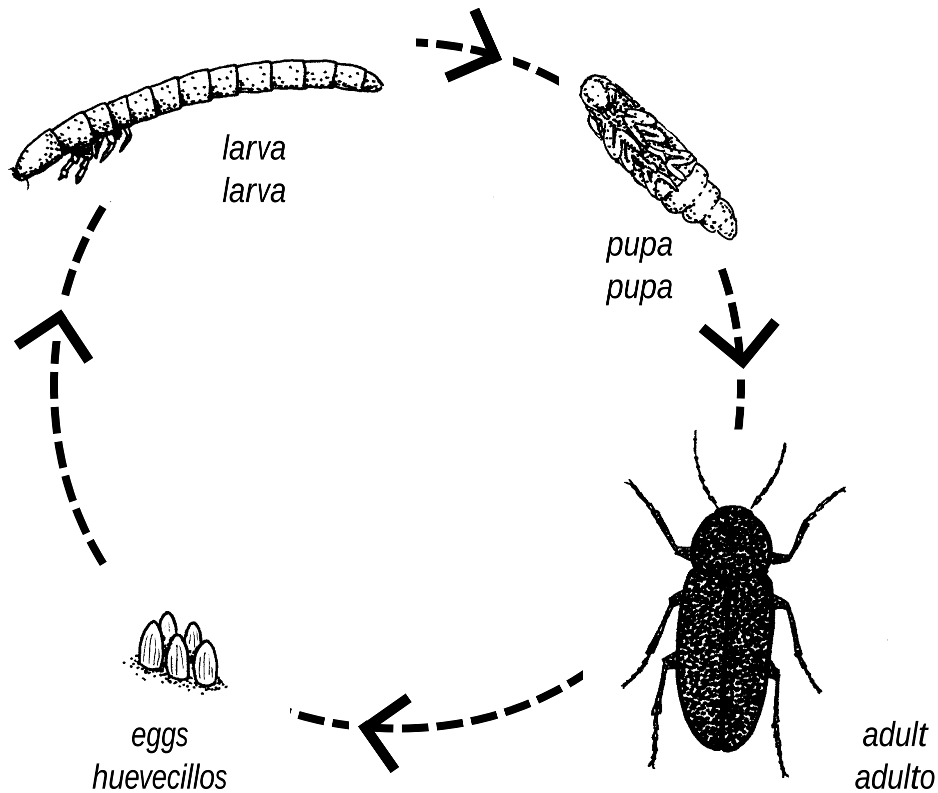
Preguntas sobre el tema de la actividad

1. ¿Qué son esos fragmentos duros, de color amarillo que aparecen en el frasco cuando los gusanos de harina están creciendo? ¿De dónde vienen? (La "piel" externa dura o exoesqueleto de los gusanos de la harina no crece al mismo tiempo que lo hace el gusano. A medida que crecen, deben mudar o cambiar su piel antigua.)

2. ¿Qué sucede con el color de la envoltura de la pupa a medida que ésta envejece? ¿Qué crees que sucede? (Se hace más oscura a medida que la larva se transforma en un escarabajo adulto en el interior de la envoltura.)

3. ¿Cuál crees que es el beneficio de un ciclo vital con tantas formas diferentes del cuerpo? (El ciclo vital, tal como el del escarabajo molinero contiene una división del "trabajo". La larva come y crece y el adulto puede volar hacia un nuevo hogar y reproducirse.)

Why It Happens/More on the Topic



During their life cycle, some organisms go through a change of body form called metamorphosis. Sometimes the change from one body form to the other can be dramatic and takes place inside a sac or case called a pupa. This is called complete metamorphosis and involves four stages: 1) egg, 2) larva, 3) pupa, and 4) adult. Examples of animals that go through complete metamorphosis are beetles and butterflies.

Other organisms go through an incomplete metamorphosis where there are fewer changes in body form. There is a nymph stage instead of the larva and pupa stages. A nymph hatches from an egg and is usually very similar to the adult. Grasshoppers grow and change this way. The grasshopper nymph is smaller and lacks the wings of an adult grasshopper.

Algo más sobre el tema...

Durante el ciclo vital, algunos organismos pasan por una transformación del cuerpo llamada metamorfosis. A veces el cambio, que se realiza en el interior de una bolsa o capullo llamado pupa, puede ser dramático. Este proceso se llama metamorfosis completa e incluye cuatro estados: 1) huevecillo, 2) larva, 3) pupa y 4) adulto. Ejemplos de animales que pasan por una metamorfosis completa son los escarabajos negros y las mariposas.

Otros organismos pasan por una metamorfosis incompleta, en la cual los cambios físicos son limitados. En este caso, hay un estado llamado ninfa en vez de los estados de larva y de pupa. Una ninfa sale de huevo y en general es bastante parecida a lo que será cuando llegue a la adultez. Los saltamontes crecen y se transforman de esta forma. Los saltamontes en el estado de ninfa son más pequeños y no tienen las alas que desarrolla un saltamontes adulto.

Modifications

With younger students, complete the Student Activity Sheet as a class.

Extensions

Have students compare butterfly, grasshopper, and frog metamorphosis with that of the Yellow Mealworm beetle. What are the similarities? What are the differences? What are the advantages of metamorphosis in frogs?

References

Mason, Adrienne. Mealworms: Raise Them, Watch Them, See Them Change. Toronto, Ontario: Kids Can Press Ltd.,1998.

Schaffer, Donna. Mealworms: Life Cycles. Mankato, MN: Bridgestone Books,1999.

STUDENT ACTIVITY SHEET

Yellow Mealworm Beetle Life Cycle

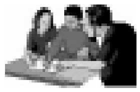
Date	Stage (larva, pupa, or adult)	Color	Number of Legs	Other Observations

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Ciclo vital del escarabajo molinero

Fecha	Estado (larva, pupa o adulto)	Color	Número de patas	Otras observaciones

CLASSIFYING
Clasificación

Grades		
3–8	Whole Class	45–60 min.

Purpose

Students will learn how to create a classification system, then use a dichotomous key to identify leaves.

Materials

Shoes
Copies of Student Activity Sheets: Leaf Drawings and Leaf Key

Concepts

- Classification is the process of grouping like objects into categories.
- Classification helps scientists organize large numbers of objects.
- A key can be used to identify an object or organism.

Conceptos

- Clasificar es el proceso de agrupar objetos similares en categorías.
- La clasificación ayuda a los cientificos a organizar una gran cantidad de objetos.
- Se puede usar un sistema de clasificación para identificar a un objeto o a un organismo.

Safety

Students shouldn't push or shove during Part 1. For Part 2, students need to know how to use a microscope and should wash hands after handling organisms. Review rules for handling live organisms.

Vocabulary

Classify
Key
Dichotomous key

Vocabulario

Clasificar
Sistema de clasificación
Sistema dicótomo o binomial

In Advance

Erase a large space on the chalkboard so you have plenty of room to draw a large classification key. Make a copy of the Student Activity Sheets (Leaf Key and Leaf Drawings) for each student.

Procedure

1. Introduce Classification

Begin by telling students that they will be learning about **classification**. Classification is the process of grouping like objects into categories. It is especially helpful when trying to organize huge quantities of things such as living organisms. Before practicing with a short classification system for leaves, the class will be developing their own classification system for their shoes.

2. Classify shoes

Have each student take off one of their shoes. Either put the shoes on a table where everyone can see them or have students form a circle around the shoes. On the top of the chalkboard write the word "shoes."

Ask students what characteristic they could use to divide the shoes into two groups. It may be the type of shoe (athletic shoes, dress shoes) or color (light colors, dark colors), etc. Once the characteristic is selected, hold up each shoe, and have students tell you which group the shoe belongs in. You should have two groups of shoes when you are finished. Draw two short lines on the board extending from the word "shoes." The lines should be drawn downwards like the branches of an upside down tree. Under each line, write the name of the category of shoes (light colored and dark colored, for example).

Starting with one group of shoes, ask students how they can divide that group into two more groups. Repeat the process, creating two groups each time, until each shoe is alone in its own category. Do the same for the second group of shoes the class created at the beginning. As students create new groups, write the characteristic for the groups on the board and draw branches from the broader classification to the more specific classification.

3. Use the shoe key

Put all the shoes back together making sure they are mixed up. Select a shoe at random and have students help you figure out which shoe it is using the shoe **key**. Return each shoe to its owner as you identify it.

4. Alternate methods for developing a sample classification system

If using shoes does not seem feasible in your classroom, the teacher can divide the class based on their **clothing** (perhaps coats or sweaters in cold months or t-shirts in warm months). You might start with light colors vs. dark colors and continue with categories such as prints vs. solids, buttons vs. zippers, short sleeves vs. long sleeves, with writing vs. without writing (e.g., t-shirts), etc.

Many teachers have **collections of items** that can also be used to develop a classification system (e.g., buttons): large vs. small, round vs. other shapes, white vs. colored, containing 2 or 4 holes, etc.

5. Use the leaf key

Hand out copies of the Leaf Key and the Leaf Drawings to each student. Using the drawings provided on both sheets, show students that there are many types of leaf shapes (bottom of leaf key) and leaf arrangements (leaf drawings sheet). These differences help scientists classify and identify the leaves and the plants they belong to.

Next, have students look at the Leaf Key. Explain that rather than a diagram like they used for the shoes, this key is all in writing. It is called a **dichotomous key**. The word dichotomous is derived from two Greek words that are combined to express "to divide into two parts." A dichotomous key is based on the idea of making a choice between two alternatives. Each pair of phrases describes different characteristics, but only one of the phrases will apply to the leaf being keyed out. Tell students that the "correct" phrase will either guide the student to the next pair of phrases or give the name of the tree the leaf grows on.

Have students begin to key out the leaves. As they identify each leaf, they should write the tree name under each leaf. When they are finished, review the answers with the class.

Questions to Ask During the Activity

1. Was there more than one way to classify the same objects? (Students should notice that there is more than one way to classify the same objects. Scientists often change classifications, especially as new information becomes available.)

2. Why is a key useful? (Even if you are not familiar with something, you can identify it correctly using a key.)

Preguntas sobre el tema de la actividad

1. ¿Se podrían haber clasificado los objetos de más de una manera? (Los estudiantes deben darse cuenta de que hay más de una manera de clasificar los mismos objetos. Los científicos, a menudo, cambian los sistemas de clasificación, especialmente cuando se da a conocer nueva información.)

2. ¿Por qué es tan útil tener un sistema de clasificación? (Aún en el caso de que no conozcas algo, lo puedes identificar correctamente si usas un sistema de clasificación.)

Why It Happens/More on the Topic

A dichotomous key is a "road map" used to identify an object's classification. At each decision point, the person has to decide which of two descriptions best fits the object. With each step, the descriptions become more specific until the object is identified. The system used to classify living organisms takes into account not only the features and behaviors of the organisms, but how the organisms might be related to one another. For instance, both butterflies and birds have wings and can fly, but they are not classified together. Unlike butterflies, all birds have feathers, are warm-blooded, and have two legs. Birds have more in common with each other than with butterflies and are grouped together for those reasons.

Algo más sobre el tema...

Un sistema dicótomo es un "mapa" que se usa para identificar la clasificación de un objeto. Cada vez que hay que tomar una decisión, existen dos posibilidades y la persona debe decidir cuál de las dos descripciones es la más adecuada para ese objeto. Cada vez, las descripciones se hacen más específicas, hasta que se identifica al objeto. El sistema que se usa para clasificar a los organismos vivos toma en consideración tanto las características y el comportamiento de los organismos como también las posibles relaciones entre ellos. Por ejemplo, tanto las mariposas como las

Algo más sobre el tema (continuación)

aves tienen alas y pueden volar, pero no están clasificadas en la misma categoría. Los pájaros, a diferencia de las mariposas, tienen plumas, son de sangre caliente y tienen dos patas. Las aves tienen más elementos en común entre ellas que con las mariposas, y por esa razón constituyen un grupo.

Modifications

This activity can also be used for younger students (K-2) by using procedure steps one through three only.

Extension

Have students classify and develop a dichotomous key for another set of objects (such as shells, pictures of animals, rocks, small toys, etc.). When they are finished, have students trade objects and keys to see if others can identify the objects using the key.

References

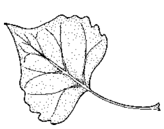
Daniel, Lucy, Edward P. Ortleb, and Alton Briggs. Merrill Life Science. Teacher Wrap-Around Edition. Lake Forest, IL: Glencoe-Macmillian/McGraw-Hill, 1993.

Weis, Jerry S., Christopher C. Smith, and Debra K. Welch. Laboratory Manual for Organismic Biology: Biology in a Nutshell. Adina, MN: Burgess Publishing, 1994.

STUDENT ACTIVITY SHEET
Leaf Key (Trees found in New Mexico)

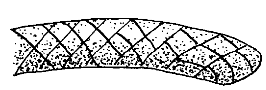
Start at number 1 and choose the option that best describes the leaves. (The diagrams at the bottom of the page will help to guide you.) Then identify the leaves on the next page.

1. If the tree has needles	go to 2
If the tree has scales	go to 4
If the tree has leaves	go to 5
2. If the needles are singular and flat, this leaf is from a	**Douglas Fir**
If the needles are in bundles	go to 3
3. If the needles are in bundles of 2, this leaf is from a	**Piñon Pine**
If the needles are in bundles of 3, this leaf is from a	**Ponderosa Pine**
4. If the branch is delicate and wispy, this leaf is from a	**Salt Cedar**
If the branch is stiff and thick, this leaf is from a	**Juniper**
5. If the leaves have lobes, this leaf is from an	**Oak**
If the leaves are without lobes, but are oval or heart-shaped	go to 6
6. If the leaves are heart-shaped with 'teeth', this leaf is from a	**Cottonwood**
If the leaves are oval, with or without 'teeth'	go to 7
7. If the leaves are oval with 'teeth,' this leaf is from a	**Siberian Elm**
If the leaves are oval without 'teeth,' this leaf is from a	**Russian Olive**



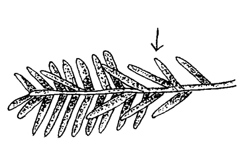
A leaf

A needle

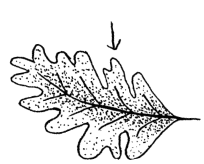


Scales

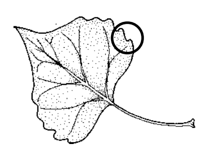
Needles in bunches



Singular needles

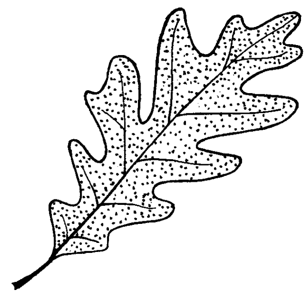


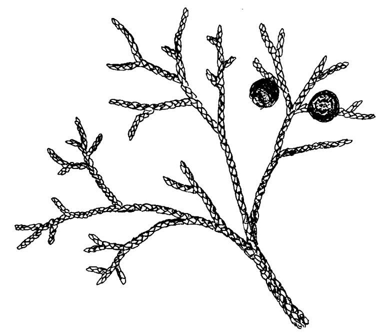
A lobe

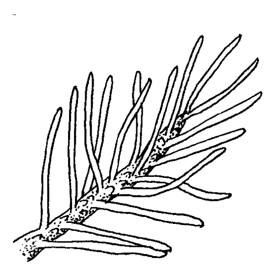


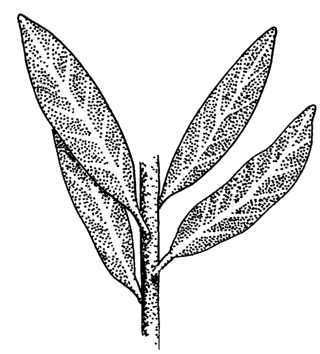
"Teeth"

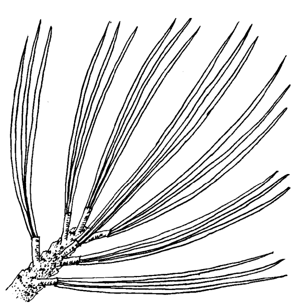
STUDENT ACTIVITY SHEET
Leaf Drawings (Trees found in New Mexico)

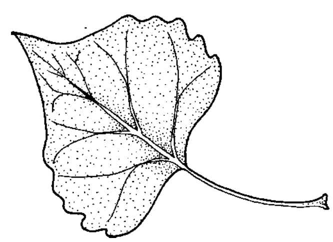


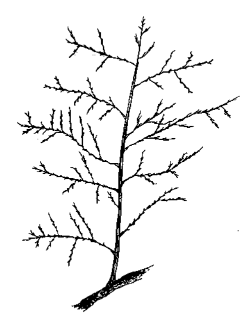






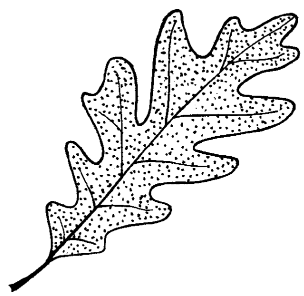




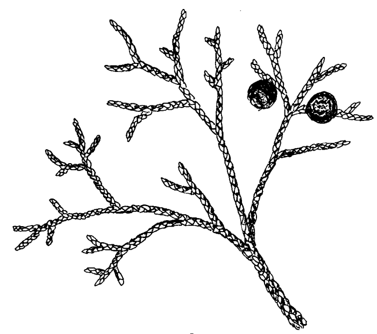


STUDENT ACTIVITY SHEET—Teacher Key
Leaf Drawings (Trees found in New Mexico)

Piñon Pine

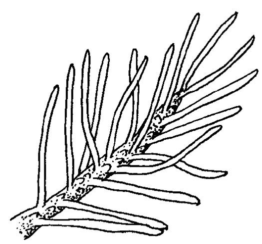


Oak

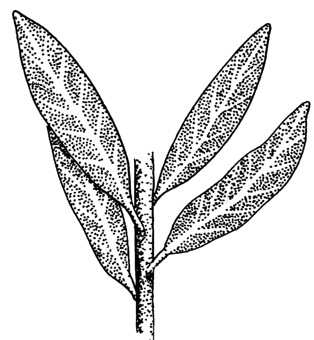


Juniper

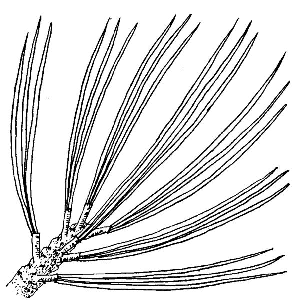
Siberian Elm



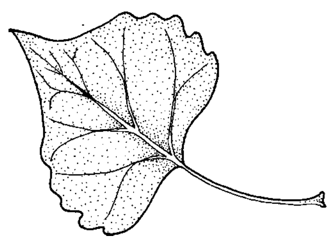
Douglas Fir



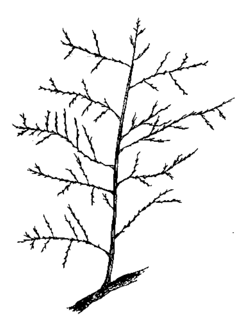
Russian Olive



Ponderosa Pine



Cottonwood



Salt Cedar

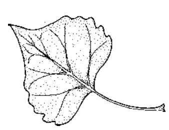
ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Sistema de clasificación para las hojas

(Árboles que se encuentran en Nuevo México)

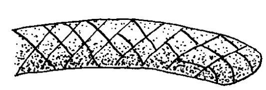
Comienza con el número 1 y elige la opción que describe mejor a tus hojas. (El diagrama al pie de página te servirá de guía.) Luego utiliza los dibujos de la siguiente página para identificar las respuestas.

1. Si el árbol tiene agujas	ir al punto 2
Si el árbol tiene escamas	ir al punto 4
Si el árbol tiene hojas	ir al punto 5
2. Si las agujas son simples y planas, esta hoja pertenece a un	**Pino de Oregón**
Si las agujas crecen en grupos	ir al punto 3
3. Si las agujas crecen en grupos de a 2, esta hoja pertenece a un	**Pino piñón**
Si las agujas crecen en grupos de a 3, esta hoja pertenece a un	**Pino ponderosa**
4. Si las ramas son delicadas y delgadas, esta hoja pertence a un	**Tamariz** (*Salt Cedar*)
Si las ramas son rígidas y gruesas, esta hoja pertenece a un	**Junípero**
5. Si las hojas tienen lóbulos, esta hoja pertenece a un	**Roble**
Si las hojas no tienen lóbulos, pero son ovaladas o acorazonadas	ir al punto 6
6. Si las hojas son acorazonadas y dentadas, esta hoja pertenece a un	**Álamo**
Si las hojas son ovaladas, ya sea dentadas o no	ir al punto 7
7. Si las hojas son ovaladas y dentadas, esta hoja pertenece a un	**Olmo de Siberia**
Si las hojas son ovaladas y no son dentadas, esta hoja es de un	**Olivo de Bohemia**



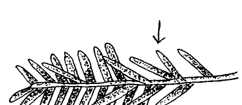
Una hoja

Una aguja

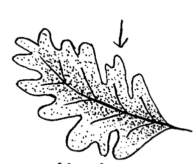


Una escama

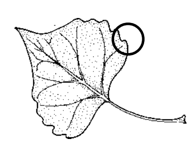
Agujas agrupadas



Agujas simples

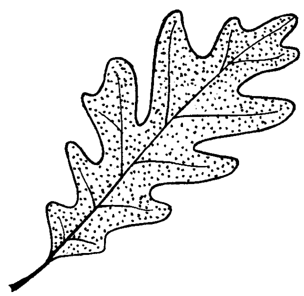
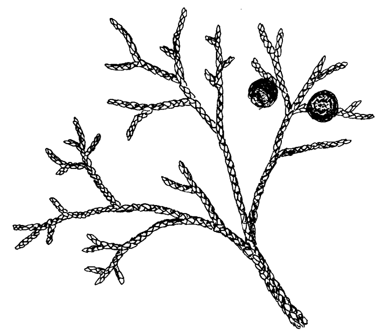
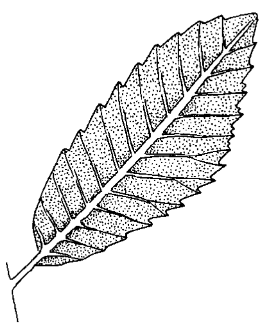
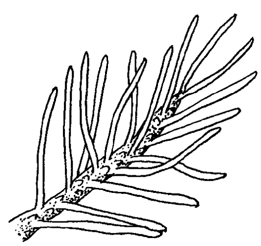
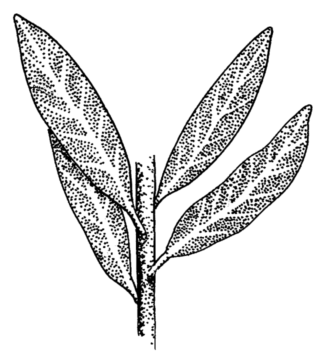
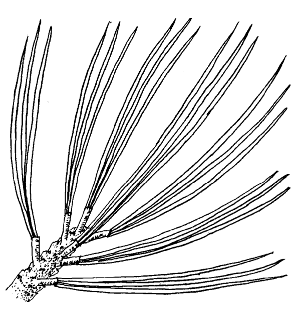
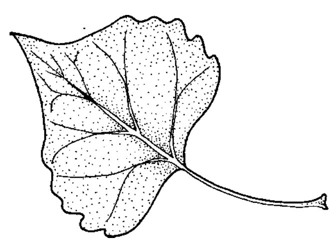
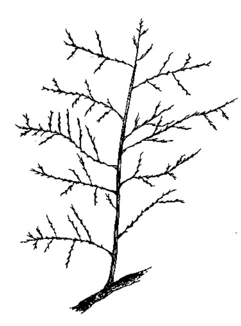


Lóbulos



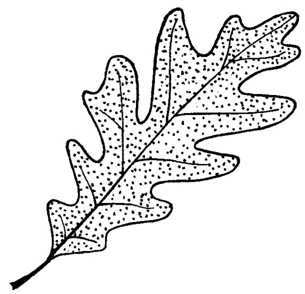
Dentada

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
(Árboles que se encuentran en Nuevo México)

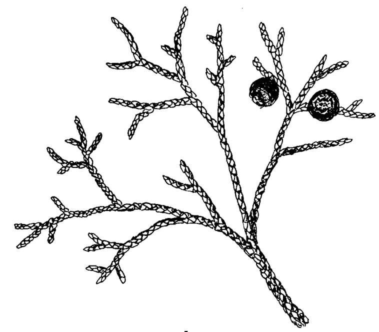










ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
(Árboles que se encuentran en Nuevo México)

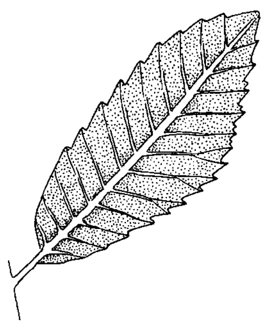
Pino piñón



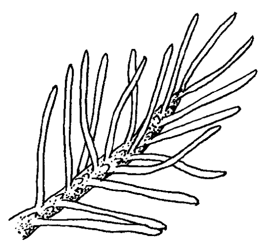
Roble



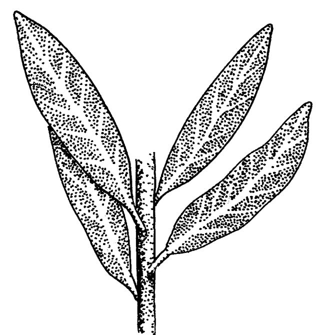
Junípero



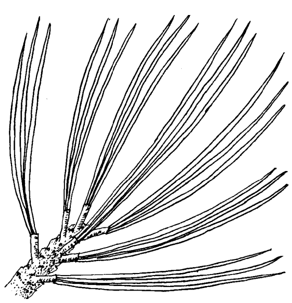
Olmo de Siberia



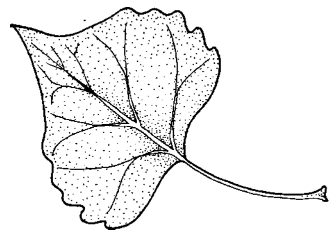
Pino de Oregón



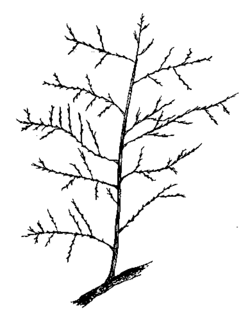
Olivo de Bohemia



Pino ponderosa



Álamo



Tamariz (*Salt Cedar*)

Introduction to
FUNGI

BACKGROUND INFORMATION—FUNGI

Fungi are unlike other living things. They are not animals. They are not plants. They are not even protists or bacteria. They are so different from these other groups of organisms that they are classified in a kingdom of their own. Though it is a group that is strange and unfamiliar to many of us, some of its members are a daily presence in our lives.

There are more than 100,000 kinds of fungi divided into the following groups: mushrooms, yeasts, molds, mildews, rusts, smuts, and blights. Although some fungi look like plants, all fungi share characteristics that distinguish them from plants, including:

• Fungi can be either single celled, like yeast, or multicellular. (Plants are all multicellular.)

• Multicellular fungi are made of many long, thin tubes called **hyphae**. Hyphae are not usually visible to the naked eye. The hyphae compact together to form visible strands called **mycelia**. You can see the mycelia strands when you pull apart a mushroom.

• Fungi do not have stems, roots, leaves, flowers, or seeds.

• Most fungi reproduce with tiny one-celled structures called **spores**. Spores do not contain any stored food (unlike plant seeds). They are as small as a speck of dust and can travel very far on even light wind currents. Some fungi reproduce by budding (a bump forms on the surface, then separates into another, independent cell).

• Fungi do not contain the green pigment **chlorophyll** that plants use to photosynthesize. Instead of making their own food through photosynthesis, fungi usually feed on dead **organic matter**. (Organic matter, like wood or bread, was once part of a living thing and contains important chemicals like carbon.) Organisms that feed on dead organic matter are called **decomposers**. Fungi digest the organic matter and break it down (or decompose it) into simpler chemicals. Chemicals such as carbon, nitrogen, and minerals are returned to the soil and used again by other organisms.

• Like plants, fungi have a cell wall (except slime mold) that surrounds each cell. Unlike plants, however, the cell walls of most fungi contain a carbohydrate called **chitin**, not cellulose. Among the algae-like fungi, the cell walls do contain cellulose.

Fungi classification is sometimes based on the type of spore-producing organs that the fungi develop (the production of spores is one way that fungi reproduce). Slime molds are sometimes classified as fungi; others would place them in the Kingdom Protista. When they are stressed, they form clusters of **sporangia**, which then release large numbers of spores.

Algae-like molds (which include potato blight, mildew, and a number of plant and fish infections) form ball-shaped sporangium that contain the spores. Black bread mold is sometimes put into this group.

The club fungi (which include the familiar mushrooms, toadstools and the lesser known rusts and smuts) form club-like fruiting bodies (mushrooms) that contain the spore-producing structures.

Sac fungi (which include yeasts, morels, penicillin and cup fungi) produce sac-like structures in which the spores are produced.

The last group, known as "imperfect fungi," is a catch-all group in which reproduction has never been observed, either because members of this group no longer have a sexual phase, or because no one has observed the reproductive structures. The fungi that causes athlete's foot and ringworm both belong to this group.

Yeasts are single-celled fungi. Most of them reproduce by "budding." As yeast grows, it changes sugars and starches into other compounds, such as carbon dioxide and alcohol. When yeast is added to a bread recipe, the bread rises because the carbon dioxide gas produces bubbles in the bread dough during this fermentation process. The alcohol produced during the same process evaporates.

Lichens: A Special Relationship

Lichen is an unusual union of two different organisms: fungus and algae. Different lichens are made up of distinct species of fungi and algae. The algae and fungi form a partnership in which each contributes something to the survival of the lichen. The green algae does the photosynthesizing for the pair. The fungus gathers most of the mineral nutrients needed for survival from the air and rainwater, and provides the algae with protection from harsh weather.

Because lichens get chemicals straight from the air, they are particularly sensitive to air pollution. When lichens begin to change or die, it can be an indication that air pollution has worsened. Healthy lichens mean we can breathe easier!

People and Fungi

Most of us eat some kind of fungus every day. Molds are used to make cheese. Yeast is used in bread baking. A mold is used to produce the citrus flavor in lemon drops. And mushrooms appear in many recipes. But, probably the most interesting way people have used fungus is in the production of penicillin.

In 1929, scientist Alexander Fleming noticed a fungus growing on a petri dish that was left uncovered. The petri dish contained a culture of bacteria that Mr. Fleming was studying. Rather than throwing it out, Mr. Fleming observed what happened in the dish. He discovered that where the fungus grew, the bacteria culture did not. After further study, he found that the fungus produced a chemical called penicillin, which prevented the bacteria from reproducing. The discovery of this **antibiotic** led to the cure of many previously crippling and often deadly diseases.

Mycologists are scientists who study fungi. In the future, another fungus may enhance the flavor of a familiar food, or cure a dreaded disease.

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Daniel, Lucy, Edward P. Ortleb, and Alton Briggs. Merrill Life Science. Teacher Wrap-Around Ed. Lake Forest, IL: Glencoe-Macmillan/McGraw-Hill, 1993.

Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn, eds. Biology of Plants. Fifth Ed. New York, NY: Worth Publishers,1992.

INFORMACIÓN BÁSICA—LOS HONGOS

Los hongos son distintos de cualquier otro organismo vivo. No son animales. No son plantas. No son ni siquiera protistas o bacterias. Son tan diferentes de cualquiera de esos otros grupos de organismos que están clasificados en su propio reino. A pesar de que éste es un grupo poco conocido para muchos de nosotros, algunos de los miembros de este grupo están presentes diariamente en nuestras vidas.

Hay más de 100,000 tipos de hongos, divididos en los siguientes grupos: hongos comestibles, levaduras, mohos, mildius, herrumbres, royas y tizones. Aunque algunos hongos parecen plantas, todos comparten ciertas características que los distinguen de éstas:

• Los hongos pueden estar compuestos por una sola célula, como por ejemplo las levaduras, o pueden tener múltiples células. (Las plantas son multicelulares.)

• Los hongos multicelulares están formados por muchos tubos largos y delgados llamados **hifas**. En general, las hifas no se ven a primera vista. Las hifas se distribuyen de una manera compacta formando unos filamentos visibles llamados **micelios**. Tú puedes ver los filamentos o micelios al separar un hongo.

• Los hongos no tienen tallos, raíces, hojas, flores ni semillas.

• La mayoría de los hongos se reproduce mediante una estructura unicelular diminuta llamada **espora**. Las esporas no almacenan alimento (a diferencia de las plantas). Son tan pequeñas como una partícula de polvo y pueden desplazarse largas distancias arrastradas por las más suaves corrientes de aire. Algunos hongos se reproducen por gemación (un pequeño brote se forma en la superficie y luego se separa y forma otra célula independiente).

• Los hongos no contienen **clorofila**, el pigmento verde que las plantas usan para realizar la fotosíntesis. En vez de producir su propio alimento a través de la fotosíntesis, generalmente, los hongos se alimentan de **materia orgánica muerta**. (La materia orgánica, como la madera o el pan, alguna vez formó parte de un organismo vivo y contiene sustancias químicas importantes como el carbono.) Los organismos que se alimentan de materia orgánica muerta se llaman **saprófitos.** Los hongos digieren la materia orgánica y la desintegran (o descomponen) en sustancias químicas simples. Estas sustancias químicas, por ejemplo, el carbono, el nitrógeno y los minerales vuelven a la tierra y son utilizados nuevamente por otros organismos.

• Al igual que las plantas, los hongos (con excepción del moho viscoso) tienen una pared celular que rodea a cada célula. Sin embargo, a diferencia de las plantas, las paredes celulares de la mayoría de los hongos contienen un carbohidrato llamado **quitina** y no contienen celulosa. La pared celular de los hongos que parecen algas tampoco contienen celulosa.

Ocasionalmente, la clasificación de los hongos se basa en los distintos tipos de estructuras que producen esporas (una forma de reproducción de los hongos es mediante esporas). A veces se clasifica al moho viscoso dentro de los hongos, otras veces se los ubica dentro del Reino Protista porque son como **amebas** gigantes y porque tienen un ciclo vital inusual. Cuando sufren estrés, forman grupos **espóricos**, los cuales más tarde liberan numerosas esporas.

El moho que parece algas (categoria que incluye a la roya de la papa, al mildius y a una cantidad de infecciones que atacan a las plantas y a los peces) forma esporangios con forma de bola. A veces se incluye al moho negro del pan dentro de este grupo.

Los hongos que se llaman hongos verdaderos, incluyen a las setas y a otros menos conocidos como las royas y las herrumbres. Estos se agrupan en asociaciones carnosas (de hongos) con estructuras que producen esporas.

Los hongos en forma de saco, que incluyen la levadura, las colmenillas, la penicilina y algunas royas, producen las esporas dentro de esos sacos.

El último grupo, llamado “hongos imperfectos,” abarca todos los hongos cuya reproducción nunca se ha observado porque los miembros de este grupo ya no tienen una fase sexual o porque nadie ha visto los órganos reproductivos. Tanto el hongo que causa el pie de atleta como el que causa la tiña pertenecen a este grupo.

Las levaduras son hongos unicelulares. La mayoría se reproduce por “gemación.” Al crecer, las levaduras transforman los azúcares y los almidones en otros compuestos como el dióxido de carbono y el alcohol. Cuando se agrega levadura a una receta para hacer pan, el pan aumenta de volumen porque el dióxido de carbono produce burbujas dentro de la masa durante el proceso de fermentación. El alcohol que se produce durante este proceso se evapora.

Liquen: Una relación especial

El liquen resulta de una unión poco común entre dos organismos: hongos y algas. Diferentes líquenes están formados por distintos tipos de hongos y de algas. Las algas y los hongos forman una asociación en la cual cada uno contribuye a la supervivencia del liquen. El alga verde realiza el proceso de fotosíntesis para esa sociedad. El hongo recolecta del aire y del agua de lluvia la mayor parte de los nutrientes que necesita para sobrevivir y además protege al alga del mal tiempo.

Los líquenes son particularmente sensibles a la contaminación del medio ambiente porque extraen las sustancias químicas directamente del aire. Cuando los líquenes comienzan a cambiar o a morir es una señal de que la contaminación del medio ambiente ha empeorado. ¡Los líquenes sanos indican que podemos respirar más tranquilos!

La gente y los hongos

La mayoría de nosotros comemos algún tipo de hongo todos los días. El queso se hace con moho. La levadura se usa para hacer pan. Otro tipo de moho se usa para producir el sabor cítrico de los caramelos de limón. Y los hongos aparecen en muchas recetas. Pero, probablemente la manera más interesante en que la gente ha usado hongos es en la producción de penicilina.

En 1929, el científico Alexander Fleming notó un tipo de hongos que crecían en una placa de Petri dejada al descubierto. La placa de Petri contenía un cultivo de bacterias que el Sr. Fleming estaba estudiando. En vez de arrojarla, el Sr. Fleming decidió observar lo que sucedía en la placa. Notó que donde crecía el hongo, la bacteria no crecía. Después de estudios adicionales, descubrió que el hongo producía una sustancia química, llamada penicilina, que impedía la reproducción de la bacteria. El descubrimiento de este antibiótico llevó a la cura de muchas enfermedades que anteriormente eran devastadoras o mortales.

Los micólogos son científicos que estudian los hongos. En el futuro, algún otro hongo puede ayudar a mejorar el sabor de alguna comida conocida o puede curar alguna temida enfermedad.

GROWING BREAD MOLD FUNGUS

Cultivo del moho negro del pan

Grades		
3–8	*3–4*	*Day 1 (setup): 10 min.* *Day 2 (setup): 30 min.* *Days 3–6 (observation): 10 min./day*

Purpose

Students will identify the conditions needed to grow bread mold fungus by exposing bread to different conditions. Students will then observe the bread mold fungus that they grow.

Materials

Fresh bread (no preservatives)—4 slices per group (Note: Do not take the bread out of its bag until students are ready to begin. The “control” bread should not be exposed to the air for more than a minute.)
Paper plates—4 for each group
Plastic wrap (or petri dishes with lids)
Water
Marker and Masking tape
Microsope or hand lenses (optional)
Commercially-prepared slide of bread mold fungus, *Rhizopus sp.* (optional)

Concepts

- Fungus is not part of the plant or animal kingdoms, but is in a kingdom of its own.
- Bread mold spores are in the air. Some of these spores settle on bread and will grow under the right conditions.
- Bread mold fungus needs warmth and moisture to grow.
- Unlike plants, fungi do not need light to grow.

Conceptos

- Los hongos no son parte de los reinos animal ni vegetal, sino que tienen su propio reino.
- Las esporas del moho del pan flotan en el aire. Algunas de esas esporas se depositan en el pan y si las condiciones son propicias lograrán crecer.
- El moho del pan necesita calor y humedad para crecer.
- A diferencia de las plantas, los hongos no necesitan luz para poder crecer.

Safety

Bread mold fungus is harmless (even if eaten). However, the conditions used to grow the bread mold fungus are also good for growing other kinds of fungi and bacteria. Handle the bread mold fungus with caution. Tell students to not breathe in while their face is very close to the bread and have them wash their hands after the activity.

Vocabulary

Fungus
Spore
Mycelium
Decomposer
Organic matter
Control (experimental)
Variable

Vocabulario

Hongo
Espora
Micelio
Saprófito
Materia orgánica
Control (experimental)
Variable

In Advance

Buy bread and gather all other materials. Make copies of the Student Activity Sheet.

Procedure

1. Introduce activity

Ask students if they know whether bread mold is a plant, animal, or something else. After several students have answered, tell them that bread mold is a **fungus**. It is not part of the animal or plant kingdom, but is classified in its own group. The fungi group includes mold, yeasts, mushrooms, and other organisms. Using the background information provided at the beginning of this section, explain some of the characteristics that all fungi share.

2. Set-up

Divide students into groups. Have each group place one slice of dry bread on a plate and cover with plastic wrap. The piece of bread should spend no more than one minute uncovered. Using the masking tape and marker, have students label the plate "dry, unexposed" and put the plates in a warm area of the room. Place three more pieces of bread on three more plates and leave uncovered overnight.

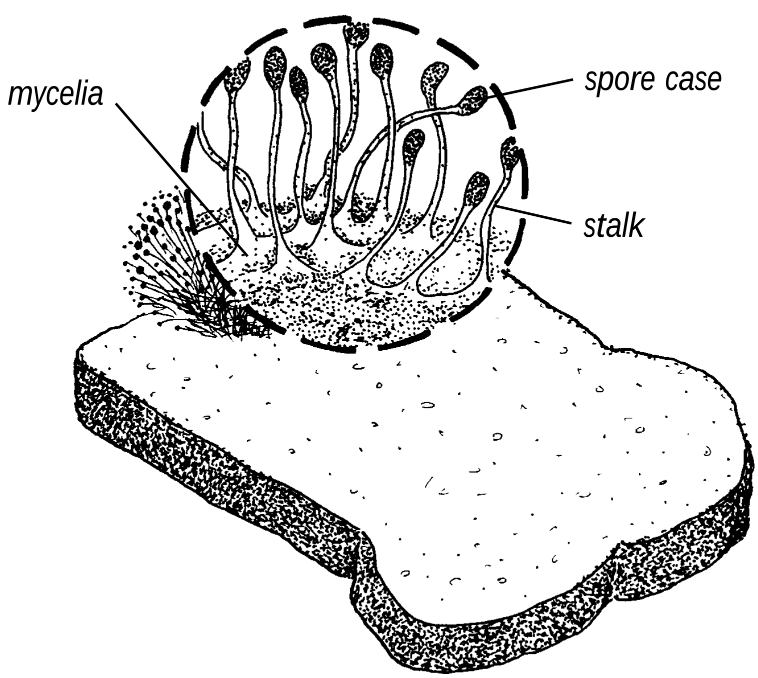
The next day, have each group cover one exposed slice of bread with plastic wrap. This slice should be labeled, "dry, warm" and placed in a warm area of the classroom. Then, instruct students to sprinkle several drops of water over the remaining two slices to moisten (but not soak) the bread. Cover each with plastic wrap. Label one of the moistened slices, "moist, warm" and place it in a warm area. Label the last slice, "moist, cool" and place in a cool spot, such as a refrigerator.

3. Predict

Ask students to guess which slices of bread will grow fungus most quickly. Have students explain their guess, then write their predictions and explanations on the Student Activity Sheet.

4. Observe

Tell students to observe the slices of bread each day and record their observations on the Student Activity Sheet. Be sure students record how much fungus each slice has and what day it appears. Also, have them note any color changes they observe. If possible, have students make a wet mount slide of the fungus to observe under a microscope. (Or use a commercially-prepared slide.) Using a microscope, they will be able to observe the tiny fungal **mycelia**, stalks, and **spore** cases shown in the diagram below.



Questions to Ask During the Activity

1. Where do you think bread mold spores come from? (They are produced by fungi, then released into the air. They are so light, that they float on air currents for a very long time. Bread needs to be exposed to the air in order for molds to grow.)

2. What conditions are best for growing bread molds? (Warm, moist conditions.)

3. Do you think fungi needs light to live and grow? (No, because they do not make their own food, like plants. Most fungi get their nutrients from dead **organic matter**. Organisms that feed on dead organic matter are called **decomposers**.)

4. Why doesn't some bread grow bread mold fungus under the same conditions? (Some breads contain preservatives that slow down the molding process.)

5. What is the **control** in this experiment? (The piece of bread that was not exposed to the air.)

6. What are the **variables** in this experiment? (Moisture and warmth.)

Preguntas sobre el tema de la actividad

1. ¿De dónde crees que provienen las esporas del pan? (Los hongos las producen y luego las liberan en el aire. Son tan livianas que pueden flotar en las corrientes de aire por mucho tiempo. El pan tiene que ser expuesto al aire para que el moho pueda desarrollarse.)

2. ¿Cuáles son las condiciones ideales para cultivar el moho del pan? (Humedad y temperatura templada.)

3. ¿Crees que los hongos necesitan luz para vivir y para desarrollarse? (No, porque ellos no producen su propio alimento como lo hacen las plantas. La mayoría de los hongos obtienen sus nutrientes de **materia orgánica** muerta. Los organismos que se alimentan de materia orgánica muerta se llaman **saprófitos**.)

4. ¿Por qué a pesar de estar bajo las mismas condiciones en algunos panes no se desarrolla el moho? (Algunos panes contienen preservantes para reducir el proceso de producción de moho.)

Preguntas (continuación)

5. ¿Cuál es la variable de **control** en este experimento? (El pedazo de pan que no se expuso al aire.)

6. ¿Cuáles son las **variables** en este experimento? (Humedad y temperatura templada.)

Why it Happens/More on the Topic

Bread mold fungus (*Rhizopus sp.*) reproduces by way of millions of tiny spores. The spores are very light and will float in the air for long periods of time before settling down on a surface. Some of these spores will settle on an exposed piece of bread. On a warm, moist slice of bread the spores will form a white, cottony fungus. The fungus grows, producing more spores in its spore cases (about 70,000 spores in each spore case). Thousands of spores will make the top of the fungus appear black. When the spores are mature, they will be released into the air to start the life cycle over again.

Algo más sobre el tema…

El moho negro del pan (*Rhizopus sp.)* se reproduce a través de millones de esporas diminutas. Las esporas son muy livianas y flotan en el aire durante mucho tiempo antes de depositarse en alguna superficie. Algunas de estas esporas se depositarán sobre un pedazo de pan expuesto al aire. Estas esporas formarán un moho blanquecino y algodonoso si se depositan sobre una rebanada caliente y húmeda de pan. Este hongo se desarrollará, produciendo más esporas en cada esporangio (alrededor de 70,000 esporas en cada esporangio). Miles de esporas harán que la parte superior del hongo se vea negra. Cuando las esporas maduran, se liberarán en el aire y el ciclo vital comenzará otra vez.

Modifications

For younger students (including K-2): Pre-label plates and help each group set-up the experiment. Assist students with the Student Activity Sheets. OR, use the activity as a demonstration.

For older students: Give students information on the conditions needed to grow bread mold fungus. Then, without telling them the steps to this activity, have each group design their own experiment to test the best conditions for growing bread mold fungus. They will need to identify the experimental control and variables. Provide each group with the materials they need to conduct their experiment.

Extensions

Now that students understand what conditions are needed to grow bread mold fungus, have them experiment with other foods to see what will grow on them. Vegetables, fruit, cheese, and yogurt ought to produce interesting results. Try adding a bit of soil as a way to introduce more spores.

References

Harty, William T. Science for Camp and Counselor. New York, NY: Associated Press, 1964.

Nelson, Leslie W. and George C. Lorbeer. Science Activities for Elementary Children. Dubuque, IA: William C. Brown Company Publishers, 1972.

GROWING BREAD MOLD FUNGUS

Student Activity Sheet

1. What is your prediction about the growth of bread mold fungus on the different plates?

____

____

____

2. Describe the changes you see on your bread each day.

	Plates			
	Dry, unexposed	Dry, warm	Moist, warm	Moist, cool
Day 1				
Day 2				
Day 3				
Day 4				

CULTIVO DEL MOHO NEGRO DEL PAN
Actividades prácticas para el estudiante

1. ¿Cuáles son tus predicciones con respecto al crecimiento del moho negro del pan en los diferentes platos?

____

____

____

2. Describe los cambios que observas diariamente en tu pan.

Platos				
	Seco, cubierto	Seco, templado	Húmedo, templado	Húmedo, frío
Día 1				
Día 2				
Día 3				
Día 4				

A FUNGUS IS NOT A PLANT

Los hongos no son plantas

Grades		
2–8	*2–3*	*Day 1 (setup): 20 min.* *Day 2–6 (observations): 10 min./day*

Purpose

Students will observe the flow of water through a celery stalk (plant) and a mushroom (fungus).

Materials (for each group)

Fresh celery stalk with leaves
Mushroom (from the grocery store)
Jar or large beaker
Bowl or small beaker
Red food coloring (2–4 teaspoons)
Water
Student Activity Sheet (one per student)

Concepts

- Fungi are not plants.
- Fungi and plants have different structures.

Conceptos

- Los hongos no son plantas.
- Los hongos y las plantas tienen diferentes estructuras.

Vocabulary

Transpiration
Xylem
Roots
Stems
Leaves

Vocabulario

Transpiración
Xilema
Raíces
Tallos
Hojas

In Advance

Trim off the bottom of the celery stalks and the mushrooms. Make copies of the Student Activity Sheet.

Procedure

1. Introduce Activity

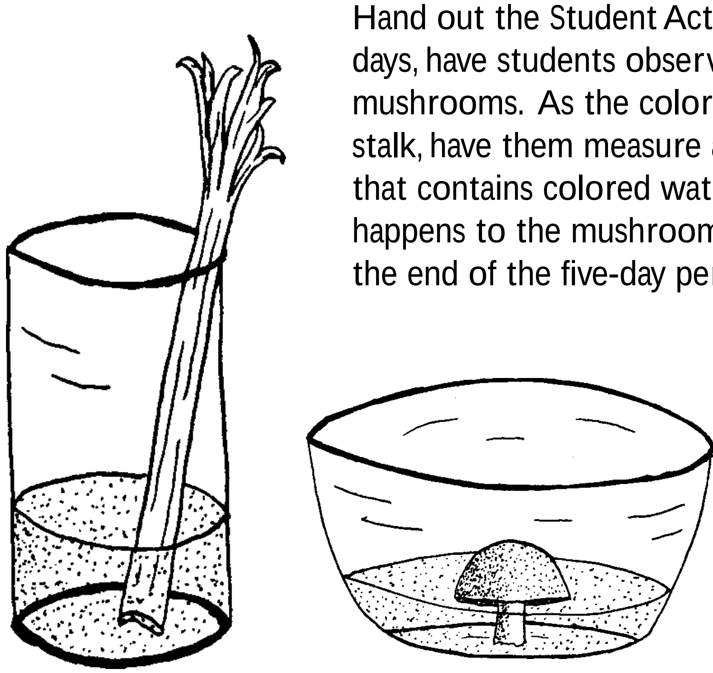
Ask students if they can describe some of the differences between plants and fungi that might affect the way water flows through them. In the **roots**, **stems**, and **leaves** of a plant, there are small tubes (**xylem**) that help pull water and food through the plant. Ask students to predict how water will move through a plant that has these structures and how it might move through a fungi, which doesn't have these structures.

2. Set-up

Divide students into groups of 2 or 3. Distribute the glasses, bowls (or beakers), celery, mushrooms, and food coloring. Have each group pour about an inch of water into their glass and about a half an inch of water into their bowl. Add 1 or 2 teaspoons of red food coloring to the glass and to the bowl. Place the base of the celery stalk into the glass and the base of the mushroom into the bowl. Set the glasses and bowls in an area of the classroom where they won't be disturbed.

3. Observe

Hand out the Student Activity Sheets. Each day for five days, have students observe their celery stalks and mushrooms. As the colored water moves up the celery stalk, have them measure and record the length of the stalk that contains colored water. Also have them record what happens to the mushroom. Discuss their observations at the end of the five-day period.



Questions to Ask During the Activity

1. Why does the colored water travel up the celery stalk rapidly, and not the mushroom? [Fungi do not have the structures (xylem in the roots, stems, and leaves) for moving water through as effectively as plants do. Students will notice these differences if they compare the bottom of the celery stalk and the mushroom after they have been in the colored water.]

2. Where does the water go after it reaches the top of the celery? (It evaporates, or **transpires**, from the leaf surfaces.)

Preguntas sobre el tema de la actividad

1. ¿Por qué viaja el agua coloreada a través del tallo del apio con tanta rapidez y no sucede lo mismo con el hongo? [Los hongos no tienen la estructura (xilema en las raíces, tallos y hojas) para transportar el agua tan eficazmente como las plantas. Los estudiantes podrán notar estas diferencias al comparar la parte inferior del tallo del apio y la del hongo después de haber estado en remojo en el agua coloreada.]

2. ¿A dónde va el agua después de haber llegado a la parte superior del tallo del apio? (Se evapora, o **transpira**, a través de la superficie de las hojas.)

Why it Happens/More on the Topic

Water molecules "stick" to each other, so as water transpires from the leaf surfaces, the water remaining in the plant is pulled upward. Because the water inside the stalk is colored, students can measure how far the water is pulled each day. Fungi do not have the same structures for moving water as plants do. Mushrooms, the "fruiting body" of a fungi, are short-lived, and do not have the same need for water as most plants.

Algo más sobre el tema…

Las moléculas de agua se atraen entre ellas, de manera que cuando las hojas transpiran, el agua del resto de la planta es atraída hacia arriba. Como el agua que fluye dentro del tallo de apio es coloreada, los estudiantes pueden medir su avance diariamente. Los hongos no tienen las mismas estructuras que las plantas para transportar agua. El sombrero carnoso del hongo vive por poco tiempo y no tiene la misma necesidad de agua que la mayoría de las plantas.

Modifications

For younger students (including K-1): Do the activity as a class demonstration and have students draw their observations on the Student Activity Sheets.

For older students: Each day, have students graph their measurements of water movements through the celery and mushroom.

Extensions

Have students cut the celery stalk and the mushroom lengthwise to observe the differences between the structures of the plant and the fungus. Then, have students cut though other types of plant stems and compare.

References

Daniel, Lucy, ed. Merrill Life Science: Laboratory Manuel. Teacher annotated edition. Columbus, OH: Glencoe Macmillian/McGraw-Hill, 1993.

Harlow, Rosie and Gareth Morgan. Fun With Science: Energy and Growth. New York, NY: Warwick Press, 1991.

Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn, eds. Biology of Plants. Fifth Ed. New York, NY: Worth Publishers, 1992.

A FUNGUS IS NOT A PLANT

Student Activity Sheet

Each day, record your observations of the mushroom and celery stalk. Also, measure and record how far the colored water traveled through the mushroom and celery stalk.

Day	Celery Stalk	Mushroom
1		
2		
3		
4		
5		

LOS HONGOS NO SON PLANTAS

Actividades prácticas para el estudiante

Escribe diariamente tus observaciones del hongo y del tallo de apio. Además, mide y anota cuánto avanza el agua coloreada a través del tallo del apio y del hongo.

Día	Tallo de apio	Hongo
1		
2		
3		
4		
5		

A FUNGUS AMONGUS

Hongos por doquier

Grades		
2–8	*2–3*	*45–60 min.* *10 min.–later the same day or next day*

Purpose

Students will observe the structures and spores of a common mushroom fungus.

Materials (for each group)

2 whole, large mushrooms (look in the grocery store for large mushrooms with a sturdy stalk)
Copies of the Student Activity Sheet
White piece of paper
Hand lenses or microscope (optional)
Commercially-prepared slides of hyphae and mycelia (optional)
Commercially-prepared slides of fungus spore (optional)

Concepts

- Mushroom structures include gills, a cap, a stalk, mycelia, and hyphae.
- The stalk gives the mushroom height so spores will be caught by wind currents as they fall.
- The cap protects the spores until they are ready to be released.
- Mushroom spores are on the gills of the mushroom.

Conceptos

- Las estructuras del hongo incluyen las laminillas, el sombrero, el estípite, el micelio y las hifas.
- El estípite le da altura al hongo para que las esporas se dispersen con las corrientes de aire al caer.
- El sombrero protege las esporas hasta que estén listas para desprenderse.
- Las esporas de los hongos se encuentran en las laminillas.

Vocabulary	***Vocabulario***
Fungus	Hongo
Hyphae	Hifas
Stalk (mushroom)	Estípite o cabillo (del hongo)
Cap (mushroom)	Sombrero (del hongo)
Mycelia	Micelio
Gill	Laminillas
Spores	Esporas

In Advance

Make copies of the Student Activity Sheet. Buy mushrooms from the grocery store.

Procedure

1. Introduce the activity

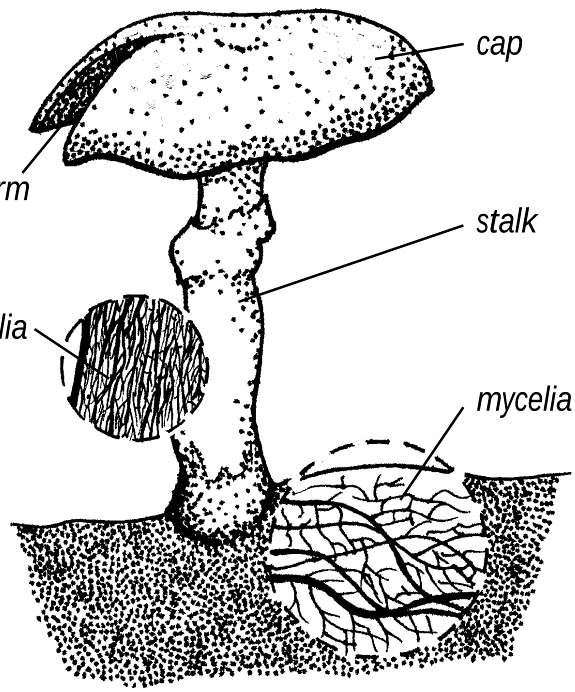
Tell students they will be taking a closer look at the structures of a mushroom fungus, then capturing some of the spores. Explain that what we see as a mushroom is the fruiting body of a much larger underground fungus. Divide students into groups of 2 or 3. Give each group a mushroom to dissect and give each individual student a copy of the Student Activity Sheet.

2. Observe

Have students observe their mushrooms, paying particular attention to the **gills** on the underside of the **cap**. If a microscope is available, have the students look at a small portion of the gills under the microscope. Instruct them to draw and label a picture of the mushroom **stalk**, cap, and gills on their Student Activity Sheet.

3. Dissect

Have students gently pull the stalk from the cap of the mushroom while looking for the strands of **mycelia**. The mycelia are small strands of **hyphae** that compact together. The hyphae are long, thin tubes found in multicellular fungi. (The hyphae will not be visible without a microscope.) As the diagram illustrates, the fruiting body and the underground structures of the mushroom fungus are all composed of mycelia. When you pull apart the mushroom, you can see some of these mycelia. Have students make a labeled drawing of the structures they see (on the Student Activity Sheet). If slides of mycelia and hyphae are available, have students look at them under the microscope.



4. Make a "mushroom print"

Give the second mushroom and a piece of white paper to each group. Tell students to gently take the cap of the mushroom off the stalk. Have them place the cap, gills side down, on the piece of paper. Set the mushrooms aside until the end of the day or the next day.

5. Observe the "mushroom print"

Have students take the mushroom cap off the piece of paper. What did the mushroom leave on the paper? Tell students these are the **spores**. They are one-celled structures that function like seeds in a plant.

Questions to Ask During the Activity

1. What is the function of the stalk? (To give the spores the height to fall so they can spread by wind currents.)

2. What is the function of the cap? (To protect the developing spores from wind and water before they are ready to be released.)

3. Why are the gills a dark color? (They are loaded with mushroom spores!)

Preguntas sobre el tema de la actividad

1. ¿Cuál es la función del estípite? (Le da altura a las esporas para que al caer sean dispersadas por las corrientes de aire.)

2. ¿Cuál es la función del sombrero? (Proteger del viento y del agua a las esporas en desarrollo antes de que estén listas para desprenderse.)

3. ¿Por qué son las laminillas de color oscuro? (¡Porque están llenas de esporas!)

Extensions

Have students dissect other types of mushrooms, then compare the shapes and sizes of the structures.

References

Raven, Peter H., Ray F. Evert, and Susan Eichhorn, eds. Biology of Plants. Fifth Ed. New York, NY: Worth Publishers, 1992.

A FUNGUS AMONGUS
Student Activity Sheet

1. Draw and label the structures of the whole mushroom below.

2. Draw and label the structures of the mushroom you have taken apart.

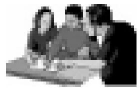
HONGOS POR DOQUIER

Actividades prácticas para el estudiante

1. Dibuja y escribe el nombre de las estructuras del hongo completo en el espacio siguiente.

2. Dibuja y escribe el nombre de las estructuras del hongo que has separado.

BUDDING IN A BOTTLE
Gemación en una botella

Grades		
2–8	4–5	Setup time: 30 min. Observations: Several times over a few hours

Purpose
Students will give yeast (a type of fungus) a variety of foods, then observe the different amounts of carbon dioxide produced by budding (reproducing).

Materials
2 packets of yeast
Warm water
Corn syrup
Flour
Unsweetened grape juice
Sugar
Cooking oil
Funnels
Measuring cups and spoons
Container to mix yeast solution
5 clean glass bottles (with a mouth small enough to stretch a balloon over)
5 large balloons
Masking tape
Pen
Rubber bands

Concepts
- Yeast cells grow and reproduce by a process called budding.
- During budding, carbon dioxide is produced as a waste product.
- Some foods encourage budding more than others.

Conceptos
- La levadura se desarrolla y se reproduce por gemación.
- Durante el proceso de gemación se produce dióxido de carbono como producto de desecho.
- Algunos alimentos estimulan la gemación más que otros.

Safety

Do not let students drink or eat any of the solutions made during the activity.

Vocabulary

Fungus
Yeast
Budding
Organic matter

Vocabulario

Hongo
Levadura
Gemación
Materia orgánica

In Advance

Gather materials. Label bottles (with masking tape and pen): corn syrup, flour, grape juice, sugar, and cooking oil.

Procedure

1. Introduce activity

Ask students if they know how plants get the food they need to grow. (They make their own food through photosynthesis.) Then ask if they know how a **fungus** gets food. (They need to get food from other sources, most often dead **organic matter**.) When **yeast**, a type of fungus, gets the food it needs, it makes more yeast cells—a process called "**budding.**" When yeast cells bud, they give off a gas called carbon dioxide. Tell students that today they will experiment with different kinds of food to see which ones are the best foods for yeast.

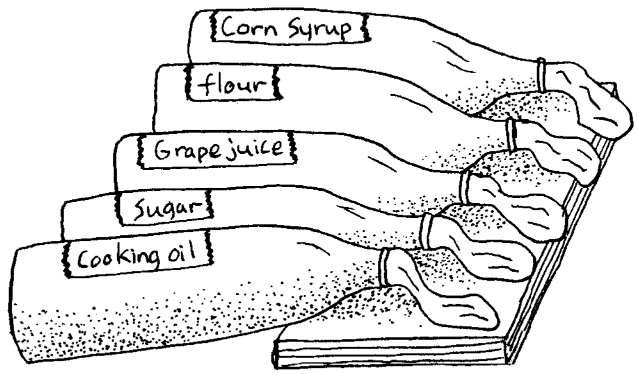
2. Set-up

Divide the class into five groups. Each group will be setting up a different bottle of yeast food. Give each group a labeled bottle and the corresponding food (corn syrup, flour, grape juice, sugar, or cooking oil). In a container, mix together 160 ml of warm water and the two packets of yeast to make the yeast solution that all the groups will need.

Write the following recipes on the board and instruct each group to mix the solution for their bottle (30 ml equals approximately 2 tablespoons and 60 ml equals approximately 1/2 cup). Solutions should be poured in the bottle once they are mixed. If groups are sharing measuring spoons and measuring cups, be sure students carefully wash them before each use.

Corn syrup bottle
60 ml corn syrup
30 ml yeast solution

Flour bottle
60 ml flour
60 ml water
30 ml yeast solution



Grape juice bottle
60 ml grape juice
30 ml yeast solution

Sugar bottle
60 ml water
15 ml sugar
30 ml yeast solution

Cooking oil bottle
60 ml cooking oil
30 ml yeast solution

When the solutions are in each bottle, give each group a balloon. Have a student in each group blow up the balloon, and then release the air. This will loosen up the balloon. Tell students to put the balloon over the top of the bottle. It is important that no air can get between the bottle and the balloon, so have students seal the balloon to the top of the bottle with a rubber band. Finally, have students bring the prepared bottles to you.

Place the bottles on their sides, but don't let the solutions go into the balloons. You may need to prop them up with a stack of books, a rolled towel, or a folded coat so the bottles will stay on a slight angle.

3. Predict
Tell students that yeast needs the right conditions in order to grow. Yeast needs warmth (from the warm water), air, water, and a type of sugar. The better the food, the more the yeast will grow, and the more carbon dioxide gas will be released. Ask

students what the balloon on the top of the bottle is for and which food they think will be best for the yeast.

4. Observe

Over the next few hours, observe the bottles and balloons. Have students note which balloons are expanding the fastest. Why are the balloons expanding? Were their predictions correct?

Questions to Ask During the Activity

1. What causes the balloons to expand? (As the yeast grows, it makes carbon dioxide gas. The gas is causing the balloons to expand.)

2. What foods made the yeast grow the most? (The foods highest in sugar should have made the yeasts grow the most.)

Preguntas sobre el tema de la actividad

1. ¿Por qué se expanden los globos? (Al crecer la levadura produce dióxido de carbono. El gas hace que el globo se expanda.)

2. ¿Qué alimentos aumentan más de volumen al usar levadura? (Cuanto más azúcares tienen los alimentos, más aumentan de volumen al usar levadura.)

Why It Happens/More on the Topic

Yeast is a single-celled fungus that uses sugar as food. The chemical process that occurs when yeast is using sugar produces carbon dioxide gas as a waste product. As the yeast cells use the sugar, they grow and reproduce by a process called budding. During budding, each yeast cell divides and multiplies into many single-celled yeast organisms.

Algo más sobre el tema…

La levadura es un hongo unicelular que se alimenta de azúcares. El proceso químico que ocurre cuando la levadura consume azúcares produce dióxido de carbono como desecho. A medida que las células de la levadura usan los azúcares, éstas crecen y se reproducen por gemación. Durante este proceso, cada célula de levadura se divide y se multiplica creando muchos organismos unicelulares.

Modifications

For younger students (including K-2): use the activity as a demonstration.

Extensions

Have students bring in other foods to try to “feed” the yeast. Be sure they make predictions about which foods will cause the most growth in the yeast. Or, have students set up an experiment where they use the same solution, but warmed to different temperatures to see which temperature is ideal for yeast growth.

References

Ardley, Neil. The Science Book of Things That Grow. San Diego, CA: Gulliver Books, 1991.

Bosak, Susan, Douglas A. Bosak, and Brian A. Puppa. Science Is...A Source Book of Fascinating Facts, Projects, and Activities. Ontario, Canada: Scholastic Canada, 1991.

Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn, eds. Biology of Plants. Fifth Ed. New York, NY, Worth Publishers, 1992.

RISING BREAD

El pan sube, sube…

Grades		
K–8	*3–4*	*20 minutes setup* *10 minutes observation and discussion 1 hour later*

Purpose

Students will observe how reproducing (budding) yeast cells help bread rise.

Materials (for each group)

3 cups white flour
2 1/2 tablespoons active dry yeast
1 tablespoon sugar
1/2 cup warm water
2 mixing bowls

Concepts

- Yeast needs food, water, warmth, and air to grow.
- Carbon dioxide gas is given off as yeast grows.
- The bubbles formed by the carbon dioxide gas causes the bread dough to expand.

Conceptos

- La levadura necesita alimentos, agua, temperatura templada y aire para crecer.
- A medida que la levadura hace que la masa del pan aumente de volumen se desprende dióxido de carbono.
- Las burbujas que forman el dióxido de carbono producen la expansión de la masa.

Vocabulary

Yeast

Vocabulario

Levadura

In Advance

Gather materials needed for the activity.

Procedure

1. Set-up

Divide students into groups. Give each group the bread ingredients and bowls. Have students put the following into each bowl:

1 1/4 tablespoons active dry yeast
1/2 tablespoon sugar
1/4 cup warm water

Have students set the bowls aside for about 5 minutes, then add 1 1/2 cups flour to each bowl. Mix all the ingredients, then have each group put one bowl in a warm spot (a sunny window or near a heater) and the other bowl in a cool spot (such as a refrigerator).

2. Predict

Ask students what they think will happen to their two loaves of dough over the next hour. Can they explain their answers?

3. Observe

After about an hour, have each group collect its bowls to see what happened. The dough placed in the warm spot should be larger. The dough in the cold spot should be unchanged.

Questions to Ask During the Activity

1. What does yeast need to grow? (Food, warmth, water, and air.)

2. What makes bread rise? (The yeast is using the sugar as food. As the yeast grows, it gives off carbon dioxide gas. The gas forms bubbles in the dough, which causes the bread to expand.)

3. Why didn't the dough kept in the cold spot rise? (It was not warm enough for the yeast to be active, therefore the yeast did not use the sugar, produce carbon dioxide gas, and cause the dough to rise.)

Preguntas sobre el tema de la actividad

1. ¿Qué necesita la levadura para producir el aumento de volumen en la masa? (Alimentos, temperatura templada, agua y aire.)

2. ¿Qué es lo que hace que el pan suba? (La levadura se alimenta de azúcares. A medida que la masa aumenta de volumen, se libera dióxido de carbono.)

3. ¿Por qué no subió la masa que se guardó en un lugar frío? (La temperatura no fue lo suficientemente templada para que la levadura se activara, por eso la levadura no usó los azúcares, no produjo dióxido de carbono y no hizo que la masa subiera.)

Why it Happens/More on the Topic

Under the right conditions (warmth and humidity), yeast will use sugar as food. This chemical process produces carbon dioxide gas as a waste product. The gas produces bubbles in the bread dough, causing the bread to expand. If the yeast does not have either warmth or humidity, it will not be active and not use the sugar.

Algo más sobre el tema…

Bajo las condiciones propicias (temperatura templada y humedad), la levadura se alimenta de azúcares. El proceso químico produce dióxido de carbono como desecho. El gas produce burbujas dentro de la masa del pan y causa la expansión de la misma. Si la levadura no tiene una temperatura moderada o humedad, no se activará y no consumirá los azúcares.

Modifications

For younger students, measure the bread ingredients in advance.

Extensions

Cook the bread dough, then give students samples of the bread that rose and the bread that didn't. Or, for a more palatable project, use the pretzel recipe below and have students shape their own pretzels before baking. This recipe will make 20 pretzels.

1 package yeast
1 1/2 cups warm water
1 1/2 teaspoon sugar
3/4 teaspoon salt
4 cups flour
cooking spray
1 egg
1 tablespoon water
coarse salt (optional)

Mix the yeast and sugar with warm water. Let stand for 10 minutes. Mix in 4 cups of flour and salt. Knead until soft and smooth (about 5 minutes). Let the dough rise, covered, in a greased bowl until it doubles in bulk (45 minutes to 1 hour.) Divide the dough into 20 pieces. Roll dough into 12-inch long ropes and shape into pretzels. Place on a greased cookie sheet. Beat the egg with 1 tablespoon water and brush it on top of pretzels. Sprinkle with coarse salt, if desired. Cover and let rise for 15 minutes. Bake pretzels at 450 degrees for 15 minutes or until golden brown.

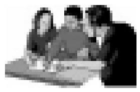
References

Ardley, Neil. The Science Book of Things That Grow. San Diego, CA: Gulliver Books, 1991.

Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn, eds. Biology of Plants. Fifth Ed. New York, NY: Worth Publishers, 1992.

A FUNGI FOREST

Un bosque de hongos

Grades		
K–3	Whole Class	45–60 min.

Purpose

Students will observe the different shapes, sizes, colors, and textures of mushrooms from photographs, then create their own version of a mushroom with art materials.

Materials

Books with pictures of mushrooms (look in your school library or public library)
Construction paper—various colors
Scissors
Pencils
Tape
Glue
Markers or crayons
Other small items to glue onto construction paper such as yarn, glitter, pieces of fabric, dried noodles, etc.

Concepts

- Mushrooms come in all shapes, sizes, colors, and textures.
- Some mushrooms are edible and others are poisonous.

Conceptos

- Los hongos tienen todo tipo de formas, tamaños, colores y texturas.
- Algunos hongos son comestibles y otros son venenosos.

Vocabulary

Edible
Poisonous
Cap
Stalk

Vocabulario

Comestible
Venenoso
Sombrero
Estípite

In Advance

Find books with pictures of mushrooms from the school library or public library. Gather art materials.

Procedure

1. Discuss mushrooms

Ask students if they have ever seen a mushroom growing outside. If so, can they describe what the mushroom looked like? Tell students that mushrooms come in many different shapes, sizes, and colors. Some are tiny, others are large and showy. Some mushrooms are tall and slender, others are short and round. While many mushrooms are brown, some mushrooms are brightly colored or have interesting patterns or textures.

Ask students if they can tell which wild mushrooms are good to eat (**edible**) and which ones are **poisonous**. Warn students that there are no characteristics that all poisonous mushrooms share. Poisonous mushrooms also come in all shapes, sizes, and colors. Tell students they should never eat a mushroom they find outside unless a knowledgeable adult says it's alright. Mushrooms that are sold in grocery stores are safe to eat, however.

2. Look at mushroom pictures

Distribute the mushroom books to small groups of students or set up some centers where students can look at the pictures of the mushrooms over the next couple of days. Tell students they will be making a mushroom with art materials and the pictures should give them some ideas.

3. Make mushrooms

Give each student a piece of colored construction paper, a pencil, and a pair of scissors. Tell each student to draw an outline of the shape of the mushroom they will be making. Remind students that mushrooms have a **cap** and **stalk**, but their shapes and sizes vary. When their outline is complete, have students cut out their mushroom.

Distribute the other art supplies and tell students to decorate their mushroom using some of the ideas they got while looking at the pictures. When students are finished, place the mushrooms in an area where the glue can dry.

4. Create a fungi forest

Once the paper mushrooms are dry, hang them together on a wall or bulletin board to create a fungi forest.

Questions to Ask During the Activity

1. Do mushrooms need light to grow? (No, mushrooms and other fungi do not need sunlight to make their own food, like plants do.)

2. Since fungi don't make their own food, what do they use for food? (They "feed" on animals and plants that have died.)

Preguntas sobre el tema de la actividad

1. ¿Necesitan luz los hongos para crecer? (No, a diferencia de las plantas, ningún hongo necesita luz para producir su propio alimento.)

2. Ya que los hongos no producen su propio alimento, ¿de qué se alimentan? (Se "alimentan" de plantas y de animales muertos.)

Extensions

Go on a fungi hunt! Take students outside to an area that stays relatively moist (near a puddle, pond, stream, or garden). Have them look for fungi growing out of the soil or decaying wood.

Introduction to
PLANTS

BACKGROUND INFORMATION—PLANTS

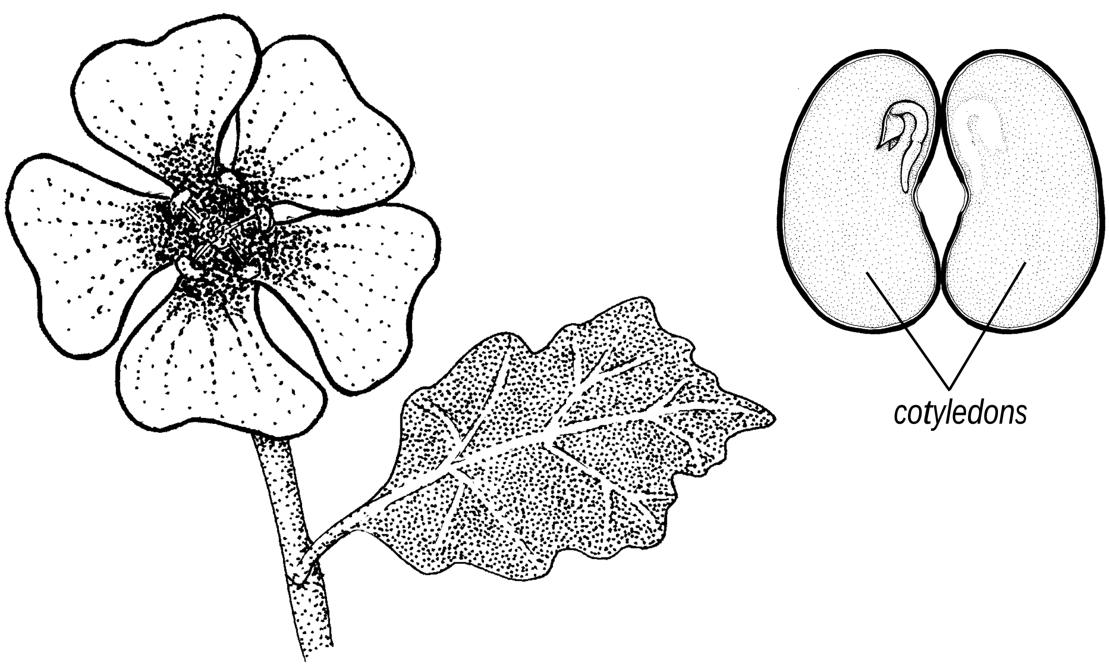
Plants are astounding in their variety and their abundance. They can live in the harshest desert, the coldest tundra, or under the ocean. They can break through solid rock with their roots or travel hundreds of miles. The tiniest plants may be less than a centimeter high, but the tallest can be hundreds of feet tall. Plants play an integral part in our lives—providing the oxygen we breathe and the food we eat. Without plants, our lives, and the lives of other animals, wouldn't exist.

The first land plants appear in the fossil record around 435 million years ago during the Silurian Period. Since then, they have diversified greatly and become the basic source of food, either directly or indirectly, for most of life on Earth. Plants produce their own food using **chlorophyll,** a green pigment unique to plants. All plants are multi-cellular and each plant cell is surrounded by a **cell wall**. The cell wall contains a special carbohydrate, called **cellulose,** that gives the plant its rigidity.

Plants are generally divided into two major groups: Seedless plants (includes mosses and ferns) and those with seeds. The plants that form seeds are then divided into two more groups. The non-flowering **gymnosperms** (includes conifers, cycads, and ginko trees) produce their seeds in a cone or cone-like structure. **Angiosperms**, or flowering plants, (such as wildflowers, cacti, and grasses) produce seeds in a flower. Just like animals, plants respond to their environment, acquire energy, reproduce, grow, and change throughout their life cycle.

Angiosperms are very diverse and include not only the plants with conspicuous flowers but also many trees (such as oak, willow, elm, maple, birch), fruits, vegetables, nuts, herbs, cactus, corn, wheat, rice, other grains, and grasses. Angiosperms are divided into two broad groups: the **monocots** and the **dicots**. The names refer to the fact that the embryo in the monocots has one cotyledon ("seed leaf," the food storage part of the seed) and in the dicots there are two cotyledons. This feature can be observed by comparing a monocot, such as corn, which does not naturally split into sections, with a dicot, such as peanuts, which naturally split into two parts. Monocots usually have leaves with veins that are parallel to each other and flowers with petals in multiples of three. Grass, lilies, corn, and palm trees are all examples of monocots. Dicots usually have leaves with a net-like pattern of veins and flowers with petals in multiples of four or five. Roses, beans, orange trees, apples and dandelions are all examples of dicots.

Monocot leaf, flower, and seed



Dicot leaf, flower, and seed

The Seed and Seedling

Plants produce **seeds** that come in all shapes and sizes. An apple tree produces seeds in the core of an apple, a pine tree produces pine nuts in a cone, and an oak produces acorns. Some seeds stay close to the parent plant, but others travel farther by blowing in the wind, floating on water, shooting out of an exploding pod, attaching to an animal's fur, and/or passing through an animal's intestines.

For a seed to grow, or **germinate**, it needs the right amount of water and warmth. Inside the seed, the embryo uses stored food to begin growing roots. Once the roots are able to get nutrients from the soil, a plant shoot grows upward and breaks through the soil. During the germination process, plants use hormones to "read" and respond to their environment. A response in growth toward or away from environmental stimuli is called **tropism**. **Geotropism** is the tendency of the roots of a germinated seed to grow in the direction of the gravitational pull and the plant shoot to grow away from the gravitational pull. Another important tropism is **phototropism**. In phototropism, the leaves and stems of a plant grow towards the sunlight. This is especially important to a forest **seedling,** which grows in the shadow of larger trees.

Through a process called **photosynthesis**, plants use sunlight to make their own food. Photosynthesis is a chemical reaction that takes place in a cellular structure called a **chloroplast.** Chloroplasts are located in the cells of green plant parts such as leaves and stems. Chlorophyll, the green pigment inside the chloroplast, absorbs light energy. During photosynthesis, light energy is used to convert water and carbon dioxide into food (carbohydrates) and oxygen. In addition to sunlight, growing seedlings will seek water and minerals from the soil.

Plants and Water

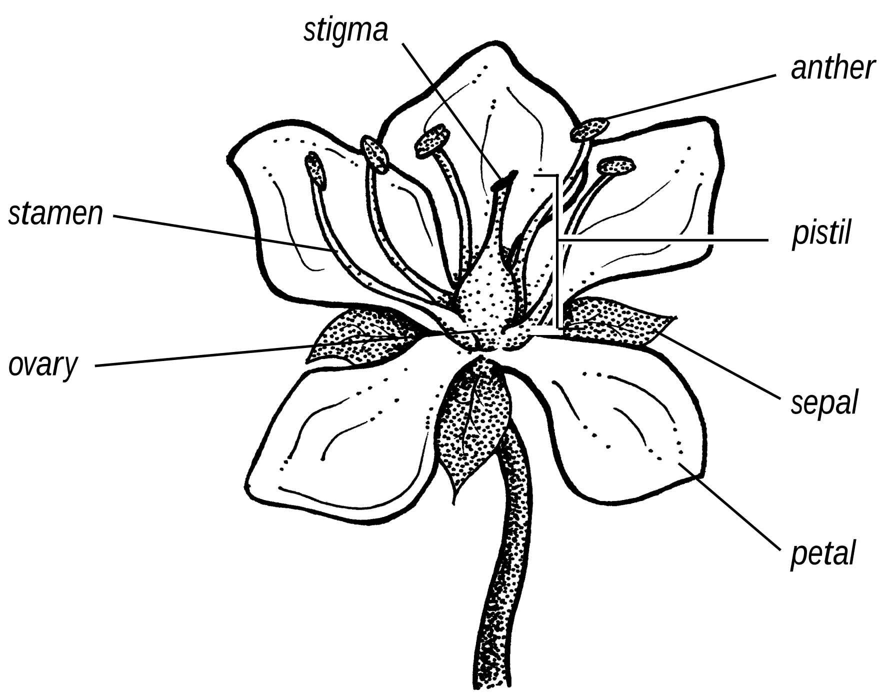
As with all organisms, water is essential to plants. It is used in photosynthesis, it helps transport food and minerals throughout the plant, and it helps the plant stand upright.

Water is constantly being pulled through a plant because of a process called **transpiration**. Transpiration is the evaporation, or loss of water vapor, from the leaves. Because water molecules "stick" together, water is pulled upward through the plant by water that is evaporating from the leaves. As this occurs, the plant takes more water from the soil through its roots. Minerals from the soil are pulled along with the water and are distributed throughout the plant as well.

Gases such as oxygen, water vapor, and carbon dioxide pass into and out of the plant through structures on the leaves and stems called **stomata**. The stomata are openings, or pores, that are opened and closed by **guard cells** on either side. The guard cells regulate the intake of carbon dioxide and the release of oxygen. Water also exits through the stomata. In dryer climates, where plants need to conserve water, stomata generally stay closed during the day and open at night to prevent too much evaporation. The stomata open and release the oxygen (a by-product of the day's photosynthesis) and take in carbon dioxide to use in photosynthesis the next day.

Flowers

A **flower** is an important part of the life cycle of a flowering plant. Flowers contain the structures used in plant sexual reproduction. The thin, vase-like structure in the center of a flower is called the **pistil**. The long, skinny structures that surround the pistil are called **stamens.** They produce pollen, the male sex cells.The sticky tip of the pistil, called the **stigma**, receives pollen. **Pollination** occurs when pollen is transferred from a stamen to the stigma. The female sex cells are produced and contained inside the **ovary,** located at the rounded base of the pistil. When pollen meets the female sex cells in the ovary they become **fertilized** and begin to produce seeds. The seed then grows inside the ovary until it is ready to be released. The petals, stamens, and pistil either wilt or become part of the fruit that forms around the seed.



How does pollen travel from the stamens of one plant to the stigma of another plant? Winds often carry pollen to the right place, but other plants rely on pollinators. Pollinators are animals such as insects, birds, or bats that drink flower nectar for food. The flower's shape, bright colors or strong scents attract them. As the pollinator reaches to the bottom of the flower for nectar, it rubs against the stamen, collecting pollen on its body. When it arrives at the next flower, some of the pollen can rub onto the stigma and pollination can occur.

Food Storage in Plants

Plants store excess carbohydrates in a number of structures, including the stem, leaves, and roots. For example, a carrot is stored food in the plant's root and a white potato is stored food in the plant's stem. This stored food can be used later by the plant during reproduction or during rapid periods of growth. It also becomes a vital source of food for animals, including humans!

The seeds and fruit are also storage places for extra carbohydrates. The stored food in the seed nourishes it during germination before there is a plant to photosynthesize. The stored nutrients in seeds and fruit also indirectly aid in **seed dispersal**. Animals that eat the seeds and fruit deposit the seeds in a new place, where under the right conditions, the seeds will sprout and continue the life cycle of the plant.

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INFORMACIÓN BÁSICA—LAS PLANTAS

Las plantas son asombrosas tanto en su variedad como en su abundancia. Pueden vivir en el desierto más seco, en la tundra más fría o en el océano. Pueden atravesar rocas sólidas con sus raíces o viajar a través de cientos de millas. Las plantas más pequeñas pueden medir menos de un centímetro de altura pero las más altas pueden tener una altura de cientos de pies. Las plantas desempeñan una función esencial en nuestras vidas, nos proveen el oxígeno que respiramos y los alimentos que comemos. Sin las plantas, nuestras vidas y las vidas de otros animales no existirían.

De acuerdo con los fósiles que se han encontrado, sabemos que las primeras plantas terrestres aparecieron hace aproximadamente 435 millones de años durante el período Silúrico. Desde entonces se han diversificado mucho y se han transformado en la fuente básica de alimentación, de manera directa o indirecta, para la mayor parte de la vida terrestre. Las plantas producen su propia alimentación usando **clorofila**, un pigmento verde que se encuentra sólo en las plantas. Las plantas son multicelulares y cada una de sus células está rodeada por una **pared celular**. La pared de la célula contiene un carbohidrato especial llamado **celulosa** que otorga rigidez a la planta.

Las plantas generalmente se dividen en dos grupos principales. Las plantas sin semillas (musgos y helechos) y las plantas con semillas. A su vez, las plantas que producen semillas se dividen en otros dos grupos. Las plantas que no producen flores, **gimnospermas** (coníferas, cicadáceas y árboles ginkgo), producen sus semillas adentro de un cono o de una estructura parecida a un cono. Las **angiospermas**, o plantas con flores (flores silvestres, cactus y gramas o pastos) producen sus semillas dentro de una flor. Al igual que los animales, las plantas responden al medio ambiente, absorben energía, se reproducen, crecen y cambian a través de su ciclo vital.

Las angiospermas son muy diversas e incluyen no sólo plantas con flores visibles, sino también muchos árboles (por ejemplo, el roble, el sauce, el olmo, el arce, el abedul), frutas, verduras, nueces, hierbas, cactus, mazorca o maíz, trigo, arroz y otros granos, además de otras gramas. Las angiospermas se dividen en dos grupos amplios: las **monocotiledóneas** y las **dicotiledóneas**. Los nombres se refieren a que el embrión en las monocotiledóneas tiene un solo cotiledón ("la hoja dentro de la semilla," es decir la parte de la semilla donde se almacenan los alimentos) y las dicotiledóneas tienen dos cotiledones. Esta característica se puede observar comparando una monocotiledónea, tal como el maíz, que no se divide naturalmente en dos secciones y una dicotiledónea, tal como el cacahuate (o maní) que se divide naturalmente en dos partes. Las monocotiledóneas usualmente tienen hojas con nervaduras paralelas entre sí y flores con pétalos agrupados de a tres. Las gramas, los lirios, el maíz y las palmas son ejemplos de monocotiledóneas. Las dicotiledóneas, en general, tienen hojas con nervaduras reticuladas y flores con pétalos agrupados de a cuatro o cinco. Ejemplos de dicotiledóneas son: rosas, frijoles, naranjos, manzanos y diente de león.

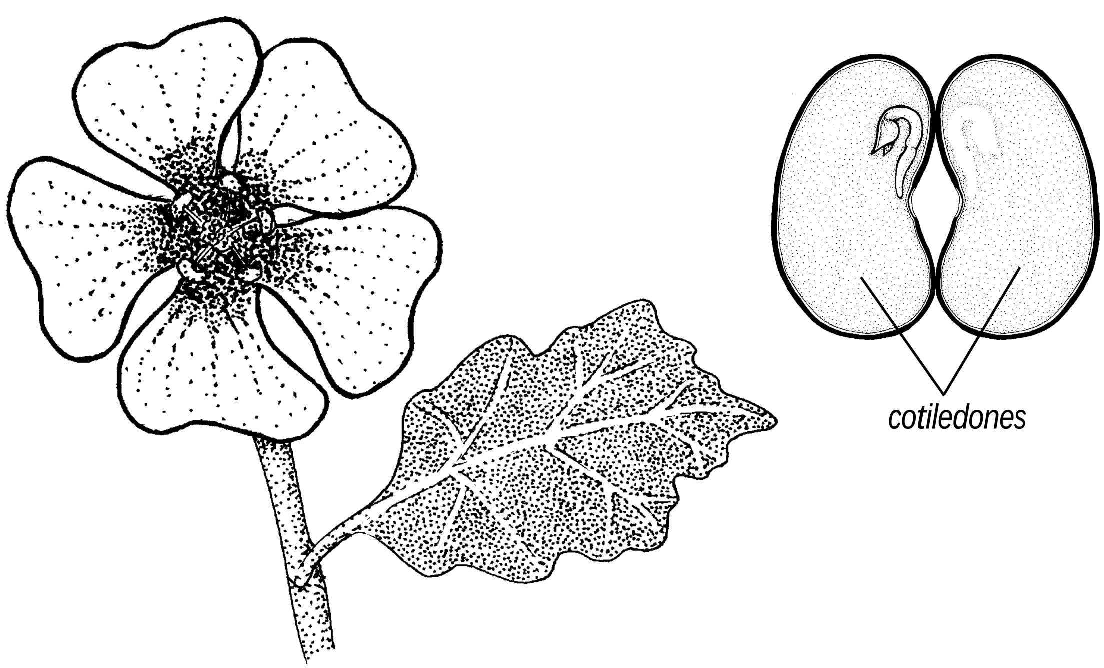
Las semillas y la plántula

Las plantas producen **semillas** de todo tipo de formas y tamaños. Un manzano produce sus semillas en el centro de la manzana, un pino produce semillas en un cono y un roble las produce en una bellota. Algunas semillas permanecen cerca de la planta paterna, pero otras se desplazan lejos por medio del viento, flotando en el agua, mediante la explosión de una vaina, al adherirse a la piel de un animal y/o al atravesar los intestinos de un animal.

Para que una semilla crezca, o **germine**, se necesita la cantidad justa de agua y la temperatura adecuada. El embrión usa el alimento almacenado para comenzar a desarrollar raíces dentro de la semilla. Una vez que las raíces pueden obtener nutrientes de la tierra, la planta crece hacia arriba y atraviesa el suelo. Durante el proceso de germinación, las plantas utilizan hormonas para "leer" las señales provenientes del medio ambiente y poder responder. El crecimiento de la planta hacia o en dirección opuesta a los estímulos del medio se llama **tropismo**. **Geotropismo** es la tendencia de las raíces de una semilla germinada a crecer en la misma dirección que la fuerza de gravedad y del resto de la planta a crecer en dirección contraria a la fuerza de gravedad. Otro tropismo importante es el **fototropismo**. Mediante el fototropismo, las hojas y los tallos de la planta crecen en dirección a la luz. Esto es especialmente importante para las **plántulas** que crecen a la sombra de árboles grandes.

Las plantas utilizan la luz del sol para fabricar su propio alimento a través de un proceso llamado **fotosíntesis**. La fotosíntesis es una reacción química que se produce dentro de una estructura celular llamada **cloroplasto**. Los cloroplastos se encuentran en las células de ciertas partes de las plantas verdes, tales como las hojas y los tallos. La clorofila es un pigmento verde que se encuentra en el interior del cloroplasto y que absorbe la energía de la luz. Durante la fotosíntesis, la energía de la luz se utiliza para convertir agua y dióxido de carbono en alimento (carbohidratos) y oxígeno. Además de la luz del sol, los brotes buscarán agua y minerales del suelo.

Hoja, flor y semilla de las monocotiledóneas



Hoja, flor y semilla de las dicotiledóneas

Plantas y agua

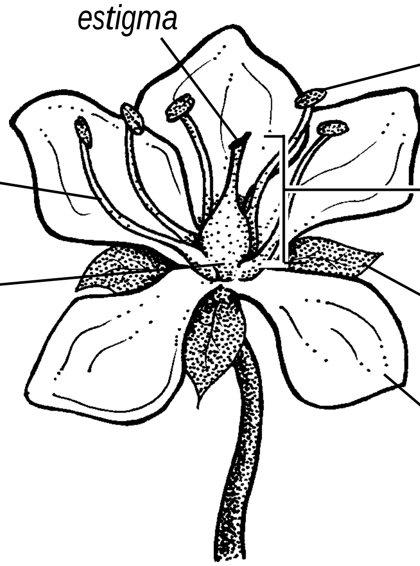
El agua es esencial para las plantas, de la misma manera que lo es para el resto de los organismos. Se utiliza en el proceso de fotosíntesis, ayuda a transportar alimentos y minerales a través de la planta y ayuda a que la misma se mantenga erguida.

El agua pasa constantemente a través de la planta mediante el proceso de **transpiración**. Transpiración es la evaporación o pérdida de vapor de agua a través de las hojas. Como las moléculas de agua se atraen entre sí, el agua transita hacia la parte superior de la planta arrastrada por el agua que se evapora por las hojas. Al mismo tiempo, la planta extrae más agua del suelo a través de las raíces. Los minerales del suelo son absorbidos junto con el agua y se distribuyen a toda la planta.

Los gases, tales como el oxígeno, el vapor de agua y el dióxido de carbono pasan hacia el interior y exterior de la planta a través de ciertas estructuras llamadas **estomas**. Los estomas son orificios, o poros, que se abren o se cierran por la acción de las **células guardianas**, ubicadas a ambos lados del poro. Las células guardianas regulan la entrada de dióxido de carbono y la salida de oxígeno. El agua sale sólo a través de los estomas. En climas secos, donde las plantas necesitan conservar agua, los estomas permanecen cerrados durante el día y se abren en la noche para evitar demasiada evaporación. Los estomas se abren y liberan oxígeno (un derivado de la fotosíntesis de ese día) y absorben dióxido de carbono para usar en la fotosíntesis del día siguiente.

Flores

Una **flor** es una parte importante del ciclo vital de las plantas con floraciones. Las flores contienen las estructuras que se usan en la reproducción. La estructura delgada con forma de florero ubicada en el centro de la flor se llama **pistilo**. Las estructuras largas y delgadas que rodean al pistilo se llaman **estambres**. Éstos producen polen, las células sexuales masculinas. El extremo pegajoso del pistilo, llamado **estigma**, recibe el polen. La **polinización** ocurre cuando el polen se transfiere de un estambre al estigma. Las células sexuales femeninas se producen y se almacenan dentro del **ovario**, que está en la base redondeada del pistilo. Cuando el polen se encuentra con las células sexuales femeninas en el ovario, éstas son fertilizadas y comienzan a producir semillas. Las semillas crecen dentro del ovario hasta que están listas para ser liberadas. Los pétalos, los estambres y el pistilo o bien languidecen y se secan o forman parte de la fruta que se desarrolla alrededor de la semilla.



¿Cómo viaja el polen de los estambres de una planta hasta el estigma de otra planta? A menudo, el viento lo deposita en el lugar adecuado, pero otras plantas necesitan agentes polinizadores. Los agentes polinizadores son animales, tales como insectos, aves o murciélagos que beben el néctar como forma de alimentación. La forma de las flores, los colores vívidos y los perfumes fuertes los atraen. Cuando el agente polinizador llega al fondo de la flor para buscar néctar, frota su cuerpo contra los estambres y el polen se adhiere al mismo. Cuando llega a la próxima flor, parte de ese polen puede adherirse al estigma y así es como ocurre la polinización.

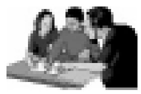
Almacenamiento de alimentos en las plantas

Las plantas almacenan el excedente de carbohidratos en varias estructuras, que incluyen los tallos, las hojas y las raíces. Por ejemplo, una zanahoria almacena los alimentos en la raíz de la planta y una papa blanca almacena los alimentos en el tallo de la planta. La planta puede usar los alimentos almacenados en algún otro momento, durante la reproducción o durante los períodos de crecimiento rápido. ¡Además, las plantas son una fuente vital de alimentos para animales, incluyendo seres humanos!

Las semillas y los frutos también son lugares donde se almacena el excedente de carbohidratos. Los alimentos almacenados en la semilla la alimentan durante la germinación, antes de que exista una planta que pueda tomar ventaja del proceso de fotosíntesis. Los nutrientes almacenados en las semillas y en las frutas colaboran indirectamente con la **dispersión de semillas**. Los animales comen las semillas y las frutas y las depositan en un nuevo lugar, donde bajo condiciones favorables, las semillas crecerán y continuarán con el ciclo vital de la planta.

WHAT'S INSIDE A SEED?

¿Qué hay adentro de la semilla?

Grades		
2–8	*3–4*	*45–60 min.*

Purpose

Students will observe and identify the parts of a lima bean seed, compare it to other seeds, and determine the difference between a monocot and a dicot.

Materials

Seeds: lima beans, corn, peas, peanuts, and sunflower seeds
Scalpel or knife
Student Activity Sheet
Pencil or pen

Concepts

- Each seed structure has a different function.
- Seeds can be divided into monocots (one cotyledon) and dicots (two cotyledons).

Conceptos

- Cada estructura dentro de la semilla tiene una función diferente.
- Las semillas se pueden dividir en monocotiledóneas (un cotiledón) y dicotiledóneas (dos cotiledones).

Safety

Do not let younger students use the scalpel. Cut open hard seeds yourself.

Vocabulary

Radicle
Plumule
Endosperm
Seed coat
Cotyledon (pronounced: cot-il-e-don)
Plant embryo

Vocabulario

Radícula
Plúmula
Endospermo
Tegumento o cáscara
Cotiledón
Embrión de la planta

In Advance

Gather and soak lima bean and pea seeds (if using dry peas) for 24 hours before beginning the activity. Make copies of the Student Activity Sheet.

Procedure

1. Introduce activity

Ask students if they know the function of a seed. They should mention that a seed is produced by the parent plant and, under the right conditions, a seed will grow into a new plant. When a seed is opened, there is usually a baby plant (**embryo**) that is surrounded by a food supply. Although most seeds have similar parts, they can look very different.Your students will be observing some of those differences.

2. Set-up

Divide students into groups of 3 or 4. Give each group a soaked lima bean, a corn kernel, a pea, a peanut, and a sunflower seed. Give each individual student a copy of the Student Activity Sheet.

3.Take apart the seeds

Beginning with the lima bean, have students carefully peel off the outer covering (**seed coat**). Have them split the seed in half and identify the seed parts using the diagram from the Student Activity Sheet.

Next, have students try to split the corn kernel in half. They will find that some kinds of seeds naturally divide in half, while others don't. Seeds that can be split into two equal halves, or **cotyledons**, are called dicotyledons or dicots (*di* means two). Seeds that can't be easily split into two halves are called monocotyledons or monocots (*mono* means one).

Tell students to record their observations on the Student Activity Sheet. Then, have students open the pea, peanut, and sunflower seeds, identify the seed parts, and record what they see. Help students open the seeds with a scalpel or knife if necessary. When students have finished dissecting their seeds and recording their observations, tell them to answer the questions on the Student Activity Sheet.

4. Review observations

Ask students which seeds are monocots and which seeds are dicots. Which seeds were more difficult to open? Which seeds had plant parts that were more difficult to identify? Review the answers to the questions on the Student Activity Sheet.

Questions to Ask During the Activity

1. What will the **radicle** become? (The root.)

2. What will the **plumule** become? (The seedling.)

3. How are the cotyledon and the **endosperm** alike? (Both store food to be used by the growing plant embryo. The endosperm produces the cotyledon before germination.)

Preguntas sobre el tema de la actividad

1. ¿En qué se convertirá la radícula? (En la raíz)

2. ¿En qué se convertirá la plúmula? (En la plántula)

3. ¿En qué se parecen el cotiledón y el endospermo? (Ambos almacenan alimentos para que utilice el embrión de la planta mientras crece. El endospermo produce el cotiledón antes de germinar.)

Why it Happens/More on the Topic

Seeds are the reproductive part of the plant. If you break open a seed, you can usually find a miniature plant (called an embryo) that is surrounded by a food supply. If the embryo is planted in the right conditions, it will grow into a new plant.

The plant embryo inside the lima bean and the corn kernel is the small bump made up of the plumule (the future seedling) and the radicle (the future root). The corn kernel is more likely to have some endosperm surrounding the plant embryo and the leafy cotyledon. Inside the lima bean, the cotyledon has likely already used up the endosperm.

Algo más sobre el tema...

Las semillas son la parte reproductiva de la planta. Si tú abres una semilla, en general encontrarás una planta en miniatura (llamada embrión) rodeada de una provisión de alimentos. Si plantas el embrión bajo condiciones propicias, éste crecerá hasta convertirse en una nueva planta.

La pequeña protuberancia que se encuentra dentro del frijol de media luna y del grano de maíz es el embrión de la planta, compuesto de la plúmula (la futura plántula) y la radícula (futura raíz). Lo más probable es que el grano de maíz tenga algo de endospermo rodeando al embrión de la planta y al cotiledón Lo más probable es que el cotiledón, dentro del frijol de media luna, ya haya consumido el endospermo.

Modifications

Use only the first page of the Student Activity Sheet with younger students.

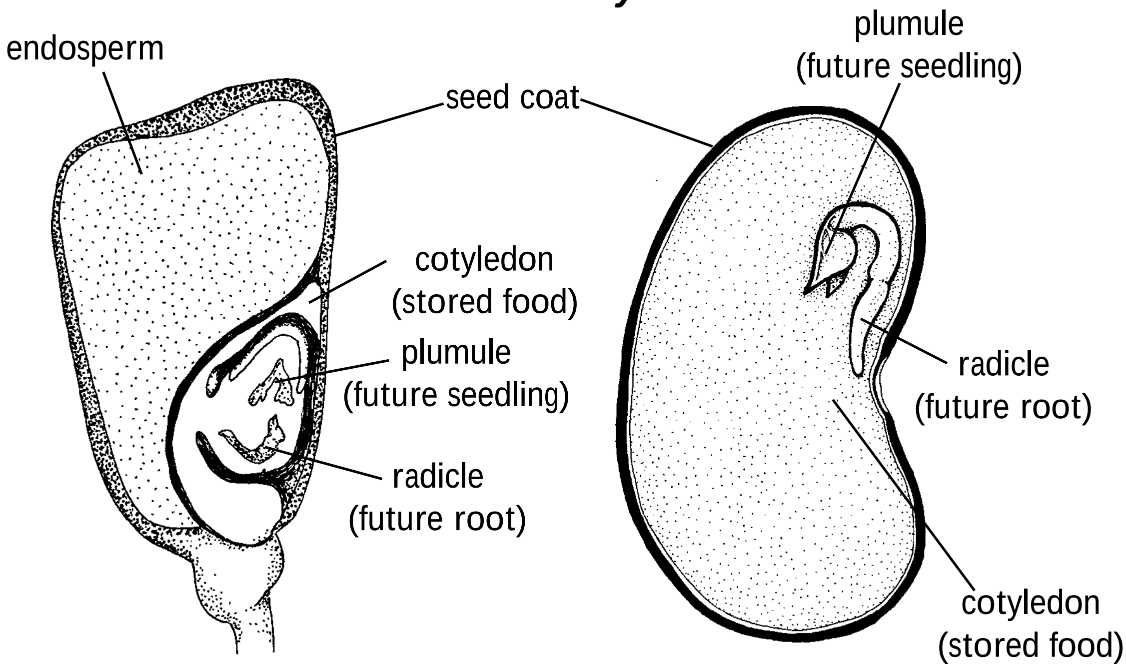
Extensions

Place a soaked lima bean, corn kernel, pea, peanut, and sunflower seed into a plastic bag containing a moistened paper towel. Put the bags in a warm spot and allow the seeds to germinate. Have students dissect the seeds and identify the same seed structures. Compare them to the seed structures they observed before germination.

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Sciences Curriculum. First edition. Albuquerque, NM, 1996.

WHAT'S INSIDE A SEED?
Student Activity Sheet



monocot seed ***dicot seed***

1. Record your observations on the chart below.

Type of Seed	***Seed Coat*** (hard or soft)	***Easily Opened?*** (yes or no)	***Number of Cotyledons*** (one or two)	***Seed Category*** (monocotyledon or dicotyledon)
Lima Bean				
Corn kernel				
Pea				
Peanut				
Sunflower seed				

WHAT'S INSIDE A SEED?
Student Activity Sheet (continued)

1. What is the function of the seed coat?

2. What is the function of the cotyledons?

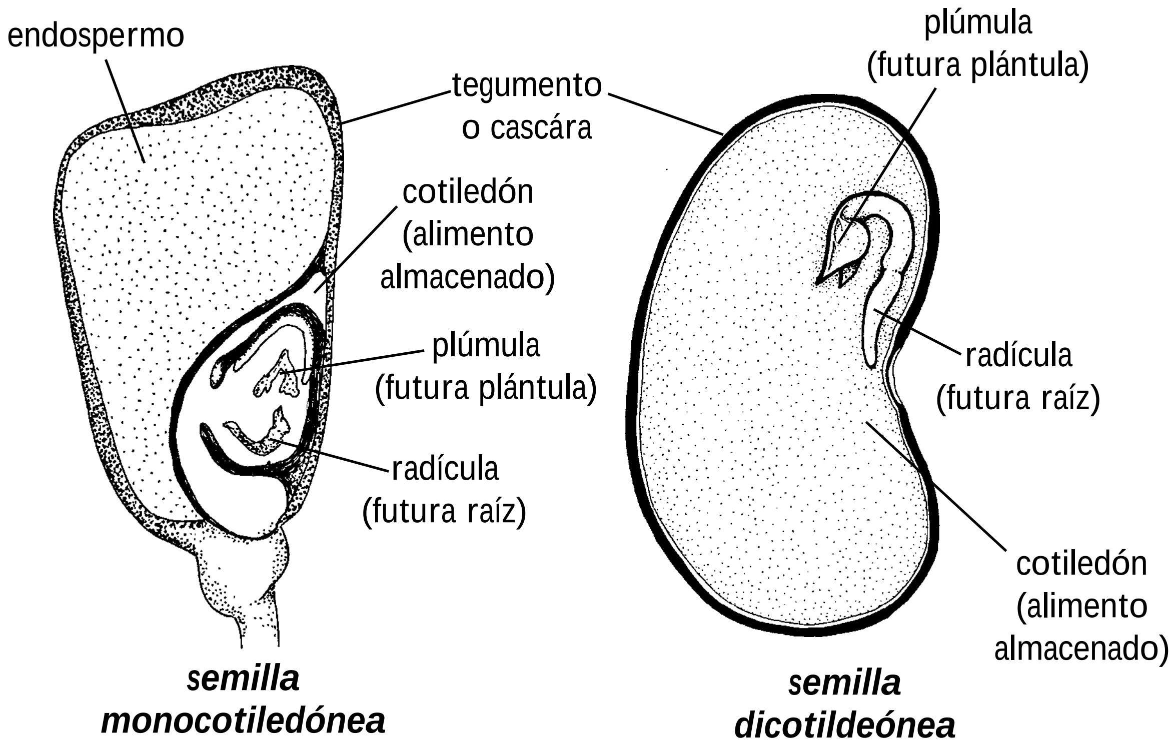
3. How do the seeds use the stored food?

4. What does the plumule turn into in an adult plant?

5. What does the radicle turn into in an adult plant?

6. Would a seed planted without a plumule or radicle develop into a seedling? Why or why not?

¿QUÉ HAY ADENTRO DE LA SEMILLA?
Actividades prácticas para el estudiante



1. Escribe tus observaciones en el cuadro siguiente.

Tipo de semilla	***Tegumento*** (duro o blando)	***¿Se abre fácilmente?*** (sí o no)	***Número de cotiledones*** (uno o dos)	***Categoría de semilla*** (monocotiledónea o dicotiledónea)
Frijol de media luna				
Grano de maíz				
Chícharo (arveja)				
Cacahuate (maní)				
Semilla de girasol				

¿QUÉ HAY ADENTRO DE LA SEMILLA?
Actividades prácticas para el estudiante (continuación)

1. ¿Cuál es la función del tegumento?

2. ¿Cuál es la función de los cotiledones?

3. ¿De qué manera usan las semillas el alimento que almacenan?

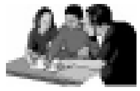
4. ¿En qué se convierte la plúmula cuando la planta es adulta?

5. ¿En qué se convierte la radícula cuando la planta es adulta?

6. ¿Crees que si plantas una semilla que no tiene ni plúmula ni radícula logrará transformarse en una plántula? ¿Por qué sí o por qué no?

SEED DISPERSAL WALK

Paseo para dispersar las semillas

Grades		
3–8	*3–4*	*1–2 hours*

Purpose

Students will collect seeds outside, then determine how the seeds are dispersed.

Materials

Small bucket, plastic grocery bag, or large zip-lock bag (one per group)
Large, old socks (at least one per group)
Outdoor area with trees and other plants
Student Activity Sheet
Gardening gloves (optional)
Hand lenses (optional)

Concepts

- Plants need to produce enough seeds to ensure that some of them will germinate and grow.
- Plants have different methods of dispersing their seeds.

Conceptos

- Las plantas necesitan producir suficientes semillas para asegurarse de que algunas de ellas van a germinar y a crecer.
- Las plantas utilizan diferentes métodos de dispersión de las semillas.

Safety

Students should handle sharp seeds and plants with care. Gardening gloves may be used. Some students may be allergic to certain plants or pollens. Have other students in the group handle those seeds and plants. Emphasize the importance of not disturbing plants and animals.

Vocabulary

Seed dispersal
Germinate

Vocabulario

Dispersión de las semillas
Germinación

Procedure

1. Introduce activity

Ask students if they were a plant how they might disperse their seeds to areas where they can **germinate**. Be sure students understand that most seeds will do better if they are dispersed far away from the parent plant or other plants. (The seed won't have to compete for sunlight, water, nutrients, etc.) Without describing **seed dispersal** strategies, tell students they will be collecting and observing some seeds to see if their ideas are accurate.

2. Seed dispersal walk

Divide the class into groups of 3 or 4 students. Take the groups outside to an area with trees and other plants. Give each group a container for the collected seeds (a bucket or plastic bag), a large sock, and gardening gloves (if available). Have a student from each group put the sock over their shoe and explain that as they walk, some seeds will stick to the sock. These seeds should be put into the collecting container. Students can take turns wearing the sock, but all members of the group should look for and collect other seeds as they find them. Remind students to be careful when touching sharp or prickly seeds and plants.

3. Look at the seeds

Bring the collected seeds into the classroom and have students sit with their groups. Hand out the Student Activity Sheet. Tell students to draw pictures of the seeds on the Student Activity Sheet. Based on each seed's characteristics, students should try to guess how the seed is dispersed and mark that space on the Student Activity Sheet.

4. Review

Gather the seeds and have students explain their guesses about how the seeds are dispersed. Using the information in the "Why it Happens" section of this activity, review the different methods of seed dispersal. Ask students if they would change their guesses based on this new information.

Questions to Ask During the Activity

1. Do you think any of the same plants grow near your home?

2. Why is it important that seeds be spread far from the parent plant? (If new seeds grow next to the parent plant, they need to compete for sunlight, water, and nutrients.)

3. Which is the least common method of seed dispersal in this area? (Water.)

Preguntas sobre el tema de la actividad

1. ¿Crees que algunas de estas plantas crecen cerca de tu casa?

2. ¿Por qué es importante que las semillas se dispersen lejos de la planta paterna? (Si las nuevas semillas crecen al lado de la planta paterna, competirán para obtener luz solar, agua y nutrientes.)

3. ¿Cuál es el método menos común de dispersión de semillas? (Agua)

Why it Happens/More on the Topic

Most plants reproduce using seeds. Plants need to make enough seeds to ensure that some will grow into thriving new plants. They use various dispersal mechanisms to make sure the seeds reach an area where there is enough sunlight, water, and nutrients. If a seed lands too close to the parent plant or another established plant, it will need to compete for sunlight, water, and nutrients. The most common methods of seed dispersal are:

WIND – Dandelions, cottonwoods, and milkweed plants have seeds attached to fluffy "parachutes" or tufts that can be carried by the wind. Maple seeds spin in the wind on wing-like attachments. Tumbleweeds roll in the wind, shaking seeds out as they travel. Some plants produce tiny seeds that can be blown in the air or on the ground for long distances before settling.

WATER – Coconuts can travel for miles in the ocean before washing ashore and sprouting in the sand.

HITCHHIKING – Burdock seeds have burrs, or little hair-like extensions with tiny hooks, that stick to the fur of animals. Thorny seeds, like goatheads, also stick to animal fur and can be carried long distances before being picked off or falling off. Hitchhiking seeds were the inspiration for velcro!

ANIMAL FOOD – Some seeds are dispersed because they are stored or eaten by animals. Nuts are collected by animals such as squirrels. When a nut is buried and forgotten, it can grow into a new plant. Some seeds are dispersed when an animal eats the surrounding fruit. Some seeds are dropped while the animal is eating the fruit. In some cases, the animal swallows the fruit whole, and the seeds are dispersed in that animal's droppings. In fact, some seeds need to be partially digested in order to germinate.

SHOOTING SEEDS – Some plants shoot their seeds up to fifty feet from the parent plant. Garden peas will shoot their seeds if the pods are allowed to fully dry. Wood sorrel produces a "pop" as its pods burst open and shoot out seeds.

Algo más sobre el tema…

La mayoría de las plantas se reproducen mediante semillas. Las plantas necesitan producir suficientes semillas para asegurarse de que algunas crecerán y se transformarán en plantas nuevas y prósperas. Las plantas utilizan numerosos mecanismos de dispersión como forma de asegurarse de que las semillas alcancen un área donde hay suficiente luz del sol, agua y nutrientes. Si una semilla se deposita muy cerca de la planta paterna o de otra planta ya establecida, va a tener que competir para obtener luz solar, agua y nutrientes. Los métodos de dispersión más comunes son:

VIENTO - Algunas plantas, tales como el diente de león, el álamo o la asclepiadea (o algodoncillo), tienen semillas adheridas a unos "paracaídas" cubiertos de plumones o borlas que pueden ser transportadas por el viento. El arce produce unas semillas con prolongaciones que parecen alas y vuelan por el aire formando espirales. Las plantas rodadoras, como su nombre lo indica, dan vueltas con el viento y sacuden las semillas al rebotar mientras se desplazan. Algunas plantas producen semillas tan diminutas que pueden volar distancias largas en el aire o en la tierra antes de detenerse en un lugar.

AGUA - El coco puede viajar muchas millas en el océano antes de depositarse en una playa y germinar en la arena.

HACER *AUTO-STOP* - Las semillas de la bardana tienen cardos o extensiones vellosas con ganchos pequeñísimos que se adhieren a la piel de los animales. Las semillas con espinas como los "toritos" pueden viajar distancias largas antes de que se caigan o que el animal las sacuda. ¡La observación de las semillas que hacen *auto-stop* inspiró la invención del *velcro*!

ALIMENTO PARA ANIMALES - Algunas semillas se dispersan al ser almacenadas o ingeridas por distintos animales. Animales, tales como las ardillas, recolectan nueces. Cuando las entierran y se olvidan de ellas, éstas pueden crecer y convertirse en una

Algo más sobre el tema (cont.)

nueva planta. Algunas semillas se dispersan cuando el animal come la fruta que la rodea. Otras semillas se caen al suelo cuando el animal come la fruta. En algunos casos, los animales se tragan la fruta entera y las semillas se dispersan con los excrementos. De hecho, algunas semillas necesitan ser digeridas parcialmente para que puedan germinar.

DISPARO DE SEMILLAS - Algunas plantas arrojan sus semillas, a veces a distancias de hasta cincuenta pies de la planta paterna. El chícharo de jardín arroja sus semillas cuando la vaina está totalmente seca. La acetocilla hace un ruido especial, como un chasquido, cuando la vaina explota, se abre y dispara las semillas.

Modifications

For younger students (including K-2): Instead of using the Student Activity Sheet, have students draw the seeds they collected, then discuss seed dispersal as a class.

Extensions

Have students plant some of the seeds they collected in potting soil. Be sure they label each container with a drawing or name of the seed. Put the containers in a warm spot and water occasionally. When plants emerge, see if students can match the young plants with those growing in the area where the seeds were collected.

References

Ardley, Neil. The Science Book of Things That Grow. San Diego, CA: Gulliver Books, 1991.

Daniel, Lucy, Ed. Merrill Life Science: Laboratory Manual. Teacher Annotated Edition. Columbus, OH: Glencoe Macmillan/McGraw-Hill, 1993.

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Nelson, Leslie W. and George C. Lorbeer. Science Activities for Elementary Children. Dubuque, IA: William C. Brown Company Publishers, 1972.

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First edition. Albuquerque, NM 1996.

STUDENT ACTIVITY SHEET
Seed Dispersal Walk

Draw an example of each kind of seed you collected. Guess how that seed might be dispersed, then mark the appropriate box next to your drawing.

DRAWING	***Wind***	***Water***	***Attaching to an Animal***	***Eaten or Stored by an Animal***	***Shot Out of a Pod***

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

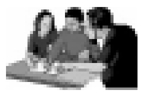
Paseo para dispersar las semillas

Dibuja un ejemplo de cada tipo de semilla que has recogido. ¿Cómo crees que se dispersó esa semilla? Haz una suposición y luego marca la columna correspondiente a tu dibujo.

DIBUJO	Viento	Agua	Adheridas a un animal	Ingeridas o almacenadas por un animal	Disparadas de una vaina

WHAT DO SEEDS NEED TO GERMINATE?

¿Qué necesitan las semillas para germinar?

Grades		
3–8	*3–4*	*Day 1: 30 mins.* *Days 2–6: 10 mins./day*

Purpose

Students will predict what conditions are best for seed germination, set up an experiment to test their predictions, record their observations, and summarize results.

Materials

Pinto beans or lima beans, soaked overnight (about 25 per group)
Petri dishes with lids, OR bowls or cups with plastic wrap (5 per group)
Masking tape and marker
Paper towels
Water
Refrigerator
Student Activity Sheets

Concepts

- Seeds need adequate water and warmth to germinate.
- Seeds do not need sunlight to make their own food. Seeds use stored food until they grow into seedlings that can photosynthesize.

Conceptos

- Las semillas necesitan una cantidad de agua adecuada y temperatura templada para germinar.
- Las semillas no necesitan luz solar para producir sus propios alimentos. Las semillas utilizan el alimento almacenado hasta que crecen y se convierten en plántulas que pueden llevar a cabo el proceso de fotosíntesis.

Vocabulary

Germinate

Vocabulario

Germinación

In Advance

Make copies of the Student Activity Sheets.

Procedure

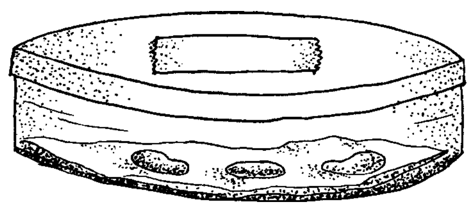
1. Introduce activity

Ask students if they can list what conditions seeds need in order to **germinate**. Are they the same things plants need to grow? What kind of experiment can test their ideas about what seeds need to grow?

2. Set-up

Divide students into groups of 3 or 4 and give each group about 25 soaked seeds, 5 dishes or bowls, 5 paper towels, 5 pieces of masking tape, and a marker. Have students place a folded paper towel into each dish or bowl and attach a piece of masking tape to the container. With the marker, have students label each container with one of the following :

1. moderate water, sun
2. moderate water, no sun
3. moderate water, cold
4. under water, sun
5. no water, sun



Also have students mark their containers with a group name or number.

Next, tell students to place about 5 seeds on top of each paper towel. Pour enough water in the "moderate water" containers to moisten the paper towels. Cover the seeds and paper towel with water in the container labeled "under water." Put plastic wrap or a lid over all 5 containers. Place the containers marked "sun" in a sunny area of the classroom, the containers labeled "cold" in a refrigerator, and the containers marked "no sun" in a dark box or closet.

3. Predict

Hand out the Student Activity Sheets to each student. Explain that they should write down their predictions about how the seeds they prepared might grow. They should consider the variables in the experiment and what they know about where seeds normally grow. Have students keep the Student Activity Sheets in a place where they can use them during the week.

4. Collect and record data

Over the next 5 days, have students check their seeds and record their findings on the Student Activity Sheets. If the paper towels are drying out in the containers labeled "moderate water" or "under water," students should add water.

5.Conclude activity

When the seeds have germinated and grown noticeably (around the fifth day), have students take the seeds out of the containers to make their final observations. They should record their data on the Student Activity Sheets and write down their conclusion about what seeds need to germinate. As a class, discuss their results and conclusions. Are there other variables that some seeds might need to begin germinating? (Some seeds need to pass through the digestive tract of an animal before germinating. Some need the heat of a fire. Others need more or less water, etc.) How could an experiment be set up to test some of these other variables?

Questions to Ask During the Activity

1. What are the variables in this experiment? (Moisture, light, and temperature.)

2. Could your results be different with other types of seeds? (Yes, other types of seeds may need different amounts of water or warmth.)

3. Why don't seeds need sunlight to live and germinate? (Seeds don't photosynthesize like plants do. The seed uses stored food to grow rather than making its own food through photosynthesis.)

4. Which part of the seedling emerges from the seed first? Why is this important? (The roots emerge first so the seedling can begin to get the nutrients and water it will need.)

Preguntas sobre el tema de la actividad

1 ¿Cuáles son las variables en este experimento? (Humedad, luz y temperatura)

2 ¿Podrían ser diferentes tus resultados si hubieras usado otro tipo de semillas? (Sí, es posible que distintas semillas necesiten una cantidad de agua diferente o una temperatura distinta.)

3 ¿Por qué razón las semillas no necesitan luz del sol para vivir y germinar? (Las semillas no pueden realizar la fotosíntesis como lo hacen las plantas. Las semillas usan el alimento que tienen almacenado para crecer en vez de producir su propio alimento a través de la fotosíntesis.)

4 ¿Qué parte de la plántula emerge de la semilla primero? ¿Por qué razón es esto importante? (Las raíces emergen primero para que la plántula pueda comenzar a recibir los nutrientes y el agua que necesita.)

Why It Happens/More on the Topic

Only the seeds under the right conditions will germinate. The seeds without the proper amount of water or warmth were unable to thrive. The amount of sun did not matter because seeds, unlike plants, do not need light to make food. Seeds use stored food rather than making food through photosynthesis.

Algo más sobre el tema…

Las únicas semillas que germinarán son las que se encuentran bajo condiciones adecuadas. Las semillas que no reciben la cantidad de agua apropiada o la temperatura templada necesarias no lograrán prosperar. La cantidad de luz del sol fue irrelevante porque las semillas, al revés de las plantas, no necesitan luz para producir alimentos. Las semillas utilizan los alimentos almacenados en vez de producir alimentos a través de la fotosíntesis.

Modifications

For younger students (including K-2), simplify the variables in the experiment. For instance, use only light vs. dark, moderate water vs. no water, or warm vs. cold conditions.

Older students can measure the length of the growing roots and shoots each day and make a graph of the results for each set of variables.

Extensions

Have students collect other types of seeds and set up an experiment to see what the ideal conditions are for those seeds to germinate.

References

Ardley, Neil. The Science Book of Things That Grow. San Diego, CA: Gulliver Books, 1991.

Harlow, Rosie and Gareth Morgan. Fun With Science: Energy and Growth. New York, NY: Warwick Press, 1991.

STUDENT ACTIVITY SHEET
What Do Seeds Need To Germinate?

1. Write your predictions for each container below:

Container	***Predictions***
Moderate water, sun	
Moderate water, no sun	
Moderate water, cold	
Underwater, sun	
No water, sun	

STUDENT ACTIVITY SHEET

What Do Seeds Need To Germinate? (continued)

2. Record your observations for each day:

	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Moderate water, sun					
Moderate water, no sun					
Moderate water, cold					
Underwater, sun					
No water, sun					

3. What happened to the seeds in each container? What do you think seeds need in order to germinate?

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

¿Qué necesitan las semillas para germinar?

1. Escribe tus predicciones para cada recipiente en el espacio indicado:

Recipiente	Predicciones
Agua en cantidad moderada, sol	
Agua en cantidad moderada, ausencia de luz solar	
Agua en cantidad moderada, frío	
Sumergidas en agua, sol	
Ausencia total de agua, sol	

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
¿Qué necesitan las semillas para germinar? (continuación)

2. Escribe diariamente tus observaciones:

	Día 1	**Día 2**	**Día 3**	**Día 4**	**Día 5**
Agua en cantidad moderada, sol					
Agua en cantidad moderada, ausencia de luz solar					
Agua en cantidad moderada, frío					
Sumergidas en agua, sol					
Ausencia total de agua, sol					

3. ¿Qué les sucedió a las semillas en cada recipiente? ¿Qué crees que las semillas necesitan para germinar?

WHAT COMES OUT OF A LEAF?

¿Qué emerge de las hojas?

Grades		
3–8	*Whole Class*	*Day 1: 20 mins.* *Days 2–4: 15 mins./day*

Purpose

Students will observe water and oxygen being released from leaf surfaces as a result of transpiration and photosynthesis.

Materials

House plant with flat leaves
Pond weed or other aquatic plant (from a pet store or biological supply company)
Clear jar
Bowl (much larger than the jar)
Plastic wrap or small sandwich bag
Water
String
Piece of cardboard

Concepts

- Water evaporates (or transpires) from plant leaves.
- Oxygen and food (sugars or carbohydrates) are produced when a plant photosynthesizes. Oxygen can be seen as gas bubbles when a photosynthesizing leaf is underwater.

Conceptos

- El agua se evapora (o transpira) por las hojas.
- Al realizar la fotosíntesis, la planta produce oxígeno y alimentos (azúcares y carbohidratos). El oxígeno se puede observar en forma de burbujas cuando el gas se libera de una hoja que está realizando la fotosíntesis bajo el agua.

Vocabulary

Transpiration
Evaporation
Water vapor
Xylem (pronounced: zi-lem)
Photosynthesis
Chlorophyll (pronounced: clor-o-fill)
Stomata

Vocabulario

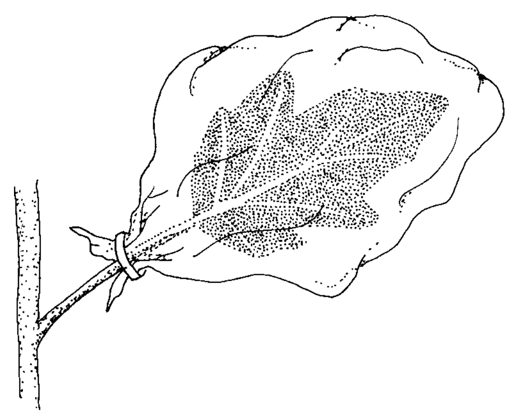
Transpiración
Evaporación
Vapor de agua
Xilema
Fotosíntesis
Clorofila
Estoma

Procedure

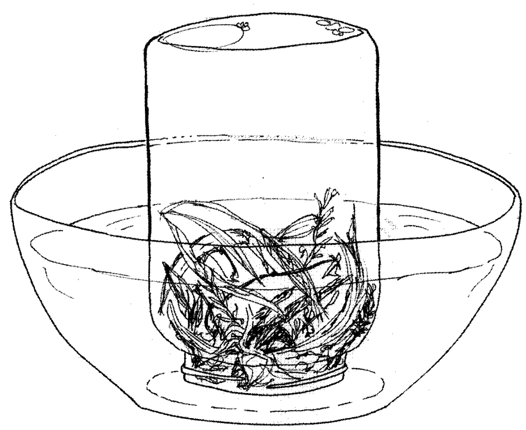
1. Set-up

Begin by telling students that you will be setting up two experiments to see what comes out of leaf surfaces.

To set up the first experiment, wrap a square of plastic wrap or a sandwich bag around a leaf (or several leaves) of the house plant. Tie the plastic at the base, leaving about an inch of space between the leaves and the plastic. Place the plant in a light area of the classroom.



To set up the second experiment, fill the bowl about three-quarters full of water. Place the pond weed into the jar and fill the jar to the top with water. While holding the cardboard over the top of the jar, carefully turn the jar upside down into the bowl of water. Remove the cardboard and place the bowl in a sunny spot.



2. Observe

The next day, have students look at the leaves that were covered in plastic. Ask them what differences they notice (some water droplets should be collecting inside the plastic). Also, have them take a look at the plants submerged in water. What has changed on the leaf surfaces? (They should see bubbles appearing on the leaves.) Ask them what must be causing these changes. Using the information in the "Why It Happens" of this activity, explain why there is water gathering on the plastic and why bubbles are forming on the leaf surfaces.

3. Predict

Now that students have observed the bubbles on the pond weed and understand that they are formed during **photosynthesis**, ask them to predict what will happen if the pond weed is placed in a dark area. Place the pond weed set-up in a dark area of the classroom or in a closet.

4. Observe and discuss

On the third day, have students observe the pond weed set-up again. What happened? Are the bubbles appearing on the leaves more quickly or more slowly? Why?

Questions to Ask During the Activity

1. Why do plants need water? (Water is used during photosynthesis. Water also helps transport minerals and food from one part of the plant to another.)

2. How is water leaving the leaf surfaces? (It is **evaporating**—called **transpiration** in plants—from the surfaces of the leaves. As water is transpired, the water inside the plant is pulled upward through small tubes called **xylem**.)

3. What does the plant make during photosynthesis? (Oxygen and food in the form of sugars or carbohydrates.)

4. What do plants need for photosynthesis to occur? (Sunlight, water, and carbon dioxide gas.)

5. Why are there fewer bubbles when the pond weed is placed in a dark area? (The plant cannot photosynthesize when there is no sunlight.)

Preguntas sobre el tema de la actividad…

1. ¿Por qué necesitan agua las plantas? (El agua se usa durante el proceso de fotosíntesis. El agua también ayuda a transportar minerales y alimentos de un lugar de la planta a otros.)

2. ¿De qué manera se desprende el agua de las hojas? (Se **evapora** de la superficie de las hojas. En las plantas este proceso se llama **transpiración**. A medida que ocurre la transpiración, el agua que se encuentra en el interior de la planta es atraída hacia arriba a través de pequeños tubos llamados **xilemas**.)

3. ¿Qué produce la planta durante el proceso de fotosíntesis? (Oxígeno y alimentos en forma de azúcares o carbohidratos.)

4. ¿Qué necesitan las plantas para que se produzca la fotosíntesis? (Luz del sol, agua y dióxido de carbono.)

5. ¿Por qué hay menos burbujas en el estanque cuando se colocan las algas en un área con sombra? (La planta no puede realizar la fotosíntesis cuando no hay luz del sol).

Why It Happens/More on the Topic

Water evaporates, or transpires, from plant leaves. When water evaporates, it becomes **water vapor**. Water vapor is a gas that is not usually seen unless it condenses into droplets like it does when it gathers on the plastic wrap.

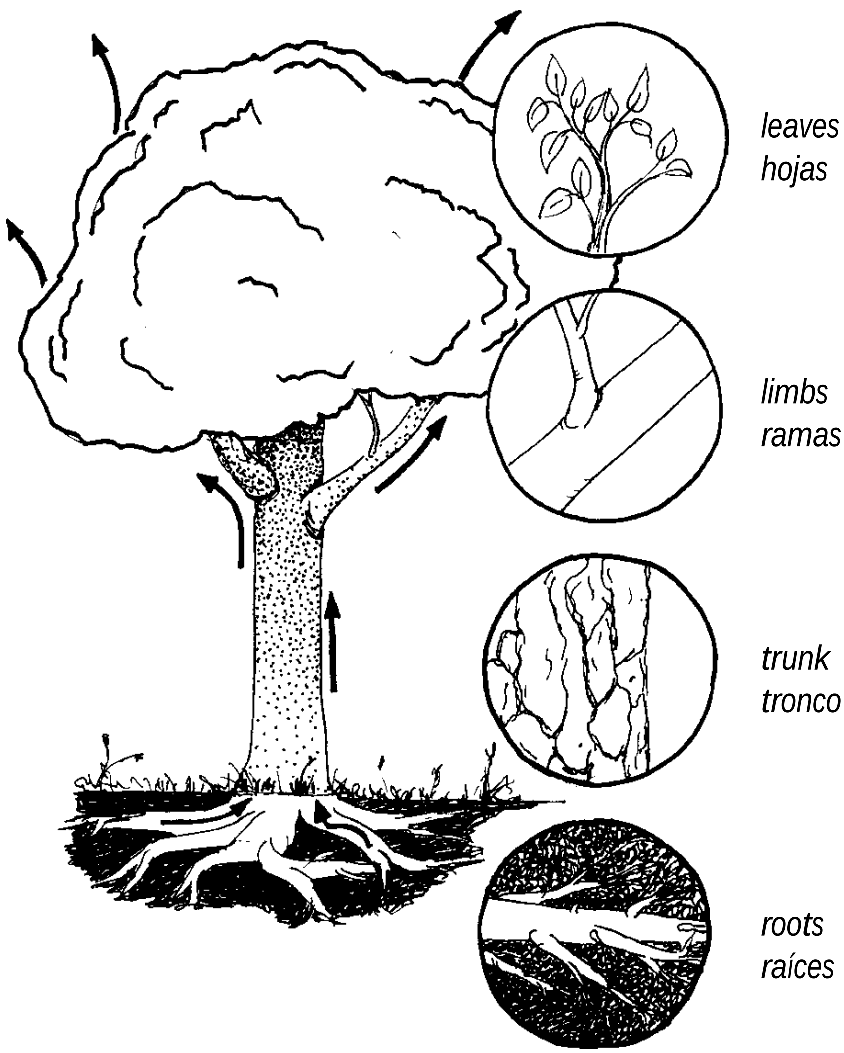
Photosynthesis is a chemical reaction that takes place in the **chlorophyll** of green plants. Photosynthesis uses sunlight to change water and carbon dioxide gas into food for the plant. A bi-product of the process is oxygen, which is released into the air. The oxygen and water is released through small holes, called **stomata**, in the leaves and stems.

Algo más sobre el tema...

El agua se evapora, o transpira, a través de las hojas. Cuando el agua se evapora, se transforma en **vapor de agua**. El vapor de agua es un gas que en general no se ve, a menos que se condense y forme gotitas como sucede cuando se juntan dentro de una bolsa de plástico.

Algo más sobre el tema (continuación)

La fotosíntesis es una reacción química que se produce en la **clorofila** de las plantas verdes. La fotosíntesis usa la luz del sol para transformar el agua y el dióxido de carbono en el alimento para la planta. El oxígeno que se libera en el aire es un derivado del proceso. El oxígeno y el agua se liberan a través de pequeños orificios, llamados **estomas**, que se encuentran en las hojas y en el tallo.



Flow of Water

Flujo del agua

Extensions

Have students try wrapping leaves on an outdoor plant with a plastic bag. Measure the water that collects in the bag over a 24 hour period. Calculate how much water the entire plant gives off each day. Try the experiment on a sunny, warm day, and also on a cloudy, cool day.

References

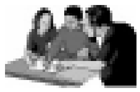
Ardley, Neil. The Science Book of Things That Grow. San Diego, CA: Gulliver Books, 1991.

Daniel, Lucy, editor. Merrill Life Science: Laboratory Manual. Teacher Annotated Edition. Columbus, OH: Glencoe Macmillan/McGraw-Hill, 1993.

Harlow, Rosie and Gareth Morgan. Fun With Science: Energy and Growth. New York, NY: Warwick Press, 1991.

Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn, editors. Biology of Plants. Fifth edition. New York, NY: Worth Publishers, 1992.

THE LIVING LEAF
La hoja llena de vida

Grades		
3–8	*4–5*	*Day 1: 15 mins.* *Day 3: 45 mins.*

Purpose
Using several experiments, students will discover that plants need sunlight, carbon dioxide, and chlorophyll to photosynthesize.

Materials
Healthy green house plant with large, individual leaves (one per group)
(plants grown during other activities may be used)
Tin foil
Petroleum jelly
Rubbing alcohol
Container large enough to submerge a leaf (one per group)
Hot plate for boiling water (optional)
Student Activity Sheet

Concepts
- Plants make their own food through photosynthesis.
- Plants have a green pigment, called chlorophyll, that is necessary for photosynthesis.
- Plants need sunlight and carbon dioxide to photosynthesize.

Conceptos
- Las plantas producen sus propios alimentos a través de la fotosíntesis.
- Las plantas tienen un pigmento verde, llamado clorofila, necesario para la fotosíntesis.
- Las plantas necesitan luz solar y dióxido de carbono para realizar la fotosíntesis.

Safety
If you will be using boiling water for the chlorophyll extraction, do not let students near the water. Dip the leaves into the boiling water yourself, then give the leaves to students.

Vocabulary

Photosynthesis
Chlorophyll
Carbon dioxide

Vocabulario

Fotosíntesis
Clorofila
Dióxido de carbono

In Advance

Make copies of the Student Activity Sheet. On the third day, you may want to set up the chlorophyll extraction demonstration in advance, if time will be limited.

Procedure

1. *Introduce the activity*

Begin by asking students if they know how plants get the food they need to grow and function. After several responses, tell them that plants produce their own food through a process called **photosynthesis**. In order for plants to photosynthesize, they need certain things. They will be setting up a couple of simple experiments to see what happens when a leaf is unable to get what it needs to photosynthesize.

2. *Set-up*

Divide the class into groups of 4 or 5 students. Give each group a house plant, three pieces of tinfoil (large enough to cover a leaf), and the petroleum jelly. Instruct each group to select three healthy leaves and cover them with tinfoil. Also have each group thoroughly cover another three leaves with the petroleum jelly. Set the plants in an appropriate place (sun or shade depending on the type of plant) for the next two days.

3. *Observe*

On the third day, hand out the Student Activity Sheets and have students retrieve their houseplants. Tell them they will be writing down their observations and their hypotheses about their houseplant. Students will need to remove the tinfoil from the leaves to see underneath. When students have completed their Student Activity Sheet, discuss their hypotheses about what plants need to photosynthesize and stay healthy. Use the information in the “Why It Happens” section of this activity to guide your discussion.

4. Set up and observe

In addition to needing **carbon dioxide** from the air and energy from the sun to photosynthesize, leaves rely on a green pigment, called **chlorophyll**. To extract chlorophyll from a leaf, have each group place a fresh leaf in a container with a small amount of rubbing alcohol. After a few hours, observe the leaf and the rubbing alcohol. Much of the chlorophyll from the leaf should be in the rubbing alcohol. To speed up the process, the leaves can be dipped into boiling water before placing them in the rubbing alcohol. Explain to students that chlorophyll is necessary for photosynthesis. Plant parts that do not contain this green pigment do not photosynthesize.

Questions to Ask During the Activity

1. What are the variables in the experiment where you covered the leaves in the tinfoil and petroleum jelly? (Light and air)

2. What is the control in the experiment? (The uncovered leaves on the plant.)

3. What does the plant need to take in for photosynthesis to occur? (Carbon dioxide gas from the air, energy from the sun, and water from the soil.)

4. Where in the plant does photosynthesis occur? (In the green parts of the plant where chlorophyll is present.)

Preguntas sobre el tema de la actividad

1. ¿Cuáles son las variables en el experimento en el cual cubriste las hojas con papel de aluminio y con vaselina? (Luz y aire)

2. ¿Cuál es la variable que actúa de control en el experimento? (Las hojas de la planta dejadas al descubierto.)

3. ¿Qué necesita la planta para que se produzca la fotosíntesis? (Dióxido de carbono del aire, energía del sol y agua del suelo.)

4. ¿En qué lugar de la planta se produce la fotosíntesis? (En las partes de color verde de la planta donde hay clorofila.)

Why It Happens/More on the Topic

The leaves that were covered with tinfoil were not able to photosynthesize properly. The sunlight necessary for photosynthesis was blocked.

The leaves that were covered in petroleum jelly were not able to get carbon dioxide gas from the air. Carbon dioxide is also necessary for photosynthesis.

The other leaves on the plant should not have changed much during the experiment. As long as the plant receives water and nutrients from the soil and some leaves can get carbon dioxide gas and sunlight, the plant will be able to photosynthesize and survive.

Photosynthesis can only take place in the parts of the plant that contain chlorophyll, a green pigment.

Algo más sobre el tema...

Las hojas cubiertas con papel de aluminio no pudieron realizar la fotosíntesis apropiadamente. La luz del sol que es necesaria para realizar la fotosíntesis fue bloqueada.

Las hojas que se cubrieron con vaselina no pudieron recibir suficiente dióxido de carbono del aire. El dióxido de carbono es necesario para realizar la fotosíntesis.

Las otras hojas de la planta no deberían haber cambiado demasiado durante el experimento. Mientras la planta reciba agua y nutrientes del suelo y algunas hojas puedan recibir dióxido de carbono y luz solar, la planta podrá realizar la fotosíntesis y sobrevivir.

La fotosíntesis sólo puede producirse en las partes de la planta que contienen clorofila, un pigmento verde.

Modifications

For younger students (including K-2), use the experiments as demonstrations and discuss observations rather than using the Student Activity Sheet.

Extensions

Have students investigate photosynthesis in trees that lose their leaves in the fall. Does the tree continue to photosynthesize? If not, how does the tree survive? Why do the leaves turn different colors in the fall? Do those colors aid in photosynthesis?

References

Bosak, Susan V. Science Is...A source book of fascinating facts, projects, and activities. Markham Ontario, Canada: Scholastic Canada, 1991.

Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn, editors. Biology of Plants. Fifth edition. New York, NY, Worth Publishers, 1992.

STUDENT ACTIVITY SHEET
The Living Leaf

Record your observations and hypotheses below:

Leaf	***Observations***	***Hypothesis***
Tinfoil-covered leaf		
Vaseline-covered leaf		
Uncovered leaf		

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

La hoja llena de vida

Escribe tus observaciones y tus hipótesis en el espacio a continuación:

Hoja	***Observaciones***	***Hipótesis***
Hoja cubierta con papel de alumino		
Hoja cubierta con vaselina		
Hoja sin cubrir		

SMART ROOTS AND SHOOTS

Raíces y brotes inteligentes

Grades		
3–8	*2–4*	*Day 1: 30 mins.* *10 mins. periodically over the next several weeks.*

Purpose

Students will determine if roots and shoots respond to gravity (geotropism) and sunlight (phototropism).

Materials

Pinto or lima beans soaked overnight (4 per group)
Large, clear jar with lid (1 per group)
Paper towels
Water
Masking tape and marker
Seedling (bean plants grow quickly) in a small pot
Box with lid (at least the size of a shoe box)
Cardboard
Student Activity Sheets

Concepts

- Seeds, seedlings, and plants use chemicals to sense and respond to their environment.
- Seeds can sense gravity and respond by sending shoots upward and roots downard into the soil.
- Seedlings can sense sunlight and will grow towards it.

Conceptos

- Las semillas, las plántulas y las plantas usan sustancias químicas para percibir y responder a su medio ambiente.
- Las semillas perciben la fuerza de gravedad y como respuesta, envían los brotes hacia arriba y las raíces hacia abajo, hacia la tierra.
- Las plántulas pueden percibir la luz solar y crecerán hacia ella.

Vocabulary

Geotropism
Phototropism
Germination

Vocabulario

Geotropismo
Fototropismo
Germinación

In Advance

Make copies of the Student Activity Sheets. Construct the plant maze with the box and cardboard (see diagram on next page). Soak bean seeds overnight.

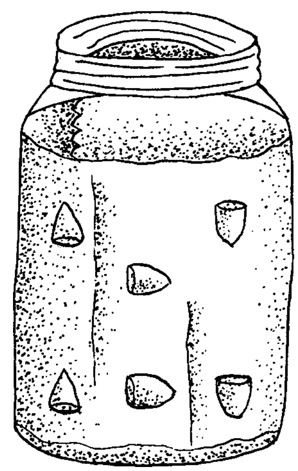
Procedure

1. Introduce activity

Ask students if they have ever seen a plant grow with its leaves in the soil and its roots growing towards the sun. Have they ever seen a plant growing towards the dark? Explain that plants have the ability to sense their surroundings and grow in a particular direction. Tell students that they will be setting up a couple of experiments that will show how seeds and seedlings respond to their environment.

2. Set-up

For the first experiment, divide the class into groups of 2-4 students. Give each group a jar and 4 beans. Tell students to line the inside of the jar with paper towels, then moisten the paper towels. Place each of the seeds between the paper towels and the jar, about half way up. Each seed should be oriented in a different position: one facing up, one down, one left, and one right. Put the lid on the jar and label the jar with a group number or name using the masking tape and marker.

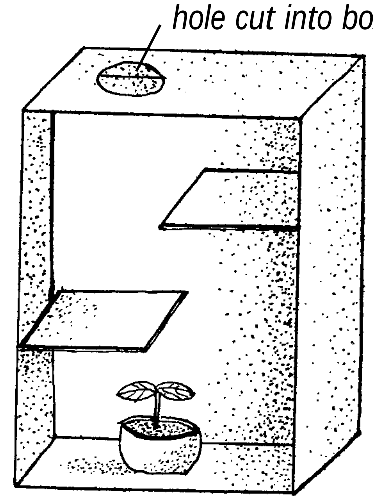


3. Hypothesis

Hand out the Student Activity Sheet and have students draw a picture of the orientation of their seeds in the jar. Also have them write down their hypothesis about how they think the roots and shoots will emerge when the seeds **germinate**. Tell students they will be watching their seeds over the next week to see what happens. Also remind them that they may need to add water to the paper towels to keep the seeds moist. Place the jars in a sunny spot in the classroom.

4. Set-up

Take out the plant maze that you constructed and the potted seedling. Place the seedling in the bottom of the box. Show students that there is a hole in the top of the box for light to get in. Close the box. Ask students if they think the plant will grow through the maze towards this small amount of light? Remember to water the plant regularly during the experiment.



5. Observe

Have students observe their seeds after the fifth day. The seeds should be starting to germinate. Tell students to draw the positions of the roots and shoots on the Student Activity Sheets. Was their hypothesis supported?

6. Further set-up

After students are finished with their observations, have them turn their jars upside down and put them back in the sunny area of the classroom.

7. Hypothesis

Ask students if they think the orientation of the roots and shoots will change over the next few days. Have them write their hypothesis on the Student Activity Sheet.

8. Observe and discuss

About three days later, have students observe their seeds again and draw their observations on the Student Activity Sheet. Was their second hypothesis supported by their observations? What could the seeds be sensing that helps them send the roots downward and the shoots upward?

About a week after setting up the plant maze, also have the class observe the growth of the seedling. What changes do they notice? Have them check the seedling after two weeks and after three weeks. The seedling should be growing towards the light. Ask students why the seedling is growing in the direction it is. What do plants need sunlight for? Does anyone know how the seeds and seedlings are sensing and responding to their environment?

Questions to Ask During the Activity

1. What is the function of the roots? (Roots obtain water and nutrients from the soil so the plant can grow and reproduce.)

2. What is the function of the shoot? (The shoot will eventually sprout leaves that will help the plant make food using sunlight and carbon dioxide gas.)

3. Why is it important that a germinating seed be able to sense gravity? (By sensing gravity, the seed can send its roots downward into the soil and its shoots upward towards the sun, no matter what position the seed is in the soil. If this did not happen, the plant would not be able to get what it needs to grow and reproduce.)

4. Why is it important for a seedling to grow towards the sun? (Plants need sunlight to make food and grow.)

Preguntas sobre el tema de la actividad

1. ¿Cuál es la función de las raíces? (Las raíces obtienen el agua y los nutrientes del suelo para que la planta pueda crecer y reproducirse.)

2. ¿Cuál es la función del brote? (Con el tiempo, las hojas van a emerger del brote y ayudarán a que la planta produzca alimentos usando luz solar y dióxido de carbono.)

3. ¿Por qué es importante que una semilla que está germinando pueda percibir la fuerza de gravedad? (Al percibir la fuerza de gravedad, la semilla puede enviar las raíces hacia abajo en el suelo y los brotes hacia arriba en dirección a la luz solar, sin tomar en cuenta la posición en que se encuentra la semilla. Si la planta no percibiera la fuerza de gravedad, no podría recibir lo que necesita para crecer y reproducirse.)

4. ¿Por qué es importante que la plántula crezca en dirección a la luz solar? (Las plantas necesitan luz solar para producir alimentos y crecer.)

Why It Happens/More on the Topic

Plants use specific chemicals (often called hormones) to respond to their environment. Humans also use hormones to sense and respond to our environment. Stress can trigger hormones, like adrenaline, that helps us respond to a stressful situation. When a seed senses and responds to gravity it is called **geotropism**. When a plant senses and responds to light, it is called **phototropism**.

Algo más sobre el tema...

Las plantas usan unas sustancias químicas (a menudo llamadas hormonas) para responder a los estímulos del medio ambiente. Los seres humanos también utilizamos nuestras hormonas para percibir y responder a los estímulos de nuestro medio ambiente. El estrés puede desencadenar la producción de hormonas, por ejemplo la adrenalina que nos ayuda a responder ante situaciones estresantes. **Geotropismo** es la percepción y respuesta de la semilla a la fuerza de gravedad. **Fototropismo** es la percepción y respuesta de la planta a la luz.

Modifications

Rather than using the Student Activity Sheet with younger students (including K-2), have them draw their seed observations on a separate sheet of paper and discuss their ideas about what is happening to the seeds. They may need help setting up their jars as well.

Extensions

Plants respond to their environment in other ways also. Some flowers open and close depending on the time of day. Climbing vines seek support that will help them grow upwards. Venus fly traps respond to the movement of an insect. Have students investigate and write a short report about other ways plants respond to their environment.

References

Ardley, Neil. The Science Book of Things That Grow. San Diego, CA: Gulliver Books, 1991.

Bosak, Susan, V. Science Is...A source book of fascinating facts, projects, and activities. Markham, Ontario, Canada: Scholastic Canada, 1991.

Daniel, Lucy, editor. Merrill Life Science: Laboratory Manual. Teacher Annotated Edition. Columbus, OH: Glencoe Macmillian/McGraw-Hill, 1993.

STUDENT ACTIVITY SHEET
Smart Roots and Shoots

Record your hypothesis and observations of the seeds on the first and fifth days.

Drawing of the seed positions in the jar before germination (Day 1)	***Hypothesis***	***Drawing of the seed positions in the jar (Day 5)***

STUDENT ACTIVITY SHEET
Smart Roots and Shoots (continued)

Record your hypothesis and observations of the seeds on the fifth and eighth days (after turning the jar **upside down**).

Drawing of the seed positions in the jar (the jar should be upside down)	***Hypothesis (Day 5)***	***Drawing of the seed positions in the jar (Day 8)***

ACTIVIDADES PRÁCTICAS PARA LOS ESTUDIANTES

Raíces y brotes inteligentes

En el primero y en el quinto día, escribe tus hipótesis y tus observaciones sobre las semillas.

Dibujos de la posición de las semillas en el frasco antes de la germinación–primer día	***Hipótesis***	***Dibujos de la posición de las semillas en el frasco–quinto día***

ACTIVIDADES PRÁCTICAS PARA LOS ESTUDIANTES

Raíces y brotes inteligentes (continuación)

En el quinto y en el octavo día, escribe tus hipótesis y tus observaciones sobre las semillas (después de haber puesto el frasco boca abajo).

Dibujos de la posición de las semillas en el frasco (el frasco debe estar al revés)	***Hipótesis–quinto día***	***Dibujos de la posición de las semillas en el frasco–octavo día***

FLOWERS, FRUITS, AND CONES

Plantas, frutas y conos

Grades		
3-8	2	45–60 min.

Purpose

Students will compare plants that produce seeds in a flower and those that produce seeds in a cone.

Materials

Lily, or similar flower (one per group)
Apple (one half per group)
Pinecone—preferably with seeds still attached (one per group)
Piece of paper
Pen or pencil
Small piece of black construction paper (one per group)
Copies of flower diagram (one per group)
Knife (teacher use only)

Concepts

- Plants that produce seeds are divided into two groups: plants that produce seeds in a flower (angiosperms) and plants that produce seeds in a cone (gymnosperms).
- Some parts of a flower can be recognized in the fruit it produces.
- Seeds in a cone are not enclosed like seeds in a flower.
- Reproduction in gymnosperms is different than in angiosperms.

Conceptos

- Las plantas que producen semillas se dividen en dos grupos: las plantas que producen semillas dentro de una flor (angiospermas) y las plantas que producen semillas en un cono (gimnospermas).
- En la fruta se pueden reconocer partes de la flor.
- Las semillas en un cono no están encerradas como lo están las semillas dentro de una flor.
- La reproducción de las gimnospermas es diferente de las angiospermas.

Safety

Only the teacher should use the knife to cut the apples and flowers.

Vocabulary

Flower
Pistil
Stigma
Stamen
Anther
Ovary
Sepal
Petal
Pollen
Pollination
Fertilization
Angiosperm
Gymnosperm (pronounced: jim-no-sperm)

Vocabulario

Flor
Pistilo
Estigma
Estambre
Antera
Ovario
Sépalo
Pétalo
Polen
Polinización
Fertilización
Angiosperma
Gimnosperma

In Advance

Make copies of the flower diagram. Cut apples in half. Find pinecones and flowers.

Procedure

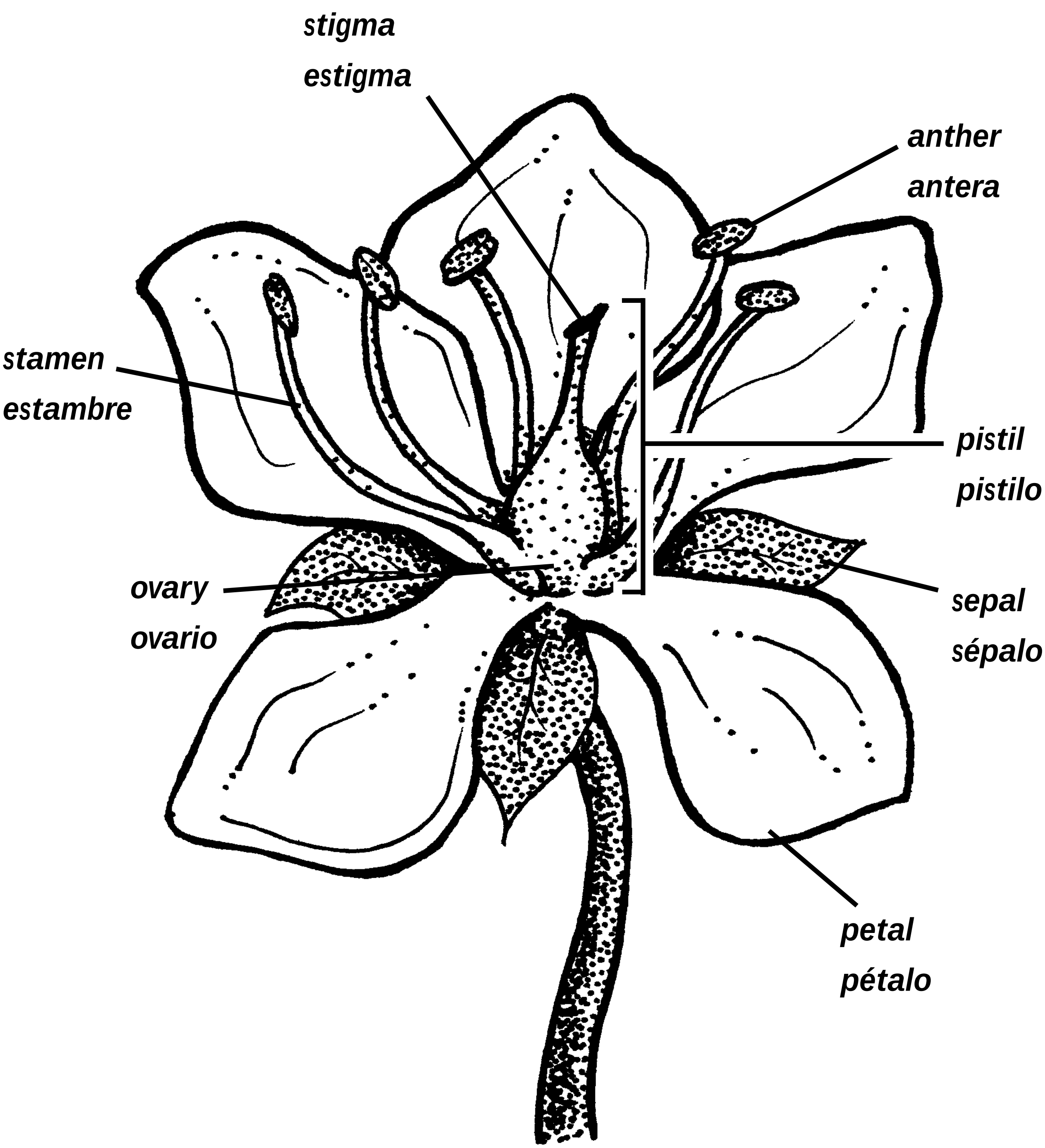
1. Introduce activity

Ask students where on a plant they can find seeds. They should mention in a fruit or flower. If no one mentions that seeds can be found in a cone, ask them where they can find a seed on a pine tree. Tell students that seed-bearing plants are divided into two main groups, depending on where those seeds are found. Plants that produce seeds in a flower are called **angiosperms**. Non-flowering plants are called **gymnosperms** and usually produce their seeds in a cone or cone-like structure. Tell students that they will be taking a closer look at flowers and cones to see how these plant groups differ.

2. Set-up

Divide students into pairs and give each pair a flower, half an apple, a pine cone, a piece of black construction paper, and a copy of the flower diagram.

Flower Diagram
Diagrama de una flor



3. Flower dissection

Before students begin to take their flower apart, have them use their flower diagram to identify some of the parts of their lily. They should easily be able to see the **petals**, **sepals**, **pistil**, **stamens**, **anthers**, and **stigma**. When they have found these parts, have the students carefully pull out one of the stamens. Tell them to gently rub the anther on the piece of black construction paper. Do they know those are tiny **pollen** grains that come off the anthers? Which part of the flower needs to receive the pollen before the flower will produce seeds? (The stigma).

Next, cut through each flower (teacher only) vertically so the **ovary** is split in two lengthwise. (The ovary is located at the rounded base of the pistil.) Have students observe the ovary and look to see if there are seeds inside.

4. Label flower parts

Have students separate the flower parts, putting them on the white piece of paper. Tell them to identify and label the following parts of their flower on the paper: petal, sepal, pistil, stamen, anther, stigma, and ovary.

5. Observe the apple

Next, have your students look at the cross section of the apple. Do they see any parts of the apple that look like the parts of the flower? (They should notice the seeds, sepals, and stem. They should also realize that the apple is an enlarged ovary with seeds inside.) What is the advantage of having the ovary grow into a large fruit?

6. Observe the pinecone and discuss

Have students look closely at their pinecone. Can they find the seeds? What is the big difference between where the seeds are on a pinecone and where they are on a flower? (They should notice that the seeds on a pinecone are not enclosed while the flower seeds are). Are other flower structures present on the pinecone?

Questions to Ask During the Activity

1. What is the function of the flower? (It is the reproductive structure of angiosperms.)

2. What is the function of the pinecone? (It is the reproductive structure of gymnosperms.)

3. What is the function of the stamen in a flower? (The stamen produces the pollen.)

4. What is the function of the stigma in a flower? (The stigma catches the pollen so that **pollination** and **fertilization** can occur.)

5. What is the function of the petals of a flower? (The petals attract insects and protect the inner structures of the flower.)

Preguntas sobre el tema de la actividad

1. ¿Cuál es la función de la flor? (Es la estructura reproductiva de las angiospermas.)

2. ¿Cuál es la función del cono del pino? (Es la estructura reproductiva de las gimnospermas.)

3. ¿Cuál es la función de los estambres de la flor? (Los estambres producen polen.)

4. ¿Cuál es la función del estigma de la flor? (El estigma captura el polen para que se lleven a cabo la **polinización** y la **fertilización.**)

5. ¿Cuál es la función de los pétalos de la flor? (Los pétalos atraen insectos y protegen la estructura interna de la flor.)

Why It Happens/More on the Topic

Flowers contain the structures used in sexual reproduction of angiosperms. The thin, vase-like structure in the center of a flower is called the pistil. The long, skinny structures that surround the pistil are called stamens. They produce pollen, the male sex cells. The sticky tip of the pistil, called the stigma, receives pollen. Pollination occurs when pollen is transferred from a stamen to the stigma. The female sex cells are produced and contained inside the ovary, located at the rounded base of the pistil. When pollen meets the female sex cells in the ovary they become fertilized and begin to produce seeds. The seed then grows inside the ovary until it is ready to be released. The petals, stamens, and pistil either wilt or become part of the fruit which forms around the seed.

Reproduction in gymnosperms is different than in angiosperms. The seeds are arranged on a female cone rather than being contained in an ovary. Pollen is produced in separate, male cones. Pollination depends on pollen blowing from the male cone to the female cone.

Algo más sobre el tema...

Las flores contienen las estructuras que se necesitan para la reproducción sexual de las angiospermas. La estructura delgada, con forma de florero en el centro de la flor, se llama pistilo. Las estructuras largas y delgadas que rodean al pistilo se llaman estambres. Éstos son los que producen polen, las células sexuales masculinas. El polen llega al extremo pegajoso del pistilo, llamado estigma. En el momento en que el polen se transfiere del estambre al estigma es cuando ocurre la polinización. Las células sexuales femeninas se producen y se almacenan en el ovario, localizado en la base del pistilo. Cuando el polen se encuentra con las células femeninas en el ovario, éstas son fertilizadas y comienza el proceso de producción de semillas. Luego, las semillas crecen dentro del ovario hasta que están listas para liberarse. Los pétalos, los estambres y el pistilo o bien se marchitan o se convierten en parte de la fruta que se forma alrededor de la semilla.

La reproducción de las gimnospermas es diferente de la de las angiospermas. Las semillas se ubican en un cono femenino en vez de en un ovario. El polen se produce de manera independiente, en conos masculinos. La polinización depende de que el polen vuele del cono masculino al femenino.

Extensions

Have students bring in and dissect a flower from their garden or neighborhood. Compare the different shapes, sizes, and colors of the various parts of each type of flower. Can they figure out how each of the flowers are pollinated, based on the differences of the flower parts? (Hint: Brightly-colored flowers tend to attract bees and hummingbirds. Flowers with strong scents that open at night tend to be pollinated by bats or nocturnal insects.)

Good References for Flower Structure

Audesirk, Teresa, Gerald Audesirk, and Bruce E. Byers, editors. Life on Earth. Second edition. Upper Saddle River, NJ: Prentice Hall, Inc., 2000.

Daniel, Lucy, Edward P. Ortleb, and Alton Briggs. Merrill Life Science. Teacher Wrap-Around Edition. Lake Forest, IL: Glencoe-Macmillan/McGraw-Hill, 1993.

Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn, editors. Biology of Plants. Fifth edition. New York, NY: Worth Publishers, 1992.

A DIVERSITY OF LEAVES

La gran variedad de hojas

Grades		
K–2	Whole Class	45–60 min.

Purpose

Students will gather a variety of leaves, then make leaf rubbings to show the different sizes, shapes, and vein patterns of their leaves.

Materials

Leaves (a variety of shapes and sizes, including pine needles)
Paper
Crayons (with paper wrap removed)

Concepts

- Leaves come in many sizes and shapes
- Leaves have veins to help transport water and nutrients through the leaf.

Conceptos

- Las hojas tienen una gran variedad de formas y tamaños.
- Las hojas tienen nervaduras que las ayudan a transportar el agua y los nutrientes.

Safety

If you take your students outside to collect leaves, be sure to identify the boundaries your students must not cross.

In Advance

Remove paper wrap from the crayons or select crayons that have already been unwrapped. Find an outdoor site for collecting leaves.

Procedure

1. Explain the activity

Begin by telling students they will be taking a close look at different leaves. Explain that they will be going outside to collect some leaves, then doing an art project using the leaves when they return to the classroom.

2.Take the class outside

Take the students outside to the site you have selected for collecting leaves. Identify the boundaries of the area they will be using. Explain that they should each collect 8 leaves of all different shapes and sizes. Tell students that pine needles can also be collected—they are the leaves from a pine tree. Give students about 10 minutes to collect their leaves.

3. Return to the classroom and begin art project

Bring students back to the classroom with their leaves and give each student a piece of paper. Also give students an assortment of crayons to share.

Before students begin, demonstrate how to make a leaf rubbing. Place a leaf on a flat surface, then put a piece of paper over the leaf. Using the side of the crayon, rub the paper over the area where the leaf has been placed. The crayon should highlight the edges and veins of the leaves in most cases. Tell students they can arrange the leaves however they like under their paper and can use more than one color crayon. It will be easier if they only place one leaf under the paper at a time. Give them 10 or 15 minutes to complete their rubbings.

4. Discuss the leaf rubbings

When students have completed their leaf rubbings, hold up a few to show the class. Ask students what parts of the leaves show up best. Do they know what the lines are in the center of some of the leaves? Do they know what the leaf veins are for? Do they recognize any of the leaves from a particular tree or shrub?

Questions to Ask During the Activity

1. What are some of the different textures of the leaves you have collected? (Leaves can be smooth, fuzzy, waxy, sticky, bumpy, etc.)

2. Can you tell which leaves fall from the tree in the autumn and which don't?

3. What are leaf veins for? (They help to transport water and nutrients to the leaves.)

Preguntas sobre el tema de la actividad

1. ¿Qué tipo de texturas diferentes tienen las hojas que recolectaste? (Las hojas pueden ser suaves, vellosas, enceradas, pegajosas, rugosas, etc.)

Preguntas (continuación)

2. ¿Cuáles son las hojas que caen de los árboles en otoño y cuáles no?

3. ¿Para qué sirven las nervaduras de las hojas? (Ayudan a transportar agua y nutrientes hacia las hojas.)

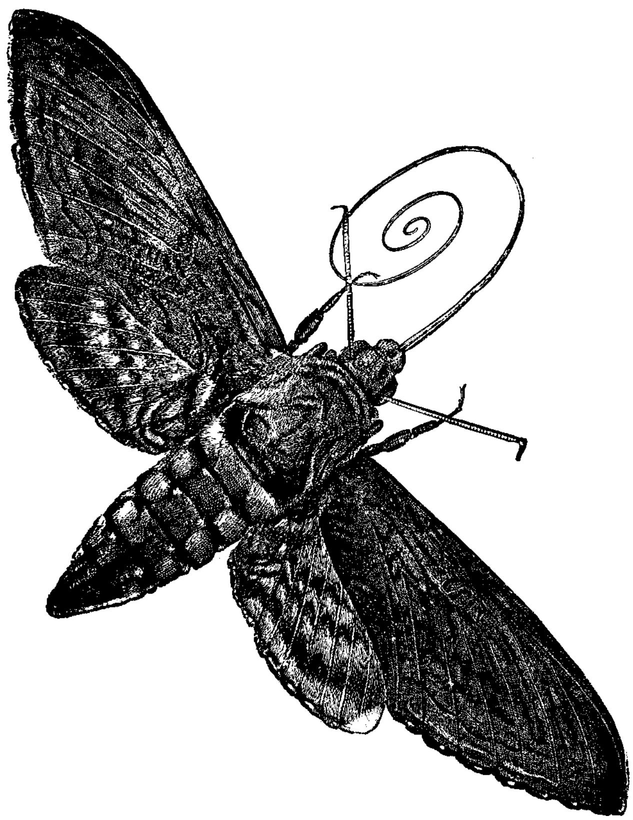
Modifications

Instead of making leaf rubbings with the leaves, you can make leaf prints. Using a paintbrush, paint the underside of a leaf, then carefully press it onto a piece of paper. Be careful not to drag the leaf across the paper if you don't want the print to smear.

Extensions

Help your students identify some of the leaves they collected. Tree and shrub identification books can be found in the local library. Have students label their leaf rubbings with the names of the trees or shrubs they came from.

Introduction to
ANIMALS: INVERTEBRATES



BACKGROUND INFORMATION—INVERTEBRATES

Organizing and identifying the vast array of animals in the world is an enormous task. Scientists have tackled this challenge by dividing animals into two separate groups—the **vertebrates** and the **invertebrates**. Vertebrates are animals that have backbones. Most vertebrates are immediately recognizable as animals. Sharks, birds, snakes, frogs, horses, and humans are all vertebrate animals. Invertebrates are animals that lack a backbone. Although most people only recognize a few kinds of invertebrate animals, invertebrates far outnumber vertebrates. In fact, 97% of all animals are invertebrates. Insects, spiders, worms, squid, snails, sponges, and coral are all members of the invertebrate group. But, invertebrates and vertebrates share certain characteristics that make them animals.

Characteristics of Animals

• Unlike plants, animals are unable to make their own food. To get the energy they need to live, they must capture and eat other organisms.

• Animals are multi-cellular, and because of the complexity of their many cells, most cannot absorb their food directly. Instead, animals digest their food in a **gut** or stomach, which breaks it down into simpler proteins, carbohydrates, and fats. (However, some parasites such as tapeworms, absorb nutrients directly from their host.)

• Animal cells are **specialized** for different "jobs" or functions. For example, the cells in the gut work differently than the cells in the lungs or heart of an animal. Some cells are specialized to carry oxygen to the different parts of the body. Other cells digest food. Still others help to sense light or pass information from the brain to other areas of the body.

• Animal cells are arranged in a pattern according to their function. Cells that share the same function make up **tissue**. For example, cells that capture oxygen for land animals make up lung tissue. Cells that filter poisons from the blood in humans make up liver tissue. **Organs** are composed of tissues that function together. Lung tissue makes up the lung, heart tissue makes up the heart, and liver tissue makes up the liver. Organs that function together make up **organ systems**. For example, the intestines and stomach are part of the digestive system. The heart pumps blood through veins and arteries, and they are all part of the circulatory system. Some simple animals, like sponges and coral, don't have distinct organs, but they are made up of specialized cells.

- Parts of animals are arranged in specific ways. The pattern or arrangement of animals' body parts is called **symmetry**. Animals are sometimes classified according to their symmetry. Some animals, like starfish, have body parts arranged in a circle around a central point. This arrangement is called **radial symmetry**. Other animals, like humans, have **bilateral symmetry**. These animals can be "divided" down the middle into two identical halves. Symmetry is usually only a surface characteristic, however. An animal's internal organs are not always symmetrical.

- The kind of food an animal eats determines its **feeding habit**. Feeding habits in the animal kingdom are extremely diverse, but include the following general categories: 1) **herbivores**, 2) **carnivores**, 3) **omnivores**. Herbivores eat only plants. Carnivores eat only other animals. (When an animal hunts and eats another animal it is referred to as a **predator**. The animal being hunted and eaten is called **prey**.) Omnivores eat both plants and animals. **Parasites** are organisms that grow, feed, and live on or in other organisms. The animal being parasitized is called the **host**. A parasite contributes nothing to the survival of its host and usually does some damage to the host. Occasionally, it's enough damage to kill the host.

Invertebrates

The word invertebrate literally means "without a backbone." Like all living things, invertebrates sense and respond to their environment, move, and reproduce. Because they are animals, invertebrates also gather food, breathe oxygen, and protect themselves. Invertebrates may have skeletons, but they don't have bones like other animals.

Sensing and Responding to the Environment

A change in an animal's **environment** that causes a reaction in the animal is called a **stimulus.** Animals sense stimuli in a variety of ways. For example, planaria, a flatworm, has an "eye spot" that detects light, but cannot form images like our eyes. Still, this ability allows them to detect the dark, rocky crevices where they like to live.

Some invertebrates have more advanced sensory abilities involving **antennae** of one kind or another. Antennae can generally detect both touch and chemicals. The "messages" the antennae receive are relayed to the animal's brain so the animal can react to the stimulus. Jellyfish (which are not actually fish) have yet another way of sensing their environment. When a jellyfish's stinging cells are touched by another animal, the cells discharge a tiny venom-filled harpoon that both ensnares and paralyzes its prey.

Respiration

All animals "breathe." When oxygen is taken in by an animal, it is carried to each cell, where it plays a part in helping to convert food into energy. The process is called **respiration**. Invertebrates that live underwater usually rely on **gills** to take in oxygen. The animal's blood then carries the oxygen to the rest of the cells in the animal's body. Invertebrates like sow bugs (isopods), clams, sea worms, and lobsters also have gills for respiration. Animals such as jellyfish and flatworms absorb oxygen directly from the environment.

Body Temperature

Most invertebrates are **ectothermic**—they are unable to maintain an internal body temperature that is independent from their surroundings. Their body temperature varies according to the temperature of their surroundings. This is why ants and houseflies tend to be less active on cold days. Moths and honeybees must warm up in order to fly and will shiver to warm up their flight muscles.

Protection

There are many different ways invertebrates protect themselves from danger. Many, like clams and snails, have shells to hide in. Others have sharp spines that discourage predators. The squid uses distraction. When a squid feels threatened, it squirts a dark inky substance towards the danger and swims the other way. Insects use distraction to protect themselves, too. For example, some butterflies have patterns on their wings that look like big, dangerous eyes. Another way invertebrates protect themselves is by matching their surroundings through **camouflage**. For example, when a praying mantis is completely still on a leaf, its green body blends in with the vegetation and is difficult to see.

Invertebrates are extremely diverse, but as with all animals, they must find food, are multicellular, and have specialized cells that are arranged in patterns according to their functions. The activities in this section will allow students to discover some of the diversity and complexity among this amazing group of animals.

INFORMACIÓN BÁSICA—LOS INVERTEBRADOS

La organización e identificación de la vasta colección de animales en el mundo es una tarea de enormes proporciones. Los científicos han abordado este desafío y comenzaron por dividir a los animales en dos grupos: los **vertebrados** y los **invertebrados**. Los vertebrados son animales que tienen columna vertebral. Es fácil darse cuenta inmediatamente de que la mayoría de los vertebrados son animales. Los tiburones, los pájaros, las serpientes, las ranas, los caballos y los seres humanos, todos ellos constituyen parte de los vertebrados. Los invertebrados son animales que no tienen columna vertebral. Aunque la mayoría de las personas sólo puede reconocer unos pocos tipos de invertebrados, existen muchos más invertebrados que vertebrados. En realidad, el 97% de todos los animales son invertebrados. Los insectos, las arañas, los gusanos, los calamares, las babosas, las esponjas y los corales, todos ellos son miembros del grupo de los invertebrados. Pero, los vertebrados y los invertebrados tienen ciertas características en común que hacen que ambos sean considerados animales.

Características de los animales

- A diferencia de las plantas, los animales no son capaces de producir su propio alimento. Para obtener la energía que necesitan para vivir deben capturar y comer otros organismos.

- Los animales son multicelulares y debido a la complejidad de las mismas células, no pueden absorber los alimentos directamente. En lugar de absorción directa, los animales digieren sus alimentos en la **barriga** o estómago, donde se desintegran en proteínas simples, carbohidratos y grasas. (Sin embargo, algunos parásitos tales como las tenias absorben nutrientes directamente de su huésped).

- Las células de los animales se especializan para realizar diferentes “trabajos” o funciones. Por ejemplo, las células de la barriga trabajan de forma diferente que las células de los pulmones o del corazón del animal. Algunas células se especializan en llevar oxígeno a las diferentes partes del cuerpo. Otras células digieren los alimentos. Y otras ayudan a percibir la luz y a enviar información del cerebro a otras áreas del cuerpo.

• Las células animales están configuradas de acuerdo a sus funciones. Las células que comparten la misma función forman el **tejido**. Por ejemplo, las células que absorben el oxígeno en los animales de tierra forman el tejido pulmonar. Las células que filtran las sustancias tóxicas que hay en la sangre de los seres humanos forman el tejido del hígado. Los **órganos** están compuestos de tejidos que funcionan en conjunto. El pulmón está formado por tejido pulmonar, el corazón está formado por tejido cardíaco, el tejido hepático forma el hígado. Los órganos que funcionan en conjunto forman un **sistema de órganos**. Por ejemplo, los intestinos y el estómago son parte del sistema digestivo. El corazón bombea sangre a través de las venas y las arterias, las cuales forman parte del sistema circulatorio. Algunos animales simples, como las esponjas y el coral, no tienen órganos diferenciados pero están compuestos por células especializadas.

• Las distintas partes del animal están organizadas de una manera específica. La configuración u organización de las partes del cuerpo se llama **simetría**. A veces, se clasifica a los animales de acuerdo con su simetría. Algunos animales, como la estrella de mar, tienen las partes de su cuerpo organizadas en un círculo alrededor de un punto central. Este tipo de configuración se llama **simetría radial**. Otros animales, como los seres humanos tienen **simetría bilateral**. Este tipo de animales puede “dividirse” por la mitad en dos partes idénticas. Sin embargo, la simetría es, en general, una característica superficial ya que los órganos internos de un animal no siempre son simétricos.

• El tipo de alimentos que come el animal determina sus **hábitos alimenticios**. En el reino animal, los hábitos alimenticios son extremadamente diversos, pero en general pueden dividirse en las siguientes categorías generales: 1) **herbívoros,** 2) **carnívoros**, 3) **omnívoros**. Los herbívoros sólo comen plantas. Los carnívoros comen otros animales. (Un animal que caza y come a otro animal, se llama **predador**. El animal que es atrapado se llama **presa**.) Los omnívoros comen tanto plantas como animales. Los **parásito**s son organismos que crecen, se alimentan y viven sobre o dentro de otros organismos. El animal que ha sido infectado con parásitos se llama **huésped**. Los parásitos no contribuyen a la supervivencia de su huésped y en general le causan algún tipo de daño. A veces, el daño es tan severo que mata al huésped.

Invertebrados

La palabra invertebrado significa, literalmente, “sin columna vertebral”. Al igual que otros organismos vivientes, los invertebrados perciben y responden al medio ambiente, se mueven y se reproducen. Como el resto de los animales, los invertebrados también deben obtener sus alimentos, respiran oxígeno y deben protegerse a sí mismos. Algunos invertebrados tienen esqueletos, pero no tienen huesos como el resto de los animales.

Percepción y respuesta al medio ambiente

Un cambio proveniente del **medio ambiente** del animal y que causa una reacción en el mismo, se llama **estímulo**. Los animales sienten los estímulos en una variedad de formas. Por ejemplo, la planaria, un gusano plano (platelminto) tiene una “mancha ocular” que detecta la luz, pero no puede formar imágenes como lo hacen nuestros ojos. Pero aún así, esta habilidad le permite detectar las grietas oscuras y rocosas en las cuales les gusta vivir.

Algunos invertebrados tienen habilidades sensoriales más avanzadas contenidas en algún tipo de **antenas**. Generalmente, las antenas pueden detectar sustancias químicas y tienen habilidades táctiles. Los “mensajes” que reciben las antenas se transmiten al cerebro del animal para que éste pueda reaccionar a los estímulos. Las medusas tienen otra manera de percibir el medio ambiente. Cuando otro animal toca las células urticantes de la medusa, estas células descargan un arpón diminuto lleno de veneno que atrapa y paraliza a la presa.

La respiración

Los animales “respiran”. Cuando un animal inhala el oxígeno, éste es transportado a cada una de las células y colabora con ellas para convertir el alimento en energía. Este proceso se llama **respiración**. Los invertebrados que viven bajo agua, en general, cuentan con sus **branquias** para inhalar oxígeno. Luego, la sangre del animal transporta el oxígeno al resto de las células del cuerpo. Los invertebrados, tales como las cochinitas de la humedad (isópodos), las almejas, los gusanos de mar y las langostas también tienen branquias para respirar. Los animales tales como la medusa y el gusano plano absorben el oxígeno directamente del medio ambiente.

La temperatura del cuerpo

La mayoría de los invertebrados son **ectotérmicos** (animales de sangre fría), no pueden mantener una temperatura interna del cuerpo independiente del medio exterior. Es decir, la temperatura del cuerpo varía con la temperatura del medio ambiente. Por esta razón las moscas comunes tienden a ser menos activas durante los días fríos. Las polillas y las abejas melíferas deben entrar en calor para poder volar y tiritan para calentar los músculos que las ayudan a volar.

La protección

Los invertebrados se protegen a sí mismos del peligro de muchas maneras distintas. Muchos de ellos, tales como las almejas y las babosas, tienen caparazones donde esconderse. Otros tienen espinas puntiagudas que desalientan a los predadores. El calamar usa la distracción como defensa. Cuando un calamar se siente amenazado, arroja una sustancia oscura como una tinta hacia el lugar de donde proviene el peligro y nada hacia el lado contrario. También los insectos usan la técnica de la distracción para protegerse. Por ejemplo, algunas mariposas tienen dibujos en sus alas que parecen ojos enormes y peligrosos. Otra manera en que los invertebrados se protegen a sí mismos es tratando de confundirse con el medio ambiente a través del **camuflaje**. Por ejemplo, cuando una mantis religiosa (mamboretá) se queda completamente quieta sobre una hoja, el cuerpo que es verde, se confunde con la vegetación y es muy difícil verla.

Los invertebrados son extremadamente diversos, pero al igual que sucede con todos los animales, cada uno de ellos debe encontrar su propio alimento, son multicelulares y tienen células especializadas configuradas para realizar funciones específicas. Las actividades prácticas de esta sección permitirán al estudiante descubrir algunas de las diversidades y complejidades de este increíble grupo de animales.

SYMMETRY
Simetría

Grades		
K–4	*Whole Class*	*45–60 min.*

Purpose
Students will find examples of bilateral and radial symmetry in their environment.

Materials
Paper (2 pieces per student)
Scissors
Student Activity Sheet

Concepts
- The pattern or arrangement of body parts on an animal is called symmetry.
- When body parts are arranged in a circle around a central point, it is called radial symmetry.
- When an animal can be “divided” down the middle into two equal halves, it is called bilateral symmetry.
- The internal organs of an animal are not necessarily symmetrical.

Conceptos
- Simetría es la configuración o disposición de las partes del cuerpo de un animal.
- Simetría radial se refiere a la disposición de las partes del cuerpo que forman un círculo alrededor de un punto central.
- Simetría bilateral se encuentra en los casos en que el animal puede “dividirse” por la mitad en dos partes iguales.
- Los órganos internos de un animal no siempre son simétricos.

Safety
If you will be doing the scavenger hunt outside, tell students which boundaries they are not allowed to cross. Also review rules for respecting animals and plants outside.

Vocabulary

Symmetry
Radial symmetry
Bilateral symmetry

Vocabulario

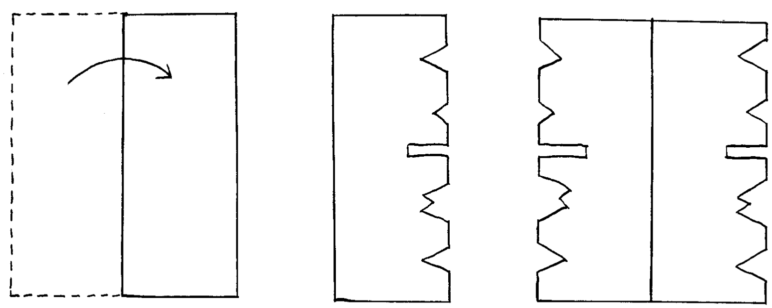
Simetría
Simetría radial
Simetría bilateral

Procedure

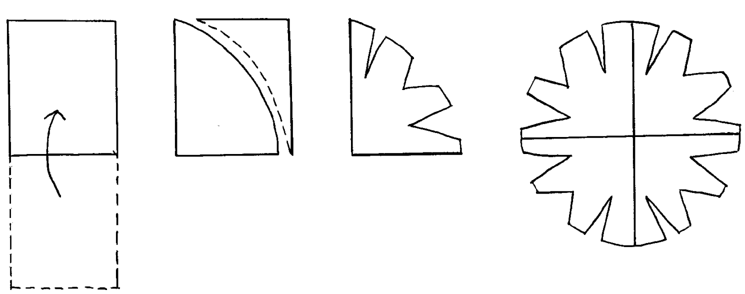
1. *Preparation*

Introduce the activity by defining **symmetry**. Hand out two pieces of paper and a pair of scissors to each student. Tell them they will be making a sample cut-out of two types of symmetry that are common in animals: **bilateral** and **radial symmetry**.

For the bilateral symmetry cut-out, have students fold one piece of paper in half. While keeping the paper folded, tell students to cut a design into the side opposite the fold. When the paper is unfolded, each half will be a mirror image of the other. This is an example of bilateral symmetry.



For the radial symmetry cut-out, have students fold the second piece of paper in half then fold it in half again. Next, tell students to make a rounded cut along the unfolded edge of the paper as if they were making a paper snow flake (see diagram). Then have students cut a design into the rounded edge. When the paper is unfolded, the design will be arranged around a central point in the middle of the paper—an example of radial symmetry.



2. Scavenger hunt

With cut-outs in hand, take students outside (or stay inside if the weather is bad) for a symmetry scavenger hunt. Give each student a pencil and a Student Activity Sheet. Tell them they will be looking for at least 10 items that have either bilateral or radial symmetry. Every time they find an item, they will be writing the item name in the appropriate column on the Student Activity Sheet. Younger students can draw a picture of the item in the column. Give students 10 to 20 minutes to search for symmetrical items.

3. Discuss scavenger hunt

Ask students to share the examples of bilateral and radial symmetry they found outside. Name some familiar animals and see if students can guess if they have bilateral or radial symmetry.

Questions to Ask During the Activity

1. What type of symmetry do people have? (Bilateral symmetry.)

2. Is our symmetry perfect? (Not quite. We all have slight differences on each side that keep us from being perfect. For example, some people have one ear that is slightly different than the other or one foot that is bigger than the other.)

3. Do plants have radial or bilateral symmetry? (Most plants have neither type of symmetry.)

Preguntas sobre el tema de la actividad

1. ¿Qué tipo de simetría tienen las personas? (Simetría bilateral)

2. ¿Es nuestra simetría perfecta? (No del todo. Tenemos pequeñas diferencias entre cada lado y por eso la simetría no es perfecta. Por ejemplo, algunas personas tienen una oreja un poco distinta que la otra o un pie más grande que el otro.)

3. ¿La simetría de las plantas es radial o bilateral? (Ninguna de las dos. La mayoría de las plantas no tienen ningún tipo de simetría.)

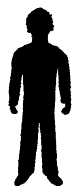
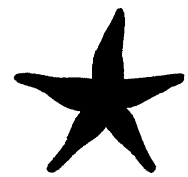
Extensions

Have students create a paper butterfly—a good example of bilateral symmetry. Tell students to fold a piece of paper in half lengthwise, then use a pattern to trace and cut the outline of a butterfly while the paper is folded. To decorate, paint one half of the butterfly. While it is still wet, fold the butterfly in half again. Before the paint dries, open the butterfly wings to see a great example of bilateral symmetry.

STUDENT ACTIVITY SHEET

Symmetry

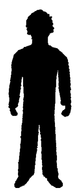
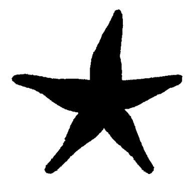
Write (or draw) the items you find that have bilateral symmetry or radial symmetry:

 ***Bilateral symmetry***	 ***Radial symmetry***

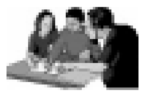
ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Simetría

Escribe (o dibuja) los objetos que hayas encontrado que tengan simetría radial o bilateral:

 ***Simetría bilateral***	 ***Simetría radial***

SOIL INVERTEBRATES
Invertebrados de tierra

Grades		
3–8	*4–5*	*Day 1: 30 min.* *Day 2: 45–60 min.*

Purpose

Students will capture and observe soil invertebrates.

Materials

For each group:
- Soil
- Jar
- Funnel
- Wet paper towel
- Small, shallow container for observing invertebrates
- Desk lamp or other direct light source
- Magnifying glass or microscope (optional)

For each individual:
- Student Activity Sheet

Concepts

- Many invertebrates live in the soil, where they are hidden from sight.
- The invertebrate group encompasses a variety of organisms that may or may not look like each other.
- Soil invertebrates like cooler, darker areas, away from direct light.

Conceptos

- Muchos invertebrados viven en la tierra, donde no se los ve a primera vista.
- El grupo de invertebrados abarca una variedad de organismos que pueden parecerse entre ellos o no.
- A los invertebrados de tierra les gustan los lugares frescos, oscuros y lejos de la luz directa.

Vocabulary

Invertebrate
Insects
Arachnids
(spiders, mites, tick, and scorpions)
Isopods
(related to shrimp, crabs, and lobsters)
Annelids
(segmented worms like earthworms)
Mollusks
(related to snails and squid)
Exoskeleton

Vocabulario

Invertebrado
Insectos
Arácnidos
(arañas, garrapatas, ácaros y escorpiones)
Isópodos
(relacionados con los camarones, cangrejos y langostas)
Anélidos
(gusanos segmentados como las lombrices de tierra)
Moluscos
(relacionados con las babosas y los calamares)
Exoesqueleto

In Advance

Collect soil or have students collect soil to bring in. (The best places to collect soil would be in a garden, in a woody area, or along a stream or river). Copy Student Activity Sheets and gather other materials.

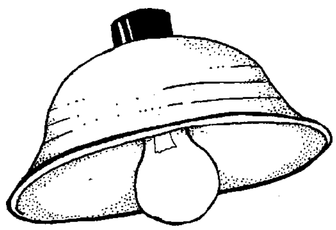
Procedure

1. *Introduce activity*

Begin by defining the **invertebrate** group. (See the background information for this section.) Tell students that many small invertebrates go unseen because they make their living in the soil. They will be setting up a "trap" to get invertebrates out of the soil where they can be observed.

2. *Set-up*

Divide the class into groups of 4 to 5 students. Give each group a jar, funnel, soil sample, wet paper towel, and desk lamp. Tell students to line the bottom of the jar with the wet paper towel, then put the funnel inside the jar's opening. Next, have students put the soil inside the funnel. (A small amount of soil might fall through.) Move the jars to an area where they can be left overnight. Set up the lamps so they shine directly on top of the funnels, leaving several inches of space between the hot bulb and the funnel top.



3. Observe

The next day, have each group turn off the lamps and remove the funnel from the jar. Collect the soil so the invertebrates can be returned to it later. Give each group a shallow container for their invertebrates and a magnifying glass or microscope if available. Also give each student a Student Activity Sheet.

Tell students to carefully transfer their invertebrates from the wet paper towel to the container and observe them with the magnifying glass or microscope. Have them draw their invertebrates and answer the questions on the Student Activity Sheet.

4. Discuss observations

When students have finished observing their invertebrates, discuss their observations as a class. Be sure to use the "Why It Happens" section of this activity to try to classify some of the invertebrates and discuss their differences. Have students show the class any unusual invertebrates they found. After the discussion, return the invertebrates to the soil. (Later, find a suitable place to release the invertebrates outside.)

Questions to Ask During the Activity

1. What was the most common type of invertebrate you found?

2. How many legs do **insects** have? (Six.)

3. How many legs do spiders (**arachnids**) have? (Eight.)

4. How many legs do **isopods** have? (Fourteen.)

5. What type of symmetry do earthworms have? (Bilateral symmetry.)

6. Are earthworms insects? (No, they are called **annelids** and they belong to a different phylum than insects.)

7. What is the hard covering on some beetles and isopods called? (**Exoskeleton**.)

Preguntas sobre el tema de la actividad

1. ¿Cuál es el tipo de invertebrado más común que encontraste?

2. ¿Cuántas patas tienen los **insectos**? (Seis)

3. ¿Cuántas patas tienen las arañas (**arácnidos**)? (Ocho)

4. ¿Cuántas patas tienen los **isópodos**? (Catorce)

5. ¿Qué tipo de simetría tienen las lombrices de tierra? (Simetría bilateral)

6. ¿Son insectos las lombrices de tierra? (No, se llaman **anélidos** y pertenecen a un filo que no es el de los insectos.)

7. ¿Cómo se llama la caparazón dura que recubre a algunos escarabajos e isópodos? (**Exoesqueletos**)

Why It Happens/More on the Topic

Invertebrates that live below the soil generally like cool, moist, dark areas. By putting the light on top of the funnel, the invertebrates move downward to avoid the heat and light. The wet paper towel keeps them from drying out.

Insects have three pairs of legs and three body segments. Adult insects generally have one or two pairs of wings. (They are the only invertebrates with wings). Often their bodies are surrounded by a hard structure called an exoskeleton.

Arachnids (includes spiders, mites, ticks, and scorpions) have four pairs of legs and breathe through lung-like sacs or breathing tubes. Some have bodies with segments, others don’t.

Isopods (a common isopod is the pillbug) are a kind of crustacean related to shrimp, crabs, and lobsters. They have seven pairs of legs and are not insects.

Annelids are segmented worms. Earthworms are annelids. They move through the soil, eating organic matter. They move by grasping the soil with tiny bristles on each of their segments.

Mollusks include clams, mussels, oysters, snails, slugs, squids, and octopuses. They usually have soft bodies often enclosed by a shell made of hard calcium carbonate (the material in chalk). In the water, they filter organic particles that pass over their gills and mouth.

Algo más sobre el tema...

Por lo general, a los invertebrados que viven debajo de la tierra les gustan los lugares frescos, húmedos y oscuros. Al poner la luz en la parte de arriba del embudo, los invertebrados se mueven hacia abajo para evitar la luz y el calor. La toalla de papel humedecida los ayuda a evitar que se sequen.

Los insectos tienen tres pares de patas y el cuerpo dividido en tres segmentos. Los insectos adultos, generalmente, tienen uno o dos pares de alas. (Son los únicos invertebrados que tienen alas.) A menudo los cuerpos están recubiertos por una estructura dura llamada exoesqueleto.

Los arácnidos (que incluyen arañas, garrapatas, ácaros y escorpiones) tienen cuatro pares de patas y respiran a través de unos pulmones que parecen sacos o tubos respiratorios. Algunos tienen cuerpos segmentados y otros no.

Los isópodos (un isópodo común es la cochinilla de la humedad) son un tipo de crustáceos relacionados con el camarón, el cangrejo y la langosta. Tienen siete pares de patas y no son insectos.

Los anélidos son gusanos segmentados. Las lombrices de tierra son anélidos. Se desplazan a través del suelo y comen sustancias orgánicas. Para desplazarse, se "agarran" a la tierra con las pequeñas cerdas que tienen en cada segmento.

Los **moluscos** incluyen almejas, mejillones, ostras, caracoles, babosas, calamares y pulpos. En general, tienen cuerpos blandos dentro de un caparazón duro de carbonato de calcio (el mismo material de las tizas). Cuando están en el agua, filtran las partículas orgánicas que pasan a través de las branquias y de la boca.

Modifications

For younger students (including K-2), the activity can be done as a demonstration. Transfer collected invertebrates to other containers for students to observe at stations throughout the classroom. Have students draw the invertebrates they see, then discuss them as a class.

Extensions

If students didn't get a broad variety of invertebrates in their soil samples, consider adding some invertebrates for them to observe. Isopods, earthworms, and mealworms or darkling beetles can be purchased from commercial biological supply companies. Clams can be purchased at the grocery store.

Another extension idea would be to gather soil from several different areas (sandy soil vs. clay soil, surface soil vs. deep soil, etc.) to see how the composition of invertebrates compares.

References

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STUDENT ACTIVITY SHEET

Soil Invertebrates

Draw pictures of the invertebrates you see in your soil sample:

1. Can you identify any of the invertebrates you see? What are they?

2. Why do you think the invertebrates ended up at the bottom of the jar?

3. What would happen to an earthworm if you did not put the wet paper towel in the bottom of the jar?

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
Invertebrados de tierra

Dibuja los invertebrados que has visto en tu muestra de tierra:

1. ¿Puedes identificar alguno de los invertebrados que has visto? ¿Qué son?

2. ¿Por qué crees que los invertebrados se fueron al fondo del frasco?

3. ¿Qué le pasaría a una lombriz de tierra si no pones la toalla de papel humedecida en el fondo del frasco?

EARTHWORMS

Lombrices de tierra

Grades		
3–8	4–5	90 minutes*

Purpose

Students will observe earthworms to learn about their characteristics and test an earthworm's preferences using the scientific method.

Materials

Earthworms (preferably night crawlers, available at local bait shops)
Paper towels
Hand lenses or magnifying glass (optional)
Spray bottle with water
Cookie sheet
Heating pad (an electric one works better than a microwavable one)
Ice tray with ice cubes
2–3 cups of different soil types (preferably a sandy soil and a dark, loamy soil)
Student Activity Sheets

Concepts

- Earthworms are classified with other segmented worms into a group called annelids.
- Earthworms need to stay moist because they breathe through their skin.
- Earthworms prefer dark, loamy soil with a lot of organic material for them to eat.

Conceptos

- Las lombrices de tierra, junto con otros gusanos segmentados, se clasifican dentro del grupo de los anélidos.
- Las lombrices de tierra necesitan mantenerse húmedas porque respiran a través de la piel.
- Las lombrices de tierra prefieren la tierra cuando es oscura, margosa y tiene mucho material orgánico para comer.

* *Can be done in three parts*

Vocabulary

Invertebrate
Detritivore
Organic matter
Ectothermic

Vocabulario

Invertebrado
Detritos
Materia orgánica
Ectotermo

In Advance

Buy earthworms. Copy Student Activity Sheets. Put the heating pad and the ice tray under each end of the cookie sheet 1/2 hour before beginning the first experiment of earthworm preferences. (The cookie sheet can be set up while students are making their first observations.)

Procedure

1. Set-up for earthworm observations

Divide the class into groups of 4 to 5 students. Tell students they will be given an earthworm to look at. You should remind students that earthworms are live animals that should be handled with care. Also, they will need to make sure their earthworm stays moist by occasionally spraying it with the spray bottle. Give each student a copy of the Student Activity Sheet “Earthworm Observations.”

Give each group a wet paper towel, an earthworm, and a magnifying glass or hand lens (optional). The earthworms should be kept on the paper towels while they are being observed.

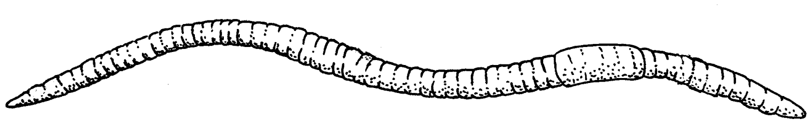
2. Observations and discussion

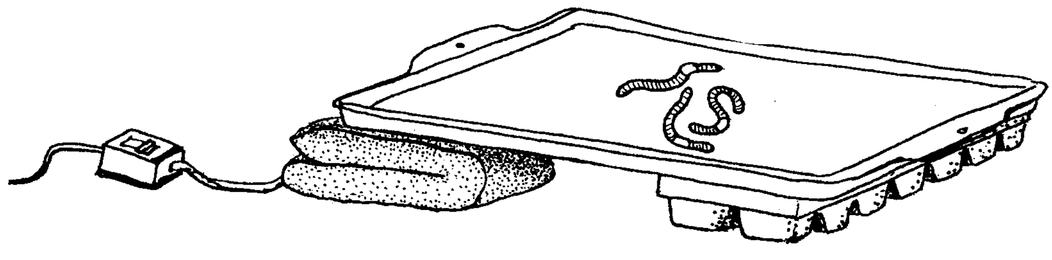
Tell students to answer the questions on the Student Activity Sheet as they make their observations. When they are finished, discuss their observations and answers as a class. Collect the earthworms and put away other materials.

Experiment 1 - Do earthworms prefer heat or cold?

1. Set-up

One half hour before the experiment, put the heating pad under half of the cookie sheet and the ice tray under the other half. Set the heating pad to medium or high.





Leave a space in the center to initially place the earthworms that is not under either the heating pad or the ice tray.

2. *Hypothesize*

Give each student a copy of the Student Activity Sheet "What Do Earthworms Like?" Tell students that you have set up an experiment to see if earthworms prefer cold temperatures or warm temperatures. Show students the cookie sheet set-up. Ask students to discuss what temperature they think the earthworms will prefer and have them write their hypothesis on the Student Activity Sheet.

3. *Procedure*

Place several earthworms in the center of the cookie sheet. Allow the earthworms to settle down and begin making their choices. Ask students why it might be better to have several earthworms rather than one earthworm for this experiment. Be sure to keep the earthworms moist with the spray bottle.

4. *Results*

When the earthworms have made their preference clear, tell students to write their observations and the outcome of the experiment on their Student Activity Sheet.

5. *Conclusion*

Have students compare the results with their hypothesis. Was their hypothesis supported by the results of the experiment? If not, what can they conclude about the experiment results and earthworms' temperature preferences?

Experiment 2 - What type of soil do earthworms prefer?

1. *Discuss experiment set-up*

Using the first experiment as an example, ask students how they might set up an experiment to see what type of soil earthworms prefer. Students will probably decide that earthworms can be given the choice between different soil types to see which they move towards (e.g., wet soil, dry soil, sandy soil, highly organic soil, potting soil, etc.).

2. *Set-up*
Using the cookie sheet again, put a mound of the sandy soil on one side and a mound of dark, loamy soil on the other side.

3. *Hypothesize*
Ask students to discuss what soil type they think the earthworms will prefer. Have them write their hypothesis on the Student Activity Sheet.

4. *Procedure*
Gently place several earthworms in the center of the cookie sheet. Again, allow the earthworms to settle down and select which soil type they prefer.

5. *Results*
When the earthworms have made their preference clear, have students write their observations and the outcome of the experiment on their Student Activity Sheet.

6. *Conclusion*
Have students compare the results with their hypothesis. Was their hypothesis supported by the results of the experiment? If not, what can they conclude about the experiment results and earthworms' soil preferences?

7. *Discuss*
Using the "Why It Happens" section of this activity, discuss earthworm structures and behaviors.

Questions to Ask During the Activity

1. What kind of **invertebrates** are earthworms? (They belong to a group called annelids, which includes segmented worms.)

2. What is the function of the tiny bristles (setae) on the underside of the earthworm? (They help the earthworm "grab" the soil particles so it can pull itself along.)

3. Why are earthworms good to have in a garden? (They loosen and aerate the soil as they burrow through it, making it easier for plant roots to grow. They also help decompose **organic matter**.)

4. What is the control in the first experiment? (The middle of the cookie sheet because it is neither very cold nor very warm.)

5. What are the experimental variables in the second experiment? (The two different types of soil.)

Preguntas sobre el tema de la actividad

1. ¿Qué tipo de **invertebrados** son las lombrices de tierra? (Pertenecen a un grupo llamado anélidos, el cual incluye a los gusanos segmentados.)

2. ¿Qué función tienen las pequeñas cerdas (septos) en la parte de abajo de la lombriz? (Ayudan a la lombriz a que “agarre” las partículas de tierra para poder arrastrarse.)

3. ¿Por qué es bueno tener lombrices de tierra en el jardín? (Aflojan y airean la tierra al enterrarse, de esta manera facilitan el crecimiento de las raíces. También ayudan a descomponer la **materia orgánica**.)

4. ¿Cuál es la variable de control en el primer experimento? (La bandeja del medio porque no está ni muy caliente ni muy fría.)

5. ¿Cuáles son las variables del experimento en el segundo experimento? (Los dos tipos de tierra.)

Why It Happens/More on the Topic

Earthworms belong to the phylum called annelids, which includes segmented worms. On an earthworm, the segments look like many horizontal lines along the body. Earthworms are not only harmless, they are beneficial to people. Earthworms help aerate the soil by mixing up the layers of soil and making it easier for plant roots to grow. Earthworms are **detritivores** that prefer dark, rich, loamy soil with a lot of organic material for them to eat.

Earthworms have a head end (anterior) and a tail end (posterior). Adult earthworms have a smooth, swollen band around their body, called a clitellum. The purpose of the clitellum is for egg and sperm exchange during reproduction. Each individual earthworm can produce both eggs and sperm. However, they cannot self-fertilize. Instead, they join with another earthworm at the clitellum to exchange sperm cells.

Earthworms have no eyes, but they are sensitive to light. They are also very sensitive to touch, especially vibrations. They have a mouth, but no teeth. Instead, they grind their food in a gizzard-like muscle in their digestive tract.

Earthworms have no lungs. Instead, oxygen diffuses from the air, through their skin, and into their blood vessels. Their skin needs to stay moist for them to breathe.
IF AN EARTHWORM DRIES OUT, IT DIES!

Earthworms move by muscular action. They have two sets of muscles: one set is circular around the earthworm; the other set runs lengthwise along the earthworm's body. An earthworm can become long and thin by contracting the muscles that encircle its body. When the earthworm contracts its long muscles, it draws the tail end toward the head end, and the earthworm becomes shorter and fatter. The rough, hair-like bristles on the underside of the earthworm, called setae, also help the earthworm move. The setae helps the earthworm "grip" soil particles and other rough surfaces.

Earthworms have a very limited ability to regenerate certain damaged or lost parts of their body. But, they cannot regenerate whole parts of their body. If you cut an earthworm in half, it will not become two earthworms.

Algo más sobre el tema...

Las lombrices de tierra pertenecen al filo de los anélidos, el cual incluye a los gusanos segmentados. Los segmentos en una lombriz de tierra parecen líneas horizontales a lo largo del cuerpo. Las lombrices de tierra no sólo son totalmente inofensivas, sino que además son muy beneficiosas para la gente. Las lombrices de tierra airean el suelo al mezclar las distintas capas de tierra, lo cual facilita el crecimiento de las raíces de las plantas. Las lombrices de tierra son **detritos**, es decir, prefieren suelos oscuros, ricos y margosos con mucha materia en descomposición para comer.

Las lombrices de tierra tienen una cabeza en el extremo anterior y una cola en el extremo posterior. Las lombrices adultas tienen una banda abultada y lisa alrededor del cuerpo, llamada clitelo. En el clitelo se intercambian óvulos y espermatozoides durante la reproducción. Cada una de las lombrices puede producir tanto óvulos como espermatozoides. Sin embargo, no se pueden fertilizar a sí mismas. Para hacerlo se juntan con otra lombriz a la altura del clitelo e intercambian espermatozoides.

Algo más sobre el tema (continuación)

Las lombrices de tierra no tienen ojos, pero son sensibles a la luz. También son muy sensibles al tacto, especialmente a las vibraciones. Tienen boca, pero no tienen dientes. Trituran los alimentos con un músculo parecido a una molleja, dentro de la estructura digestiva.

Las lombrices de tierra no tienen pulmones. El oxígeno del aire es absorbido por la piel a través de un proceso de difusión y luego va a los vasos sanguíneos. La piel necesita permanecer húmeda para que puedan respirar. ¡SI UNA LOMBRIZ DE TIERRA SE SECA, MUERE!

Las lombrices de tierra se desplazan mediante la acción muscular. Tienen dos grupos de músculos: uno es circular, ubicado alrededor del cuerpo de la lombriz y el otro es longitudinal, ubicado a lo largo. Una lombriz puede hacerse larga y delgada contrayendo los músculos circulares. Cuando la lombriz contrae sus músculos longitudinales, atrae el extremo de la cola hacia la cabeza y la lombriz se hace corta y gruesa. Las cerdas ásperas que parecen pelos ubicadas en la parte inferior de la lombriz se llaman septos y la ayudan a deslizarse. Los septos ayudan a la lombriz a “agarrarse” de las partículas de tierra y de otras superficies rugosas.

Las lombrices de tierra tienen una habilidad muy limitada para regenerar las partes del cuerpo que se han dañado o que se han desprendido. Pero, no pueden regenerar partes enteras. Si cortas la lombriz al medio, no se transformará en dos lombrices.

Modifications

For younger grades, use the Student Activity Sheet “Earthworm Observations” as a guide to lead a class discussion while students observe their earthworms. The experiments can be done without using the Student Activity Sheet.

Extensions

Students can experiment with other earthworm preferences. For instance, some of the loamy soil can be mixed with vinegar (acidic), some can be mixed with baking soda (alkaline), and some left unmodified. Place the soil mixtures in mounds along the cookie sheet. This will test the earthworm’s preference for acidic, alkaline, or unmodified loamy soil.

Additional activities with earthworms

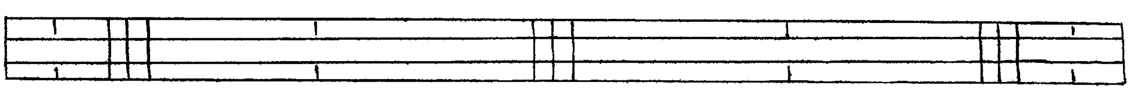
For activities that help children understand movement, anatomy, and behaviors of worms, we suggest that you purchase Canadian crawlers from a bait shop. They are large and easier to observe. However, they must be refrigerated to be kept alive, and they will not survive in a classroom worm bin that is kept at room temperature. Do not force anyone to handle worms if they seem hesitant or afraid, and do not allow children to tease others with the worms. It is cruel to the worm as well as their classmates! Most children will overcome their fears if allowed to watch others handle the worms with confidence and interest.

"Inside a Worm"

Place the worm in a clear plastic shoe box. Be sure to spray it with water to keep it moist. Darken the room and shine a flashlight up through the box. Students will be able to see the worm's internal organs—particularly the intestines. The light will make the worm uncomfortable, so do not do this for very long periods of time.

"Worm Motion"

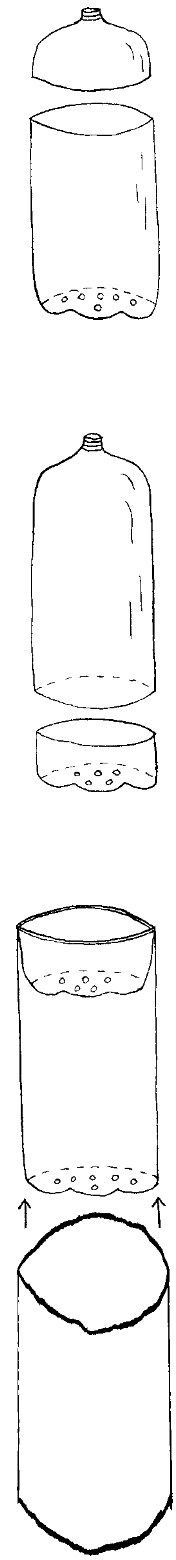
Watch a worm move. Can you tell which end is the head? A worm has muscles that run around the circumference of its body, and longitudinal muscles that run the length of its body. When it contracts the circular muscles, the body becomes longer and slimmer. When it contracts the longitudinal muscles, its body becomes shorter and bigger around. In addition, each worm has **setae**, or hair-like appendages on the underside of its body. These setae can be used as "brakes" to keep part of its body from moving. To model the movement of a worm, use a wide rubber band that is cut to lay flat. Mark one end as the head and the other as the tail. Draw a few lines the length of the band, and then draw some lines across the band at 1/2 inch intervals. Make some small marks along the sides of the band to represent the setae. Lay the "worm" on the table, hold the tail end in place and stretch the head end forward. The worm will become long and slim. This is what a worm looks like when it has contracted its circular muscles, holding its tail end in place with its setae. Slowly release the pressure on the tail end while holding down the head end. Your "worm" will move its tail end forward, and its body will become shorter and wider. This represents the worm contracting its longitudinal muscles, while holding its front end still with the setae.



Markings on wide rubber band

"A Classroom Worm Bin"

Red wigglers are ideal for a classroom worm bin. They thrive with very little attention, reproduce rapidly, and do well in a worm bin at room temperature. A covered plastic storage box from your local discount store (20–30 gal) will easily hold hundreds of worms. Drill some 1/4 inch holes in the bottom and sides for aeration, and line with newspaper. Fill with damp soil, strips of newspaper, and leaves. Put a sheet of newspaper over the soil and spray this paper with water. Your worm bin could be started with as few as six worms. (Remember, all worms are both male and female, and are able to produce young!) Students will enjoy "worm tending" (feeding table scraps and spraying the worms with water). It is not a good idea to put scraps that are animal products in the bin. The worms will eat egg, cheese, or meat, but the bin will smell bad and maggots will appear. It is also not advisable to use citric fruit very often, or the soil will become too acidic. Watch the bin carefully to judge how often and how much to feed and spray the worms. Your worm bin should smell of rich soil when the lid is open. You will not be able to smell it with the lid closed. If it begins to smell sour or rotten, take out the extra spoiled food and leave the lid off overnight to let the soil dry out. Don't worry if you don't see worms for a while—there are probably some surviving cocoons that will hatch.



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"Individual Worm Farms"

Students enjoy having their own worm farms made from 2-liter soda bottles. The container requires two bottles. Cut the top section off one bottle, and use the bottom section of the other bottle as the lid for the container (placed upside down) and it will also serve as a "watering cup" for the container (see illustration). Drill 1/8" holes in the bottom of the container for drainage, and in the watering cup to provide a light sprinkle to the soil when a small amount of water is poured into the cup. Line the bottom of the container with shredded newspaper, then fill three-quarters full with a mixture of soil, shredded paper, and leaves. Three wigglers will give the student a good start on his/her worm farm. Top the soil with more shredded paper, fit the cup/lid into the top, and water lightly. Make a dark paper sleeve to cover the container. It should be loosely taped so it will easily slide off and on. Students will enjoy decorating the paper to represent a worm habitat or to illustrate the varieties of food the worms might enjoy. Because the worms are in a dark environment, some of their burrows will be made against the clear plastic sides of the bottle, and can be observed when the sleeve is removed. Once a week, allow students to dump out their worm farms into flat boxes and check on their worms. Encourage them to keep a record of the increasing population. With a small container such as this, it is best to feed and water sparingly once or twice a week. If a worm farm smells bad, it is being fed and watered too much. Take out the extra food and leave the lid off overnight. As with the classroom worm bin, do not add animal products as food items.

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In addition to the above teacher references, there are a number of excellent books for children. Check your local library for resources with clear photographs or drawings to help your students understand the anatomy and behaviors of earthworms.

STUDENT ACTIVITY SHEET

Earthworm Observations

Answer the questions below as you look at your earthworm.

1. What color is the earthworm? ______________________________

2. Describe how the earthworm feels. ______________________________

____

3. How does the top side of the earthworm feel different from the bottom side?

____

____

4. Look at the underside of the earthworm with the hand lens or a magnifying glass. What do you see?

____

____

5. Place a check next to the body parts you see on the earthworm:

____ eyes ____ mouth ____ ears ____nose

6. Can you tell which is the front end and which is the tail end of the earthworm? Describe the difference.

____

____

7. Describe how your earthworm moves. ______________________________

____

8. What else to you notice about your earthworm?

____

____

9. Draw a picture of your earthworm below:

STUDENT ACTIVITY SHEET

What Do Earthworms Like?

Experiment 1: Warm, cold or in between?

Hypothesis (What do you think the earthworms will choose?)	***Results*** (What did the earthworms choose?)	***Observations*** (What did you notice as the earthworms made their choice?)

Experiment 2: Soil preferences

Hypothesis (What do you think the earthworms will choose?)	***Results*** (What did the earthworms choose?)	***Observations*** (What did you notice as the earthworms made their choice?)

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Observaciones sobre la lombriz de tierra

Contesta las siguientes preguntas mientras observas tu lombriz de tierra.

1. ¿De qué color es tu lombriz de tierra? ______________________________

2. Describe que sientes al tocar a la lombriz. ______________________________

____

3. ¿Cuál es la diferencia al tacto entre el lado de arriba y el lado de abajo de la lombriz?

____

____

4. Observa el lado de abajo de la lombriz con un lente de aumento o con una lupa. ¿Qué ves? ______________________________

____

5. Marca en el espacio apropiado las partes de la lombriz que has podido observar:

____ ojos ____ boca ____ orejas ____ nariz

6. ¿Puedes darte cuenta de cuál es el extremo anterior y cuál es el posterior en tu lombriz? Describe las diferencias.

____

____

7. Describe cómo se desplaza la lombriz. ______________________________

____

8. ¿Qué otra cosa has notado en tu lombriz? ______________________________

____

9. Dibuja tu lombriz en el espacio siguiente:

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

¿Qué le gusta a la lombriz de tierra?

Experimento No 1: ¿Frío, caliente o templado?

Hipótesis (¿Qué crees que la lombriz elegirá?)	***Resultados*** (¿Qué eligió la lombriz?)	***Observaciones*** (¿Qué notaste cuando la lombriz eligió?)

Experimento No 2: Preferencia de suelos

Hipótesis (¿Qué crees que la lombriz elegirá?)	***Resultados*** (¿Qué eligió la lombriz?)	***Observaciones*** (¿Qué notaste cuando la lombriz eligió?)

EARTHWORM WORK

Labor de las lombrices de tierra

Grades		
3–8	*Whole Class*	*30 min. setup* *15 min./week for 2 weeks* *20 min. at the end of the third week (observations)*

Purpose

Students will conduct an experiment to see how earthworms affect soil.

Materials

Three 1 gallon buckets (or larger)
Soil—enough to almost fill the buckets
Small shovel
Paper plates—2 per student
Earthworms (can be purchased at a local bait shop)
Composting material (food scraps, dry leaves, etc. cut into one inch chunks)
Magnifying glasses or hand lenses (optional)
Water
Student Activity Sheet

Concepts

- As earthworms eat their way through hard soil, they create spaces for air and water to pass through.
- Earthworms improve soil for growing plants by decomposing dead plants and animals.

Conceptos

- A medida que los gusanos comen y se mueven a través del suelo duro, crean túneles por donde pueden pasar el aire y el agua.
- Las lombrices descomponen las plantas y los animales muertos y así mejoran la calidad de la tierra para que crezcan las plantas.

Vocabulary

Experimental control
Variables
Decompose
Nutrients

Vocabulario

Control del experimento
Variables
Descomposición
Nutrientes

In Advance

Gather enough soil to almost fill all three buckets. Look for compacted soil, perhaps from the side of a road or a heavily used trail. Collect composting material such as bits of food (except meat) or leaves (except from pine trees). Copy the Student Activity Sheets.

Procedure

1. *Look at soil*

Give each student a paper plate with a sample of the soil on it. Also give each student a copy of the Student Activity Sheet. Tell students where you collected the soil and what, if anything, was growing in it. Ask students what type of things they might expect to find in soil that is good for growing plants.

Have students take a close look at their soil, using hand lenses or magnifying glasses if available. What color is the soil? Do they see small bits of plants in the soil? Are there any invertebrates? If so, how many? How would they describe the texture of the soil? Have students write their observations on the Student Activity Sheet.

2. *Set-up*

Tell students you will be setting up an experiment to see how earthworms affect soil. Have students return their soil samples to the buckets.

Add some water to one bucket and set it aside. Tell students that this bucket will be the **experimental control**. All you will be doing to this bucket is adding some water once a week.

In the second bucket, add half of the composting material and the same amount of water as the first bucket. Mix the contents of the bucket with the small shovel, then set the bucket aside.

In the third bucket, add the other half of the composting material, the same amount of water as the other buckets, and the earthworms. (The more earthworms you add, the faster the soil will change). Gently mix the contents of the bucket and set the bucket aside. Buckets can be kept inside or outside. Ask students what the **variables** are in this experiment.

3. Predict

On the Student Activity Sheet ask students to write their predictions about the changes they expect to see in the three buckets over the next several weeks. Will the soil look the same? Which soil will change the most?

4. "Feed" the soil

Once a week for the next two weeks, add some water to each bucket. Also add more composting material to the second and third buckets. Students can bring in composting material from home.

5. Look at soil again

After three weeks, give each student a paper plate with a sample of the soil from the first bucket. Have students look at the soil again and write down any changes they observe on their Student Activity Sheet. Next, give each student a soil sample from the second bucket (have them keep the sample from the first bucket for comparison). What differences do they notice between the two soil samples? Finally, give students a sample from the third bucket. Have them write their observations on the Student Activity Sheet.

6. Discuss

Ask students what they noticed about the three soil samples. What happened to the soil in the third bucket? Which soil looks the best for growing plants now? What do earthworms do in the soil? Use the information in the "Why It Happens" section of this activity to guide your discussion.

The earthworms can be released outside in a moist area when you are finished with the activity.

Questions to Ask During the Activity

1. What happens to soil next to roads or on trails people walk on? (It gets compacted.)

2. How do earthworms help soil that has been compacted? (As they work their way through the soil, they create spaces for air and water to pass through.)

3. What do earthworms do with the composting material? (They help to **decompose** it by eating and digesting it. The **nutrients** that are released enrich the soil and make it better for growing plants.)

Preguntas sobre el tema de la actividad

1. ¿Qué sucede con la tierra que se encuentra cerca de los caminos o en senderos donde camina la gente? (Se compacta)

2. ¿De qué manera pueden ayudar las lombrices a la tierra que se ha compactado? (Horadan la tierra a medida que se desplazan y crean túneles por donde pueden pasar aire y agua.)

3. ¿Qué hacen las lombrices con la materia en descomposición? (Al consumir y digerir la materia, ayudan a **descomponerla**. Luego los **nutrientes** que se liberan enriquecen el suelo y lo hacen más propicio para que crezcan plantas.)

Why It Happens/More on the Topic

Earthworms belong to the phylum called annelids, which includes segmented worms. On an earthworm, the segments look like many horizontal lines along the body. Earthworms are not only harmless, they are beneficial to people. Earthworms help aerate the soil by mixing up the layers of soil and making it easier for plant roots to grow. Earthworms are **detritivores** that prefer dark, rich, loamy soil with a lot of organic material for them to eat.

Algo más sobre el tema...

La lombriz de tierra pertenece al filo de los anélidos, que incluye a los gusanos segmentados. Los segmentos de la lombriz de tierra parecen líneas horizontales a lo largo del cuerpo. Las lombrices de tierra no sólo son inofensivas sino que además son beneficiosas para la tierra. Las lombrices ayudan a airear el suelo al mezclar las capas de tierra y facilitan el crecimiento de las raíces de las plantas. Las lombrices de tierra son detritos y prefieren la tierra oscura, húmeda y margosa con materia orgánica para consumir.

Modifications

The activity can be done with younger students using the Student Activity Sheet as a guide for class discussion rather than using it individually.

Extensions

Plant fast-growing seeds in each of the three soil types created during the activity. Have students predict which soil will be the best for growing seeds, then watch what happens.

References

Bosak, Susan V. Science Is...A Source Book of Fascinating Facts, Projects, and Activities. Markham, Ontario, Canada: Scholastic Canada, 1991.

Western Regional Environmental Education Council. Project Wild. Boulder, CO, 1986.

STUDENT ACTIVITY SHEET
Earthworm Work

1. Describe the soil sample on the first day of the experiment:

____

____

____

____

2. Predict how the soil will change in each of the three buckets:

Bucket	Prediction
Bucket 1 • soil • water	
Bucket 2 • soil • water • composting material	
Bucket 3 • soil • water • composting material • earthworms	

STUDENT ACTIVITY SHEET
Earthworm Work (continued)

3. Describe the soil in each bucket after three weeks:

Bucket	Description
Bucket 1 • soil • water	
Bucket 2 • soil • water • composting material	
Bucket 3 • soil • water • composting material • earthworms	

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Labor de las lombrices de tierra

1. Describe la muestra de tierra durante el primer día del experimento.

____

____

____

____

2. Haz predicciones sobre el cambio que sufrirá la tierra que se encuentra en cada una de las cubetas.

Cubeta	Predicción
Cubeta No 1 • tierra • agua	
Cubeta No 2 • tierra • agua • materia orgánica	
Cubeta No 3 • tierra • agua • materia orgánica • lombrices de tierra	

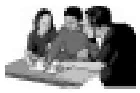
ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
Labor de las lombrices de tierra (continuación)

3. Describe la tierra que se encuentra en cada una de las cubetas tres semanas más tarde.

Cubeta	**Descripción**
Cubeta No 1 • tierra • agua	
Cubeta No 2 • tierra • agua • materia orgánica	
Cubeta No 3 • tierra • agua • materia orgánica • lombrices de tierra	

ISOPOD FEEDING HABITS

Hábitos alimenticios de los isópodos

Grades		
2–8	4–5	60 minutes

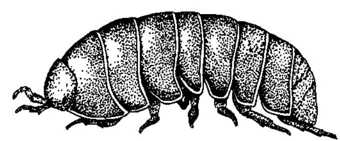
Purpose

Students will use an experiment to see what isopods (pillbugs) like to eat.

Materials

For each group:

10 isopods (Isopods can be purchased from a biological supply company or found outside in moist areas underneath leaves, branches, rocks, or boards.)
Shoe box with lid
1 tablespoon lunch meat
1 small piece of potato
1 small piece of apple
1 tablespoon of grass clippings
Student Activity Sheet
Hand lenses (optional)



Concepts

- Isopods are crustaceans classified in the order Isopoda.
- Isopods are omnivores.

Conceptos

- Los isópodos son crustáceos clasificados en la orden de los Isopoda.
- Los isópodos son omnívoros.

Safety

Have students wash their hands after the activity.

Vocabulary

Feeding habit
Omnivore
Herbivore
Carnivore
Variable

Vocabulario

Hábitos alimenticios
Omnívoros
Herbívoros
Carnívoros
Variable

In Advance

Collect isopods from outside or order them from a biological supply company. Gather other materials and copy the Student Activity Sheet.

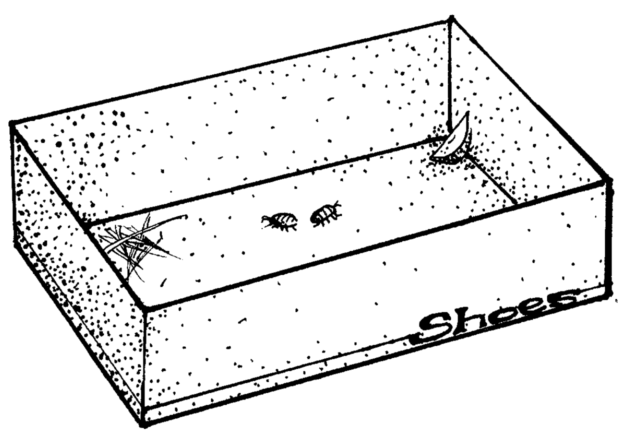
Procedure

1. Introduce the isopods

Show the class one of the isopods and ask them what they call this bug. They are commonly referred to as pill bugs, rolly-poly bugs, and sow bugs. Ask students if they think the isopod is a type of insect. Remind them, if necessary, that insects have three pairs of legs. Tell students that isopods are classified in the order Isopoda. They are a kind of crustacean and are related to shrimp, crabs, and lobsters. Tell the class that they will be setting up an experiment to see what type of food isopods prefer to eat.

2. Set-up

Divide the class into groups of 4 to 5 students. Give each group a shoe box, the meat, the piece of potato, the piece of apple, the grass clippings, and a Student Activity Sheet. Tell the groups to place each of the four foods into a different corner of the box. Next, hand out the isopods and have students place them in the center of the shoe box. To keep the isopods from escaping, have students put the lid on the box.



3. Observations

Explain to students that they will be making observations of the isopods every five minutes for the next 45 minutes. Each time, they should record their observations on the Student Activity Sheet. Remind students to replace the box lid after each observation.

Tell the class you will be announcing the time of each observation. Between observations, you may want students to be occupied with another activity that can be easily interrupted. One option is to have students take a closer look at an isopod's features with a hand lens. They can also experiment to see what the isopod does when it is gently disturbed.

4. Interpreting the data

When the observations are complete, collect the isopods, and have students throw the food in the trash can. The isopods can be released into a moist area outside later.

Ask students if they were able to figure out what the isopod's favorite food was. Did the isopods eat more than one type of food? Was there a food that none of the isopods chose? Based on their observations, what type of **feeding habit** do isopods have? Are isopods **herbivores** (plant-eaters), **carnivores** (meat-eaters), or **omnivores** (eat both plants and animals)?

Questions to Ask During the Activity

1. What is the **variable** in this experiment? (The food types.)

2. Did all the isopods prefer the same food type? (Probably not. Individual isopods have different food preferences.)

3. If the isopods were given a different type of meat, a banana, bread, and leaves, what do you think they would choose to eat? (Isopods are not choosy, they may eat a little bit of everything.)

Preguntas sobre el tema de la actividad

1. ¿Cuál es la **variable** en el experimento? (Los distintos tipos de alimentos.)

2. ¿Prefirieron la misma comida todos los isópodos? (Probablemente no. Cada uno de los isópodos tiene diferentes preferencias alimenticias.)

3. Si les dieras a los isópodos distintos tipos de carne, banana, pan y hojas, ¿qué crees que elegirían? (Los isópodos no son exigentes, es posible que coman un poco de todo.)

Why It Happens/More on the Topic

Isopods are a type of crustacean classified in the same order as shrimp, crabs, and lobsters—the order Isopoda. There are many different isopod species around the world. Unlike shrimp, crabs, and lobsters, isopods live on the land instead of in the water. They are also one of the few land animals that breathe with gills. When isopods feel threatened, they roll up in a tight ball to protect themselves.

Because isopods have difficulty retaining water, they prefer to live in moist, humid environments. They are often found underneath logs, leaves, or rocks where the soil is moist. Generally, isopods are more active at night.

Isopods can be kept in a classroom terrarium if they have a potato slice, a moist paper towel, and a hiding place.

Algo más sobre el tema...

Los isópodos son un tipo de crustáceos clasificados en la misma orden que los camarones, los cangrejos y las langostas, la orden de los Isopoda. Hay muchas especies distintas de isópodos en el mundo. A diferencia de los camarones, cangrejos y langostas, los isópodos viven en la tierra en vez de en el agua. Además, son unos de los pocos animales de tierra que respiran por las branquias. Cuando los isópodos se sienten amenazados, se hacen una bolita para protegerse.

Los isópodos tienen dificultad para retener agua, prefieren vivir en lugares húmedos o mojados. A menudo se encuentran debajo de troncos, de hojas o de rocas donde el suelo es húmedo. En general, los isópodos son más activos durante la noche.

Los isópodos pueden vivir en el terrario de la clase siempre que tengan una rodaja de papa, una toalla de papel húmeda y un lugar donde esconderse.

Modifications

Each group can use a different set of food items to test isopod preferences. Try fruit, bread, rice, cheese, different leaves, etc.

Extensions

Have all the groups pool their data, then create bar graphs showing the number of isopods at each type of food over time. Older students can use the same data to calculate the percentage of the isopods that preferred each food type.

References

Burnett, Robin. The Pillbug Project: A Guide to Investigation. Washington, DC: National Science Teachers Association, 1992.

STUDENT ACTIVITY SHEET
Isopod Feeding Habits

Write the number of isopods closest to each food type below:

Time	Meat	Potato	Apple	Grass Clippings
5 minutes				
10 minutes				
15 minutes				
20 minutes				
25 minutes				
30 minutes				
35 minutes				
40 minutes				
45 minutes				

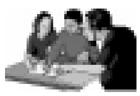
ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
Hábitos alimenticios de los isópodos

Escribe el número de isópodos que se encuentran más cerca de cada tipo de alimento.

Tiempo transcurrido	Carne	Papa	Manzana	Hebras de grama
5 minutos				
10 minutos				
15 minutos				
20 minutos				
25 minutos				
30 minutos				
35 minutos				
40 minutos				
45 minutos				

CAMOUFLAGE

Camuflaje

Grades		
K–2	*Whole Class*	*45 minutes*

Purpose

Students will play a game to show how animals that are camouflaged are less likely to be "eaten."

Materials

30 green twist ties or 15 green pipe cleaners cut in half
30 pieces of string or yarn (a few inches long, any color but green)
30 beige rubber bands
Books with pictures of camouflaged animals (especially invertebrates)

Concepts

- Camouflage is an adaptation that allows animals to blend into their surroundings.
- An animal that eats other animals is a predator.
- Animals that are camouflaged are less likely to be found and eaten by predators.
- Many invertebrates are camouflaged.

Conceptos

- El camuflaje es una adaptación que permite que los animales se confundan con el medio ambiente.
- Un animal que come a otro se llama predador.
- Los animales que pueden camuflarse tienen menos posibilidades de que un predador los encuentre y los coma.
- Muchos invertebrados pueden camuflarse.

Vocabulary

Camouflage
Predator
Prey
Invertebrate

Vocabulario

Camuflaje
Predador
Presa
Invertebrado

In Advance

Select a small, grassy site outdoors or a barren desert-type area with little vegetation. Cut yarn and gather materials.

Procedure

1. *Set up game*

Take students outside to the area you selected and have them line up along one edge. Define the words **predator** and **prey** and tell students that they will pretend to be predators looking for prey in the selected area (e.g, grassy area or sandy area).

Take out the twist ties, yarn, and rubber bands and tell students these items are the "prey" they will be hunting for. Explain that they will be hunting one at a time and they will be picking up one prey item during their turn. Spread the items throughout the selected area while students wait. (It's OK if students watch you spread the items.)

2. *Play the game*

Call on students one at a time to run into the selected area and "catch" a prey item. They should not spend too much time looking, but should pick an item quickly. The other students can cheer the predator on as he/she searches for prey. Each child should keep his/her prey item for the time being.

If you have time, each student can have a second turn. Pick up the remaining prey items when you are finished.

3. *Return to the classroom and count the prey*

Bring the students back into the classroom with their prey items. Ask students to raise their hands if they "caught" a twist tie. Write the total number on the chalkboard. Repeat with the yarn and rubber bands. Collect the twist ties, yarn, and rubber bands when they are all counted.

4. *Discuss*

Ask students which prey item was the most difficult to find in the selected area. Was it the same item that was picked up the least during the game? Students should begin to realize that in a grassy area the green twist ties match the green grass and in a sandy or barren area the beige rubber bands match the surrounding area, which make them difficult to spot. Tell students when an animal matches its surroundings, it is called **camouflage**. Animals use camouflage to hide from danger, especially predators.

Animals that are able to avoid predators live longer. Some predators are also camouflaged. It helps them to avoid detection while they sneak up on their prey.

5. Show pictures

Using picture books, show students pictures of animals that use camouflage to protect themselves. Tell students that many invertebrates are camouflaged, such as the walking stick insect, moths, and butterflies. If possible, show them pictures of invertebrates that match their surroundings. Can they think of any other examples of camouflage?

Questions to Ask During the Activity

1. In what ways can an animal be camouflaged? (Color, pattern, and body shape.)

2. If camouflage helps an animal hide from predators, why are some animals brightly colored animals? (Some animals are brightly colored as a warning to predators that they are toxic to eat. Sometimes an animal's colors help to attract a mate. In some cases, an animal already has another feature that protects it from predators, like a hard shell or spines.)

Preguntas sobre el tema de la actividad

1. ¿De qué manera puede camuflarse un animal? (Color, diseño y forma del cuerpo)

2. ¿Si el camuflaje ayuda a los animales a esconderse de sus predadores, ¿por qué hay algunos animales que tienen colores fuertes y brillantes? (Algunos animales tienen colores brillantes como una manera de advertir a los predadores de que son tóxicos y no deben comerlos. A veces los colores brillantes sirven para atraer a un consorte. En algunos casos, un animal ya tiene algo para protegerse de los predadores, por ejemplo un caparazón o espinas.)

Why It Happens/More on the Topic

Camouflage is an adaptation that helps an animal avoid detection. Animals can be camouflaged by matching the color of their surroundings (a green frog in green grass), or by matching the pattern of their surroundings (a speckled moth on speckled tree bark), or by matching the shape of something in their surroundings (a walking stick is shaped like the stems of a plant).

Algo más sobre el tema...

El camuflaje es una adaptación que ayuda a que los animales no sean detectados. Los animales pueden camuflarse cambiando de color para amalgamarse con el medio ambiente (una rana verde en pasto verde) o mimetizando el diseño del medio (una polilla moteada sobre la corteza de un árbol con manchas) o tratando de confundirse con la forma de algo que se encuentra en los alrededores (el insecto palo tiene la forma del tallo de una planta).

Modifications

The game can be modified for play on other surfaces. On asphalt, use dark grey yarn.

Extensions

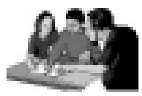
Have each student bring in a picture of a wild animal from a magazine or book, then draw a picture of a place where that animal would be camouflaged.

References

Bosak, Susan V. Science Is...A Source Book of Fascinating Facts, Projects, and Activities. Markham, Ontario, Canada: Scholastic Canada, 1991.

THE SPONGE: AN UNUSUAL INVERTEBRATE

La esponja: un invertebrado inusual

Grades		
4–8	3–4	45 minutes

Purpose

Students will look at the internal structure of natural and synthetic sponges, then measure the water-holding capacity of each.

Materials

For each group:

- Pieces of natural and synthetic sponges (available in grocery stores, pharmacies, home improvement stores, and biological supply companies)
- Balance or kitchen scale
- Beaker or water container
- Water
- Hand lens
- Microscope (optional)
- Pictures of live sponges

For each individual:

- Student Activity Sheet

Concepts

- Natural sponges are invertebrate animals that live in the water.
- Natural sponges feed by filtering food out of the water that passes through their bodies.
- Synthetic sponges are designed to mimic the water-holding capacity of natural sponges.

Conceptos

- La esponja natural es un animal invertebrado que vive en el agua.
- La esponja se alimenta filtrando los alimentos del agua que pasan a través de sus cuerpos.
- La esponja sintética está diseñada para mimetizar la capacidad de absorción de agua que tiene la esponja natural.

Vocabulary

Invertebrate
Nutrients
Endoskeleton
Sponges

Vocabulario

Invertebrado
Nutriente
Endoesqueleto
Esponja

In Advance

Cut up pieces of both kinds of sponges. Copy the Student Activity Sheet.

Procedure

1. *Introduce activity*

Begin by asking students if they know whether a natural sponge is an animal, plant, or a non-living organism. If they guess it's an animal, can they guess how it is classified and why? Sponges are **invertebrates**, but it's not clear they are even living organisms until they are seen up close.

2. *Observe the sponges*

Divide the class into groups of 3 or 4 students. Give each group a piece of the natural sponge, a piece of the synthetic sponge, and a hand lens (or microscope if available). Also give each individual a copy of the Student Activity Sheet.

Instruct the students to look at the natural sponge and the synthetic sponge with the hand lenses or microscopes. They should draw their observations on the Student Activity Sheet. Also tell them to write a description of the differences they notice between the two types of sponges. Ask if they can predict which kind of sponge will hold more water.

3. *Measure and calculate the water-holding capacity of the sponges*

Give each group a balance or kitchen scale and a beaker with water. Tell students they will be weighing their sponges with and without water to see how much water each type of sponge can hold. Because the two sponges are not exactly the same size, they will need to do some calculations after the sponges are weighed.

Have students use the balance or kitchen scale to weigh each dry sponge. Be sure they write the weight (mass) of the dry sponges on the Student Activity Sheet. Next, students should soak each sponge in the beaker of water, weigh them, and write the weight (mass) on the Student Activity Sheet.

Using the information on the Student Activity Sheet, have students calculate the water-holding capacity of each type of sponge.

4. Compare and discuss

When all the groups have finished their calculations, discuss the results as a class. Were all the water-holding capacities the same? Why or why not? Why is water-holding capacity important for a natural sponge?

Questions to Ask During the Activity

1. What is the function of the sponge's "skeleton"? (The skeleton, in addition to the surrounding water, helps to support the sponge.)

2. How do sponges get **nutrients**? (Nutrients are filtered from the water as they pass by special cells within the sponge's body.)

3. How do cell wastes leave the sponge? (They are released into the water that is filtered through the sponge.)

4. Why is water-holding capacity important for a natural sponge? (The more water a sponge can filter, the more nutrients the sponge will pick up.)

5. Is the natural sponge you are using today still alive? (No, what you are looking at is the skeleton of a once-living sponge.)

6. Why do most people use synthetic sponges instead of natural sponges? (Since a natural sponge is part of an animal, there is a limited supply of natural sponges. Also, synthetic sponges are usually less expensive.)

Preguntas sobre el tema de la actividad

1. ¿Cuál es la función del "esqueleto" de la esponja? (El esqueleto junto con el agua que la rodea ayuda a sostener el cuerpo de la esponja.)

2. ¿Cómo recibe la esponja los nutrientes? (Los nutrientes del agua se filtran al pasar por unas células especiales que se encuentran dentro del cuerpo de la esponja.)

3. ¿Cómo se desprende la esponja de los excrementos? (Se liberan en el agua que se filtra a través de la esponja.)

Preguntas (continuación)

4. ¿Por qué es importante para la esponja natural tener mucha capacidad para absorber agua? (Cuanta más agua puede filtrar la esponja, más nutrientes podrá juntar.)

5. ¿Está viva todavía la esponja natural que estás usando hoy? (No, lo que ves es el esqueleto de una esponja natural que alguna vez estuvo viva.)

6. ¿Por qué la mayoría de la gente usa esponjas sintéticas en vez de naturales? (Como la esponja natural es parte de un animal, la oferta es limitada. Además, generalmente las esponjas sintéticas son mucho más baratas.)

Why It Happens/More on the Topic

Natural sponges are invertebrate animals that live in the water. Most sponges stay in one place, attached to a solid surface. They feed by straining food out of the water as it passes through their bodies. The water-holding capacity of a sponge is a measure of how much water the sponge could filter while it was alive.

Natural sponges have an internal skeleton, called an **endoskeleton**, that helps to support their body. The skeleton of many sponges is made of a fibrous protein called **spongin**. Some sponges have endoskeletons made of calcium carbonate or silicon. After the sponge dies, the skeleton remains. It is the skeleton we use.

Algo más sobre el tema...

La esponja natural es un animal invertebrado que vive en el agua. La mayoría de las esponjas se quedan en un lugar adheridas a una superficie sólida. Se alimentan filtrando los alimentos del agua que pasa a través de sus cuerpos. La capacidad de la esponja para absorber agua es una forma de medir cuanta agua podía filtrar esa esponja mientras estaba viva.

La esponja natural tiene un esqueleto interno, llamado **endoesqueleto**, que la ayuda a sostener su cuerpo. El esqueleto de muchas de las esponjas está formado por una proteína fibrosa llamada **espongina**. Otras esponjas tienen esqueletos formados por carbonato de calcio o por dióxido de cilicio. Después de que la esponja muere, queda el esqueleto. El esqueleto es la parte que nosotros usamos.

Modifications

Show younger students an example of how to calculate the water-holding capacity before they calculate their own.

Extensions

Have students research sponges. Where in the world are sponges found? How do the sponge's cells help it to filter water and get the nutrients the sponge needs? Why are sponges classified as an animal rather than a plant or fungi?

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First edition. Albuquerque, NM: 1996.

STUDENT ACTIVITY SHEET

Sponges

1. Look at the natural sponge and synthetic sponge under magnification, then draw what you see below:

Natural Sponge	Synthetic Sponge

2. Describe the differences between the two types of sponges.

3. Predict which sponge will hold more water.

4. Weigh both sponges when they are dry and when they are wet. (Weigh them dry first). Write the weights (mass) in the spaces below, then calculate the water-holding capacity of each sponge.

	Wet weight (mass)	Dry weight (mass)	Water-holding capacity = wet mass divided by dry mass
Natural sponge			
Synthetic sponge			

5. Which sponge holds more water? Why?

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

La esponja

1. Observa la esponja natural y la sintética bajo un lente de aumento y luego dibuja lo que ves en el espacio a continuación.

Esponja natural	**Esponja sintética**

2. Describe las diferencias entre los dos tipos de esponjas.

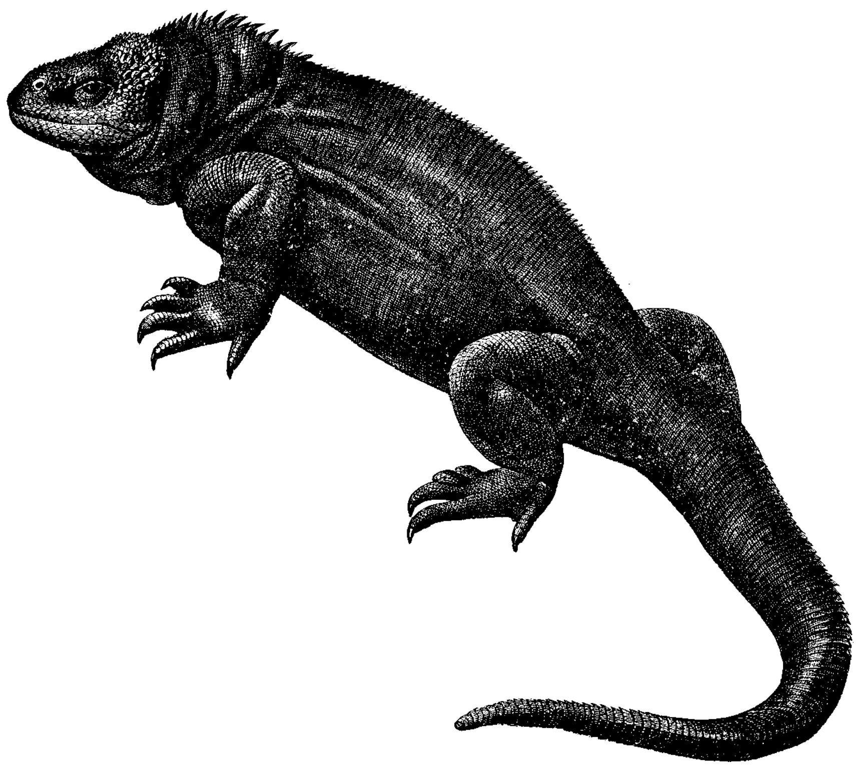
3. Predice cuál de las esponjas absorberá más agua.

4. Pesa ambas esponjas cuando están secas y luego cuando están mojadas. (Pésalas primero cuando están secas.) Escribe el peso de ambas (masa) en los espacios a continuación, luego calcula la capacidad para retener agua de cada esponja.

	Peso estando mojada (masa)	Peso estando seca (masa)	Capacidad de retención = masa mojada dividido por la masa seca
Esponja natural			
Esponja sintética			

5. ¿Cuál de las dos esponjas retiene más agua? ¿Por qué?

Introduction to
ANIMALS: VERTEBRATES



BACKGROUND INFORMATION—VERTEBRATES

Vertebrates are a relatively small group of organisms under the phylum Chordata (see chart below). Chordates were the first animals to have a central support column and nerve cord running along their back. In vertebrates, this characteristic is called a backbone.

The vertebrate backbone is part of a more extensive, internal skeleton. By comparison, invertebrates, such as insects, have an **exoskeleton** that helps to support their small size and weight. The weight of aquatic organisms is supported by the water. Larger animals that live on land need additional support, however. This support comes from the **endoskeleton** made of bones.

Classification of living chordates within the animal kingdom

Kingdom Animalia
- Phylum Cnideria (coral, anemones)
- Phylum Platyhelminthes (flatworms—includes planaria and tapeworms)
- Phylum Nematoda (roundworms—many are parasitic)
- Phylum Mollusca (snails, clams, squid)
- Phylum Annelida (segmented worms)
- Phylum Arthropoda (insects, spiders, crustaceans)
- Phylum Echinodermata (sea stars, starfish)
- **Phylum Chordata**
  - **Subphylum Vertebrata (vertebrates)**
    - **Class Chondrichthyes (cartilaginous fish)**
    - **Class Osteichthyes (bony fish)**
    - **Class Amphibia (amphibians)**
    - **Class Reptilia (reptiles)**
    - **Class Aves (birds)**
    - **Class Mammalia (mammals)**

About 500 million years ago, the ancestors of the subphylum Vertebrata began to evolve into fish, amphibians, reptiles, birds, and mammals. Each developed different characteristics as they adapted to their differing environments, but they all share some characteristics in common.

Vertebrate characteristics:

- Vertebrates have a definite head, well-developed backbone of vertebrae, and well-developed brain.

- Vertebrates have an internal support system called an **endoskeleton**. With an endoskeleton, an animal's support system can grow as the animal grows rather than needing to be shed like an insect's exoskeleton.

- Muscles are attached and anchored to the strong, supportive backbone. The muscles and bones work together as levers to create precise and efficient movements.

- Rather than traveling through a dispersed net of nerves found in most invertebrates, nerve "messages" in vertebrates are quickly shuttled up and down the central "highway" of the spinal cord to a brain.

- Vertebrates have complex circulatory systems. A vertebrate circulatory system includes a heart that pumps blood through blood vessels to all parts of the body. The blood picks up oxygen from the respiratory organs (lungs or gills) and the oxygen is carried to all the cells of the body. The cells use the oxygen to make energy from food. Carbon dioxide is formed as a waste product, then released into the blood where it is carried back to the respiratory organs and expelled. The chemical process of using oxygen to convert food into energy is called **respiration**.

- Vertebrates have complex digestive systems that include a mouth, stomach, and intestines. Each organ is specialized to efficiently break down food into nutrients that the cells need.

Major groups of vertebrates

Bony Fish

Bony fish belong to the scientific class *Osteichthyes* (pronounced "os-tee-ick-thees"), the largest class of vertebrates. Their bodies are highly adapted for the underwater environment they inhabit.

Bony fish have gills that collect dissolved oxygen from the water. By opening and closing their mouths, water moves over the gills and the blood collects the oxygen from the gills. The blood is then pumped throughout the body by a two-chambered heart. (Humans have a four-chambered heart). Most bony fish need water to breathe, although a few species of lungfish have simple lungs in addition to gills, which allows them to breathe air out of the water.

The digestive system of a fish is made up of a mouth, stomach, and intestines. Food is broken down into its simpler components in the stomach and intestines.

Bony fish have a special organ, called a **swim bladder**, which allows them to control their depth underwater without expending a lot of energy. The swim bladder, located just beneath the backbone, can collect or expel gas taken from the blood vessels. When the swim bladder is filled with gas, the fish will be more buoyant and rise higher in the water. If there is less gas in the swim bladder, the fish will be less buoyant and sink lower in the water.

Cartilaginous Fish

The *Chondrichthyes* (pronounced "con-dri-ick-thees") class includes sharks, skates, rays, and sawfishes. Members of the *Chondrichthyes* class have skeletons made entirely of cartilage and they also lack the well-developed ribs of most other vertebrates. Unlike the scaled skin of bony fish, cartilaginous fish have tiny, sharp teeth that cover their skin, making their skin rough enough to use as sandpaper.

Another big difference between bony fish and cartilaginous fish is how they float. While bony fish use a swim bladder, cartilaginous fish rely on oil in their liver to help them float. This system is less efficient and cartilaginous fish need to constantly swim to avoid sinking. Cartilaginous fish also have an unusual ability to find prey. They are able to detect the electricity emitted by other animals.

Amphibians

The class *Amphibia* contains frogs, toads, salamanders, and newts. Amphibians evolved from ancient fish. In the fossil record, there is evidence that relatives of the lungfish existed just prior to the evolution of amphibians. It is hypothesized that as the climate changed from wet to dry, lakes dried up and the ancestors of the lungfish would have been able to survive by using their lungs to breathe air. Over hundreds of thousands of years, some of the lungfish evolved into the amphibians we know today.

Amphibians have lungs and breathe air when on land, but they can also "breathe" oxygen through their skin through **diffusion**. They have relatively thin, moist skin with many blood vessels just under the surface. The pores in the skin allow some chemicals, like oxygen, to pass through while keeping other chemicals out. Thus, an amphibian's skin is a **semi-permeable membrane**.

Because of their thin skin, frogs, salamanders, and newts lose a lot of water to evaporation. They must stay in moist environments to survive. Toads, on the other hand, generally have thicker, drier skin and can live in slightly drier areas. Some amphibians, like the Southwest's spade foot toad, simply avoid the driest seasons by burrowing underground and "sleeping" (torpor). They emerge to breed and reproduce when the summer monsoon rains begin. The new offspring develop quickly, and then burrow underground until the following year.

Female amphibians lay their eggs in the water, where they are fertilized by sperm from the male. The eggs need to stay moist because they are unable to conserve water. In frogs, the eggs hatch into tadpoles that look like small fish. The tadpoles use gills to obtain oxygen from the water. As they begin to reach maturity, frogs develop legs and lungs and their tail disappears. Finally, they are able to breathe air and move on land. This change, or **metamorphosis,** is a gradual process and the length of time varies between species. For example, the metamorphosis of a spade foot toad can take only 2 weeks, while it can take 10-14 months for a bullfrog!

Reptiles

The class *Reptilia* includes turtles, lizards, snakes, alligators, and crocodiles. Unlike amphibians, reptiles do not need to live near water. Reptiles live in a variety of environments, from moist and cool to dry and hot.

Reptile eggs have a leathery shell that protects the developing embryo from water loss while still allowing oxygen into the egg. The eggs are usually laid in a place where they are protected from excess heat, such as sand, leaves, or rotting logs. Not all reptiles lay eggs. Some lizards and snakes keep the eggs inside the female's body until they "hatch" and are born "live."

Unlike amphibians, reptiles have thick, leathery skin that helps to prevent water loss. But, their skin also keeps oxygen from passing through easily. Instead of breathing with gills or through diffusion, reptiles breathe with lungs.

Reptiles are **ectothermic**, meaning they regulate their body temperature based on the external environment. They rely on the sun's heat to warm them to a temperature where they can function. Because water doesn't evaporate from their skin easily, they can afford to bask in the sun for long periods of time without becoming dehydrated.

Birds

Birds belong to the scientific class *Aves*. They appear to be the first vertebrates able to maintain a constant internal body temperature (**endothermic**) regardless of the air temperature. This quality allows them to live in a broad range of climates.

Birds evolved from reptiles, and are considered to be the living descendants of the dinosaurs. Birds have reptile-like scales on their feet and bird feathers are made of the same material as reptile scales. The eggs produced by both groups are also similar in structure and composition.

Birds have a number of adaptations that make them efficient flyers. Wings and streamlined bodies enable them to pass through the air smoothly. Feathers are a lightweight way to stay warm and help the bird maneuver through the air. Large chest muscles give birds the strength to fly and to control their wings. Lightweight bones and no teeth also are weight-saving adaptations. Rather then carrying young until they are born, eggs can be left in a nest. Even the respiratory and circulatory systems of a bird are designed so energy is not wasted.

Mammals

Mammals (class *Mammalia)* are probably the most familiar groups of animals to most people. Mammals are endothermic, have hair, and have complex circulatory and respiratory systems. Female mammals also have a special organ, called a **placenta,** that houses the developing young and **mammary glands** that produce milk for the young once they are born.

Hair helps to insulate a mammal's body. Even mammals that appear hairless, such as elephants, whales, and armadillos, have some sparse hair. Many mammals are born with virtually no hair and grow more as they mature.

Relative to fish, amphibians, reptiles, and birds, mammals invest a great deal of energy to ensure that their young survive. Most mammals are live-bearing, although the duck-billed platypus and two related species still lay eggs. In pouched mammals, like the kangaroo, the young are born very early and develop in the pouch, where they suckle milk. In the placental mammals, like humans, most development takes place in the placenta, and milk is produced after birth to feed the young.

Unlike the lightweight bones of birds, mammal bones are denser and made for high-impact activities of running and jumping on land. Mammals also have efficient and diversified teeth that begin to break down food before it is swallowed. This helps make their digestion more efficient. Teeth vary in shape depending on what the animal eats. Herbivores, like deer and moose, have wide, flat teeth that can grind vegetation. Carnivores, like wolves and tigers, have very sharp teeth that help tear and cut the meat they eat. Omnivores, like humans and bears, have some of both kinds of teeth so they can eat both vegetables and meat.

INFORMACIÓN BÁSICA—LOS VERTEBRADOS

Los vertebrados forman parte de un pequeño grupo de organismos dentro de la categoría de los filo *Chordata* (más información en el cuadro que sigue). Los cordados fueron los primeros animales que desarrollaron una columna central de sostén y un cordón nervioso dorsal. Esta característica de los vertebrados se llama columna vertebral.

La columna vertebral de los vertebrados forma parte de un esqueleto interno más amplio. A diferencia de los vertebrados, los invertebrados tales como los insectos tienen un **exoesqueleto** para ayudar a sostener sus cuerpos pequeños y livianos. El agua sostiene el peso de los organismos acuáticos. Pero, los animales de mayor tamaño que viven en tierra seca necesitan más sostén. El **endoesqueleto,** que está compuesto por huesos, proporciona este sostén.

Clasificación de los cordados vivientes del reino animal

Reino Animalia
- Filum Cnidaria (coral, anémonas de mar)
- Filum Platyhelminthes (gusanos planos – incluye planarias y tenias)
- Filum Nematoda (ascárides – muchos de ellos parásitos)
- Filum Mollusca (babosas, almejas, calamares)
- Filum Annelida (gusanos segmentados)
- Filum Arthropoda (insectos, arañas, crustáceos)
- Filum Echinodermata (estrellas de mar, erizos de mar)
- **Filo Chordata**
  - **Subfilum Vertebrata (vertebrados)**
    - **Clase Chondrichthyes (peces cartilaginosos)**
    - **Clase Osteichthyes (peces óseos)**
    - **Clase Amphibia (anfibios)**
    - **Clase Reptilia (reptiles)**
    - **Clase Aves (aves)**
    - **Clase Mammalia (mamíferos)**

Hace 500 millones de años, los antepasados de los subfilum Vertebrata comenzaron a evolucionar hasta transformarse en anfibios, reptiles, aves y mamíferos. Cada uno de ellos desarrolló características diferentes que les permitieron adaptarse a los distintos medio ambientes, pero aún así todos ellos comparten características comunes.

Características de los vertebrados:

- Los vertebrados tienen una cabeza bien definida, una columna vertebral bien desarrollada y también un cerebro bien desarrollado.

- Los vertebrados tienen un sistema de sostén interno llamado **endoesqueleto**. Al tener un endoesqueleto, el sistema de sostén del animal crece al mismo tiempo que crece el resto del animal, con lo cual evita tener que cambiarlo como sucede con el dermatoesqueleto de los insectos.

- Los músculos están ligados y adheridos a una columna vertebral fuerte que le sirve de sostén. Los músculos y los huesos actúan en conjunto para crear movimientos precisos y eficaces haciendo uso de un sistema de palancas.

- En vez de viajar a través de una red dispersa de nervios como sucede con la mayoría de los invertebrados, en los vertebrados, los "mensajes" del sistema nervioso corren rápidamente por la "autopista central" hacia arriba y hacia abajo por la médula espinal hasta el cerebro.

- Los vertebrados tienen un sistema circulatorio complejo. Este sistema circulatorio está compuesto de un corazón que bombea sangre a todas las partes del cuerpo a través de los vasos sanguíneos. La sangre absorbe el oxígeno de los órganos respiratorios (pulmones o branquias) y transporta el oxígeno a todas las células del cuerpo. Las células usan el oxígeno para transformar a los alimentos en energía. El desecho que resulta de este proceso es dióxido de carbono, el cual se libera en la sangre y fluye de vuelta a los órganos respiratorios y desde allí se exhala. El proceso químico de usar oxígeno para convertir los alimentos en energía se llama **respiración**.

- Los vertebrados tienen un sistema digestivo complejo que incluye boca, estómago e intestinos. Este sistema se especializa en degradar químicamente los alimentos para convertirlos en el tipo de nutrientes que necesitan las células.

Grupos principales de vertebrados

Peces óseos

Los peces óseos pertenecen a la clase científica de los *Osteichthyes*, la clase más numerosa de vertebrados. El cuerpo del pez óseo está muy bien adaptado al medio ambiente en que habitan, debajo del agua.

El pez óseo tiene branquias, donde acumula el oxígeno que absorbe el agua. Al abrir y cerrar la boca, el agua se mueve por encima de las branquias y la sangre acumula el oxígeno que éstas han absorbido. Un corazón compuesto con dos cámaras bombea la sangre a todo el cuerpo. (Los seres humanos tienen un corazón con cuatro cámaras.) La mayoría de los peces óseos necesita estar en el agua para respirar, aunque unas pocas especies de peces pulmonados tienen pulmones simples además de las branquias, lo cual les permite respirar fuera del agua.

El sistema digestivo del pez está compuesto por la boca, el estómago y los intestinos. Los alimentos se degradan transformándose en componentes simples en el estómago y en los intestinos.

Los peces óseos tienen un órgano especial llamado **vejiga natatoria**, que les permite controlar la profundidad a la cual desean ubicarse en el agua sin consumir demasiada energía. La vejiga natatoria, ubicada exactamente debajo de la columna vertebral, les permite acumular o expulsar el gas de los vasos sanguíneos. Cuando la vejiga natatoria se llena de gas, el pez se siente con más fuerza para ascender en el agua. Si hay menos gas en la vejiga natatoria, el pez se siente menos vigoroso y se desplaza hacia abajo en el agua.

Peces Cartilaginosos

La clase de los *Chondrichthyes* incluye tiburones, rayas, mantas y peces sierra. Los miembros de la clase de los *Chondrichthyes* tienen esqueletos formados totalmente por cartílago y no tienen costillas bien desarrolladas como la mayoría de los vertebrados. A diferencia de la piel escamosa de los peces, la piel de los peces cartilaginosos está recubierta por unos dientes diminutos y afilados y es tan áspera que podría usarse como papel de lija.

Otra gran diferencia entre los peces cartilaginosos y los óseos es la manera en que flotan. Mientras que los peces óseos usan la vejiga natatoria, los peces cartilaginosos dependen de un cierto aceite que tienen en el hígado que los ayuda a flotar. Este sistema es menos eficiente y los peces cartilaginosos necesitan nadar constantemente para evitar hundirse. Además, los peces cartilaginosos tienen una habilidad inusual para encontrar a sus presas. Pueden detectar la electricidad que emiten otros animales.

Anfibios

La clase de los *Amphibia* está compuesta por ranas, sapos, salamandras y tritones. Los anfibios evolucionaron de un pez de tiempos ancestrales. De acuerdo a información aportada por fósiles, se sabe que existían parientes del pez pulmonado poco antes de que comenzaran a evolucionar los anfibios. Una de la hipótesis es que el clima cambió de húmedo a seco, se secaron los lagos y los antepasados del pez pulmonado pudieron haber sobrevivido usando los pulmones para respirar aire. Hace cientos de miles de años, algunos de los peces pulmonados evolucionaron hasta convertirse en los anfibios que conocemos en la actualidad.

Los anfibios tienen pulmones y respiran cuando están en tierra seca, pero también pueden "respirar" oxígeno a través de la piel mediante un proceso llamado **difusión**. La piel es relativamente delgada, húmeda y tiene muchos vasos sanguíneos cerca de la superficie. Los poros de la piel permiten que algunas sustancias químicas, como el oxígeno, la atraviesen, pero evitan la salida de otras sustancias. La piel de los anfibios es una **membrana semipermeable.**

La piel de las ranas, de las salamandras y de los tritones es delgada, lo cual permite que se evapore una gran cantidad de agua. Para sobrevivir deben estar en un ambiente húmedo. Los sapos, por otro lado, generalmente tienen piel más gruesa, más seca y pueden vivir en lugares un poco menos húmedos. Algunos anfibios, tales como el sapo espolonado americano sobrevive los períodos de sequía enterrado en el suelo y "durmiendo" (latencia). Cuando comienzan las lluvias que vienen con los vientos monzones, salen para procrear y reproducirse. Las crías se desarrollan rápidamente y se entierran hasta el año siguiente.

Los anfibios hembra ponen los huevos en el agua, donde el esperma del macho los fertiliza. Los huevos necesitan estar en un medio húmedo porque no tienen la capacidad de conservar agua. En las ranas, los huevos se transforman en renacuajos que parecen pequeños peces. Los renacuajos usan sus branquias para absorber el oxígeno del agua. Cuando están por llegar al estado de madurez, las ranas desarrollan pulmones y las colas desaparecen. Finalmente, pueden respirar aire y moverse en tierra seca. Este cambio, o **metamorfosis,** es un proceso gradual y el tiempo que tarda varía de acuerdo a las especies. Por ejemplo, la metamorfosis del sapo espolonado americano puede durar sólo dos semanas mientras que el de una rana bramadora puede tomar ¡de 10 a 14 meses!

Reptiles

La clase de los *Reptilia* incluye tortugas, lagartijas, serpientes, lagartos y cocodrilos. A diferencia de los anfibios, los reptiles no necesitan vivir cerca del agua. Los reptiles habitan en una variedad de medio ambientes, desde húmedos y fríos hasta calientes y secos.

Los huevos de reptiles tienen una cubierta dura y flexible que evita que el embrión en desarrollo se seque y al mismo tiempo permite la entrada de oxígeno dentro del huevo. Los huevos se depositan en lugares protegidos del exceso de calor, tales como la arena, entre las hojas o en medio de troncos en descomposición. No todos los reptiles ponen huevos. Algunos lagartos y algunas serpientes conservan los huevos dentro del cuerpo de la hembra hasta que están listos para nacer y salen "vivos" del cuerpo de la madre.

A diferencia de los anfibios, los reptiles tienen piel gruesa, dura y flexible que los ayuda a evitar la pérdida de agua. Pero la piel también evita que el oxígeno pase con facilidad. En vez de respirar a través de branquias o por difusión, los reptiles respiran a través de pulmones.

Los reptiles son **ectotérmicos**, lo que significa que regulan la temperatura del cuerpo de acuerdo al ambiente exterior. Cuentan con el calor del sol para entibiar sus cuerpos hasta llegar a una temperatura que les permita funcionar. Como el agua no se evapora fácilmente a través de la piel, pueden asolearse por periodos prolongados sin deshidratarse.

Aves

Los pájaros pertenecen a la clase científica de las *Aves*. Parecen haber sido los primeros vertebrados capaces de mantener una temperatura interna del cuerpo constante (**endotérmicos**) independientemente de la temperatura del aire. Esta característica les permite vivir en climas variados.

Los pájaros evolucionaron de los reptiles y se los considera los actuales descendientes de los dinosaurios. Las escamas en las patas de las aves son parecidas a las de los reptiles y las plumas están compuestas por el mismo material que las escamas de los reptiles. Los huevos que producen ambos grupos tienen una estructura y una composición similares.

Las aves han sufrido un gran número de adaptaciones hasta llegar a volar eficazmente. Las alas y los cuerpos aerodinámicos les permite atravesar el aire suavemente. Las plumas les permiten mantener el calor sin agregar demasiado peso y los ayuda a maniobrar en el aire. Los grandes músculos pectorales les dan fuerza para poder volar y para controlar las alas. Los huesos son livianos y la ausencia de dientes es otra adaptación para ahorrar peso. En vez de transportar a las crías en desarrollo hasta que nacen, pueden depositar los huevos en el nido. Aún los sistemas circulatorio y respiratorio de las aves están diseñados para ahorrar energía.

Mamíferos

Los mamíferos (clase *Mammalia)* probablemente constituyen el grupo de animales más conocido para la mayoría de las personas. Los mamíferos son endotérmicos, tienen pelo y un sistema circulatorio y respiratorio complejos. Las hembras tienen un órgano especial llamado **placenta,** dentro del cual se desarrolla la cría y **glándulas mamarias** que producen leche para el recién nacido.

El pelo ayuda a aislar el cuerpo del mamífero. Aún cuando algunos mamíferos parecen no tener pelos, tales como los elefantes, las ballenas y los armadillos, en realidad lo tienen, aunque en poca cantidad. Muchos mamíferos nacen casi sin pelo y éste crece cuando maduran.

A diferencia de los peces, anfibios, reptiles y aves, los mamíferos invierten una gran cantidad de energía para asegurarse que sus crías sobrevivan. La mayoría de los mamíferos dan a luz crías vivas, aunque el ornitorrinco y otras dos especies de la misma familia aún ponen huevos. El nacimiento de los mamíferos que tienen una bolsa, tales como los canguros, ocurre muy temprano y las crías se terminan de desarrollar en la bolsa mientras se amamantan. En el caso de mamíferos con placenta, como los seres humanos, la mayor parte del desarrollo ocurre en la placenta y la producción de leche para amamantar al crío comienza después del nacimiento.

Al comparar los huesos livianos de las aves con los huesos de los mamíferos encontramos que estos últimos son más densos y sirven para actividades de alto impacto, tales como correr y saltar en tierra seca. Los mamíferos también tienen dientes diversificados y eficaces que pueden empezar a triturar los alimentos antes de que sean tragados. Esto ayuda a que la digestión sea más eficiente. Los dientes tienen distintas formas, de acuerdo con lo que come el animal. Los herbívoros, tales como los ciervos y los alces, tienen dientes anchos y planos que los ayudan a triturar la vegetación. Los carnívoros, por ejemplo los lobos y los tigres, tienen dientes afilados que los ayudan a desgarrar y a cortar la carne que comen. Los omnívoros, tales como los seres humanos y los osos, tienen ambos tipos de dientes para poder comer vegetales y carnes.

THE SIX VERTEBRATE GROUPS

Los seis grupos de vertebrados

Grades		
2–6	Whole Class	45 minutes

Purpose

Students will be able to identify the characteristics of animals from the six vertebrate groups.

Materials

6 sheets of flip chart paper or other large paper
Markers
Tape
Vertebrate Characteristics Cards
Vertebrate Characteristics Key

Concepts

- All vertebrates have a backbone and an internal support system (an endoskeleton).
- Vertebrates have a centralized nervous system, and complex circulatory and digestive systems.
- Vertebrates are organized into six classes of animals: bony fish, cartilaginous fish, amphibians, reptiles, birds, and mammals.
- Each vertebrate class has characteristics that distinguish them from other vertebrate classes.

Conceptos

- Todos los vertebrados tienen una columna vertebral y un sistema interno de sostén del organismo (el endoesqueleto).
- Los vertebrados tienen un sistema nervioso central y un sistema circulatorio y digestivo complejos.
- Los vertebrados están organizados en seis clases de animales: peces óseos, peces cartilaginosos, anfibios, reptiles, aves y mamíferos.
- Cada clase de vertebrados tiene características particulares que la diferencian de las otras clases de vertebrados.

Vocabulary

Vertebrate
Endoskeleton
Exoskeleton
Cartilage
Nervous system
Circulatory system
Digestive system

Vocabulario

Vertebrados
Endoesqueleto
Exoesqueleto
Cartílago
Sistema nervioso
Sistema circulatorio
Sistema digestivo

In Advance

Copy and cut out the Vertebrate Characteristics Cards. On the top of each flip chart paper, write the name of one class of vertebrates with a marker. (Write the word “bird” on one piece of paper, the word “amphibian” on another piece of paper, and so on.)

Procedure

1. *Introduce the vertebrates*

Begin by asking students if they know what characteristic distinguishes **vertebrate** animals from invertebrate animals. The presence of a backbone is the biggest difference between the two groups, but vertebrate animals also have some other characteristics that differentiate them from invertebrates. Using the background information for this section, explain to students that in addition to a backbone, vertebrates have an **endoskeleton** rather than an **exoskeleton**, as well as more complex **nervous systems**, **circulatory systems**, and **digestive systems**.

Now, explain to students that the vertebrate group is separated into six classes of animals—bony fish, cartilaginous fish, amphibians, reptiles, birds, and mammals. Each has characteristics that are shared by other members of the class. Many of those characteristics are familiar. Some are surprising.

2. *Set-up*

Tell students that they will be learning more about the characteristics of the six vertebrate classes by playing a guessing game. Hang up the six flip chart papers on the walls of the classroom. Tear some pieces of tape and place them below each flip chart paper so students will be able to use them to hang their vertebrate characteristic cards.

Explain to the class that each person will be getting a card with a vertebrate characteristic written on it. When they receive their card, they need to decide which group of vertebrates has that characteristic and tape their card on the appropriate piece of flip chart paper. In some cases, more than one group may share the same characteristic.

3. Begin activity and review guesses

Hand each student a Vertebrate Characteristic Card and give them about 10 minutes to make their decision and tape their cards to the flip chart papers. Using the Vertebrate Characteristics Key at the end of this activity, review the students' guesses. Be sure to explain that some groups share a few characteristics but no two groups share all the same characteristics.

Questions to Ask During the Activity

1. What are some examples of animals from each group?

2. What group do humans belong to? (Humans are mammals.)

Preguntas sobre el tema de la actividad

1. ¿Puedes dar ejemplos de animales de cada uno de los grupos?

2. ¿A qué grupo pertenecen los seres humanos? (Los seres humanos son mamíferos.)

Why It Happens/More on the Topic

The following are some characteristics of the six vertebrate classes:

Bony fish:

Most bony fish have gills (a few have simple lungs) that collect oxygen from the water they live in. Most bony fish have a swim bladder located beneath the backbone. By filling and releasing gas in the swim bladder, the fish can control their depth in the water.

Cartilaginous fish:

Cartilaginous fish have skeletons made entirely of **cartilage**. Most cartilaginous fish also have gills. Rather than a swim bladder, cartilaginous fish have an oil in their liver that helps them float (but not as well as a swim bladder—cartilaginous fish need to swim constantly to avoid sinking.) Cartilaginous fish have tiny, sharp teeth covering their skin and an ability to detect the electricity emitted by their potential prey.

Amphibians:

Amphibians have lungs and breathe air on land. Some amphibians have gills and live underwater during part of their life cycle. Amphibians have thin skin and can also "breathe" oxygen through their skin. Most amphibians need to keep their skin moist and all of them return to an aquatic environment to reproduce. Eggs are laid in the water so they will not dry out.

Reptiles:

Reptiles do not need to stay moist or reproduce near water. Their thicker skin keeps water from evaporating rapidly from their skin. They do not "breathe" through their skin. Most reptiles lay their eggs on land, where a leathery covering keeps the eggs from drying out. Some reptiles keep the eggs inside until they "hatch."

Birds:

Birds have wings and are streamlined for flight. They have feathers that keep them warm and help them fly. Birds' bones are hollow and lightweight. They are able to maintain an internal body temperature (endothermic). They also have complex and efficient respiratory and circulatory systems.

Mammals:

Mammals have hair, specialized teeth, and most females have a placenta (an internal organ that houses the developing young) and produce milk to feed their young once they are born. Mammals also have complex respiratory, circulatory, and digestive systems. Mammals are endothermic like birds.

Algo más sobre el tema...

A continuación encontrarás algunas características de cada una de las seis clases de vertebrados:

Peces óseos:

La mayoría de los peces óseos tienen branquias (unos pocos tienen pulmones simples) con las cuales absorben oxígeno del agua en la que habitan La mayoría de los peces óseos tienen una vejiga natatoria, ubicada debajo de la columna vertebral. La vejiga natatoria es un órgano hidrostático que al liberar y absorber gas ayuda al pez a controlar el nivel de profundidad del agua en el cual desean ubicarse.

Algo más sobre el tema (continuación)

Peces Cartilaginosos:

El esqueleto del pez cartilaginoso está formado, en su totalidad, por **cartílago**. La mayoría de los peces cartilaginosos tienen branquias pero en vez de una vejiga natatoria, tienen un tipo de aceite en el hígado que les permite flotar (aunque no tan bien como con una vejiga natatoria, por eso los peces cartilaginosos necesitan nadar constantemente para evitar hundirse). Los peces cartilaginosos tienen dientes diminutos y afilados que recubren la piel y saben como detectar la electricidad que emiten las presas potenciales.

Anfibios:

Los anfibios tienen pulmones y respiran oxígeno cuando están en tierra seca. Algunos anfibios tienen branquias y viven bajo agua durante parte del ciclo vital. Los anfibios tienen piel delgada y también pueden "respirar" oxígeno a través de la piel. La mayor parte de los anfibios necesita conservar la piel húmeda, y todos ellos vuelven a un medio ambiente acuático para reproducirse. Ponen los huevos en el agua para que no se sequen.

Reptiles:

Los reptiles no necesitan ni permanecer húmedos ni reproducirse cerca del agua. La piel es gruesa y eso evita que la humedad se evapore con rapidez. No "respiran" por la piel. La mayoría de los reptiles ponen los huevos en tierra seca y los cubren con una sustancia dura y flexible que evita que se sequen. Algunos reptiles mantienen los huevos dentro del cuerpo hasta que están listos para romper el "cascarón".

Aves:

Las aves tienen alas y su constitución aerodinámica les permite volar. Las alas además de permitirles volar, los mantienen calientes. Los huesos de las aves son huecos y livianos. Las aves son capaces de mantener la temperatura interna del cuerpo (son endotérmicas) y además tienen un sistema respiratorio y circulatorio complejo y eficaz.

Mamíferos:

Los mamíferos tienen pelos, sus dientes son especializados y la mayoría de las hembras tienen una placenta (órgano interno que recubre a la cría en desarrollo) y producen leche para alimentar a los bebés cuando nacen. Los sistemas respiratorio, circulatorio y digestivo de los mamíferos son complejos. Al igual que las aves, los mamíferos también son endotérmicos

Modifications

For younger students, hand out one card at a time and read the card out loud. Have the student place the card on one of the flip chart papers and discuss before handing out the next card. Draw or tape a picture of an animal from each vertebrate class onto the top of the flip chart papers.

Extensions

Gather old magazines with animal pictures and have students go on a “scavenger hunt” for animals from the six vertebrate classes. Use the pictures to make a collage poster for each of the vertebrate classes.

VERTEBRATE CHARACTERISTICS KEY

Use the following key to discuss the characteristics of the six vertebrate classes. Some of the classes have members who share a characteristic with another class. That is why some characteristics are repeated.

BONY FISH

Breathe with gills. (One exception is lungfish, who can breathe with gills and simple lungs.)

Live in water all the time.

Have a "swim bladder."

Some have teeth. (Most fish don't have teeth, but a few do.)

CARTILAGINOUS FISH

Skeleton made of cartilage.

Breathe with gills.

Live in the water all the time.

Oil in liver helps them float.

Tiny, sharp teeth covering skin.

AMPHIBIANS

Live in water part of the time.

Can "breathe" through their skin. (Oxygen can pass through an amphibian's skin.)

Eggs need to be laid in water.

Have thin skin.

REPTILES

Eggs laid on land. (Although some reptiles have eggs that "hatch" inside the mother's body.)

Eggs have a shell.

Need to be warm to stay active. (That's why reptiles often bask in the sun and are rarely found in very cold climates.)

Have thick, scaly skin.

Some have teeth.

VERTEBRATE CHARACTERISTICS KEY (continued)

BIRDS

Eggs laid on land.
Eggs have a shell.
Have feathers.
Have hollow bones.
Have wings.
Body temperature doesn’t depend on outside temperature (endothermic).

MAMMALS

Have hair or fur.
Make milk.
Never lay eggs. (There are a couple of exceptions, like the platypus, which is a mammal that lays eggs.)
Body temperature doesn’t depend on outside temperature (endothermic).
Have teeth. (All mammals have teeth at some point during their development.)

VERTEBRATE CHARACTERISTICS CARDS

Breathe with gills.	Live in water all the time.	"Swim bladder."	Oil in liver helps them float.
Live in water part of the time.	Can "breathe" through their skin.	Eggs need to be laid in water.	Thin skin.
Eggs laid on land.	Eggs have a shell.	Need to be warm to be active.	Thick, scaly skin.
Skeleton made of cartilage.	Tiny, sharp teeth covering skin.	Eggs have a shell.	Feathers.
Hollow bones.	Wings.	Body temperature doesn't depend on outside temperature.	Hair or fur.
Makes milk.	Never lays eggs.	Body temperature doesn't depend on outside temperature.	Have teeth.

CARACTERÍSTICAS PRINCIPALES DE LOS VERTEBRADOS

Utilice la siguiente lista de características de las seis clases de vertebrados para conversar con los estudiantes. Algunos vertebrados comparten características aunque pertenecen a distintas clases; es por eso que en algunos casos se repiten las características.

PECES ÓSEOS

Respiran por medio de branquias. (El pez pulmonado, que puede respirar a través de branquias o pulmones simples, es una excepción.)
Viven en el agua todo el tiempo.
Tienen "vejiga natatoria".
Algunos tienen dientes. (La mayoría de los peces no tiene dientes, pero unos pocos sí los tienen.)

PECES CARTILAGINOSOS

Esqueleto formado por cartílago.
Respiran por medio de branquias.
Viven en el agua todo el tiempo.
El aceite en el hígado los ayuda a flotar.
Dientes diminutos que recubren la piel.

ANFIBIOS

Viven en el agua parte del tiempo.
Pueden "respirar" a través de la piel (el oxígeno puede atravesar la piel).
Los huevos deben depositarse en el agua.
La piel es delgada.

REPTILES

Depositan los huevos en tierra seca. (Aunque en algunos reptiles las crías salen del cascarón aún estando dentro del cuerpo de la madre.)
Los huevos tienen un cascarón.
La temperatura exterior debe ser calurosa para que se mantengan activos. (Por eso, con frecuencia encontramos reptiles asoleándose y raramente los vemos en climas fríos.)
La piel es escamosa y gruesa.
Algunos tienen dientes.

CARACTERÍSTICAS PRINCIPALES DE LOS VERTEBRADOS (continuación)

AVES

Ponen huevos en tierra seca.
Los huevos están recubiertos por un cascarón.
Tienen plumas.
Tienen huesos huecos.
Tienen alas.
La temperatura interna del cuerpo no depende de la temperatura externa (endotérmicas).

MAMÍFEROS

Tienen pelo o piel.
Producen leche.
Nunca ponen huevos. (Existen algunas excepciones, por ejemplo, el ornitorrinco, que es un mamífero que pone huevos.)
La temperatura interna del cuerpo no depende de la temperatura externa (endotérmicos).
Tienen dientes. (Todos los mamíferos tienen dientes en algún momento de su desarrollo.)

TARJETAS CON LAS CARACTERÍSTICAS DE LOS VERTEBRADOS

Respiran por las branquias.	Viven en el agua todo del tiempo.	“Vejiga natatoria.”	Tienen aceite en el hígado para ayudarlos a flotar.
Viven en el agua parte del tiempo.	Pueden “respirar” a través de la piel.	Necesitan poner los huevos en el agua.	Piel delgada.
Los huevos se despositan en tierra seca.	Los huevos están recubiertos por un cascarón.	El cuerpo tiene que estar caliente para que se mantengan activos.	Piel escamosa y gruesa.
El esqueleto está formado por cartílago.	Dientes afilados y diminutos recubren la piel.	Los huevos están recubiertos por un cascarón.	Plumas.
Huesos huecos.	Alas.	La temperatura interna del cuerpo no depende de la temperatura exterior.	Pelo o piel.
Producen leche.	Nunca ponen huevos.	La temperatura interna del cuerpo no depende de la temperatura exterior.	Tienen dientes.

EGG LAB

Actividad práctica con un huevo

Grades		
4–6	2	60–90 minutes

Purpose

Students will identify the structures and functions of a chicken egg.

Materials

For each pair of students:

- Raw chicken egg
- Warm water
- Clear glass container or 500ml beaker
- Shallow bowl or petri dish
- Newspapers to protect the table and floors
- Hand lenses (optional)

For each student:

- Student Activity Sheet

Concepts

- Egg shells are shaped so they are less likely to roll out of the nest.
- Egg shells are designed for strength and gas exchange.
- Inside the egg are structures that help nourish, cushion, and keep the chick from drying out.

Conceptos

- La forma de los huevos minimiza el riesgo de que rueden y se caigan del nido.
- El cascarón del huevo es duro y permite el intercambio de gases.
- La estructura del huevo permite que el polluelo se nutra, actúa como protección y mantiene la humedad para que no se seque.

Safety

Raw eggs can carry *Salmonella* bacteria, which can cause food poisoning. Tell students to handle the egg carefully, minimize contact with the liquids inside the egg, avoid touching their mouths, and wash their hands thoroughly when they are finished.

Vocabulary

Pores
Calcium carbonate
Shell membrane
Albumen
Chalazae
Yolk
Blastodisc

Vocabulario

Poros
Carbonato de calcio
Membrana del cascarón
Albúmina
Chalaza
Yema
Disco germinal o blastodermo

In Advance

Gather materials and copy Student Activity Sheets. Put warm water into the glass containers, leaving room for one egg to be placed inside during the activity.

Procedure

1. *Set-up*

Tell students they will be learning all about eggs by closely examining the structures of a chicken egg. Divide the class into teams of two and give each pair an egg, a container of warm water, a shallow bowl, and a hand lens (if available). Explain how to handle a raw egg safely.

2. *Look at the egg's shell*

Ask students if they know why eggs are oval rather than round. After several guesses, tell students to gently roll the egg on the table and observe what happens. (It will probably not roll straight.) Can students guess why this rolling pattern might be a good adaptation for an egg to have? (Interesting fact: The ledge-dwelling murre lays a single pear-shaped egg. Its very pointy end allows it to roll in a very tight circle. This decreases the chances of the egg rolling off the cliff.)

Next, have students look closely at the surface of the egg shell (with a hand lens if possible). Can they describe what the surface looks like? Have students gently place the egg into the container of warm water and watch what happens. After a short time, tiny bubbles should begin to escape the egg, especially from the flatter end of the shell. Do students have any ideas why this happens?

3. Experiment with egg shell strength

Over the newspapers and with arms outstretched, place an egg end to end with the ends resting in the palm of each of your hands. Lace your fingers together and squeeze the ends of the egg between your hands as if you are trying to crush it. Unless the egg has a crack, it should not break. Be sure to tell students this only works if the egg is held end to end, not around the middle.

Now, offer students the chance to try it one at a time over the newspaper. Be sure they hold the egg end to end in their palms. Check the egg for cracks in between tries. (You may want to have an apron available, in case the egg develops cracks that go undetected and the egg breaks.) When everyone has had a chance, ask students why they think the egg is so strong. Use the “Why It Happens” section of this activity to discuss egg shell strength.

4. Look inside the egg

Give each student a copy of the Student Activity Sheet. Tell them they will be cracking the egg open to look at the structures inside. The Student Activity Sheet will help them keep track of the structures and functions as you discuss each one.

Tell students to carefully crack open their egg and let the insides pour into the shallow dish. Instruct them to try not to break the **yolk** and to touch the inside of the egg as little as possible.

Now that the eggs are open, identify the parts of the egg one at a time. Ask students to guess what the function of each structure is before explaining them to students. Use the “Why It Happens” section to guide your explanations. Tell students to draw each part and explain its function on the Student Activity Sheet.

5. Clean up

Collect the eggs, shells, and other materials. Clean all work areas with warm water and bleach to prevent the growth of harmful bacteria.

Questions to Ask During the Activity

1. Why are eggs oval shaped? (The shape of the egg helps it to roll in a circular pattern, so they are less likely to roll out of the nest.)

2. Why does more air escape from the flatter end of the egg when they are put in warm water? (The egg has an air sac on the flatter side. When the chick is ready to hatch, the sac is broken and the chick can breathe and stretch before breaking through the shell.)

3. What is the **albumen** for? (It keeps the developing chick from drying out and acts as a cushion.)

4. What is the yolk? (The yolk is the actual egg cell. It provides food for the developing chick.)

Preguntas sobre el tema de la actividad

1. ¿Por qué tienen forma ovalada los huevos? (La forma del huevo le permite rodar en círculos, minimizando la posibilidad de que se caiga del nido.)

2. ¿Por qué se sale el aire más fácilmente del lado plano del huevo cuando está sumergido en agua tibia? (El huevo tiene una cámara de aire en el lado plano. Cuando el polluelo está listo para salir, se rompe la membrana y el polluelo puede respirar y estirarse antes de romper la cáscara.)

3. ¿Para qué sirve la **albúmina**? (Evita que el polluelo se seque y actúa como cojín.)

4. ¿Qué es la yema? (La yema es la célula del huevo y es la fuente de alimento para el polluelo en desarrollo.)

Why It Happens/More on the Topic

The Shell

Shape and Size - The oval shape of an egg causes the egg to roll in a circular pattern. As it rolls, it returns to where it started. This adaptation prevents it from easily rolling out of the nest.

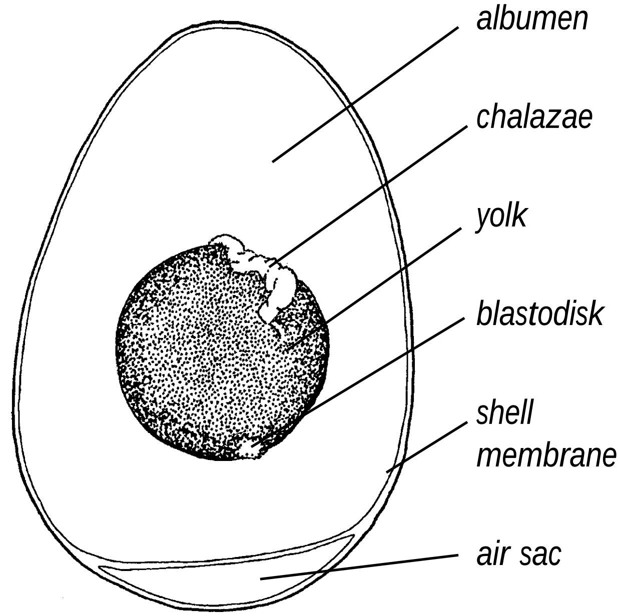
Porosity - The egg shell has tiny openings, called **pores**, which allow gases to exchange as the chick develops.

Egg strength - The shape of the egg and the evenly distributed force prevented the egg from breaking when it was squeezed. When the egg is cracked against a pan, it is easily broken because the force is not evenly distributed. Eggs are also strong and hard because they are made of **calcium carbonate**. As the chick grows, the chick uses some of the calcium. When the chick is ready to hatch, the shell is thinner than it was when the egg was laid.

The Insides

Shell membrane - The **shell membrane** lines the inside of the egg, except at the flat end of the egg. The membrane keeps moisture in and germs out while still allowing gases (oxygen and carbon dioxide) to be exchanged. The air sac at the flat end of the egg is broken when the chick is ready to hatch. The chick can breathe and stretch before breaking through the shell.

Albumen - (pronounced "al-byu-men") The **albumen** is the egg "white." It keeps the developing chick from drying out and acts as a cushion. It is mostly made of water, but also contains 10% protein and some minerals.



Chalazae - (pronounced "kuh-la-zee") The **chalazae** are two slimy, white rope-like structures attached to each side of the yolk. These are the twisted ends of the albumen's inner layer. The egg receives the albumen as it descends down the oviduct (or egg tube). The egg turns as it descends, causing the chalazae to thicken and twist.

Yolk - The yolk is the actual egg cell. (It is all one cell!) The yolk is the food source for the developing chick. It is made of proteins, fats, and carbohydrates and is a complete food source for the chick during its 21 days of development inside the egg. The chick even uses a small amount of the yolk after it hatches.

Blastodisc - The **blastodisc** is a tiny white spot, sometimes called a "snowflake," found on the surface of the yolk. This is where the egg is fertilized and where the chick begins to develop.

Algo más sobre el tema...

El cascarón

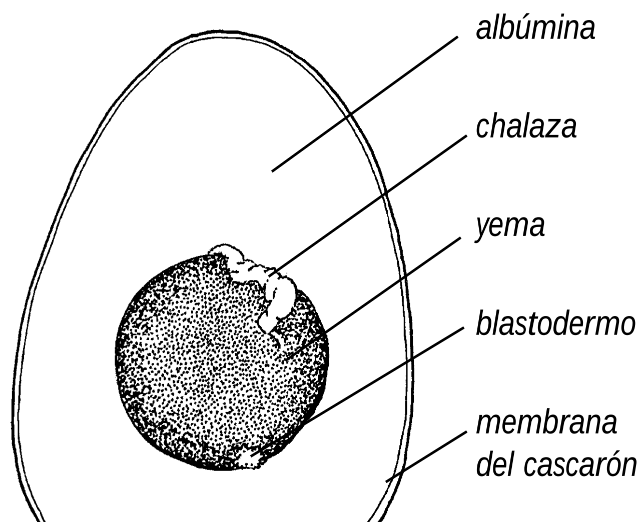
Forma y tamaño - La forma ovalada del huevo le permite rodar en círculos y al rodar vuelve a la posición original. Con esta adaptación se le hace más difícil caerse fuera del nido.

Porosidad - El cascarón tiene aberturas diminutas, llamadas **poros,** que permiten el intercambio de gases durante el desarrollo del embrión.

Dureza del huevo - La forma del huevo junto con la distribución uniforme de fuerza evitaron que el huevo se rompiera cuando fue apretado. Es fácil romper un huevo contra una sartén porque la fuerza no está distribuida de forma uniforme. Otra razón por la cual los huevos son fuertes es porque están formados por **carbonato de calcio.** El espesor del cascarón disminuye a medida que el polluelo se desarrolla y cuando está por salir, el cascarón es mucho más delgado que en el momento en que se puso el huevo.

Las partes internas

Membrana del cascarón - La **membrana del cascarón** está adherida a la superficie interna del cascarón, excepto en el extremo plano del huevo. La membrana mantiene la humedad adentro y los gérmenes afuera, pero al mismo tiempo permite el intercambio de gases (oxígeno y dióxido de carbono). Cuando el polluelo está listo para salir, se rompe la cámara de aire que se encuentra en el lado plano y el polluelo puede respirar y estirarse antes de empezar a romper el cascarón.



Albúmina - La **albúmina** es la "clara del huevo". Evita que se seque el polluelo en desarrollo y además actúa como cojín. La albúmina está

Algo más sobre el tema (cont.)

compuesta, casi en su totalidad, por agua pero también contiene un 10% de proteína y algunos minerales.

Chalaza - Las **chalazas** son dos estructuras viscosas, con forma de soga que están adheridas a ambos lados de la yema. Éstos son los extremos retorcidas de la capa interior de la albúmina. El huevo recibe la albúmina a medida que desciende por el oviducto (o tubo del huevo). El huevo gira al descender y al hacerlo las chalazas se tuercen y se vuelven más gruesas.

Yema - La yema es en realidad un óvulo. (¡Y es sólo una célula!) La yema es la fuente de nutrición para el polluelo en desarrollo. Está formada por proteínas, grasas y carbohidratos y es una fuente completa de alimentación para el polluelo durante los 21 días de desarrollo dentro del huevo. Cuando sale del cascarón, el polluelo todavía utiliza la pequeña cantidad restante de la yema.

Blastodermo - El **blastodermo** es un pequeño punto blanco, a veces llamado “copo de nieve”, que se encuentra en la superficie de la yema. Este punto es el lugar donde el huevo se fertiliza y donde el polluelo comienza su desarrollo.

Modifications

The egg lab can be done with younger students by demonstrating each part of the procedure and not using the Student Activity Sheet.

Extensions

While the pores in the egg shell are beneficial for gas exchange, they can also cause problems in a polluted environment. To help students understand how an oil spill can affect eggs that are laid on the ground, submerge three hard boiled eggs in a container of cooking oil. (Mix in some food coloring for a more dramatic demonstration). Open and observe one egg after 5 minutes, the second egg after 15 minutes, and the third egg after 30 minutes.

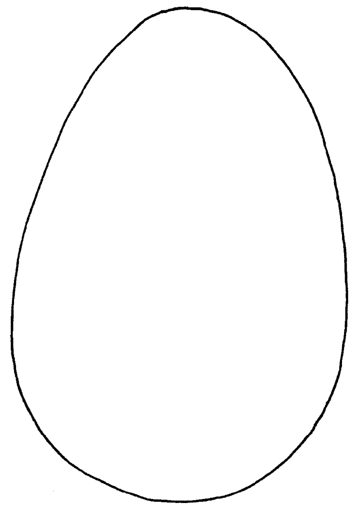
References

New Mexico Natural History and Science Museum. Proyecto Futuro Life Science Curriculum, First Edition. Albuquerque, NM, 1996.

STUDENT ACTIVITY SHEET

Egg Lab

Draw and label the parts of the egg
inside the oval shown here:



Describe the function of the following structures:

Shell membrane:

Air Sac:

Albumen:

Chalazae:

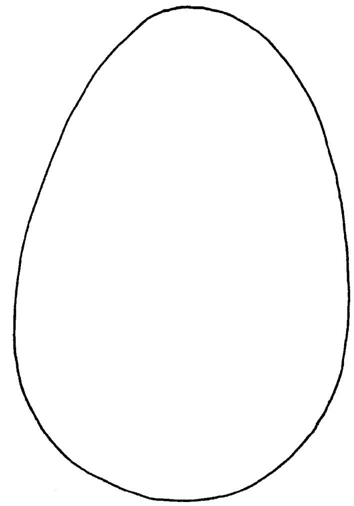
Yolk:

Blastodisc:

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Actividad práctica con un huevo

Dibuja y escribe los nombres de las partes del huevo dentro de la siguiente figura ovalada:



Describe la función de las siguientes estructuras:

Membrana del cascarón:

Cámara de aire:

Albúmina:

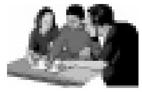
Chalazas:

Yema:

Blastodermo:

BIRD BEAK BANQUET

Papilla para los picos de los pájaros

Grades		
1–8	*6 equal groups*	*60 minutes*

Purpose

Students will use various tools to demonstrate how different bird beaks are adapted to gathering specific types of foods.

Materials

Beaks:
- Straws (one per student)
- 1 pair of chopsticks
- 1 nutcracker or pliers
- 1 strainer
- 1 envelope
- 1 pair of tweezers

Also:
- Bird beak pictures (field guides are a good source)
- Paper
- Marker
- Student Activity Sheets

Foods:
- Paper cups with water (one per student)
- Bowls (one per table)
- Dry oatmeal (enough to almost fill bowls)
- 1 bag of gummy worms
- Uncooked rice
- Popped popcorn
- Nuts with shell (one per student)
- Styrofoam chunks
- Bucket or large container filled with water (one per table)

Concepts

- Adaptations are physical or behavioral characteristics that help a plant or animal survive in its environment.
- Bird beaks vary in size, shape, and strength.
- Bird beaks are adapted to eating certain types of food.

Conceptos

- Adaptaciones son características físicas o de comportamiento que ayudan a las plantas o a los animales a sobrevivir en el medio ambiente en que viven.
- Los picos de las aves varían en tamaño, forma y fuerza.
- Los picos de las aves son un reflejo de sus hábitos alimenticios.

Safety

Students should not eat any of the food materials or share straws.

Vocabulary

Adaptation

Vocabulario

Adaptación

In Advance

Gather materials. Fill cups and buckets with water. Place Styrofoam chunks in the water buckets. Put gummy worms into bowls and cover them with oatmeal. Make labels for each "beak" using the paper and marker (see chart below) and place them on a table with each "beak." Make copies of the Student Activity Sheet.

Procedure

1. *Introduce the activity*

Begin by explaining **adaptations** in plants and animals. Ask students if they can think of examples of adaptations in vertebrates. Tell students they will be learning how bird beaks are adapted to eating different types of foods.

2. *Set-up*

Divide the class into six groups and have each group sit at a separate table. Show students each of the items that represent the bird beaks (straws, chopsticks, nutcracker, strainer, envelope, and tweezers). Explain which items correspond to which type of bird and show them the bird pictures (see chart below). Give each student a copy of the Student Activity Sheet and show them the list of birds and their "beaks" so they can use them during the activity.

Distribute the "foods" to each group. Each table should have a paper cup filled with water for each student, a nut for each student, a bowl of oatmeal with gummy worms, a few pieces of popcorn, a bucket of water with Styrofoam chunks, and a small handful of rice (spread on the table). Using the chart below, explain to students what each "food" represents. Also show them the list on the Student Activity Sheet.

3. *Explain and begin activity*

Tell students that each group will be using the bird beaks to collect the food items on their table. The popcorn must be thrown into the air and caught when it is in the air. Each group will get a turn with each type of bird beak. Be sure that every student in the group gets to try each bird beak. When everyone is finished with the first beak, have the groups trade beaks. Hand out new straws to the groups when the beaks are traded so students won't be sharing straws. Continue the process until all the groups have tried all the beaks. Have students keep track of what is happening on the Student Activity Sheet.

4. *Discuss activity*

When all the groups have experimented with all the bird beaks, ask students which worked best with which foods. Can they think of other types of birds with similar beaks? What do they eat? What about birds with different types of beaks (toucans, storks, hawks, woodpeckers)? What kind of food are they adapted to eating?

BIRD BEAKS	FOOD
Straw = Hummingbird	Cups of water = nectar in a flower
Nutcracker = Grosbeak	Bowls of oatmeal and gummy worms = worms in mud
Chopstick = Snipe	Nuts = seeds and nuts in hard shells
Strainer = Duck	Styrofoam chunks in water = fish and other aquatic animals
Envelope = Nighthawk	Popcorn tossed into the air = flying insects (must be caught in the air)
Tweezers = Warbler	Rice spread on the table = caterpillars and other crawling insects

Questions to Ask During the Activity

1. How does the shape of the beak relate to the kind of food the bird eats? (The shape of the beak is adapted to eating particular kinds of food. For example, the grosbeak has a large, thick bill strong enough to crack hard seeds. The hummingbird has a long, thin bill and tongue that helps it to sip nectar from deep inside flowers.)

2. What other beak shapes can you think of and what do those birds eat?

3. Why don't birds all eat the same type of food? (The competition would be too great. With different types of beaks, many different types of birds can live and eat in the same area.)

Preguntas sobre el tema de la actividad

1. ¿Cuál es la relación entre la forma del pico y el tipo de alimentos que ingiere un ave? (La forma del pico se adapta para poder comer determinados tipos de alimentos. Por ejemplo, el pájaro llamado pico gordo tiene un pico suficientemente grande y ancho como para poder partir semillas. El colibrí tiene un pico angosto y largo y una lengua que lo ayuda a sorber néctar del interior profundo de algunas flores.)

2. ¿Puedes pensar en otras formas de picos e imaginarte qué comen esas aves?

3. ¿Por qué las aves comen distintos tipos de alimentos? (Porque si comieran lo mismo habría demasiada competencia por esos alimentos. Al haber distintos tipos de picos, diferentes aves pueden vivir y alimentarse en la misma área.)

Why It Happens/More on the Topic

An adaptation is a behavior or physical characteristic of an organism that helps it to survive. In the case of birds, each type of bird has a different beak shape that is used for eating certain types of food. Adaptations take time to develop. Individuals within a population might have slight variations that help them to survive. If those characteristics continue to benefit the individuals, the characteristic may be passed to their offspring and eventually incorporated into the whole population.

Algo más sobre el tema...

Una adaptación es una característica física o de comportamiento de un organismo que lo ayuda a sobrevivir. En el caso de las aves, cada tipo de ave tiene una forma diferente de pico que le sirve para comer distintos tipos de alimentos. Las adaptaciones toman tiempo. Los individuos de una población tienen pequeñas variaciones que los ayudan a sobrevivir. Si esas características son beneficiosas para esos individuos, es muy posible que las pasen a su progenie y que finalmente se incorporen a la población general.

Modifications

For younger students, instead of using the Student Activity Sheet, draw a chart on the chalkboard and fill it out when you discuss the results of the activity. (Draw pictures rather than using words for non-readers.)

For older students, repeat the activity, but have students see how many of each type of food they can collect with the different beaks within ten seconds. Have them record their data and create a graph that shows the results.

Extensions

Have students investigate other adaptations in vertebrates. Each student should find one adaptation and be able to explain to the class how that adaptation helps the animal to survive.

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum, First Edition. Albuquerque, NM, 1996.

STUDENT ACTIVITY SHEET

Bird Beak Banquet/Papilla para los picos de los pájaros

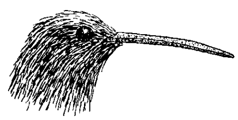
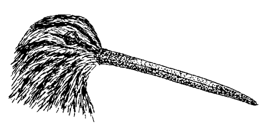
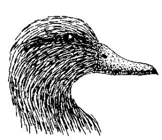
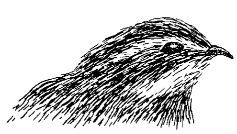
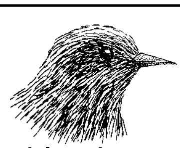
BIRD BEAKS	FOOD
Straw = Hummingbird Nutcracker = Grosbeak Chopstick = Snipe Strainer = Duck Envelope = Nighthawk Tweezers = Warbler	Cups of water = nectar in a flower Bowls of oatmeal and gummy worms = worms in mud Nuts = seeds and nuts in hard shells Styrofoam chunks in water = fish and other aquatic animals Popcorn tossed into the air = flying insects (must be caught in the air) Rice spread on the table = caterpillars and other crawling insects

PICOS DE PÁJAROS	ALIMENTOS
Popote = Colibrí Rompenueces = Pico gordo Palillos chinos = Agachadiza Colador = Pato Sobre = Chotocabra Pinzas = Sílvido	Vasos de agua = néctar adentro de la flor Tazón de avena y confites de goma con forma de gusanitos = gusanos en el barro Nueces = semillas y nueces con cáscaras duras Pedacitos de espuma de poliestireno en agua = pesces y otros animals acuáticos Palomitas de maíz arrojadas al aire = insectos voladores (deben ser atrapados en el aire) Arroz desparramado sobre la mesa = orugas y otros insectos que se arrastran

STUDENT ACTIVITY SHEET

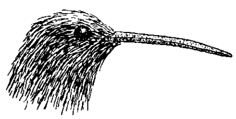
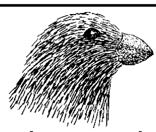
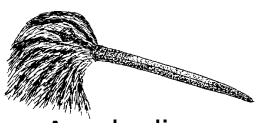
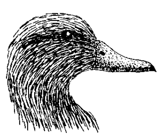
Bird Beak Banquet

Record your "feeding" results in the chart below:

Bird Beak	**Easiest Food to Gather**
 Hummingbird (straw)	
 Grosbeak (nutcracker)	
 Snipe (chopsticks)	
 Duck (strainer)	
 Nighthawk (envelope)	
 Warbler (tweezers)	

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
Papilla para los picos de los pájaros

Anota tus observaciones en el cuadro siguiente:

Picos de pájaros	**¿Cuál es el alimento más fácil de atrapar?**
 Colibrí (popote)	
 Pico gordo (rompenueces)	
 Agachadiza (palillos chinos)	
 Pato (colador)	
 Chotocabra (sobre)	
 Sílvido (pinzas)	

BONE DENSITY

Densidad ósea

Grades		
4–8	2–3	60 minutes

Purpose

Students will measure and compare the density of mammal and bird (avian) bones.

Materials

For each group:

Clean, dry mammal bones (beef or pork rib bones)
Clean, dry bird bones (chicken or turkey leg bones or wing bones)
500 ml graduated cylinder
100 ml graduated cylinder
Water
Balance

For each student:

Student Activity Sheet

Concepts

- Mammals and birds have similar skeletons.
- Birds have fewer bones with less density as an adaptation to flight.

Conceptos

- Los mamíferos y las aves tienen esqueletos similares.
- Las aves tienen menos huesos y de menor densidad, esta adaptación las ayuda a volar.

Safety

Glass items should be handled carefully.

Vocabulary

Density
Mass
Avian
Mammal
Adaptation

Vocabulario

Densidad
Masa
Característico de las aves
Mamífero
Adaptación

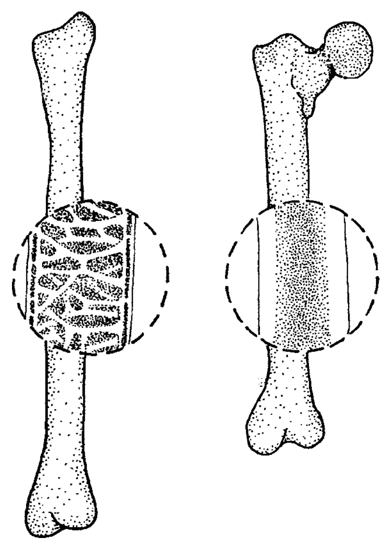
In Advance

Several weeks before doing the activity, start saving leftover bones. Prepare the bones by boiling off the meat. Be sure the bones you collect will fit into the cylinders. Make copies of the Student Activity Sheet and gather materials.

Procedure

1. *Introduce the activity*

Begin by telling students that bird (**avian**) and **mammal** skeletons are similar, but each is **adapted** to a different lifestyle. Not only are the number of bones different, but the actual bones are different. They have different **masses** and **densities**. Explain that mass is the measure of the amount of stuff in an item. Density is the ratio of mass to the volume of an item. For instance, two loaves of bread might have the same mass, but a loaf filled with many air bubbles would be less dense than one that has no air bubbles.



avian bone *mammal bone*

2. *Hypothesis*

Give each student a Student Activity Sheet. Show the students the bones they will be comparing and ask them to hypothesize which bones will be the most dense. Have them write their answer on the Student Activity Sheet.

3. Set-up

Divide students into groups of 2 or 3. Give each group the graduated cylinders and the bones they will be measuring.

4. Measure the mass of the bones

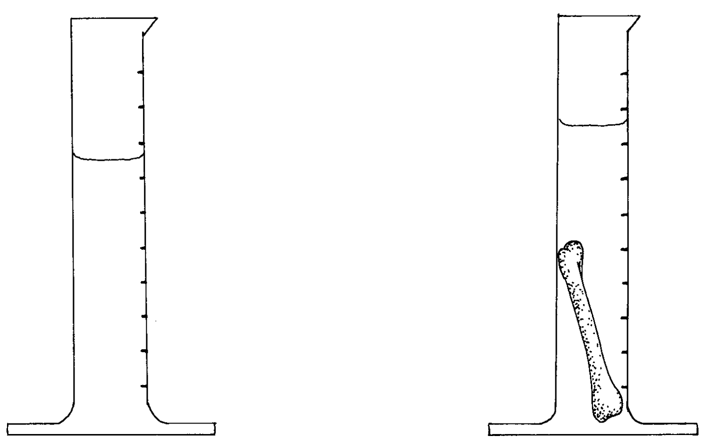
Have each group weigh their bones (separately) on the balance and record their mass (in grams) on the Student Activity Sheet.

5. Measure the volume of the bones

Tell students to fill their graduated cylinders 3/4 full with water. Starting with one bone, have students describe the bone on the Student Activity Sheet and choose the smallest graduated cylinder the bone will fit in. Before adding the bone, tell students to record the volume (in milliliters) of the water in the cylinder on the Student Activity Sheet.

To measure the volume of the bone, place the bone in the cylinder. (If it floats, the bone can be held down with a pencil or finger—tell students to try to keep the pencil or finger out of the water so it does not become part of the measurement.) The water will rise in the cylinder and this measurement should be recorded on the Student Activity Sheet.

To calculate the volume of the bone itself, subtract the initial volume of the water from the volume of the water when the bone is submerged. Instruct students to record this measurement on the Student Activity Sheet. Have the students repeat the procedure with the remaining bones. The volume of the water should be recorded between each measurement before adding each bone because some water will remain on the bones that were measured before.



6. Calculate the density of the bones

Finally, have students calculate the density (in grams per milliliter) of the bones. To do this, divide the mass of the bone by the volume, then record the result on the Student Activity Sheet.

7. Discuss the results

Ask students what they found out from their measurements. Did their measurements and calculations support their hypotheses? Why is it an advantage for birds to have less dense bones? Why is it helpful for mammals to have dense bones?

Questions to Ask During the Activity

1. Which bones float? Why? (Small bird bones are more likely to float because they are light and hollow.)

2. Why are bird bones hollow? (Birds are adapted for flight. Having lightweight, hollow bones makes it easier to stay in the air.)

3. Why are mammal bones more dense? (Mammal bones are designed to sustain the pressure and impact of running and jumping on land.)

4. What other adaptations do birds have for flight? (They have lightweight feathers covering their bodies, strong chest muscles for powerful wing beats, and very efficient circulatory and respiratory systems.)

5. Do you think a pencil or a piece of chalk is denser? How would you test your hypothesis? (The same procedure can be used to determine the density of the pencil and piece of chalk.)

Preguntas sobre el tema de la actividad

1. ¿Cuáles son los huesos que flotan? ¿Por qué? (Los huesos de los pájaros pequeños tienen más posibilidades de flotar porque son livianos y huecos.)

2. ¿Por qué son huecos los huesos de los pájaros? (Los pájaros se han adaptado al vuelo. Al tener huesos livianos y huecos se les hace más fácil mantenerse en el aire.)

Preguntas (continuación)

3. ¿Por qué son más densos los huesos de los mamíferos? (Los huesos de los mamíferos están diseñados para aguantar la presión y el impacto de correr y saltar en tierra seca.)

4. ¿Qué otras adaptaciones para volar tienen las aves? (El cuerpo está cubierto de plumas livianas, tienen un pecho con músculos poderosos para poder batir las alas y un sistema circulatorio y respiratorio muy eficaces.)

5. ¿Qué crees que tiene más densidad: un lápiz o un pedazo de tiza? ¿Cómo probarías tu hipótesis? (Se puede usar el mismo procedimiento para probar la densidad del lápiz que para probar la densidad de la tiza.)

Why It Happens/More on the Topic

When an object is placed in water, it displaces some of the water. The amount of water displaced is equal to the volume of the object. Knowing the mass of an object and its volume enables you to calculate its density. Density is a measure of amount of mass in a given space.

Birds have skeletons similar to mammal skeletons. Both have skulls, backbones, ribs, pectoral and pelvic girdles, and limbs. The skeletons of birds and mammals provide different amounts of support, flexibility, and strength. A bird's skeleton is adapted for flight. Birds have fewer vertebrae and fewer bones at the ends of their limbs. Fewer bones result in reduced skeletal mass. Skeletal mass is also reduced because their bones are less dense.

Algo más sobre el tema...

Cuando ponemos un objeto en agua, parte del agua se desplaza. La cantidad de agua que se desplaza es igual al volumen del objeto. Si sabes la masa y el volumen de un objeto, puedes calcular su densidad. La densidad es una medida de la cantidad de masa en un espacio dado.

Los esqueletos de las aves son similares a los de los mamíferos. Ambos tienen cráneo, columna vertebral, costillas, anillos pectorales y pélvicos y extremidades. El nivel de sostén, flexibilidad y fuerza del esqueleto es diferente en los mamíferos y en los pájaros. El esqueleto del pájaro está adaptado para volar. Los pájaros tienen menos

Algo más sobre el tema (continuación)

vértebras y menos huesos en la parte inferior de las extremidades. Al tener menos huesos, tienen una masa ósea más reducida. Además, la masa ósea es más reducida porque los huesos son menos densos.

Modifications

You can demonstrate the different masses of mammal and bird bones to younger students by selecting bones of similar size and weighing them on a balance. You can also have students hold the bones to see if they can feel the difference.

Extensions

Test the strength of mammal and bird bones by dropping increasingly heavy objects on them until the bones are damaged or broken. Wear safety goggles while dropping the objects.

Or, using the same methods used in this activity, have students calculate the densities of bones from other vertebrates, such as fish, reptiles, and amphibians.

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum, First Edition. Albuquerque, NM, 1996.

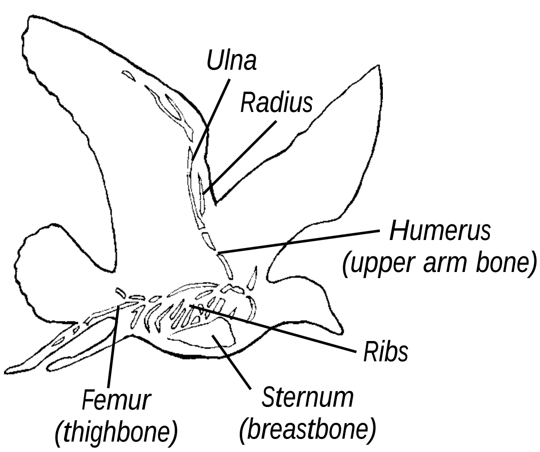
STUDENT ACTIVITY SHEET

Bone Density

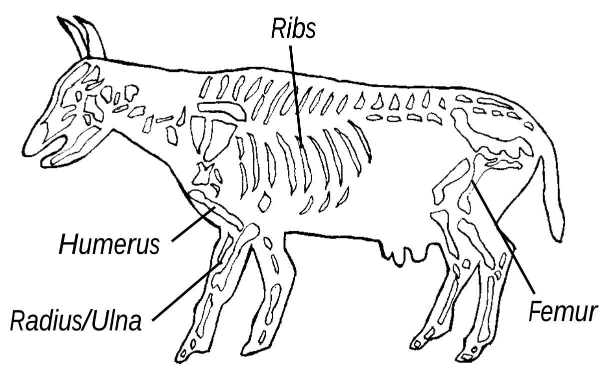
1. Which bones will be the most dense? Which will be the least dense? Write your hypothesis below.

2. Record your data in the chart below.

1	2	3	4	5	6
Bone	**Mass** in grams	**Volume of water without bone** (in milliliters)	**Volume of water with bone** (in milliliters)	**Volume of bone** (Column #4 minus Column #3)	**Density of bone** (Column #2 divided by Column #5)



Bird Skeleton



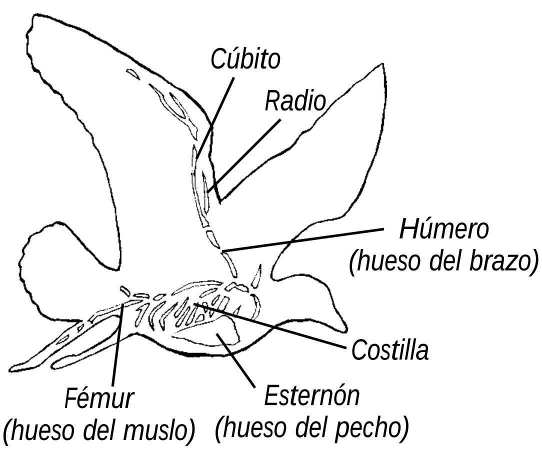
Cow Skeleton

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
Densidad ósea

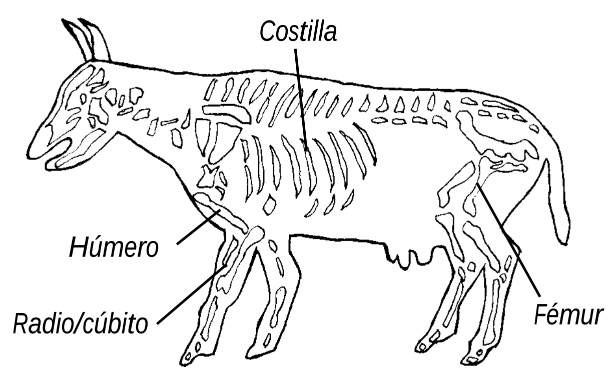
1. ¿Cuáles son los huesos más densos? ¿Cuáles son los menos densos? Escribe tu hipótesis abajo.

2. Anota tus datos en el cuadro siguiente.

1	2	3	4	5	6
Hueso	**Masa** en gramos	**Volumen del agua sin el hueso** (en mililitros)	**Volumen del agua con el hueso** (en mililitros)	**Volumen del hueso** (Columna #4 menos Columna #3)	**Densidad del hueso** (Columna #2 dividida por la Columna #5)



Esqueleto de un ave



Esqueleto de una vaca

SWIM BLADDER
Vejiga natatoria

Grades		
K–8	*6 equal groups*	*45 minutes*

Purpose
Students will observe how a bony fish's swim bladder works by using a balloon model.

Materials
Large bucket (filled with water)
Balloons
String
Small weights (bolts or metal washers work well)
Paper
Pen or pencils

Concepts
- Bony fish can fill or deflate their swim bladder to regulate their depth in the water.
- The gas that fills the swim bladder is taken from the surrounding blood vessels.

Conceptos
- Los peces óseos pueden inflar o desinflar la vejiga natatoria para regular la profundidad del agua en la que quieren mantenerse.
- El gas que llena la vejiga natatoria proviene de los vasos sanguíneos cercanos.

Vocabulary
Swim bladder
Adaptation

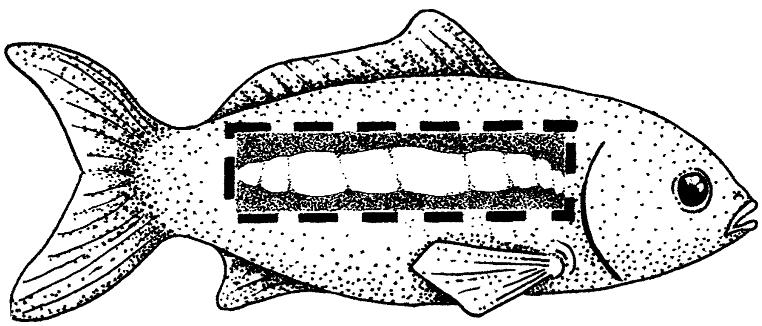
Vocabulario
Vejiga natatoria
Adaptación

In Advance
Gather materials and fill bucket with water.

Procedure

1. *Introduce activity*

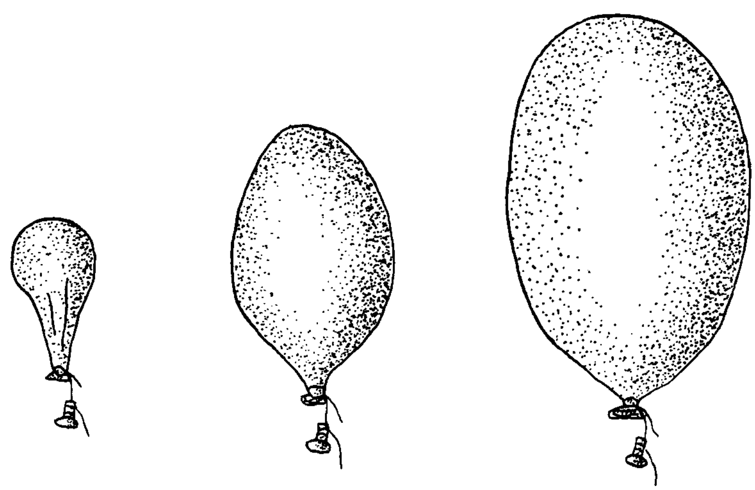
Begin by asking students if they can think of some ways bony fish are **adapted** to living in the water. Besides being streamlined and using gills to breathe, bony fish have a way of moving vertically through the water without expending a lot of energy. Bony fish have a **swim bladder** located just below their backbone that fills with gas and deflates to help the fish move vertically in the water. Students will be making some models of a swim bladder and testing them out in a bucket of water.



2. *Set-up*

Divide students into six groups. Give each group a balloon, a weight, and a piece of string.

Tell two groups to blow up their balloon until it is full and tie it. Then tie one end of the string to the weight and the other end to the balloon. The distance between the weight and the balloon should be as short as possible.



Have two other groups blow up their balloon half full and tie it. Then tie one end of the string to the weight and the other end to the balloon. Again, the distance between the weight and the balloon should be as short as possible.

Finally, have the last two groups blow up their balloon only slightly so it stays almost empty. They should also tie the balloon and the weight together with the string, with only a short distance between them.

Tell students their balloons represent the swim bladder of a bony fish when it is full, half full, and almost empty. Tell students to develop a hypothesis about what each of the balloons will do when it is placed in the bucket of water. Have them write their hypotheses on a sheet of paper.

3. Test the swim bladders

Tell the class to gather around the bucket of water so everyone can see. (If possible, use more than one bucket of water.) Have the two groups with the half-full balloons place the balloon and weight into the bucket of water. What happens?

Repeat the procedure with the balloons that are full and almost empty to see what happens.

4. Discuss observations

Have students return to their seats and discuss their observations.

Questions to Ask During the Activity

1. If bony fish didn't have swim bladders, how would they adjust their depth in the water? (They would need to use their fins, which would take more energy.)

2. How do you think a bony fish fills its swim bladder? (The gas that fills the swim bladder is taken from the blood vessels surrounding it.)

Preguntas para sobre el tema de la actividad

1. ¿Cómo crees que los peces óseos elegirían el nivel de profundidad del agua donde quieren estar si no tuvieran una vejiga natatoria? (Tendrían que usar las aletas, para lo cual necesitarían más energía.)

Preguntas (continuación)

2. ¿Cómo crees que el pez óseo llena su vejiga natatoria? (Con gas que extrae de los vasos sanguíneos cercanos.)

Why It Happens/More on the Topic

Adaptations are physical and behavioral characteristics in an animal or plant that help it to survive in its environment.

The balloons used in this activity represent the swim bladder of a bony fish. The bony fish can fill or "deflate" the swim bladder to move up and down in the water. The gas that fills the swim bladder is taken from the blood vessels surrounding it.

Algo más sobre el tema...

Una adaptación es una característica física o de comportamiento de una planta o de un animal que lo ayuda a sobrevivir en su medio ambiente.

Los globos que se usan en esta actividad representan la vejiga natatoria de un pez óseo. El pez óseo puede inflar o desinflar su vejiga natatoria para moverse en el agua hacia arriba y hacia abajo. El gas que llena la vejiga natatoria proviene de los vasos sanguíneos cercanos a la misma.

Modifications

For younger students, make the model swim bladders yourself, then let the students try them in the bucket of water.

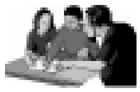
Extensions

Help students dissect a whole bony fish (from the grocery store) to see if they can find the swim bladder. Also, look for the structures that are common to all vertebrates.

References

Mitchell, Lawrence G., John A. Mutchmor, and Warren D. Dolphin. Zoology. Menlow Park, CA: The Benjamin/Cummings Publishing Company, Inc. 1988.

THIN SKIN
Piel delgada

Grades		
K–8	*Whole Class*	*Setup: 10 min in the morning* *Observation & discussion: 15 minutes at the end of the day*

Purpose

Students will observe the diffusion of vanilla molecules through the semi-permeable membrane of a balloon to see how molecules can pass through the skin of an amphibian.

Materials

Balloon
Box with lid (large enough for the blown up balloon)
Dropper
Vanilla extract

Concepts

- The skin of an amphibian is thin and porous like the membrane of a balloon.
- Some molecules are small enough to go through an amphibian's skin, and the balloon.

Conceptos

- La piel de los anfibios es delgada y porosa, como la membrana de un globo.
- Algunas moléculas son lo suficientemente pequeñas como para pasar a través de la piel del anfibio y del globo.

Vocabulary

Pores
Molecules
Diffusion
Semi-permeable

Vocabulario

Poros
Moléculas
Difusión
Semipermeable

In Advance

Gather materials.

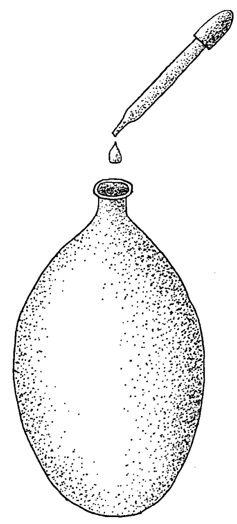
Procedure

1. *Introduce the activity*

Begin by holding up the deflated balloon and asking students what this balloon and an amphibian have in common. Explain that both the balloon and the amphibian's skin are thin and have tiny holes (or **pores**) that allow small **molecules** to pass through, while keeping out larger molecules. The molecules **diffuse** from one side of a **semi-permeable** membrane to the other. Explain that you will be setting up a demonstration to show how molecules pass from the inside of the balloon to the outside.

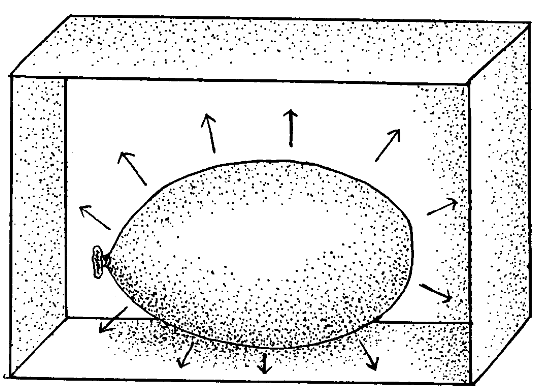
2. *Set-up*

Squeeze several drops of the vanilla extract into the balloon with the dropper. Blow up the balloon and tie it off. Place the balloon inside the box and have students look at the box before closing the lid. Tell students you will be leaving it in the box all day. Ask if they can guess what will happen during the day.



3. *Observe and discuss*

At the end of the day, remove the lid from the box and have students observe what happened. The small vanilla molecules passed through the balloon and were trapped in the air inside the box. The box should smell like vanilla!



Questions to Ask During the Activity

1. Based on what you learned about the balloon, why do you think balloons deflate over time? (Air passes through the membrane of the balloon and causes it to deflate.)

2. What other animals "breathe" through their skin? (Earthworms and isopods are a couple of examples.)

Preguntas sobre el tema de la actividad

1. De acuerdo con lo que has aprendido sobre globos, ¿por qué crees que los globos se desinflan con el pasar del tiempo? (El aire pasa a través de la membrana del globo y hace que se desinfle.)

2. ¿Qué otros animales "respiran" a través de la piel? (Un par de ejemplos son los gusanos de tierra y los isópodos.)

Why It Happens/More on the Topic

The plastic balloon is porous at a microscopic level. Certain molecules, like air or the scent of vanilla extract, can pass through the balloon. The high concentration of air on the inside of the balloon forces some of it to pass through the balloon to the lower concentration of air surrounding the balloon. Mylar balloons (the shiny, metallic balloons) have a thin layer of aluminum that makes them less porous so they stay inflated longer.

The skin of an amphibian is similar to the plastic of the balloon. It is thin and porous at a microscopic level. Some molecules are too large to pass through, but others, like oxygen are small enough to go through it.

Algo más sobre el tema...

Si se miran a través del microscopio, los globos de plástico son porosos. Algunas moléculas pueden pasar a través del globo, por ejemplo las moléculas de aire o el aroma de la esencia de vainilla. La alta concentración de aire en el interior de un globo hace que parte de ese aire trate de pasar hacia afuera, donde la concentración es menor. Los globos de *Mylar* (esos globos metálicos y brillantes) tienen una capa delgada de aluminio que los hace menos porosos y por eso permanecen inflados por más tiempo.

Algo más sobre el tema (continuación)

La piel de los anfibios es similar al plástico de los globos. Es delgada y porosa cuando se la mira a través de un microscopio. Algunas moléculas son demasiado grandes para atravesar la piel, pero otras son lo suficientemente pequeñas como para hacerlo.

Extensions

Try the same demonstration with a Mylar balloon (the shiny metallic balloons). Put a few drops of vanilla extract inside before blowing the balloon up. Mylar balloons can be sealed with a curling iron.

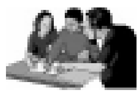
Or, have students investigate the downside of an amphibian's thin and porous skin. Their skin makes them more susceptible to air and water pollutants. Students can research how pollutants might be affecting amphibians around the world.

References

Mitchell, Lawrence G., John A. Mutchmor, and Warren D. Dolphin. Zoology. Menlo Park, CA: The Benjamin/Cummings Publishing Company, Inc., 1988.

LIZARD ADAPTATIONS

Adaptaciones de la lagartija

Grades		
3–8	2 equal groups	45 minutes

Purpose

Students will learn what special characteristics lizards have that help them survive.

Materials

Characteristics Cards
Function Cards
Answer Key

Concepts

- Lizards have many adaptations that help them to capture food, conserve energy, protect themselves from danger, and move through their habitats.

Conceptos

- La lagartija ha sufrido muchas adaptaciones que le permiten atrapar alimentos, protegerse en situaciones peligrosas y moverse dentro de su hábitat.

Vocabulary

Adaptation
Camouflage
Venom
Ectothermic
Hibernation

Vocabulario

Adaptación
Camuflaje
Veneno
Ectotérmico
Hibernación

In Advance

Make one set of the lizard Characteristics Cards and one set of the Function Cards (copy and cut out). Use a different color of paper for each set, if possible, and keep them separate. If you have fewer than 26 students, be sure to eliminate the matching card from each set (characteristics that “match” with a function are located on the corresponding squares of each sheet of cards).

Procedure

1. *Introduce the activity*

Begin by asking students what makes reptiles different from other vertebrate animals. Tell them that within the reptile group there are also many variations and **adaptations**, particularly when it comes to lizards. They will be learning about some common and unusual lizard adaptations.

2. *Set-up and play the matching game*

Divide the class into two teams. Give one team one set of characteristics cards and the second team the function cards. Explain that one team received cards with lizard characteristics and the other team received cards that describe a function for one of the characteristics. The students need to find their "match." In order to do this, students will need to talk with each other and agree that their characteristic card seems related to another student's function card. When two students feel they are a match, have them stand together until everyone else is finished. If some students are struggling to find a match, suggest they talk with students who already believe they have found a match. They may be wrong!

3. *Discuss the answers*

Have each pair read their Characteristic Card and their Function Card. Did everyone find their match? Discuss their guesses using the Answer Key provided.

4. *Search for lizards outside*

During the warmer months lizards can be found outside (they **hibernate** in many areas when it is cold). If time permits, take your students outside to look for lizards. Have them observe the lizards to see what features and behaviors they have. What adaptations do the lizards have? Are there any other adaptations that were not on the cards they used for the game? How many different kinds of lizards can they find?

Questions to Ask During the Activity

1. Why do lizards have so many adaptations that help them conserve energy? (Lizards are **ectothermic,** so their body temperature varies with the external environment and their level of activity is impacted by their body temperature. They need to conserve energy for times when their body temperature is not optimal.)

2. Why are many lizards camouflaged? (It helps them hide from predators and sneak up on their prey.)

3. What do lizards eat? (Different lizards eat different things, but their diets can include leaves, insects, fruit, and eggs.)

Preguntas sobre el tema de la actividad

1. ¿Por qué han sufrido las lagartijas tantas adaptaciones para poder conservar energía? (Las lagartijas son **ectotérmicas,** por eso la temperatura de sus cuerpos varía con la del medio ambiente y el nivel de actividad depende de la temperatura del cuerpo. Necesitan conservar energía para usar cuando la temperatura de sus cuerpos no es óptima.)

2. ¿Por qué es tan común ver lagartijas camufladas? (Las ayuda a evadir a sus predadores y a andar a hurtadillas para capturar a sus presas.)

3. ¿Qué comen las lagartijas? (Diferentes lagartijas comen diferentes alimentos, pero sus dietas incluyen hojas, insectos, frutas y huevos.)

Modifications

Create several sets of cards. Divide students into smaller teams and give each team a whole set of cards. Have them work at their tables to match the characteristic cards with the functions cards.

Extensions

Younger students might enjoy inventing their own lizards based on the characteristics they have learned about. Give students paper, glue, scissors, tape, old buttons, felt, etc. and have them create a lizard with special adaptations. When they are finished, have them explain to the class how their lizard is adapted to living in its environment.

References

Cherry, Jim. Loco for Lizards. Flagstaff, AZ: Northland Publishing Company. 2000.

CHARACTERISTIC CARDS

Characteristic Able to store fat in their tails.	Characteristic Flicking tongue in the air.	Characteristic Running on hind limbs.	Characteristic Doing “push-ups” and bobbing their heads.
Characteristic Hibernating.	Characteristic Changing skin colors.	Characteristic Hair-like extensions on the bottom of their feet.	Characteristic Skin flaps that extend along the lizard’s sides.
Characteristic Fringed toes.	Characteristic A sticky, long tongue.	Characteristic Eyes that swivel.	Characteristic A tail that breaks off easily, then grows back.
Characteristic Loads of bacteria in their mouths.			

FUNCTION CARDS

Function Stores energy for later use.	Function Allows the lizard to “taste” the air insted of smelling.	Function Good for speed.	Function Attracts mates and warns intruders.
Function Lowers energy needs when it’s cold outside.	Function Enables the lizard to match its surroundings.	Function Enables the lizard to climb vertically.	Function Enables the lizard to glide between trees.
Function Good for running across water.	Function Good for grabbing and trapping insects.	Function Good for spotting prey without moving too much.	Function Allows the lizard to escape a predator.
Function When this type of lizard bites, its victim dies from blood poisoning.			

ANSWER KEY

Characteristic	***Function***
1. Able to store fat in their tails.	1. Stores energy for later use.
2. Flicking tongue in the air.	2. Allows the lizard to "taste" instead of smelling. *(Lizards are unable to smell. Instead they collect molecules to "taste" from the air.)*
3. Running on hind limbs.	3. Good for speed. *(In the Soutwest, collared and leopard lizards run on their hind limbs.)*
4. Doing "push-ups" and bobbing their heads.	4. Attracts mates and warns intruders.
5. Hibernating.	5. Lowers energy needs when it's cold outside.
6. Changing skin colors.	6. Enables the lizard to match its surroundings *(Chameleons are able to change color this way. It may have to do with light, mood or temperature.)*
7. Hair-like extensions on the bottom of their feet.	7. Enables the lizard to climb vertically. *(The tiny hair-like structures can help the lizard grasp…even on glass.)*
8. Skin flaps that extend along the lizard's sides.	8. Enables the lizard to glide between trees. *(The draco lizard glides more than it walks.)*
9. Fringed toes.	9. Good for running across water. *(Water lizards can run across the surface of the water.)*
10. A sticky, long tongue.	10. Good for grabbing and trapping insects.
11. Eyes that swivel.	11. Good for spotting prey without moving too much.
12. A tail that breaks off easily, then grows back.	12. Allows the lizard to escape a predator.
13. Loads of bacteria in their mouths.	13. When this type of lizard bites, its victim dies from blood poisoning. *(Monitor lizards use this strategy.)*

TARJETAS CON LAS CARACTERÍSTICAS

Característica Puede almacenar grasas en la cola.	Característica Sacude la lengua en el aire.	Característica Corre sobre las patas posteriores.	Característica Hacen flexiones con los brazos y mueven la cabeza verticalmente.
Característica Hibernación.	Característica Cambia el color de la piel.	Característica Extensiones en la planta de las patas que parecen pelos.	Característica Faldones de piel a lo largo de las lagartijas.
Característica Dedos membranosos.	Característica Lengua larga y pegajosa.	Característica Ojos que giran.	Característica Cola que se separa con facilidad pero vuelve a crecer.
Característica Muchísimas bacterias en la boca.			

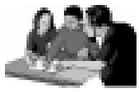
TARJETAS CON LAS FUNCIONES

Función Almacena energía para usar más tarde.	Función Permite que el lagarto "le tome el gusto" al aire en vez de olerlo.	Función Bueno para la velocidad.	Función Atrae a las parejas y previene a los intrusos.
Función Disiminuye la necesidad de energía cuando hace frío afuera.	Función Permite que el lagarto emule el entorno.	Función Permite que el lagarto trepe verticalmente.	Función Permite que el lagarto se deslice entre los árboles.
Función Buenos para correr sobre el agua.	Función Buena para agarrar y atrapar insectos.	Función Buenos para divisar una presa sin moverse demasiado.	Función Permite que el lagarto se escape del predador.
Función Cuando este tipo de lagarto muerde, la víctima muere de envenenamiento de la sangre.			

CLAVE PARA LAS RESPUESTAS

Characterística	***Función***
1. Puede almacenar grasas en la cola.	1. Almacena energía para usar más tarde.
2. Sacude la lengua en el aire.	2. Permite que el lagarto “le tome el gusto” al aire en vez de olerlo. *(Como los lagartos no pueden oler, recolectan moléculas para tomarle el gusto al aire.)*
3. Corre sobre las patas posteriores.	3. Bueno para la velocidad. *(En el Sudoeste, las lagartijas de collar y los geckos leopardo corren parados en sus patas posteriores.)*
4. Hace flexiones con los brazos y mueve verticalmente la cabeza.	4. Atrae a las parejas y previene a los intrusos.
5. Hibernación.	5. Disminuye la necesidad de energía cuando hace frío afuera.
6. Cambia el color de la piel.	6. Permite que el lagarto emule el entorno. *(Los camaleones pueden cambiar de esta manera. Es posible que esté relacionado con la luz, con el humor o con la temperatura.)*
7. Extensiones en la planta de las patas que parecen pelos.	7. Permite que el lagarto trepe verticalmente. *(Estas pequeñas estructuras que parecen pelitos ayudan a la lagartija a agarrarse…aún al vidrio.)*
8. Faldones de piel a lo largo de las lagartijas.	8. Permite que el lagarto se deslice entre los árboles *(La lagartija voladora se desliza más a menudo de lo que camina.)*
9. Dedos membranosos.	9. Buenos para correr sobre el agua. *(Las lagartijas de agua pueden correr sobre la superficie del agua.)*
10. Lengua larga y pegajosa.	10. Buena para agarrar y atrapar insectos.
ll. Ojos que giran.	11. Buenos para divisar una presa sin moverse demasiado.
12. Cola que se separa con facilidad pero vuelve a crecer.	12. Permite que el lagarto se escape del predador.
13. Muchísmas bacterias en la boca.	13. Cuando este tipo de lagarto muerde, la víctima muere de envenenamiento de la sangre. *(Las lagartijas monitor usan esta estrategia.)*

VERTEBRATE CHARADES
Acertijos para la actividad de vertebrados

Grades		
K–4	Whole Class	45 minutes*

Purpose

Students will learn (or review) what types of animals are vertebrates.

Materials

Animal Cards

Concepts

- Vertebrates are animals with backbones.
- Vertebrates include bony fish, cartilaginous fish, amphibians, reptiles, birds, and mammals.

Conceptos

- Los vertebrados son animales con columna vertebral.
- Los peces óseos, los peces cartilaginosos, los anfibios, los reptiles, las aves y los mamíferos pertenecen a la categoría de vertebrados.

Vocabulary

Vertebrates
Invertebrates
Bony fish
Cartilaginous Fish
Amphibian
Reptile
Bird
Mammal

Vocabulario

Vertebrados
Invertebrados
Peces óseos
Peces cartilaginosos
Anfibios
Reptiles
Aves
Mamíferos

In Advance

Copy and cut out the Animal Cards.

** Can be done in small amounts of time.*

Procedure

1. *Introduce the activity*

Begin by telling students that **vertebrates** are animals with backbones. They have an internal skeleton that helps to support their weight, so they tend to be larger than **invertebrates**.

Explain to students that there are six main types of vertebrates: bony fish, cartilaginous fish, amphibians, reptiles, birds, and mammals. Ask students if they can list some of the differences between the animals in these groups, then discuss their answers.

Tell students that they will be playing a charades game to help them learn what animals belong in the vertebrate group. One student at a time will be given a card that names an animal. They will silently "act" like that animal and the class will ask questions to help them guess what the animal is.

2. *Play the game*

Have one student come to the front of the class and select an Animal Card. Be sure the student understands what his/her animal is. Give the student a moment to think about how that animal acts, then have him/her "perform" for the class. Remind the student that the "performance" is supposed to be silent, and their body should move like the animal.

Call on one student at a time to ask questions about the animal. The questions should be asked so the answers will be limited to "yes," "no," or "maybe." Appropriate questions might be: "Is it an amphibian?" "Does the animal have hair?" "Does the animal live in the water all the time?" etc. Help students reword questions like, "What color is it?" or "How many legs does it have?" so they can be answered with "yes," "no," or "maybe." If they get stuck, you can suggest some questions to ask.

Repeat the game so all students get a chance to choose an Animal Card and "perform" a charade.

Questions to Ask During the Activity

1. Other than having a backbone, what are some other differences between vertebrates and invertebrates? (Vertebrates have more complicated circulatory, respiratory, digestive, and nervous systems.)

Preguntas sobre el tema de la actividad

1. Además de tener columna vertebral, ¿qué otras diferencias hay entre los vertebrados y los invertebrados? (Sistemas circulatorio, respiratorio, digestivo y nervioso más complejos.)

Modifications

Non-readers will need help reading the Animal Cards.

The charades game can also be played in teams. Each team member can become a different body part of the animal so the whole team looks like the entire animal.

Extensions

Have students cut out pictures of vertebrate animals from old magazines. Make a class collage of each vertebrate group (one for bony fish, one for amphibians, and so on). Be sure students tell you which picture belongs with which vertebrate group.

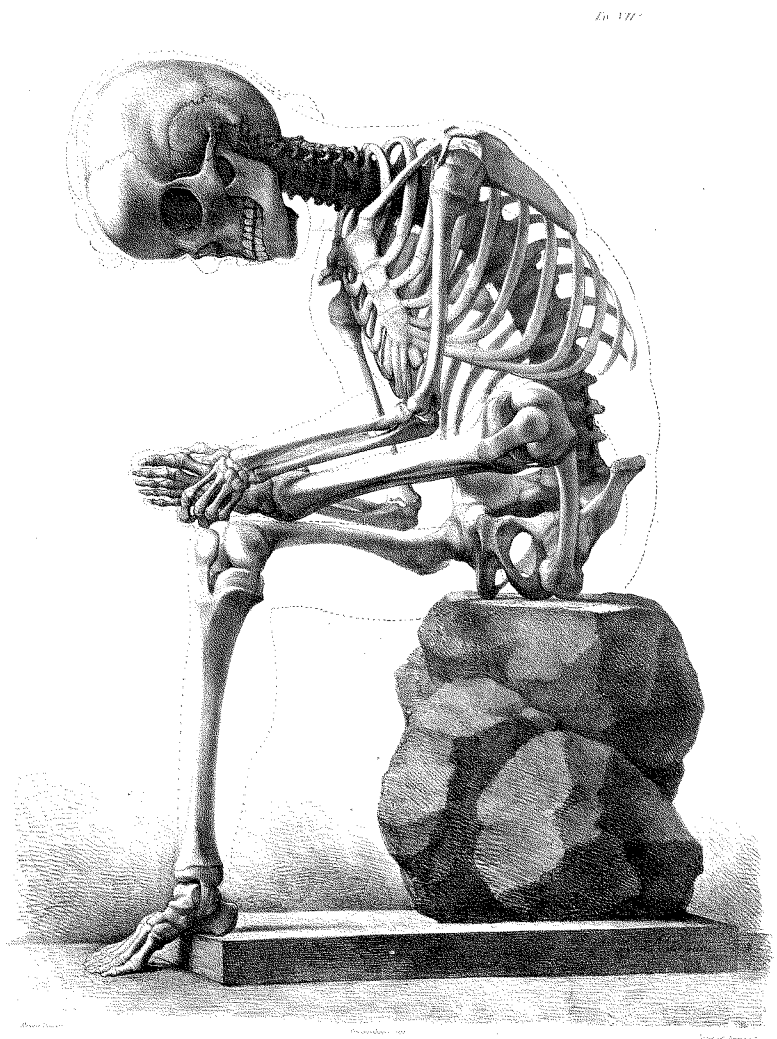
VERTEBRATE CARDS

Elephant	**Monkey**	**Lizard**	**Fish**	**Turtle**
Lion	**Mouse**	**Frog**	**Rabbit**	**Owl**
Horse	**Parrot**	**Gorilla**	**Shark**	**Dog**
Giraffe	**Alligator**	**Hummingbird**	**Bear**	**Toucan**
Rattlesnake	**Woodpecker**	**Peacock**	**Tadpole**	**Human**

TARJETAS DE LOS VERTEBRADOS

Elefante	**Mono**	**Lagartija**	**Pez**	**Tortuga**
León	**Ratón**	**Rana**	**Conejo**	**Búho**
Caballo	**Loro**	**Gorila**	**Tiburón**	**Perro**
Jirafa	**Cocodrilo**	**Colibrí**	**Oso**	**Tucán**
Serpiente de cascabel	**Pájaro carpintero**	**Pavo real**	**Renacuajo**	**Ser humano**

Introduction to
THE HUMAN BODY



BACKGROUND INFORMATION—THE HUMAN BODY

In the animal kingdom, humans are classified as mammals. We are grouped with apes, monkeys, and lemurs in the scientific class *Primates*. Like the bodies of other animals, human bodies are made of cells. Specialized cells make up tissues and organs and groups of organs work together in integrated and organized ways to form **body systems**. Together, the body systems of a human being form a complex and fascinating example of adaptation.

Skin

Our **skin** is the largest organ of the human body. It is not technically part of another body system. An adult has about 20 square feet of skin. It is only three millimeters thick, but acts as a first barrier to heat or cold, bacteria, irritants, allergens, and other dangers from the outside world. Skin also acts as a sensory organ, alerting us to stimuli through our sense of touch.

Skin is made up of two distinct layers. The outer layer is the thinnest and is called the **epidermis**. The epidermis is only about as thick as a sheet of paper. The cells of the epidermis "live" for about 30 days and new cells are constantly added as the older cells dry up and slough off. In fact, the epidermis makes about one and a half million new cells every hour!

The inside layer, the **dermis**, contains blood vessels, nerves, oil and sweat glands. It is 15 to 40 times thicker than the epidermis layer. Together, the two layers help retain body moisture and keep dangerous substances from entering the body.

The sweat glands in the skin help to regulate body temperature. As our bodies heat up, the sweat glands produce sweat on our skin. When it evaporates into the air, heat is lost, cooling the body. In the sunlight, the cells of the skin also make Vitamin D. Vitamin D helps our body absorb the calcium we need for healthy bones.

Skeletal system

Our hard, supportive **skeletal system** is made of bone. Bone is living tissue that is constantly being renewed. It is made up of tiny blood vessels and calcium that requires oxygen and nutrients to supply its cells with energy for growth and maintenance. Oxygen is carried to all parts of the body on special cells called **red blood cells**, which are produced in the bone **marrow** in the center of large bones.

In addition to supporting our bodies and producing red blood cells, bones protect internal organs from impacts. For example, our skull protects our brain and our ribs protect our lungs and heart. Bones also act as levers for our muscles to attach to for movement.

Adults have 206 bones, most of which are found in the hands, wrists, feet, and ankles. Babies are born with about 300 bones, but as they grow, some of the small bones fuse together to form larger bones.

Muscles

Human beings have more than 600 **muscles**. They are a part of every other system in the body. Muscles are organs made up of long, thin cells called muscle fibers. When groups of muscle fibers contract, the whole muscle contracts, causing nearby body parts to move. As muscles are used, they become larger and stronger. Without exercise, they become smaller and weaker.

A single muscle fiber can only contract for a short period. As you work and use a muscle, the muscle fibers take turns contracting. This way, the whole muscle can work for a longer period of time. Still, the muscle will eventually tire and will not contract as easily and efficiently as when the muscle is rested. This is called **muscle fatigue**. Once a muscle is fatigued, it will need to be rested before working effectively again.

There are two groups of muscles: **voluntary muscles** and **involuntary muscles**. Voluntary muscles are those that are under our control. The muscles that move our arms and legs are examples of voluntary muscles. Involuntary muscles cannot be consciously controlled. They work all the time, every day of our lives. The muscles in our heart, stomach, and intestines are involuntary muscles.

Digestive system

The major organs involved in **digestion** are the mouth, the stomach, and the small intestine. There are two types of digestion: mechanical digestion and chemical digestion. **Mechanical digestion** is simply the physical breaking apart of a substance into smaller particles. **Chemical digestion** changes the chemical make-up of the substance by breaking it into its simpler chemical components.

The mouth functions in both mechanical and chemical digestion. When we chew, the teeth break apart the food mechanically. The saliva begins the chemical process of breaking down starches. The stomach also continues to break apart food mechanically by churning it with involuntary muscle contractions. The food continues to be broken down chemically in the stomach and the small intestine. The stomach contains **hydrochloric acid** (HCl) and a special chemical called **pepsin**. Together, HCl and pepsin chemically break down protein in the stomach. It is in the small intestine where nutrients are absorbed into the bloodstream and carried to the other cells in the body.

The simple components that result from the digestion of food are **nutrients**. There are six categories of nutrients: carbohydrates, fats, proteins, vitamins, minerals and water.

Carbohydrates are the main source of energy for cells. Carbohydrates are made of carbon, oxygen, and hydrogen. They are available in the form of sugar, starch and plant fiber.

Fats are important sources of energy. In large quantities, however, they can contribute to obesity and heart problems.

Proteins are made up of **amino acids**. Amino acids are simple compounds of carbon, oxygen, hydrogen and nitrogen. There are 22 amino acids necessary for human life. Fourteen of these can be made in the human body. However, eight must be consumed in food.

Vitamins are organic compounds available in the food we eat. No single food contains all the vitamins we need for a healthy body, so we need to eat a variety of foods from all the food groups.

Minerals are inorganic chemical elements such as phosphorous, potassium, and calcium that are essential to proper body functions. Minerals help send nerve messages, carry oxygen to cells, and are important for muscle contraction.

Water is necessary for life. All the body's chemical reactions take place in water. Since water is constantly leaving the body when we breathe, sweat, or urinate, it is necessary to drink fluids throughout the day. However, many of the foods we eat also contain water.

Some nutrients, like vitamins and minerals, are needed to help the cells function properly. Other nutrients, like carbohydrates, fats, and proteins, combine with oxygen to produce energy. The amount of energy a nutrient can produce is measured in **calories**. For example, one gram of fat provides about 9.0 calories of energy. Proteins and carbohydrates provide about 4.9 calories of energy per gram.

Respiratory system

The **respiratory system** includes the nose, mouth, trachea, lungs, and diaphragm. The function of the respiratory system is to obtain oxygen from the air we breathe. Oxygen is used in the cells to help make energy. The **diaphragm** is a large muscle just beneath the chest cavity. When we breathe in, the diaphragm muscle contracts and opens the lungs. This action brings air into the lungs through the nose and mouth, via the wind pipe, or **trachea**. When the diaphragm muscle relaxes, air is expelled to the outside through the trachea, mouth and nose.

In the lungs, there are many tiny, "dead-end" passageways lined with blood vessels. These passageways are called **alveoli**. Just like the oxygen diffusing across a frog's thin, moist skin, the oxygen diffuses across the thin walls of the alveoli into the blood vessels. These blood vessels, called **pulmonary veins**, carry the oxygen from the lungs to the heart to be pumped to the rest of the body.

Blood is carried from the heart to the lungs via different blood vessels called **pulmonary arteries**. In the lungs, carbon dioxide is released and oxygen is picked up, then delivered to the rest of the body by other arteries (see below).

Circulatory system

The **circulatory system** is the "transportation system" for all the substances in the body, including oxygen, nutrients, and carbon dioxide waste. The circulatory system takes oxygen and nutrients to the cells for **respiration**. It also carries the waste products, formed during the chemical reaction of respiration, away from the cells.

The circulatory system is made up of the **heart** and **blood vessels**. The heart is a muscle that pumps the blood through the body. The heart is divided into four cavities, or chambers, through which blood circulates. The human body has about 70,000 miles of blood vessels. Blood vessels that carry blood away from the heart are called **arteries** and blood vessels that carry blood to the heart are called **veins**. The pulmonary arteries that travel from the heart to the lungs carry little oxygen. The pulmonary veins that travel to the heart from the lungs are rich in oxygen. When the oxygen-rich blood arrives at the heart, the heart pumps this blood to the rest of the body through **systemic arteries**. Blood that passes by respiring cells picks up waste carbon dioxide. This oxygen-poor blood returns to the heart in **systemic veins**. It is then pumped to the lungs so the carbon dioxide can be expelled.

There are several components that make up human blood. About 60% of blood is watery **plasma** that carries the blood's other components through the blood vessels. Blood is also made up of **red blood cells**, **white blood cells**, and **platelets**. Red blood cells contain **hemoglobin** and carry oxygen and carbon dioxide throughout the circulatory system. White blood cells are part of the immune system and help fight infections. Platelets help clot blood when there is a break in a blood vessel, such as a cut in the skin.

Nervous system

The **brain** is made up of millions of cells, which together control the whole human body. The brain sends and receives messages through a network of nerves. The **spinal cord** is the conduit for many of the nerves that go to and from the brain. The eyes, ears, nose, skin, and the tongue sense various changes and send that information by way of the nerves to the brain. The message travels through the nerves at 350 feet per second, allowing the brain to quickly receive the information and react quickly. Overall, the human body has over 10 billion nerve cells that cover every part of the body.

INTRODUCCIÓN AL ESTUDIO DEL CUERPO HUMANO

En el reino animal, los seres humanos están clasificados como mamíferos. Estamos agrupados junto con los simios, los monos y los lémures en la clase científica de los *Primates*. Al igual que el cuerpo de otros animales, el cuerpo humano está compuesto por células. Las células especializadas forman tejidos y órganos y los grupos de órganos funcionan juntos de una manera integrada y organizada constituyendo los **sistemas del cuerpo**. En conjunto, los sistemas del cuerpo de un ser humano reflejan un complejo y fascinante ejemplo de la adaptación.

Piel

La **piel** es el órgano de mayor tamaño del cuerpo humano. Técnicamente, no forma parte de ningún otro sistema corporal. Un adulto tiene aproximadamente 20 pies cuadrados de piel. La piel tiene sólo tres milímetros de grosor pero actúa como defensa inicial ante el frío o el calor, bacterias, irritantes, alergenos y otros peligros del mundo externo. La piel también actúa como un órgano sensorial. A través del sentido del tacto, percibimos los distintos estímulos.

La piel está formada por dos capas diferentes. La capa externa es la más delgada y se conoce como **epidermis**. La epidermis es tan delgada como una hoja de papel. Las células de la epidermis “viven” alrededor de 30 días. Constantemente se están produciendo nuevas células a medida que las más antiguas se secan y degradan. Más aún, ¡la epidermis produce alrededor de un millón y medio de células por hora!

La capa interna de la piel, llamada **dermis**, contiene vasos sanguíneos, nervios y glándulas sebáceas y sudoríparas.Tiene un grosor entre 15 y 40 veces mayor que la epidermis. En conjunto, las dos capas ayudan a retener la humedad corporal e impiden que las sustancias peligrosas entren al cuerpo.

Las glándulas sudoríparas de la piel ayudan a regular la temperatura del cuerpo. A medida que nuestro cuerpo se calienta, las glándulas sudoríparas producen sudoración en la piel. Cuando la sudoración se evapora en el aire, se pierde calor y se enfría el cuerpo. Las células de la piel también producen vitamina D cuando se exponen a la luz solar. La vitamina D ayuda al cuerpo a absorber el calcio que necesitamos para tener huesos sanos.

Sistema esquelético

El poderoso sostén de nuestro **sistema esquelético** está compuesto por hueso. El hueso es un tejido vivo que se renueva constantemente. Está constituido por pequeños vasos sanguíneos y calcio y necesita oxígeno y nutrientes para proporcionar a sus células la energía necesaria para el crecimiento y mantenimiento. El oxígeno se transporta a todas las partes del cuerpo a través de unas células especiales llamadas **glóbulos rojos**, los cuales se producen en la **médula ósea**, la parte central de los grandes huesos.

Además de actuar como un soporte para el cuerpo y de producir glóbulos rojos, los huesos protegen a los órganos internos de los impactos. Por ejemplo, el cráneo protege al cerebro y las costillas protegen a los pulmones y al corazón. Los huesos también actúan como un sistema de palanca, proporcionando un lugar para la inserción de los músculos y permitiendo el movimiento.

Los adultos tienen 206 huesos, la mayoría de los cuales se encuentran en las manos, las muñecas, los pies y los tobillos. Los bebés nacen con 300 huesos, pero al crecer, algunos de éstos se fusionan formando huesos más grandes.

Músculos

El cuerpo humano tiene más de 600 **músculos**. Ellos forman parte de otro sistema del cuerpo. Los músculos son órganos compuestos por células largas y delgadas llamadas fibras musculares. Cuando los grupos de fibras musculares se contraen, todo el músculo se contrae haciendo que las distintas partes del cuerpo de muevan. Cuando los músculos se utilizan, éstos crecen y se fortalecen. Sin ejercicio, se achican y se debilitan.

Una sola fibra muscular se puede contraer únicamente por un corto período de tiempo. Cuando trabajamos y usamos un músculo, las fibras musculares se turnan para contraerse. De esta manera, todo el músculo puede trabajar por un período de tiempo más prolongado. Pero aún así, el músculo finalmente se cansará y no se contraerá tan fácilmente y eficazmente como cuando está descansado. Esto se llama **fatiga muscular**. Una vez que un músculo se ha fatigado, necesitará descansar para poder trabajar de nuevo de una manera eficaz.

Existen dos grupos de músculos: los **músculos voluntarios** y los **músculos involuntarios**. Los músculos voluntarios son aquellos que están bajo nuestro control.

Los músculos que mueven los brazos y las piernas son ejemplos de músculos voluntarios. Los músculos involuntarios no pueden controlarse conscientemente. Ellos trabajan todo el tiempo, todos los días de nuestra vida. Los músculos del corazón, del estómago y de los intestinos son músculos involuntarios.

Sistema digestivo

Los principales órganos involucrados en la **digestión** son la boca, el estómago y el intestino delgado. Existen dos tipos de digestión: la digestión mecánica y la digestión química. La **digestión mecánica** consiste simplemente en fragmentar una sustancia en partículas más pequeñas. La **digestión química** cambia la composición química de estas sustancias degradándolas a sus componentes químicos más simples.

La boca tiene una función tanto en la digestión mecánica como en la química. Cuando masticamos, los dientes desmenuzan los alimentos mecánicamente. La saliva empieza el proceso químico de degradación de almidones. El estómago también continúa descomponiendo los alimentos mecánicamente revolviéndolos con las contracciones de los músculos involuntarios. Los alimentos siguen descomponiéndose químicamente en el estómago y en el intestino delgado. El estómago contiene **ácido clorhídrico** (HCl) y una sustancia química especial llamada **pepsina**. Juntos, el HCl y la pepsina degradan químicamente las proteínas en el estómago. En el intestino delgado, los nutrientes se absorben hacia los vasos sanguíneos y son transportados a otras células del cuerpo.

Los componentes simples que se obtienen de la digestión de los alimentos son los **nutrientes**. Existen seis categorías de nutrientes: carbohidratos, grasas, proteínas, vitaminas, minerales y agua.

Los **carbohidratos** son la principal fuente de energía para las células. Los carbohidratos están compuestos por carbono, oxígeno e hidrógeno. Se encuentran en forma de azúcar, almidón y en las fibras de las plantas.

Las **grasas** son una importante fuente de energía. Sin embargo, en grandes cantidades contribuyen a la obesidad y a los problemas cardíacos.

Las **proteínas** están compuestas por aminoácidos. Los aminoácidos son combinaciones simples de carbono, oxígeno, hidrógeno y nitrógeno. Existen 22 aminoácidos necesarios para la vida humana. Catorce de éstos pueden ser producidos en el cuerpo humano. Sin embargo, ocho deben ser ingeridos a través de los alimentos.

Las **vitaminas** son compuestos orgánicos que se encuentran en los alimentos que ingerimos. No existe ningún alimento que contenga todas las vitaminas que necesitamos para tener un cuerpo sano, por lo tanto debemos ingerir una variedad de alimentos de todos los grupos alimentarios.

Los **minerales** son elementos químicos inorgánicos, tales como el fósforo, el potasio y el calcio, los cuales son esenciales para las funciones corporales apropiadas. Los minerales ayudan a enviar mensajes a través de los nervios, transportan oxígeno a las células y son importantes para la contracción muscular.

El **agua** es necesaria para la vida. Todas las reacciones químicas del cuerpo involucran la presencia de agua. Debido a que el cuerpo está perdiendo agua constantemente cuando respiramos, transpiramos u orinamos, es necesario beber líquidos durante el día. Sin embargo, muchos de los alimentos que ingerimos también contienen agua.

Algunos nutrientes, como las vitaminas y los minerales, son necesarios para ayudar a que las células funcionen adecuadamente. Otros nutrientes, como los carbohidratos, las grasas y las proteínas, se combinan con oxígeno para producir energía. La cantidad de energía que un nutriente puede producir se mide en calorías. Por ejemplo, un gramo de grasa proporciona aproximadamente 9.0 calorías de energía. Las proteínas y los carbohidratos proporcionan alrededor de 4.9 calorías de energía por gramo.

Sistema respiratorio

El **sistema respiratorio** incluye la nariz, la boca, la tráquea, los pulmones y el diafragma. La función del sistema respiratorio es captar oxígeno desde el aire que respiramos. Las células utilizan el oxígeno para producir energía. El **diafragma** es un músculo grande que se encuentra en la parte inferior de la cavidad torácica. Cuando inspiramos, el diafragma se contrae y expande los pulmones. Esta acción permite que el aire pase a los pulmones a través de la nariz, de la boca y del tubo respiratorio o **tráquea**. Cuando el diafragma se relaja, el aire se expele hacia afuera, a través de la tráquea, de la boca y de la nariz.

En los pulmones, existen muchos pequeños "sacos" rodeados de vasos sanguíneos. Estos sacos se llaman **alvéolos**. De la misma manera que el oxígeno se difunde a través de la piel delgada y húmeda de una rana, el oxígeno se difunde a través de las delgadas paredes de los alvéolos hacia los vasos sanguíneos. Estos vasos sanguíneos, llamados **venas pulmonares**, transportan el oxígeno desde los pulmones hacia el corazón donde será bombeado al resto del cuerpo.

La sangre es transportada desde el corazón hacia los pulmones a través de diferentes vasos sanguíneos llamados **arterias pulmonares**. En los pulmones, se libera dióxido de carbono y se capta oxígeno, el cual se distribuye al resto del cuerpo a través de las arterias (vea le descripción que sigue).

Sistema circulatorio

El **sistema circulatorio** es el “sistema de transporte” para todas las sustancias en el cuerpo, incluyendo el oxígeno, los nutrientes y los desechos de dióxido de carbono. El sistema circulatorio capta oxígeno y nutrientes para la **respiración** de las células. Además, transporta los productos de desecho provenientes del interior de las células, resultantes de la reacción química de la respiración.

El sistema circulatorio está compuesto por el **corazón** y los **vasos sanguíneos**. El corazón es un músculo que bombea la sangre a través del cuerpo. El corazón está dividido en cuatro cavidades o cámaras, a través de las cuales circula la sangre. El cuerpo humano tiene aproximadamente 70,000 millas de vasos sanguíneos. Los vasos sanguíneos que transportan sangre desde el corazón se llaman **arterias** y los vasos sanguíneos que transportan la sangre hacia el corazón se llaman **venas**. Las arterias pulmonares que llevan sangre desde el corazón hacia los pulmones transportan muy poco oxígeno. Las venas pulmonares que llevan sangre desde los pulmones hacia el corazón son ricas en oxígeno. Cuando la sangre rica en oxígeno llega al corazón, éste la bombea al resto del cuerpo a través de las **arterias sistémicas**. La sangre que pasa cerca de las células que están respirando, capta los desechos de dióxido de carbono. Esta sangre pobre en oxígeno vuelve al corazón a través de las **venas sistémicas**. Entonces es bombeada hacia los pulmones para que el dióxido de carbono se pueda liberar.

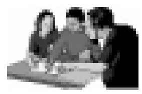
La sangre humana tiene varios componentes. Cerca del 60% de la sangre es un líquido llamado **plasma** que transporta los otros componentes de la sangre a través de los vasos sanguíneos. La sangre también está compuesta por **glóbulos rojos**, **glóbulos blancos** y **plaquetas**. Los glóbulos rojos contienen **hemoglobina** y transportan el oxígeno y el dióxido de carbono a través del sistema circulatorio. Los glóbulos blancos son parte del sistema inmunitario y ayudan a combatir las infecciones. Las plaquetas ayudan a coagular la sangre cuando existe una ruptura de un vaso sanguíneo, como ocurre en una herida de la piel.

Sistema nervioso

El **cerebro** está compuesto por millones de células que en conjunto controlan todo el cuerpo humano. El cerebro envía y recibe mensajes a través de una red de nervios. La **médula espinal** es el conducto por el que circulan muchos nervios hacia y desde el cerebro. Los ojos, los oídos, la nariz, la piel y la lengua perciben estímulos y envían esa información al cerebro a través de los nervios. El mensaje viaja a través de los nervios a 350 pies por segundo, permitiendo que el cerebro reciba y reaccione a la información rápidamente. En total, el ser humano tiene más de 10 billones de células nerviosas distribuidas en todo cuerpo.

THE HUMAN MACHINE

La máquina humana

Grades		
3–8	2 equal groups	45 minutes

Purpose

Students will play a guessing game designed to introduce them to the amazing systems of human beings.

Materials

Teacher Question Sheet
Chalkboard or flip chart paper for scoring.

Concepts

- Body systems are made up of organs that function together.
- Humans have skeletal, digestive, circulatory, nervous, and respiratory systems as well as skin and muscles.
- Skin is an organ that acts as a barrier to the outside world.

Conceptos

- Los sistemas del cuerpo están compuestos por órganos que funcionan en conjunto
- Los seres humanos tienen sistemas esquelético, digestivo, circulatorio, nervioso y respiratorio, así como también piel y músculos.
- Los piel es un órgano que actúa como barrera frente al mundo exterior.

Vocabulary

Organ
Skeletal system
Muscle
Skin
Digestive system
Respiratory system
Circulatory system
Nervous system

Vocabulario

Órgano
Sistema esquelético
Músculo
Piel
Sistema digestivo
Sistema respiratorio
Sistema circulatorio
Sistema nervioso

In Advance

Draw two columns on the chalkboard or flip chart paper to form a scoreboard. Label one column "Team 1" and the second column "Team 2."

Procedure

1. *Introduce the game and divide class into teams*

Begin by telling students that over the next several days (or weeks) they will be learning about different systems in the human body. Each system is made up of a group of **organs** that works together to keep the body functioning properly. Using the background information for this section, briefly discuss the **skeletal system**, the **muscles**, the **skin**, the **digestive system**, the **respiratory system**, the **circulatory system**, and the **nervous system**. Tell students that they will be playing a guessing game to introduce them to some interesting facts about these organs and **body systems**.

Divide the class into two teams (Team 1 and Team 2) and have the members of each team sit together. Explain that you will begin by asking Team 1 a question. If they answer it correctly, they get a point. If they answer it incorrectly, the other team will have a chance to answer the question. Alternate between the two teams until one team answers the question correctly and gets a point. For the next question, start with Team 2 and alternate teams with each new question.

2. *Play the game*

Using the Teacher Question Sheet, begin the game. Give the teams a few moments to discuss the question before answering. Keep track of correct answers using the "scorecard." If the teams are having a difficult time with a particular question, you may give them a hint about the answer. The team with the most points at the end wins.

Extensions

Divide the class into seven teams and assign each team a different body system (skin, skeletal system, the muscles, circulatory system, respiratory system, nervous system, or digestive system). Have each team find five more interesting facts about "their" body system. Either ask each team to share their findings with the class or develop questions for the rest of the class to answer.

References

Bosak, Susan V. Science Is...A Source Book of Fascinating Facts, Projects, and Activities. Markham, Ontario, Canada: Scholastic Canada, 1991.

Berger, Melvin and Gilda. Why Don't Haircuts Hurt? New York, NY: Scholastic Inc., 1998.

TEACHER QUESTION SHEET

1. Are you shorter in the morning or at the end of the day? (At the end. The separate bones that make up your backbone are squished together by gravity throughout the day. You may be one inch shorter at the end of the day!)

2. The right side of the brain controls which side of the body? (The left side. The nerve fibers cross over in the brain.)

3. The human body contains 650 of these. (Muscles.)

4. Which facial expression uses more muscles – a smile or a frown? (To make a frown you use 43 muscles. A smile only takes 17 muscles.)

5. Why can't you breathe and swallow at the same time? (Because the throat and nose share the same tube. When you swallow, the tube closes and you can't breathe.)

6. An adult person has 206 of these. (Bones.)

7. The hardest part of the human body is what? (The enamel on your teeth.)

8. Over the average lifetime, the human body does this nearly 3 billion times. (The heart beats.)

9. People who exercise a lot have a faster or slower heartbeat than those who don't exercise when they are resting? (Slower. A healthier heart can pump the same amount of blood with fewer heartbeats.)

10. Everyday we take in more of this than food or water. (Oxygen from the air.)

11. Where are the smallest bones in your body? (In your ears. They are the hammer, anvil, and stirrup bones.)

12. If you made a rope with 10,000 of these, it would be strong enough to lift a car. (Your hair.)

TEACHER QUESTION SHEET (cont.)

13. What is the biggest organ of the body? (The skin.)

14. Name one of the two places where your skin is the thinnest. (The lips or eyelids.)

15. Every year you grow 7 miles of what? (Hair.)

16. Most of the dust in your house comes from what part of your body? (Your skin. 50,000 bits of dead skin cells fall off every minute.)

17. Which two parts of your body have no hair? (The palms of your hands and the soles of your feet.)

18. Which part of an adult's body has 27 bones? (The hand.)

19. Which muscles do you use the most? (The muscles of the eye.)

20. Does your hair grow faster in the summer or in the winter? (The summer because your circulation speeds up in warmer weather.)

21. Who has more bones – an adult or a baby? (Babies have about 300 bones while adults have 206. Some of the bones in a baby fuse to form larger bones as they grow.)

22. When you do this, air comes out of your mouth at 100 miles per hour. (Sneeze.)

23. Which of your bones is the largest? (The thigh bone, or femur.)

24. A signal can travel 350 feet a second on what kind of cell? (A nerve cell.)

CUESTIONARIO DEL MAESTRO

1. ¿Cuándo eres más bajo, en la mañana o al final del día? (Al final del día. Los huesos que componen la columna vertebral se comprimen por la gravedad durante el día. Al final del día puedes medir una pulgada menos.)

2. ¿Qué lado del cuerpo controla el lado derecho del cerebro? (El lado izquierdo. Las fibras nerviosas se cruzan en el cerebro.)

3. El cuerpo humano contiene 650 ________. (Músculos)

4. ¿En cuál expresión facial se utilizan más músculos: al sonreír o al hacer un gesto de enojo? (Al hacer un gesto de enojo utilizas 43 músculos. Para sonreír sólo usamos 17 músculos.)

5. ¿Por qué no puedes respirar y tragar al mismo tiempo? (Porque la garganta y la nariz comparten el mismo tubo. Cuando tragas, el tubo se cierra y no puedes respirar.)

6. Una persona adulta tiene 206 __________. (Huesos)

7. ¿Cuál es la parte más dura del cuerpo humano? (El esmalte de los dientes.)

8. Durante una vida promedio, el ____________ aproximadamente 3 billones de veces. (Corazón late.)

9. Al estar en reposo, ¿las personas que realizan ejercicio tienen una frecuencia cardíaca más rápida o más lenta que aquellas que no realizan ejercicio? (Más lenta. Un corazón sano puede bombear la misma cantidad de sangre con unos pocos latidos.)

10. Todos los días consumimos más ______________ que alimentos o agua. (Oxígeno del aire.)

11. ¿Dónde se encuentran los huesos más pequeños del cuerpo? (En los oídos. Ellos son el martillo, el yunque y el estribo.)

CUESTIONARIO DEL MAESTRO (cont.)

12. Si fabricas una cuerda con 10,000 __________, sería lo suficientemente fuerte como para levantar un automóvil. (Pelos)

13. ¿Cuál es el órgano más grande del cuerpo? (La piel.)

14. ¿Nombra uno de los dos lugares donde la piel es más delgada. (Los labios o los párpados.)

15. Cada año produces 7 millas de ________. (Pelo)

16. La mayoría del polvo que encuentras en tu hogar proviene de una parte de tu cuerpo. ¿Cuál es? (La piel. Cada minuto caen 50,000 células de piel muerta.)

17. ¿Cuáles son las dos partes del cuerpo que no tienen pelo? (Las palmas de las manos y las plantas de los pies.)

18. ¿Qué parte del cuerpo de un adulto tiene 27 huesos? (La mano.)

19. ¿Cuáles son los músculos que más usas? (Los músculos del ojo.)

20. ¿Cuándo crece el pelo más rápido, en verano o en invierno? (En verano porque la circulación se acelera en climas calurosos.)

21. ¿Quién tiene más huesos, un adulto o un bebé? (Los bebés tienen alrededor de 300 huesos mientras que los adultos tienen 206. Cuando un bebé crece, algunos de los huesos se fusionan formando huesos más grandes.)

22. Cuando _________, el aire sale de la boca a 100 millas por hora. (Estornudas.)

23. ¿Cuál es el hueso más grande? (El hueso del muslo o fémur.)

24. Una señal a través de una célula puede viajar a 350 pies por segundo. ¿A qué célula nos referimos? (A una célula nerviosa.)

FINGERPRINTS
Huellas digitales

Grades		
2–8	5–8	45 minutes

Purpose

Students will observe the unique characteristics of their fingerprints and compare them with other classmates.

Materials

Black ink pads
5 x 7 index cards (one per student)
Pen or pencil
Scissors
Hand lens (optional)
Fingerprint Pattern Diagram

Concepts

- All humans have some traits that are the same and some that vary from person to person.
- No two people have identical fingerprints.
- Because fingerprints are unique in every person, they can be used to identify an individual.

Conceptos

- Todos los humanos tienen algunas characterísticas similares y otras que varían de persona a persona.
- No hay dos personas que tengan huellas digitales idénticas.
- Debido a que las huellas digitales son únicas para cada persona, éstas se pueden utilizar para identificar a un individuo.

In Advance

Make a copy of the Fingerprint Pattern Diagram for each student.

Procedure

1. Introduce the activity

Begin by asking students which characteristics most people share. Then ask which characteristics no two humans have in common. Fingerprints are one of the characteristics that vary from person to person. Because no two fingerprints are identical, they can be used to identify different people.

2. Set-up

Divide the class into groups of 5-8 students. Smaller groups will work better for younger students. Larger groups will make the activity more challenging for older students.

Give each student an index card and distribute the ink pads. Have them fold the index card in half, then unfold to form two halves. Have them write their name on one side of each half. (If your index cards have lines on one side, have students write their names on that side.) Tell students they will be making a thumb print in each half, then cutting the index card along the fold.

To make the thumb print, instruct students to press the tip of their right thumb onto the surface of the ink pad and check to make sure the ink is on their thumb. Next, roll the thumb from left to right across one half of the card (the side without their name). Immediately lift the thumb straight from the paper so the fingerprint doesn't smear. Have students repeat the same procedure to make a thumb print in the other half. When they are finished, they should wash and dry their hands.

3. Observe fingerprints

Give each student a copy of the Fingerprint Pattern Diagram and distribute the hand lenses, if available. Have students identify the pattern that best matches their fingerprint.

4. Exchange fingerprints and identify

Instruct each group to make a pile of fingerprints using one thumb print from each group member. The names that identify each thumb print should be face down in the pile. Spread the remaining thumb prints on a table in the center of each group. Tell each group member to take a thumb print from the pile without looking at the name written on the back. Now, see if students can find a "match" among the thumb prints spread out on their table. They can use the Fingerprint Pattern Diagram to narrow down the choices, but no peeking at the names! When they think they have a match, they should keep the two thumb prints together. When everyone is finished, students can turn over their cards to see if they have a match. Return the fingerprints to the correct person.

5. *Discuss*

As a class, discuss similarities and differences among the students' fingerprints. Were some very similar? How many students had each type of pattern? Which is the most common pattern of fingerprint in the class? Which pattern is the most unusual?

Questions to Ask During the Activity

1. Why is a fingerprint a good way to identify a person? (Because everyone's fingerprints are unique.)

2. Where else on your body can you find the kinds of skin patterns seen on your fingertips? (On your toes.)

Preguntas sobre el tema de la actividad

1. ¿Por qué una huella digital es una buena manera para identificar a una persona? (Porque las huellas digitales de cada persona son únicas.)

2. ¿En qué otra parte del cuerpo se ve el mismo tipo de configuración que se ve en las huellas digitales? (En los dedos de los pies.)

Why It Happens/More on the Topic

Every organism can be identified by its characteristics or traits. All humans have some traits that are the same, but each individual human also has a set of traits that are different from any other human. Among these individual traits are fingerprints, patterns in the iris of the eye, and voice patterns.

Algo más sobre el tema...

Cada organismo puede ser identificado por sus características o sus rasgos. Todos los humanos tienen algunas características que son iguales, pero también tienen un conjunto de características que son únicas para cada individuo. Entre estas características individuales se encuentran las huellas digitales, la configuración del iris y de la voz.

Modifications

Have younger students (including K-1) work in smaller groups to identify each other's fingerprints. For very young children, help them make one thumb print on the index card and see if they can identify their fingerprint pattern using the Fingerprint Pattern Diagrams, rather than exchanging fingerprints with other classmates.

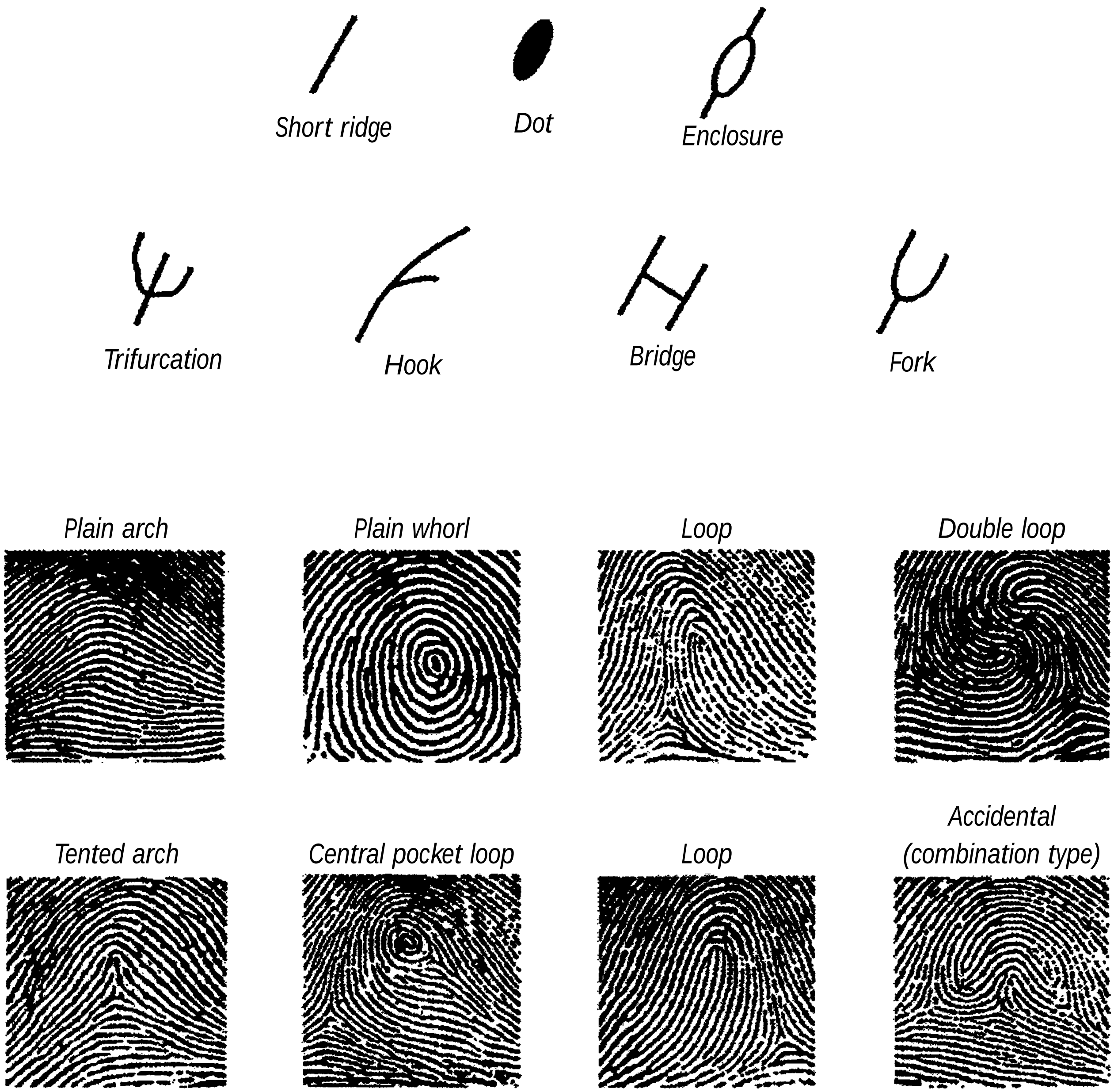
Extensions

Have students hypothesize what their other fingerprints might look like. Will they be similar to their thumb prints? Will they be different than other students' fingerprints? What about their toe prints? Have students make prints of their other fingers and their toes to see if their hypothesis is correct.

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First Edition. Albuquerque, NM, 1996.

FINGERPRINT PATTERN DIAGRAM



PATRÓN DE HUELLAS DIGITALES

Crestas papilares

Varilla

Punto

Encerrada

Trifurcación

Gancho o rama

Puente o crestas cruzadas

Bifurcación

Patrones

Arco común

Espiral o remolino

Curva o lazo

Curva o lazo doble

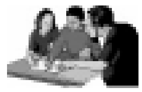
Arco tendido

Isla encerrada en un lazo

Curva o lazo

No estándar o accidental (mixto)

SKELETON SKETCH
Diagrama del esqueleto

Grades		
K–3	*2*	*60 minutes*

Purpose
Students will learn about the bones in the human body by drawing their skeleton into an outline of their own body.

Materials
Large sheets of paper (large enough to make a life-sized silhouette for each of your students)
Markers or crayons
Student Activity Sheet

Concepts
- Bones help support our bodies.
- Bones protect the soft organs inside our body.
- Part of our blood is produced inside the long bones of our body.

Conceptos
- Los huesos nos ayudan a sostener el cuerpo.
- Los huesos protegen a los órganos blandos que están dentro del cuerpo.
- Parte de la sangre se produce dentro de los huesos largos del cuerpo.

Vocabulary
Skeleton
Bones
Organs
Blood

Vocabulario
Esqueleto
Huesos
Órganos
Sangre

In Advance
Cut a large sheet of paper for each student in the class. Make copies of the Student Activity Sheet.

Procedure

1. *Discuss the function of bones*

Ask students if they can think of several reasons why **bones** are important. What would their life be like without bones? Mention that bones support our bodies, protect the soft **organs** inside, and produce a very important component of our **blood**—red blood cells.

2. *Draw silhouettes*

Divide the class into groups of two. Give each student a large piece of paper and a marker or crayon. Tell the class that one person in each pair will lay down on the sheet of paper and their partner will carefully outline their body. When they are finished, have the pairs trade roles using a new sheet of paper. Be sure students write their names on their paper.

3. *Draw skeletons*

Give each student a copy of the Student Activity Sheet. Explain that you have given them a diagram of a human **skeleton**. The bones they see on the paper are also in their body. Give students markers or crayons and have them draw the bones in the appropriate places on their silhouette. Give them plenty of time to draw their skeletons.

4. *Discuss*

Hang the skeleton drawings on the wall. Ask students what they discovered when they were drawing their bones. What part of the body does the skull protect? What soft body parts are protected by the ribs and pelvic bones? What keeps all the bones together?

Questions to Ask During the Activity

1. How many bones are in the leg? (Four bones. One bone in the thigh, two bones in the lower leg, and the kneecap.)

2. How many bones are in the arm? (Three bones. One bone in the upper arm and two in the lower arm.)

3. Which body parts seem to have the most bones? (The hand, wrist, foot, and ankle.)

4. Which is the longest bone in the body? (The thigh bone.)

5. Which is the smallest bone in the body? (The three tiny bones inside the ear. They are so small that they don't even show up on the diagram.)

Preguntas sobre el tema de la actividad

1. ¿Cuántos huesos hay en la pierna? (Cuatro huesos. Un hueso en el muslo, dos huesos en la parte inferior de la pierna y la rótula.)

2. ¿Cuántos huesos hay en el brazo? [Tres huesos. Un hueso en el brazo (parte superior) y dos antebrazo (parte inferior).]

3. ¿Qué partes del cuerpo tienen más huesos? (La mano, la muñeca, el pie y el tobillo.)

4. ¿Cuál es el hueso más largo del cuerpo? (El hueso del muslo.)

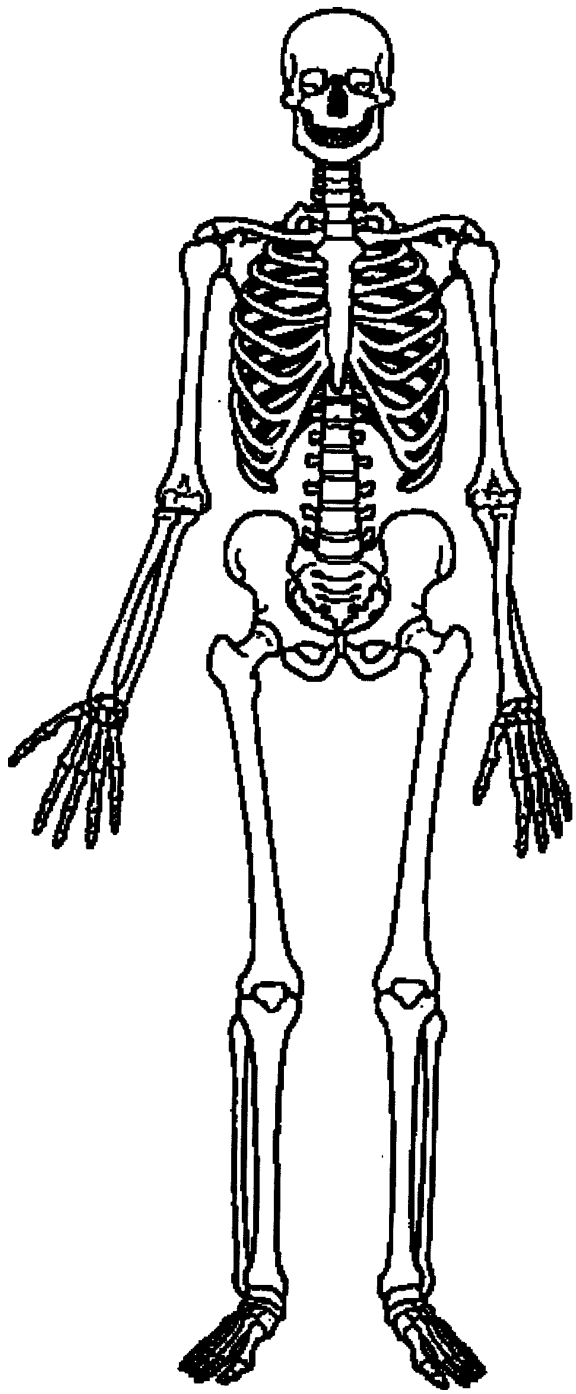
5. ¿Cuál es el hueso más pequeño del cuerpo? (Los tres huesos dentro del oído. Son tan pequeños que incluso no aparecen en el diagrama.)

Extensions

Have students draw the silhouettes again, but instead of drawing their bones, have them draw their internal organs. Discuss the function of each organ when they are finished.

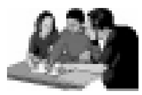
STUDENT ACTIVITY SHEET

Skeleton Sketch/Diagrama del esqueleto



MUSCLES—VOLUNTARY AND INVOLUNTARY

Músculos—voluntarios e involuntarios

Grades		
2–8	2	45 minutes

Purpose

Students will discover if eye blinking is voluntary, involuntary, or both, then determine if blinking has a protective purpose.

Materials

Watch or clock with second hand
Student Activity Sheet
Cotton balls
Plastic wrap, 30cm x 30 cm (one for each pair of students)

Concepts

- Voluntary muscles are muscles that are under our control.
- Involuntary muscles are muscles that are not under our control.
- The muscles of the eyelids are both voluntary and involuntary.
- Eyelid muscles work involuntarily to protect the eyes when somehting is coming towards them suddenly.

Conceptos

- Los músculos voluntarios son los músculos que están bajo nuestro control.
- Los músculos involuntarios son los músculos que no están bajo nuestro control.
- Los músculos de los párpados son tanto voluntarios como involuntarios.
- Los músculos de los párpados actúan involuntariamente para proteger al ojo de amenazas repentinas.

Safety

Plastic wrap should be held away from the face, not on it.

Vocabulary

Involuntary
Voluntary

Vocabulario

Involuntario
Voluntario

In Advance

Make copies of the Student Activity Sheet. Cut pieces of plastic wrap.

Procedure

1. *Introduce the activity*

Explain the differences between **involuntary** and **voluntary** muscles. Ask students if they think the muscles of the eyelid are involuntary or voluntary. Do they have to remind themselves to blink? Can they stop themselves from blinking? Tell them they will be doing three short experiments to determine if the muscles of the eye are voluntary, involuntary, or both.

2. *Procedure for Part A*

Divide students into pairs and give each student a copy of the Student Activity Sheet. Explain that they will be entering their data into the chart for Part A.

Have one student in each pair observe his/her partner's eyes for a minute at a time to see how often the partner blinks. The partner should not try to increase or decrease the number of blinks, but should blink naturally. The other student will be counting the number of blinks in one minute. Using a stop watch or clock, tell students when to begin and end counting. Have them record the number of blinks on the Student Activity Sheet. Repeat the procedure three more times, then total and average the number of blinks and record the information on the Student Activity Sheet. Switch roles and have the pairs repeat the procedure.

3. *Procedure for Part B*

Have one student in each pair look at his/her partner's eyes again. This time the partner should try to hold his/her eyes open as long as possible while you count the number of seconds that pass. When the partner finally blinks, that number of seconds should be recorded on the Student Activity Sheet in Part B. Again, have each pair of students switch roles, repeat the procedure, and record the results. Students should be aware of how their eyes feel after they have held them open as long as possible.

4. *Procedure for Part C*

Give each pair of students a piece of the plastic wrap and a cotton ball. One student in each pair should hold the plastic wrap in front of their eyes, but it should NOT TOUCH THE FACE. Have the partner throw the cotton ball towards the plastic. The student with the plastic should try not to blink as the cotton ball comes towards him/

her. On the Student Activity Sheet, have students record whether or not there was a blink in response to the cotton ball. Have students repeat this procedure six times, and then switch roles.

Questions to Ask During the Activity

1. Does your data from Part A show that blinking is voluntary or involuntary? (Answers may vary. Students may notice that they are blinking voluntarily or involuntarily.)

2. Does your data from Part B show that blinking is voluntary or involuntary? (Students probably found out that they could control their blinking for a while, and then blinked involuntarily.)

3. Describe how your eyes felt after not blinking in Part B. (Probably students will describe their eyes as feeling dry or gritty.)

4. Does your data from Part C show that blinking is voluntary or involuntary? (Most students would have blinked at least once in response to the cotton ball coming towards them. They might correctly conclude that blinking is both voluntary and involuntary.)

5. How does blinking protect your eyes? (Blinking moistens the eyes and protects them from objects that can be harmful.)

6. What other body system is involved when your eyes blink? (The nervous system. A message travels to and from your brain when your muscles work.)

Preguntas sobre el tema de la actividad

1. Según tus datos de la Parte A, ¿es el parpadeo voluntario o involuntario? (Las preguntas pueden variar. Los estudiantes pueden notar que están parpadeando voluntaria o involuntariamente.)

2. Según tus datos de la Parte B, ¿es el parpadeo voluntario o involuntario? (Probablemente, los estudiantes descubrieron que pueden controlar el parpadeo por un tiempo y que luego parpadean involuntariamente.)

3. Describe cómo sentiste los ojos después de no parpadear durante la actividad de

Preguntas (continuación)

la Parte B. (Probablemente los estudiantes describirán que sienten los ojos secos o arenosos.)

4. Según tus datos de la Parte C, ¿es el parpadeo voluntario o involuntario? (La mayoría de los estudiantes habrá parpadeado por lo menos una vez cuando se acercaba la mota de algodón a los ojos. Es probable que concluyan correctamente que el parpadeo es tanto voluntario como involuntario.)

5. ¿De qué manera el parpadeo protege a los ojos? (El parpadeo humedece los ojos y los protege de objetos que pueden ser peligrosos.)

6. ¿Qué otro sistema del cuerpo está involucrado en el parpadeo de los ojos? (El sistema nervioso. Para que los músculos actúen, es necesario que el cerebro reciba y envíe mensajes.

Why It Happens/More on the Topic

Voluntary muscles are those muscles that are under our control, like leg and arm muscles. Involuntary muscles are not under our control, such as the muscles in our stomach.

Some muscles, like those that close the eyelids, are both voluntary and involuntary. We can decide to open and close our eyelids much of the time, but because it is important to keep our eyes moist and protected, our eyelids also blink involuntarily. The involuntary action of the eyelid muscles enables them to react quickly to sudden stimuli. Our nerves, brain, and muscles work more slowly when we need to think about a reaction consciously, so this involuntary action is more likely to prevent injury.

Algo más sobre el tema...

Los músculos voluntarios son aquellos músculos que están bajo nuestro control, tales como los músculos de las piernas y de los brazos. Los músculos involuntarios no están bajo nuestro control, tales como los músculos del estómago.

Algunos músculos, como los que cierran los párpados, son tanto voluntarios como involuntarios. La mayor parte del tiempo, nosotros podemos decidir si abrimos o cerramos los ojos, pero debido a que es importante mantener los ojos húmedos y

Algo más sobre el tema... (continuación)

protegidos, también parpadeamos involuntariamente. La acción involuntaria de los músculos de los párpados les permite reaccionar rápidamente a estímulos repentinos. Los nervios, el cerebro y los músculos trabajan más lentamente cuando necesitamos pensar concientemente en reaccionar. Por lo tanto, es más probable que la acción involuntaria prevenga el daño.

Modifications

With younger students, only count the number of blinks for each student one time rather than four times. Have them simply record the appropriate numbers for Part A, Part B, and Part C on a sheet of paper rather than using the Student Activity Sheet. Discuss the results as a class.

Extensions

Have students research the three types of muscle tissue: skeletal, smooth, and cardiac. Where are these types of muscles found in the body and what do they do?

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First Edition. Albuquerque, NM, 1996.

STUDENT ACTIVITY SHEET

Muscle Action

PART A

Number of blinks per minute

TRIAL	PARTNER	YOU
1		
2		
3		
4		
Total		
Average (total divided by 4)		

PART B

Time without blinking (in seconds)

	PARTNER	YOU
Seconds without blinking		

PART C

Reaction to cotton balls

TRIAL	PARTNER		YOU	
	Did Blink	**Did Not Blink**	**Did Blink**	**Did Not Blink**
1				
2				
3				
4				
5				
6				
Total				

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Acciones de los músculos

PARTE A

Número de parpadeos por minuto

PRUEBA	COMPAÑERO	TÚ
1		
2		
3		
4		
Total		
Promedio (total dividido por 4)		

PARTE B

Tiempo sin parpadear (en segundos)

	COMPAÑERO	TÚ
Segundos sin parpadear		

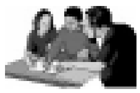
PARTE C

Respuesta a la mota de algodón

PRUEBA	COMPAÑERO		TÚ	
	Parpadeó	**No parpadeó**	**Parpadeó**	**No parpadeó**
1				
2				
3				
4				
5				
6				
Total				

WORKING MUSCLES

Trabajo muscular

Grades		
3–8	2	45–60 minutes

Purpose

Students will investigate the amount of work their muscles can do under various conditions and discover how their bodies react when muscles are working.

Materials

Clock or stopwatch with second hand
Bucket or bowl filled with 1/2 water and 1/2 ice
Steps or sturdy wooden (or plastic) box
Student Activity Sheet

Concepts

- Muscle fatigue occurs when the energy supply to the muscle cells is depleted and waste products have accumulated.
- When muscles are working, they create heat that causes our bodies to warm up and sometimes sweat.
- Aerobic exercise requires oxygen. To get more oxygen around our body, our breathing rate and heart rate increase.
- Anaerobic exercise doesn’t rely on oxygen.
- Muscles work better when they are warm.

Conceptos

- La fatiga muscular se produce cuando se ha agotado el suministro de energía que reciben las células de los músculos y se han acumulado productos de desecho.
- Cuando los músculos están trabajando, producen calor y se eleva la temperatura del cuerpo. Por eso, a veces transpiramos.
- El ejercicio aeróbico requiere oxígeno. Para captar más oxígeno del medio aumentamos la frecuencia respiratoria y la frecuencia cardíaca.
- El ejercicio anaeróbico no depende del oxígeno inhalado.
- Los músculos funcionan mejor cuando están precalentados.

Safety

Do not let students overexert themselves.

Vocabulary

Muscle
Muscle fatigue
Aerobic exercise
Anaerobic exercise

Vocabulario

Músculo
Fatiga muscular
Ejercicio aeróbico
Ejercicio anaeróbico

In Advance

Gather materials and copy Student Activity Sheet.

Procedure

1. *Introduce the activity*

Tell students that they will be doing two experiments to see how **muscles** are affected by work. One experiment will be to find out how long it takes for a muscle to get **fatigued.** In the other, students will investigate how muscles are affected by temperature.

Divide the students into pairs and give each student a copy of the Student Activity Sheet.

2. *Procedure for Part A*

Take students to the steps you will be using or set up the wooden or plastic box that can be used like a step. Working in pairs again, students will be stepping up and down as many times as they can in 20 seconds. The same leg should be used to step up each time and the partner will count how many times the student is able to step up and down. Each number should be recorded on the Student Activity Sheet. Tell students they will be doing 6 trials, and then their partner will repeat the same procedure.

When students are ready, have them begin and keep track of their time using the stopwatch or clock. Remind students not to overexert themselves. When everyone is finished, return to the classroom and discuss what changes they noticed as they did more trials. They probably found that they slowed down the more they exercised, they heated up, their heart rate increased, their breathing increased, and perhaps, they began to sweat.

3. Procedure for Part B

Ask students if they have a hypothesis about whether temperature affects the ability of a muscle to do work. Have them record their hypothesis on the Student Activity Sheet.

Tell students to write their full name on the line provided on the Student Activity Sheet. Have one student in each pair hold his/her hand in the bowl of ice water for one minute. When the minute has passed, have the students immediately write their name on the Student Activity Sheet twice. Repeat the procedure with the other member of the pair. When everyone's hands have warmed up, tell them to write their name one more time on the Student Activity Sheet. Do the signatures look different when their hands were different temperatures? Was it easier to write when their hands were cold or warm?

Questions to Ask During the Activity

1. How did your leg feel at the end of Part A? (It should have been fatigued.)

2. What else did you notice about how your body felt at the end of Part A? (Students may have noticed that they were warmer, they were breathing harder, and their hearts were beating faster.)

3. How did the ice affect the muscles of your hand? (The cold should have made it more difficult to work the muscles of the hand.)

Preguntas sobre el tema de la actividad

1. ¿Cómo sentiste la pierna al final de la Parte A? (Debería sentirse fatigada.)

2. ¿Qué otra cosa sentiste en el cuerpo al final de la Parte A? (Los estudiantes pueden haber notado que la temperatura era mayor, que respiraban con más dificultad y que el corazón latía más rápido.)

3. ¿Cómo afecta el frío del hielo a los músculos de la mano? (El frío debería haber hecho más difícil el trabajo de los músculos de la mano.)

Why It Happens/More on the Topic

Fatigue occurs when the energy supply to the muscle cells has been depleted and waste products have accumulated. The muscle cells are unable to respond to stimuli. During moderate exercise, the blood supplies enough oxygen from inhaled air to provide the muscles with energy. This is known as **aerobic** exercise. Actions that require intense, **anaerobic** exertion, such as weight lifting, draw on sources of energy other than inhaled oxygen.

Muscle action produces heat, which in turn can make you feel hot and sweaty when you exercise. Proper exercise, however, can improve the aerobic capacity of the cardiovascular system and decreases the chance of developing cardiovascular disease.

Algo más sobre el tema...

La fatiga ocurre cuando se agota la energía que se suministra a las células del músculo y se han acumulado productos de desecho. Las células musculares son incapaces de responder al estímulo. Durante el ejercicio moderado, la sangre suministra suficiente oxígeno del aire inhalado para proporcionar energía al músculo. Esto se conoce como ejercicio **aeróbico**. Las acciones que requieren un ejercicio **anaeróbico** intenso, tales como levantar pesas, extraen energía de fuentes diferentes del oxígeno inhalado.

La acción muscular produce calor y por eso puedes sentirse acalorado y sudoroso cuando realizas ejercicio. Sin embargo, el ejercicio apropiado puede mejorar la capacidad aeróbica del sistema cardiovascular y disminuir la posibilidad de padecer enfermedades cardiovasculares.

Modifications

With younger students, have them trace a picture rather then write their names in Part B. They also may need help using the Student Activity Sheet.

Extensions

Are muscles as strong when they are fatigued? Have students design and conduct an experiment to see if muscle fatigue affects the strength of muscle contractions.

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First Edition. Albuquerque, NM, 1996.

STUDENT ACTIVITY SHEET
Working Muscles

PART A

1. Write the number of steps you made during each trial below:

TRIAL	1	2	3	4	5	6
How many steps?						

PART B

1. How do you think temperature affects the way your muscles work?
Write your hypothesis here:

___

___

2. Write your name here:

___

3. After submerging your hand in the ice for one minute, write your name two times below:

___

___

4. After your hand warms again, write your name one more time:

___

5. Was your hypothesis correct?

___

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Trabajo muscular

PARTE A

1. Escribe aquí el número de pasos que diste en cada prueba:

PRUEBA	1	2	3	4	5	6
¿Cuántos pasos?						

PARTE B

1. ¿Cuál crees que es el efecto de la temperatura en el trabajo muscular?
Escribe tu hipótesis a continuación:

____

____

____

2. Escribe tu nombre aquí: ______________________________

3. Sumerge tu mano en el hielo durante un minuto y luego escribe tu nombre dos veces en el espacio a continuación:

____

____

4. Después de que tu mano entre en calor nuevamente, escribe tu nombre una vez más:

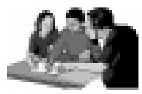
____

5. ¿Era correcta tu hipótesis?

____

PROTEIN DIGESTION

Digestión de proteínas

Grades		
4–8	*4–5*	*55 minutes*

Purpose

Students will investigate the conditions needed for pepsin to break down protein.

Materials

For each group:

- Unflavored gelatin
- Dropper
- 2 small glass jars (or 2 test tubes in a rack)
- Large bowl with cold water (if using glass jars)
- Large drinking glass with cold water (if using test tubes)
- Pepsin powder (available from a biological supply company)
- Diluted hydrochloric acid (HCl) (available from a biological supply company)
- Cold water
- Masking tape
- Marker

For each student:

- Student Activity Sheet

Concepts

- Foods are digested both chemically and mechanically.
- Protein is broken down chemically in the stomach using hydrochloric acid and pepsin.

Conceptos

- Los alimentos se digieren tanto química como mecánicamente.
- Las proteínas se degradan químicamente en el estómago por medio de la acción del ácido clorhídrico y la pepsina.

Safety

Hydrochloric acid should be handled carefully. To keep students from getting a mild skin burn, put the drops of hydrochloric acid in the jars yourself. Wash hands thoroughly afterwards.

Vocabulary

Mechanical digestion
Chemical digestion
Protein
Pepsin
Hydrochloric acid

Vocabulario

Digestión mecánica
Digestión química
Proteína
Pepsina
Ácido clorhídrico

In Advance

Mix the gelatin, using the directions on the package. Pour about 10 milliliters into each jar or test tube. Put the jars aside and don't disturb them until the gelatin sets. Gather the materials and copy the Student Activity Sheet.

Procedure

1. *Discuss digestion*

Ask students if they can describe the digestive process, beginning from the moment food enters their mouth. Describe the difference between **mechanical digestion** and **chemical digestion** and where they take place. Tell students that the chemicals in the mouth begin to digest starches, but the chemical digestion of proteins takes place primarily in the stomach. Today they will be experimenting with the chemicals that break down protein in the stomach.

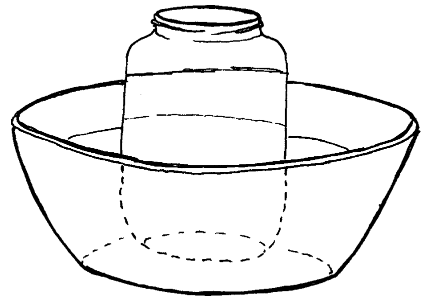
2. *Set-up*

Divide the class into groups of 4 or 5 students. Give each group two jars with the gelatin. Using the marker and tape, have the groups label one jar "pepsin with acid" and the other jar "pepsin without acid." Tell students that gelatin is made from a protein.

To the jars labeled "pepsin with acid" add 10 drops of diluted hydrochloric acid. To all the jars (with or without acid), sprinkle enough pepsin powder to cover the surface of the gelatin. Put the jars into the containers of cold water, but keep the water from entering the jars (or test tubes).

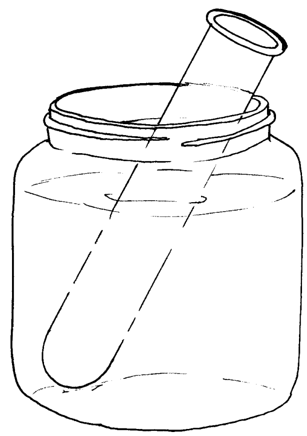
3. Observations

Give each student a copy of the Student Activity Sheet. Have them look at the gelatin in their jars and record their observations on the Student Activity Sheet. At ten minute intervals, have students look at the changes in the jars and record what they see on the Student Activity Sheet.



4. Discuss the data

Ask students what differences they noticed between the jar with acid and the jar without acid. Does pepsin work alone to digest protein in the stomach? Why do they think the jars were placed in the container of water? What might happen if the same two chemicals were used on a piece of meat? A piece of bread?



Questions to Ask During the Activity

1. What is the control in the experiment? (The jar without hydrochloric acid.)

2. What is the variable in the experiment? (The presence of hydrochloric acid.)

Preguntas sobre el tema de la actividad

1. ¿Cuál es el control en el experimento? (El frasco sin ácido clorhídrico.)

2. ¿Cuál es la variable en el experimento? (La presencia de ácido clorhídrico.)

Why It Happens/More on the Topic

In the stomach, pepsin contributes to the chemical digestion of protein. Pepsin is active in the presence of hydrochloric acid. In the jar of gelatin, the pepsin and hydrochloric acid work together to chemically break down the protein. Without the hydrochloric acid, the gelatin changes very little. The cold water keeps the gelatin from becoming a liquid again.

Algo más sobre el tema...

En el estómago, la pepsina contribuye a la digestión química de las proteínas. La pepsina se activa en presencia de ácido clorhídrico. En el frasco con gelatina, la pepsina y el ácido clorhídrico actúan juntos para degradar químicamente las proteínas. Sin el ácido clorhídrico, la gelatina cambia muy poco. El agua fría evita que la gelatina se transforme nuevamente en un líquido.

Modifications

The activity can be done as a demonstration with younger elementary students.

Extensions

Have students develop an experiment to see if protein digestion using pepsin and hydrochloric acid varies with different temperatures. Or, have students use the two chemicals with different types of food (starches, fruit, yogurt, meat, etc.) to see how effective they are.

References

Daniel, Lucy, ed. Merrill Life Science: Laboratory Manual. Teacher Annotated Edition. Columbus, OH: Glencoe Macmillan/McGraw-Hill, 1993.

STUDENT ACTIVITY SHEET
Protein Digestion

1. Record your observations in the chart below:

TIME	PEPSIN WITH ACID	PEPSIN WITHOUT ACID
Beginning		
10 minutes		
20 minutes		
30 minutes		
40 minutes		

2. Describe the changes you observed in the two jars.

3. Based on your observations, what does pepsin need to digest protein?

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
Digestión de proteínas

1. Anota tus observaciones en el cuadro de abajo:

TIEMPO	PEPSINA CON ÁCIDO	PEPSINA SIN ÁCIDO
Comienzo		
10 minutos		
20 minutos		
30 minutos		
40 minutos		

2. Describe los cambios observados en los dos frascos.

3. De acuerdo a tus observaciones, ¿qué necesita la pepsina para digerir proteínas?

HEART RATE AND DRUGS

Frecuencia cardíaca y drogas

Grades		
4–8	*4–5*	*55 minutes*

Purpose

Students will investigate the effects of different drugs on the heart rate of daphnia (water fleas).

Materials

Stop watch or clock with a minute hand
Very dilute solutions of coffee, cola, ethyl alcohol, and cough medicine containing dextromethorphen hydrobromide (Try 1 part drug with 4 parts water for each solution.)
Daphnia culture (enough for 5 animals per group)
Dissecting microscope
4 droppers (one for each solution)
Two large containers (labeled "aged tap water" and "used Daphnia")
Aged tap water (let the water sit undisturbed in a container for a few days)
Well slides
Student Activity Sheet

Concepts

- Stimulants, such as coffee and cola, speed up body functions including heart rate.
- Depressants, such as ethyl alcohol and cough medicine, slow down body functions.

Conceptos

- Los estimulantes, tales como el café y las bebidas cola, aceleran las funciones del cuerpo, incluyendo la frecuencia cardíaca.
- Los depresores, tales como el alcohol etílico y los medicamentos para la tos, reducen las funciones corporales.

Safety

Be sure students don't taste any of the solutions. Review procedures for handling live animals in the classroom.

Vocabulary
Heart rate
Drug
Stimulant
Depressant

Vocabulario
Frecuencia cardíaca
Drogas
Estimulante
Depresor

In Advance
Obtain Daphnia from a biological supply company. Copy Student Activity Sheets. Make dilute solutions of coffee, cola, ethyl alcohol, and cough medicine. Gather other materials.

Procedure
1. *Introduce activity*

Have students put their hands over their heart and ask them to count their heart beats for 15 seconds. Was everyone's **heart rate** the same? Ask students what factors can affect the rate at which their hearts beat. Be sure to mention that some "**drugs**" increase the heart rate and others decrease it. Tell them they will be investigating how different substances affect the heart rate of a tiny crustacean, to see how those same substances might affect humans.

2. *Set-up*

Divide the class into groups of 4 or 5 students. Give each student a copy of the Student Activity Sheet. Distribute slides, droppers, and microscopes to each group.

Have each group use a dropper to place a *Daphnia* onto the slide and observe it under the microscope. Tell students to use the diagram on the Student Activity Sheet to locate the heart on their *Daphnia*. When everyone has found the heart, have a student from each group count the number of times the *Daphnia*'s heart beats in 30 seconds. Use the stop watch or second hand on a clock to tell the students when to start and stop counting. Have students record the number of heartbeats on the Student Activity Sheet.

3. *Predict*

Next, tell students they will be observing how four different drugs affect the *Daphnia*'s heart rate. Have students circle their prediction about whether the drugs are **stimulants** or **depressants** on the Student Activity Sheet.

4. Observe the effects of the drugs on the heart rate

Have students add one drop of the coffee solution to the slide containing the *Daphnia* and wait briefly for the solution to be absorbed by the *Daphnia*. Using the stop watch or clock, have a student in each group count the number of times the heart beats in 30 seconds. (Each student should have at least one chance to count heart beats by the end of the activity.) Tell students to record their number on the Student Activity Sheet.

Using the aged tap water, have students clean the slide by putting the *Daphnia* into the "used Daphnia" container, then rinsing the slide in the "aged tap water."

Repeat the whole procedure using each of the drug solutions. Be sure students count the number of heartbeats for each new *Daphnia* before introducing the drug AND after introducing the drug. Numbers should be recorded on the Student Activity Sheet.

5. Conclusion

For each drug solution, have students determine whether the drug increased (a stimulant) or decreased (a depressant) the heart rate of the *Daphnia*. Were their predictions accurate? Discuss how these same drugs might affect the heart rate in a person.

Daphnia can be saved for other experiments or released.

Questions to Ask During the Activity

1. What was the control in this experiment? (The heart rate of each *Daphnia* before the drug solutions were introduced.)

2. Did the heart rates between each individual Daphnia differ before the drug solutions were introduced? (There probably will be some individual variation just as there is in humans.)

3. How were the *Daphnia* "consuming" the drug solutions? (*Daphnia* are aquatic animals and feed by filtering the water around them.)

4. Which drugs are stimulants? (The coffee and cola speed up the heart rate because they both contain caffeine.)

5. Which drugs are depressants? (The ethyl alcohol and the cough medicine slow

down the heart rate.)

6. How do you think the drugs in this experiment would affect humans? (Generally, the effects on the human heart rate are similar, but it depends on how much of the drug is consumed.)

Preguntas sobre el tema de la actividad

1. ¿Cuál fue el control en este experimento? (La frecuencia cardíaca de cada *Daphnia* antes de administrar las soluciones con drogas.)

2. ¿Era diferente la frecuencia cardíaca de cada *Daphnia* antes de utilizar las soluciones con drogas? (Probablemente existirán algunas variaciones individuales al igual que en los seres humanos.)

3. ¿De qué manera "ingirieron" las soluciones con drogas las *Daphnia*? (Las *Daphnia* son animales acuáticos y se alimentan filtrando el agua que las rodea.)

4. ¿Qué drogas son estimulantes? (El café y las bebidas cola aceleran la frecuencia cardíaca porque ambos contienen cafeína.)

5. ¿Qué drogas son depresoras? (El alcohol etílico y los medicamentos para la tos reducen la frecuencia cardíaca.)

6. ¿Cómo crees que las drogas utilizadas en el experimento afectarían a los seres humanos? (En general, en los seres humanos, el efecto de estas drogas sobre la frecuencia cardíaca es similar al observado en el experimento, pero va a depender de la cantidad de droga que se consuma.)

Why It Happens/More on the Topic

Daphnia, or "water fleas," are small crustaceans that live in freshwater. They are transparent, so it is easy to see their heart working.

Stimulants are substances that cause the body functions to speed up, such as the caffeine in coffee and cola. Depressants are substances that cause the body functions to slow down. The ethyl alcohol and a chemical in many cough medicines act as depressants. The alcohol in alcoholic beverages also acts as a depressant.

Algo más sobre el tema...

Las *Daphnia* o pulgas de agua son pequeños crustáceos que viven en agua fresca. Son transparentes, lo cual facilita la observación del funcionamiento del corazón.

Los estimulantes son sustancias que aceleran las funciones del cuerpo, tales como la cafeína y las bebidas cola. Los depresores son sustancias que reducen las funciones del cuerpo. El alcohol etílico y las sustancias químicas que se encuentran en muchos medicamentos para la tos actúan como depresores. El alcohol de las bebidas alcohólicas también actúa como depresor.

Modifications

If time is limited, divide the class into four groups and have each group use one drug solution on their *Daphnia*. Compare the results of each group to determine which drug solutions are stimulants and which ones are depressants.

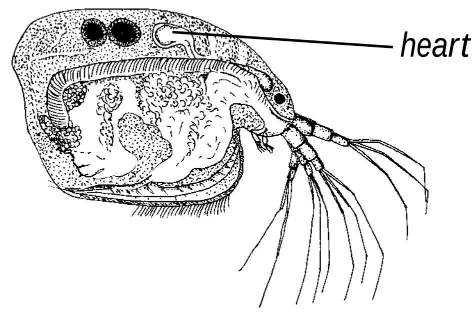
Extensions

Have students repeat the experiment, but this time, have students observe and record how long it takes the *Daphnia*'s heart rate to return to normal after being exposed to the drug solutions. Which drug affected the *Daphnia's* heart rate the longest?

References

Daniel, Luch, ed. Merrill Life Science: Laboratory Manual. Teacher Annotated Edition. Columbus, OH: Glencoe Macmillian/McGraw-Hill, 1993.

STUDENT ACTIVITY SHEET
Heart Rate and Drugs



1. Predictions: Below each drug type, circle whether you think it is a stimulant or depressant:

Coffee	**Cola**	**Ethyl Alchohol**	**Cough Medicine**
Stimulant	Stimulant	Stimulant	Stimulant
Depressant	Depressant	Depressant	Depressant

2. Write the heart rates in the chart below:

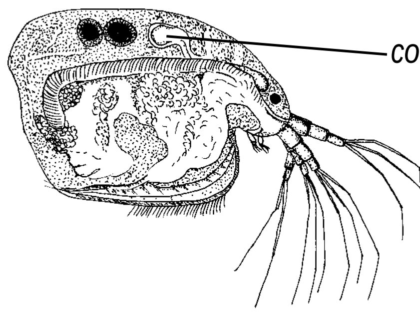
Daphnia 1		**Daphnia 2**		**Daphnia 3**		**Daphnia 4**	
No Drug		No Drug		No Drug		No Drug	
Coffee		Cola		Ethyl Alcohol		Cough Medicine	
Difference=		Difference=		Difference=		Difference=	

3. Were your predictions for each drug solution correct? Why or why not?

4. What was the average heart rate for the four Daphnia before they were exposed to a drug and after they were exposed to the various drugs?

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Frecuencia cardíaca y drogas



1. Predicciones: Debajo de cada tipo de droga, dibuja un círculo alrededor de respuesta correcta (estimulante o un depresor):

Café	Bebida cola	Alcohol etílico	Medicamento para la tos
Estimulante	Estimulante	Estimulante	Estimulante
Depresor	Depresor	Depresor	Depresor

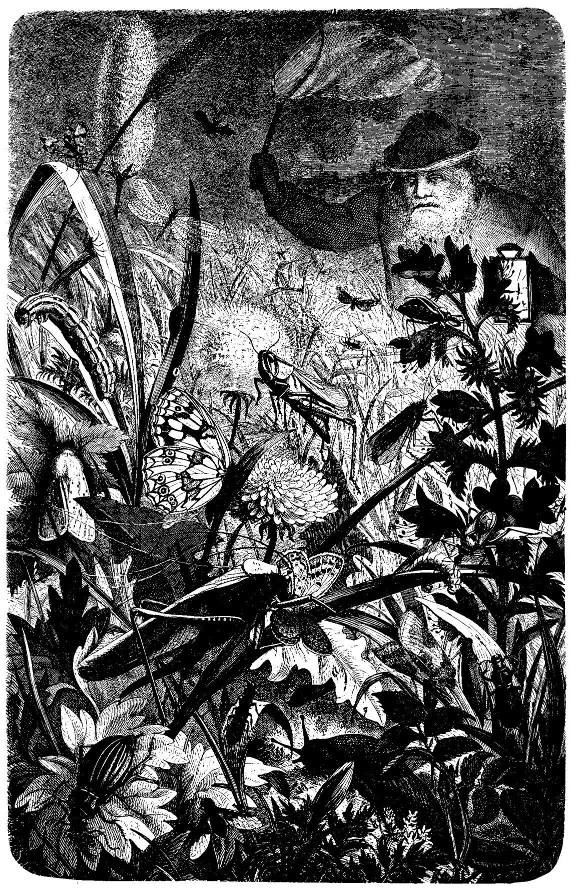
2. Anota las frecuencias cardíacas en el cuadro que aparece a continuación:

Daphnia 1		Daphnia 2		Daphnia 3		Daphnia 4	
Sin Droga		Sin Droga		Sin Droga		Sin Droga	
Café		Bebida cola		Alcohol etílico		Medicina para la tos	
Diferencia=		Diferencia=		Diferencia=		Diferencia=	

3. ¿Fueron correctas tus predicciones para cada droga? ¿Por qué sí o por qué no?

4. ¿Cuál fue el promedio de la frecuencia cardíaca de las cuatro *Daphnia* antes de ser expuestas a una droga y después de ser expuestas a las distintas drogas?

Introduction to
ECOLOGY



BACKGROUND INFORMATION—ECOLOGY

Protists, fungi, plants, and animals don't live in isolation. They interact with each other and with non-living systems to form a unique and intricate world. **Ecology** is the study of these complex interactions.

Ecologists have various ways of categorizing groups of living and non-living things. An **ecosystem** is a group of living things that interact with each other and with the non-living components in the environment. Ecosystems can be as small as a rotting log or as large as the whole world.

Biomes are major ecosystems that are characterized by either a dominant plant type or by the climatic and physical characteristics of the area. For example, grasslands and pine forests are biomes with a dominant plant type. Biomes that are characterized by climate or physical attributes include tropical rainforests and deserts that have a wide variety of plant types, but very particular rain patterns.

A **habitat** describes a natural area in a slightly different way. A habitat is the place *where* a particular animal or plant lives. An ecological **niche** is *how* that animal lives or *what* it does. In other words, the habitat is the animal's home and the niche is the animal's job.

Relationships Between Organisms

Organisms in an ecosystem can interact in a number of different ways. Sometimes organisms have a **symbiotic relationship** where both species benefit from the relationship. A flower and a butterfly are an example of a symbiotic relationship. The butterfly benefits by gathering the flower's nectar for food. The flower benefits because pollen is carried from flower to flower by the butterfly.

In other relationships, one individual benefits at the expense of the other. **Predators** obviously benefit when they are able to capture, kill, and eat their **prey**. In the case of **parasites** and their **host**, it is in the parasite's best interest to take what it needs without killing the host, but the host can still be harmed.

The feeding relationships and energy flows between organisms are represented as **food chains** and **food webs**. The driving force behind all life processes is energy from the sun. **Producers** (mostly plants) are able to capture and convert the sun's energy.

Animals that eat producers are **primary consumers**. An example of a primary consumer would be a deer, which only eats vegetation. **Secondary consumers** are predators, scavengers, or parasites that eat other animals. Cougars are secondary consumers. Some animals are **omnivores**, which eat both plants and other animals. **Decomposers** feed on animals and plants once they are dead.

The string of feeding relationships—producer, primary consumer, secondary consumer—form a food chain. Often those relationships are not so simple, however. For instance, deer eat a variety of plants, other animals eat plants, cougars eat a variety of animals, and deer are eaten by several kinds of predators. These interwoven food chains are called food webs.

Cycles

Cycles are also an important concept in ecology. Individual organisms have life cycles that include birth, growth, reproduction and death, but there are cycles in ecosystems as well. The **carbon cycle** and the **water cycle** are two cycles that have an obvious impact on our everyday life.

Carbon is found in the atmosphere in the form of carbon dioxide. During photosynthesis, plants take in carbon dioxide. When an animal eats the plant, some of the carbon is passed to the animal. Carbon can then be passed to a predator. Some carbon goes back to the atmosphere when animals respire and it is also returned to the atmosphere when living things decompose or burn.

Water is also found in the atmosphere. Water **condenses** to form clouds, and as those clouds get heavy with water, the water is released in the form of rain, snow, hail, or sleet. Some of the precipitation is used by plants and animals, but the majority of it becomes part of lakes, ponds, rivers, and oceans or seeps into the ground to become **groundwater**. Some groundwater may travel to open bodies of water as well. Water then **evaporates** from the surface of the Earth or is **transpired** by plants, where it becomes part of the atmosphere again.

In addition to the carbon and water cycles, oxygen, nitrogen, sulfur, and phosphorous cycle through **biotic** and **abiotic** systems.

Succession

Groupings of animals and plants change in a community over of time. Those changes most often occur in a predictable sequence called **succession**, which is the change in the variety and numbers of organisms in a community over time. There are two types of succession. **Primary succession** takes place in an area where living things don't already exist, such as on bare rock or newly formed lava beds. **Secondary succession** occurs in areas where there are already some living things. Secondary succession most often takes place in areas that have been disturbed, such as after a fire or flood.

The first animals and plants to move into an area are called **pioneer species.** They are typically hardy, adaptable plants and animals. They are followed by a series of other animal and plant communities, eventually becoming a **climax community**. The climax community is the final stage of succession—the animals and plants replace themselves rather than being replaced by different species.

Human Impacts

Ecosystems are naturally in a state of **dynamic equilibrium**. They are constantly changing, but there is a certain balance that is maintained. When changes are large, it may be more difficult or impossible for an ecosystem to maintain that balance. Unfortunately, ecosystems are changing dramatically because of human activities.

One way people are changing the global environment is through various pollutants. Burning fossil fuels and burning forests to make way for farms or developments releases carbon dioxide into the atmosphere. This increase in carbon dioxide, in addition to some other gases, is changing the global climate. Other pollutants have affected the ozone layer (the protective blanket of gases high in the atmosphere) that surrounds the Earth. As the ozone has been depleted, more of the sun's rays reach the Earth's surface. This not only affects people by causing more sunburns and skin cancers, but also can harm plants and other animals (especially amphibians).

Pollutants can also affect ecosystems on a smaller scale. They enter our rivers, streams, lakes, oceans, soil, and air. Pollutants can affect the way plants and animals grow, reproduce, and function during their daily activities.

Currently many species of animals and plants are threatened or endangered because of **habitat loss.** As the human population grows, habitat is being lost at a faster pace.

Activities such as agriculture, logging, urbanization, gathering fuelwood, and overgrazing are just some of the ways that habitat is being converted or damaged.

Because of these large-scale changes to the Earth's ecosystems, the field of ecology has gained importance. Understanding how healthy ecosystems function will be key if we are to understand how to manage the changes that are occurring to them now and find solutions for the future.

INFORMACIÓN BÁSICA—LA ECOLOGÍA

Los protistas, los hongos, las plantas y los animales no viven aislados sino que interactúan unos con otros y con los sistemas no vivos formando un mundo único e intrincado. La **ecología** es el estudio de estas complejas interacciones.

Los ecologistas tienen varias maneras de categorizar los grupos de seres vivos y no vivos. Un **ecosistema** es un grupo de seres vivos que interactúan tanto entre sí como también con los componentes no vivos del medio ambiente. Los ecosistemas pueden ser tan pequeños como un tronco en descomposición o tan grandes como el mundo entero.

Los **biomas** son grandes ecosistemas que se caracterizan, ya sea por un tipo de plantas dominante o por los factores climáticos y físicos del área. Por ejemplo, las praderas y los bosques coníferos son biomas que poseen un tipo de plantas dominante. Los biomas caracterizados por factores físicos o climáticos incluyen las selvas tropicales húmedas y los desiertos. Éstos tienen una amplia variedad de tipos de plantas pero las características pluviales son muy particulares.

Un **hábitat** describe un área natural de una manera levemente diferente. Un hábitat es el lugar *dónde* vive un animal o planta en particular. Un nicho ecológico es *cómo* vive el animal o *qué* es lo que hace. En otras palabras, el hábitat es el hogar del animal y el nicho es el trabajo del animal.

Relación entre los organismos

Los organismos en un ecosistema pueden interactuar de muchas maneras diferentes. A veces, los organismos tienen una **relación simbiótica**, en la cual ambas especies se benefician de dicha relación. Una flor y una mariposa son un ejemplo de una relación simbiótica. La mariposa se beneficia al recolectar el néctar de la flor para alimentarse. La flor se beneficia porque la mariposa lleva el polen de flor en flor.

En otro tipo de relaciones, un individuo se beneficia a expensas del otro. Los **predadores** obviamente se benefician cuando son capaces de capturar, matar y alimentarse de su **presa**. En el caso de los **parásitos** y de su **huésped**, el parásito se beneficia ya que toma lo que necesita del huésped sin matarlo, pero es posible que el huésped se vea perjudicado.

Las relaciones alimentarias y la transferencia de energía entre los organismos se representan como **cadenas alimentarias** y **redes alimentarias.** La fuerza motora que yace tras todos los procesos vitales es la energía del sol. Los **productores** (la mayoría de las plantas) son capaces de capturar y de convertir la energía del sol.

Los animales que comen productores se llaman **consumidores primarios**. Un ejemplo de consumidor primario sería un ciervo, que sólo se alimenta de materia vegetal. Los **consumidores secundarios** son los predadores, los animales que se alimentan de carroña o los parásitos que se alimentan de otros animales. Los pumas son consumidores secundarios. Algunos animales son omnívoros, es decir, se alimentan de plantas y también de otros animales. Los **descomponedores** se alimentan de otros animales o plantas que ya han muerto.

Los eslabones de las relaciones alimentarias (productor, consumidor primario, consumidor secundario) forman una cadena alimentaria. Sin embargo, a menudo esas relaciones no son simples. De hecho, el ciervo se alimenta de una variedad de plantas, otros animales comen plantas, los pumas se alimentan de una variedad de animales y los ciervos constituyen el alimento de varios tipos de predadores. Estas cadenas alimentarias entrelazadas se llaman redes alimentarias.

Ciclos

Los ciclos también son un concepto importante en ecología. Los organismos individuales tienen ciclos de vida que incluyen nacimiento, crecimiento, reproducción y muerte, pero también existen ciclos en los ecosistemas. El **ciclo del carbono** y el **ciclo del agua** son dos ciclos que tienen un gran impacto en nuestro diario vivir.

El carbono se encuentra en la atmósfera en forma de dióxido de carbono. Durante la fotosíntesis, las plantas absorben dióxido de carbono. Cuando un animal come una planta, parte del carbono pasa al animal. Luego el carbono pasa a un predador. Cuando los animales respiran, parte del carbono vuelve a la atmósfera. Además, el carbono vuelve a la atmósfera cuando la materia viva se descompone o se quema.

El agua también se encuentra en la atmósfera. El agua se **condensa** formando nubes y cuando esas nubes se llenan de agua, ésta se libera en forma de lluvia, nieve, granizo o aguanieve. Una parte de la precipitación es utilizada por las plantas y por los animales, pero la mayoría pasa a formar parte de lagos, lagunas, ríos y océanos o se filtra en la tierra y se transforma en **agua subterránea**. Una parte del agua subterránea puede desplazarse también hacia las grandes masas de agua en la superficie de la Tierra. Luego el agua se **evapora** de la superficie de la Tierra o **transpira** desde las plantas y llega nuevamente a la atmósfera.

Además de los ciclos del carbono y del agua, el oxígeno, el nitrógeno, el azufre y el fósforo tienen ciclos a través de los sistemas **bióticos** y **abióticos**.

Sucesión

Las agrupaciones de plantas y animales cambian con el tiempo en una comunidad. Estos cambios ocurren con mayor frecuencia de una manera predecible llamada **sucesión**. La sucesión consiste en el cambio en la variedad y en el número de organismos en una comunidad a través del tiempo. Existen dos tipos de sucesiones. La **sucesión primaria** ocurre en un área donde no existen seres vivos, como por ejemplo sobre una roca al descubierto o en formaciones recientes de lava. La **sucesión secundaria** ocurre donde ya existe algún tipo de materia viva. La sucesión secundaria se produce más a menudo en áreas que han sido alteradas, como por ejemplo después de un incendio o de una inundación.

Los primeros animales y plantas que se trasladan a un área se llaman **especies pioneras**. Son plantas y animales típicamente resistentes. Luego les sigue una serie de otras comunidades de animales y de plantas, transformándose finalmente en una **comunidad clímax**. La comunidad clímax es la etapa final de una sucesión, los animales y las plantas se reemplazan a sí mismos en vez de ser reemplazados por especies diferentes.

Consecuencias de la actividad humana en el medio ambiente

Los ecosistemas están naturalmente en un estado de **equilibrio dinámico**. Esto quiere decir que están cambiando constantemente pero se mantiene un cierto equilibrio. Cuando los cambios son grandes, puede ser más difícil o imposible que un ecosistema mantenga ese equilibrio. Desgraciadamente, los ecosistemas están cambiando dramáticamente debido a las actividades de los seres humanos.

Una de las maneras en que el ser humano está cambiando el medio ambiente global es a través de una variedad de contaminantes. Cuando se queman combustibles fósiles y bosques para instalar granjas y urbanizaciones se libera dióxido de carbono a la atmósfera. El aumento del dióxido de carbono, además de otros gases, está cambiando el clima global. Otros contaminantes han afectado la capa de ozono (la capa protectora de gases en la parte alta de la atmósfera) que rodea la Tierra. A medida que el ozono se reduce, más rayos solares alcanzan la superficie de la Tierra. Esto no sólo afecta a las personas causando más quemaduras de sol y cáncer de la piel, sino que también daña a las plantas y a otros animales (especialmente a los anfibios).

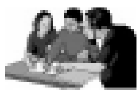
Los contaminantes también pueden afectar a los ecosistemas en una escala menor. Ellos llegan a nuestros ríos, arroyos, lagos, océanos, tierra y aire. Los contaminantes pueden afectar la manera en que las plantas y los animales crecen, se reproducen y cumplen sus funciones diarias.

Actualmente, muchas especies de animales y de plantas se han visto amenazadas o están en peligro de extinción debido a la **pérdida del hábitat**. A medida que la población humana crece, el hábitat se pierde con mayor rapidez. La agricultura, la tala de árboles, la urbanización, la recolección de combustible derivado de la madera y el exceso de pastoreo, son algunos ejemplos de las maneras que han transformado o dañado el hábitat.

El campo de la ecología ha adquirido importancia debido a esta gran escala de cambios en los ecosistemas de la Tierra. Para poder enfrentar los cambios que están ocurriendo en los ecosistemas actualmente y buscar soluciones para el futuro, debemos entender cómo funcionan los ecosistemas.

FOOD CHAIN MOBILE

Móvil de la cadena alimentaria

Grades		
K–3	*Whole Class*	*45 minutes*

Purpose

Students will create a mobile that represents a simple food chain.

Materials

Food Chain Picture Sheet
Scissors
Coat hangers (each student can bring one from home)
String (cut into 6 inch pieces, 8 pieces per student)
Straws (one per student)
Crayons or markers
Tape

Concepts

- Food chains and food webs represent the feeding relationships of organisms in an ecosystem.

Conceptos

- Las cadenas alimentarias y las redes alimentarias representan las relacíones alimentarias de los organismos en un ecosistema.

Safety

Remind young students to be careful with scissors and coat hangers.

Vocabulary

Food chain
Food web
Producer
Consumer
Decomposer
Predator
Prey

Vocabulario

Cadena alimentaria
Red alimentaria
Productor
Consumidor
Descomponedor
Predador
Presa

In Advance

Tell students a few days in advance to bring a coat hanger to school and be sure to bring in a few extras in case some students forget. Make one copy of the Food Chain Picture Sheet for each student (preferably on heavy paper). Gather other materials.

Procedure

1. Explain concepts

Introduce **food chains**, **food webs**, **producers**, **consumers**, **decomposers, predators**, and **prey**. Ask students to name an animal, identify what that animal eats, and whether or not it is eaten by other animals. Tell students they will be making a mobile that represents a simple food chain.

2. Hand out materials. Color and cut pictures.

Give each student a copy of the Food Chain Picture Sheet, 8 pieces of string, a straw, scissors, and crayons or markers. Also distribute tape to share. Have students color the pictures, then cut each picture along the lines.

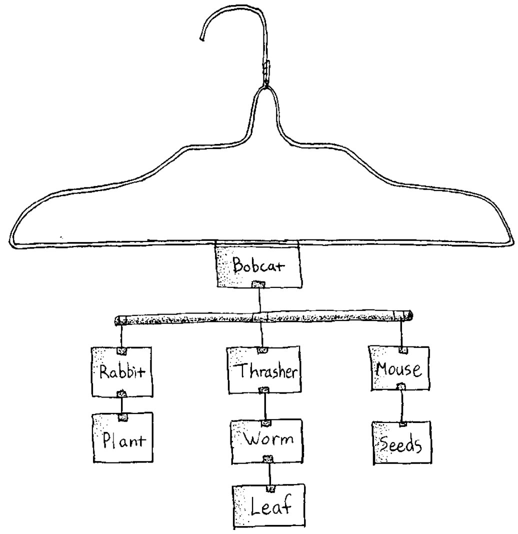
3. Organize the pictures into food chains

Begin assembling the food chains by having students tape a string to the top of each picture. Then have students tape the bobcat picture to the bottom center of the coat hanger. Next, have students tape another string to the bottom of the bobcat picture. Attach that string to the center of the straw.

Now, ask students if they know what bobcats eat. Do they eat only one type of prey? In fact, bobcats eat a variety of items including rabbits, mice, and birds. Tell students to tape each of these prey animals to the straw. (Have students tape the curved-billed thrasher to the center of the straw and the rabbit and mouse on each end.)

Next, ask students what each of these prey animals eat. They also eat a variety of things, but in this case the rabbit matches with the plant, the thrasher eats the worm, and the mouse eats the seeds. Have students tape each of these items to the animal that eats them.

There is one picture left. It is a decomposing leaf. Ask students what animal helps the leaf decompose. Once they have figured out that the worm helps the leaf decompose, have students tape the leaf to the worm picture.



4. Discuss food chain mobiles

Using the food chain mobiles, ask students to identify several food chains. When these food chains are brought together, they form a simple food web.

Questions to Ask During the Activity

1. Are there any other animals or plants that could be added to the food chain mobile? (Bobcats might eat other kinds of birds, mice eat more than just seeds, and the thrasher also eats insects and berries.)

2. Would it make sense for a person to be added into the food web? (Yes. People eat plants, some types of seeds, and occasionally rabbits.)

Preguntas sobre el tema de la actividad

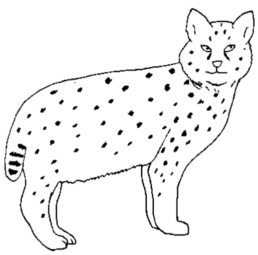
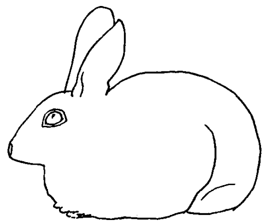
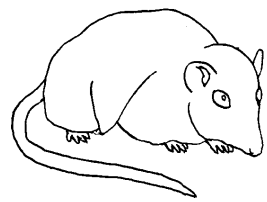
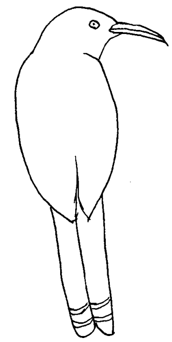
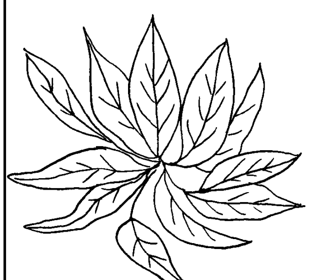
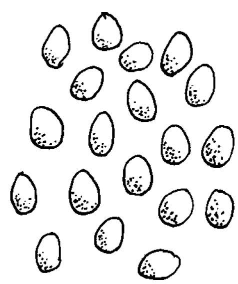
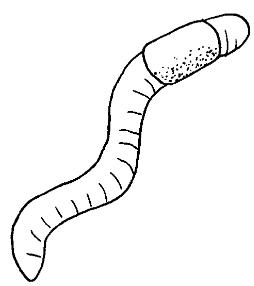
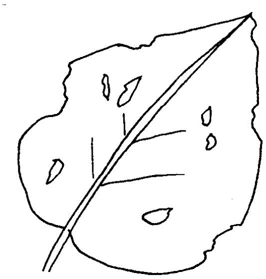
1. ¿Hay algún otro animal o planta que te gustaría agregar al móvil de la red alimentaria? (El lince o gato montés puede comer otros tipos de pájaros, el ratón come otras cosas además de semillas y el sinsonte también come insectos y bayas.)

2. ¿Tiene sentido que un ser humano forme parte de la red alimentaria? (Sí. Los seres humanos comen plantas, algunos tipos de semillas y a veces, conejos.)

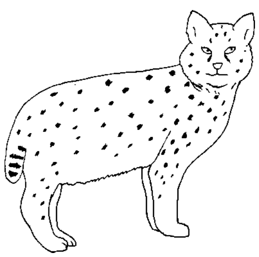
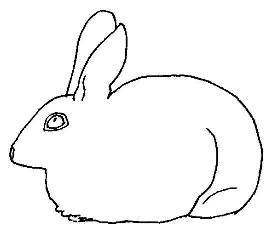
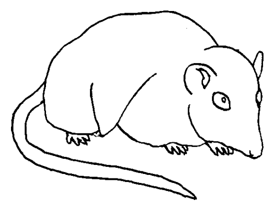
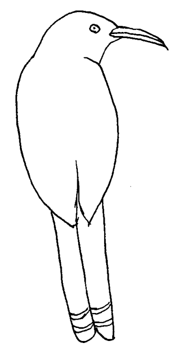
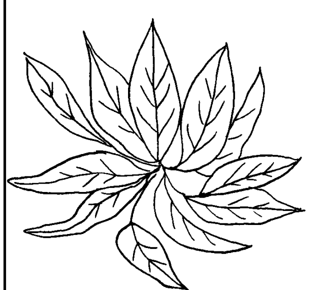
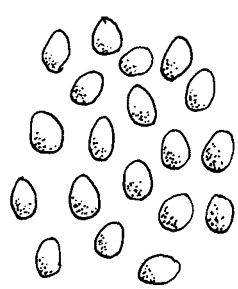
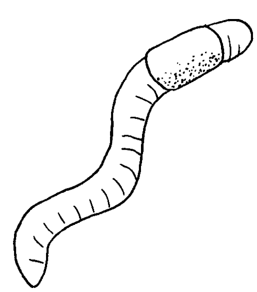
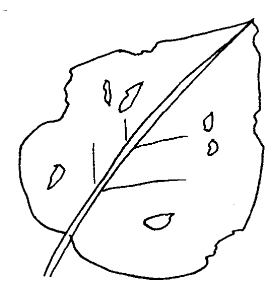
Extensions

When an owl eats a small rodent, the owl cannot digest all the bones and fur. The undigested parts are formed into a pellet and coughed up. Owl pellets can be purchased from a biological supply company and dissected by your students for a first-hand look at part of a food chain. Older students can try to organize the bones into complete skeletons.

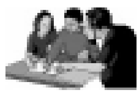
FOOD CHAIN PICTURE SHEET

BOBCAT 	**RABBIT** 	**MOUSE** 	**THRASHER** 
PLANT 	**SEEDS** 	**WORM** 	**DECAYING LEAF** 

ILUSTRACIONES DE INTEGRANTES DE LA CADENA ALIMENTARIA

LINCE O GATO MONTÉS	**CONEJO**	**RATÓN**	**SINSOTE**
			
PLANTA	**SEMILLAS**	**GUSANO**	**HOJA EN DESCOMPOSICIÓN**
			

THE WATER CYCLE
El ciclo del agua

Grades		
K–2	Whole Class	45 minutes

Purpose
Students will learn about natural cycles by making a wheel that demonstrates the water cycle.

Materials
Copies of the Student Activity Sheet (one per student)
Lightweight paper plates (9 inch diameter, two per student)
Crayons or markers
Scissors
Glue or glue sticks
Tape
Paper fasteners (brads)

Concepts
- Some ecological events occur in a repeating pattern called a cycle.
- Water moves from the air to the land, then back into the air.

Conceptos
- Algunos eventos ecológicos ocurren con un patrón que se repite llamado ciclo.
- El agua se desplaza del aire a la tierra y luego vuelve al aire.

Safety
Remind young students to be careful with scissors and paper fasteners.

Vocabulary

Cycle
Water cycle
Condensation
Precipitation
Runoff
Groundwater
Evaporation
Transpiration

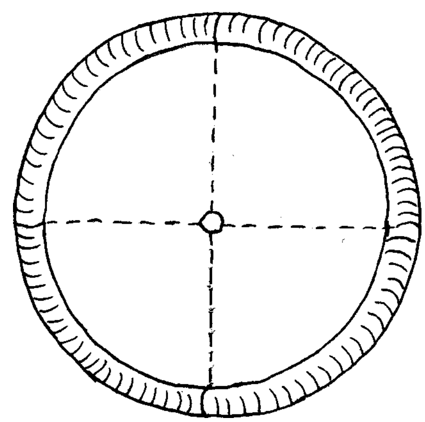
Vocabulario

Ciclo
Ciclo del agua
Condensación
Precipitación
Afluencia o escurrimiento
Agua subterránea
Evaporación
Transpiración

In Advance

Make copies of the Student Activity Sheet. Follow the instructions below to make triangular patterns for students to use:

1. Cut out the circle from the Student Activity Sheet and tape it lightly to the back of a paper plate.
2. Cut out each of the four segments along the straight lines without cutting out the center circle. You should have four triangular shaped patterns. (See diagram.)
3. Remove the Student Activity Sheet that was lightly taped, so you have blank patterns.
4. Repeat with another plate or two so you have more patterns for students to share.



Procedure

1. Introduce the activity

Begin by asking students if they can define a **cycle**. Explain that there are many types of cycles in nature including life cycles, nutrient cycles, and the **water cycle**. Tell students they will be making a special wheel that shows how water cycles from the sky to the ground and back into the sky.

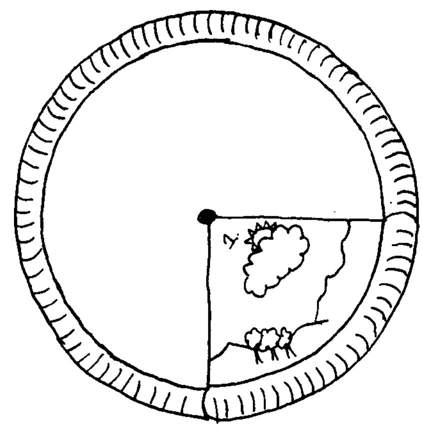
Using the following steps, walk students through the procedure for making their water cycle wheel. Hand out the materials for each step as you go along.

2. Make the water cycle wheel

Give each student a copy of the Student Activity Sheet and crayons or markers. Tell students to color the pictures, then cut out the complete circle along the outer line.

Give each student a paper plate. Using a thin layer of glue, tell students to glue their circle to the back of the paper plate. Set these plates aside.

Give each student another paper plate and hand out the triangular patterns. Have students lay a triangular pattern on the back of the new paper plate so the edges line up. Tell them to trace the pattern and cut out the triangular shape. They should only cut out one triangle. While students are working with their patterns, poke a hole with a pen or scissors through the center of all the paper plates.



Tell students to put the cut paper plate on top of the plate with pictures so they stack together snugly. Give each student a paper fastener and explain how to put the fastener through the holes, then bend the ends so it keeps the plates together.

3. Discuss the water cycle

Have students turn their water cycle wheel to the section marked with the number "1." Explain that this picture shows water in the air, called **condensation**. Sometimes the water forms clouds, as seen in the picture, but there is also water in the air that is not seen as clouds.

Now, tell students to turn their water cycle wheel to the second section. Explain that when clouds become heavy with water, the water falls to the ground in the form of rain, snow, hail, and sleet. This is called **precipitation**.

Next, have students turn their water cycle wheel to the third section. Explain that when water lands on the ground, some of it becomes **runoff** and flows to streams, rivers, lakes, and oceans. Some of the water soaks into the ground (**groundwater**) and stays there, or flows underground and eventually resurfaces.

Finally, have students turn their water cycle wheel to the fourth section. This picture shows how water **evaporates** from lakes, oceans, and other bodies of water. It also evaporates from the surface of the ground. Water **transpires** from the surfaces of leaves back into the air. When enough water accumulates in the air and clouds become heavy with water, the cycle begins again.

Questions to Ask During the Activity

1. When we drink water, does that mean it's no longer part of the water cycle? (No. Some of the water we drink leaves our body when we breathe, sweat, or go to the bathroom.)

2. What happens to the water cycle when large forests are cut down? (When large areas of tropical rainforest are removed, there are fewer trees to transpire, less water gathers in the air, and the whole area receives less rainfall. With less rainfall, it is harder for the forest to grow back.)

Preguntas sobre el tema de la actividad

1. Cuando bebes agua, ¿te parece que ésta ya no forma parte del ciclo del agua? (No. Parte del agua que bebemos sale de nuestros cuerpos cuando respiramos, transpiramos o vamos al baño.)

2. ¿Qué ocurre con el ciclo del agua cuando se talan grandes bosques? (Cuando se eliminan grandes áreas de selva tropical húmeda, hay menos árboles que transpiran, menos agua pasa al aire y toda el área recibe menos lluvia. Con menos lluvia, es más difícil que el bosque vuelva a crecer.)

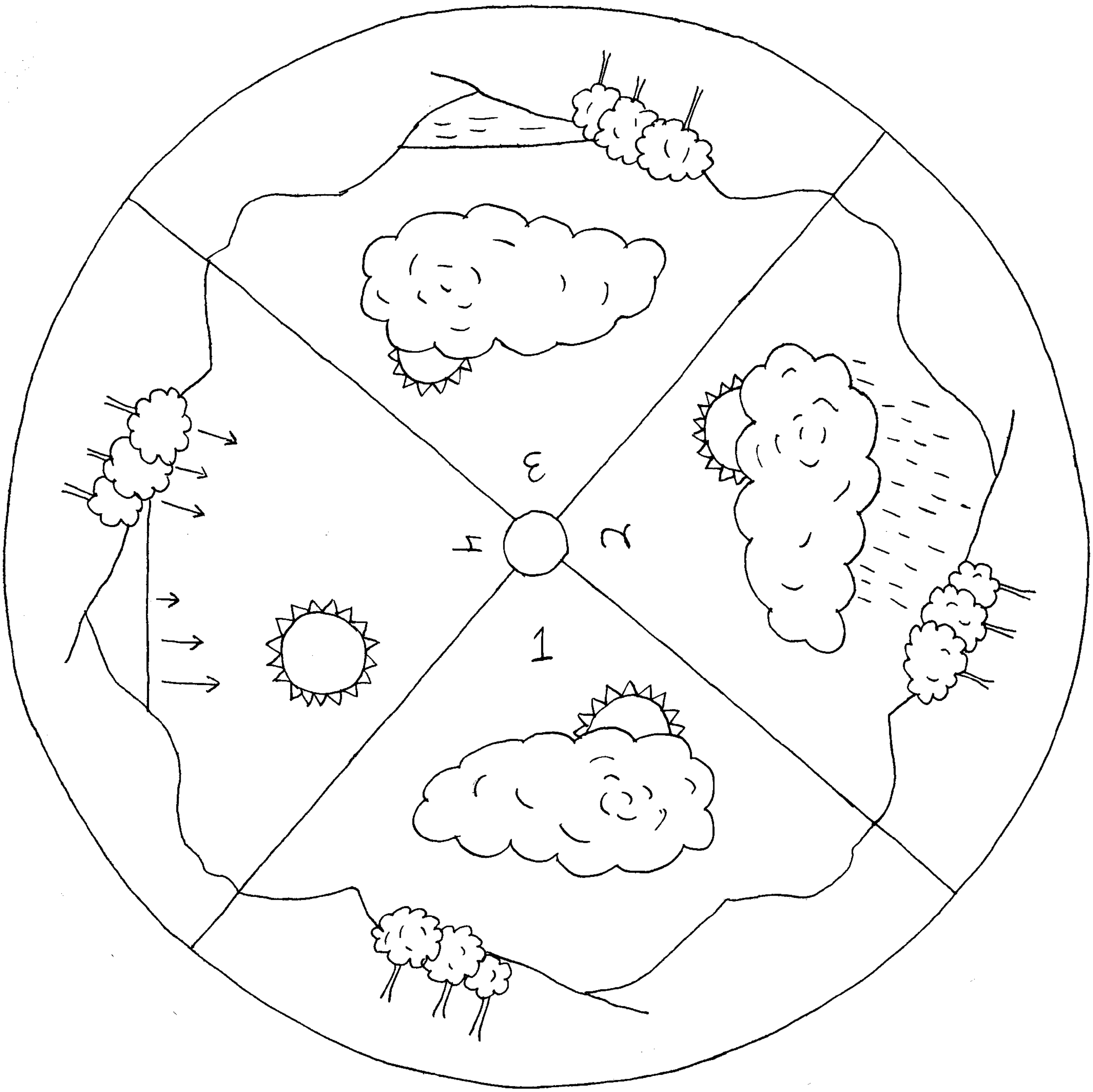
Modifications

This same type of wheel can be used to explain other types of natural cycles, including the carbon cycle and the life cycles of different organisms. Have students draw the steps in the cycle in triangular-shaped sections, then figure out how to assemble them in order on the wheel.

Extensions

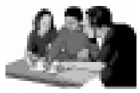
Shortly after a rain shower, take the class on a water cycle walk. See how many parts of the water cycle your students can observe.

STUDENT ACTIVITY SHEET
The Water Cycle/El ciclo del agua



ECOSYSTEM SCAVENGER HUNT

Búsqueda de tesoros ecológicos

Grades		
K–8	*Whole Class*	*60 minutes*

Purpose

Students will look around their school campus to find examples of the interactions between plants, animals, and humans.

Materials

Student Activity Sheets
Pencil

Concepts

- Plants support all forms of animal life.
- Some organisms live together for mutual benefit (symbiotic relationship).
- Food chains are feeding relationships that transfer energy through a natural community.
- Wildlife and humans often share the same environment and are all subject to environmental problems.

Conceptos

- Las plantas sostienen a todas las formas de vida animal.
- Algunos organismos viven juntos para beneficio mutuo (relación simbiótica).
- Las cadenas alimentarias son relaciones alimentarias que transfieren energía a través de una comunidad natural.
- La vida silvestre y los seres humanos a menudo comparten el mismo medio ambiente y todos deben enfrentar problemas ambientales.

Safety

Remind students they should avoid picking up any unknown plants, animals, or debris. Define boundaries that students are not to cross.

Vocabulary

Ecosystem
Food chains
Food webs
Producer
Consumer
Decomposer
Predator
Prey
Symbiotic relationship

Vocabulario

Ecosistema
Cadenas alimentarias
Redes alimentarias
Productor
Consumidor
Descomponedor
Predador
Presa
Relación simbiótica

In Advance

Make copies of the Student Activity Sheet appropriate for your grade level. (With very young students, consider reading each question on the Student Activity Sheet and have them draw their answers on a sheet of paper.) Identify an outdoor space suitable for the scavenger hunt.

Procedure

1. *Define vocabulary words*

Using the list of definitions below, discuss the vocabulary words that students will need to know to do their scavenger hunt.

Ecosystem–a community of living organisms that interact with each other and the non-living environment. An ecosystem can be as large as a rainforest or as small as a rotting log.

Food chains–the feeding relationships that transfer energy through a community of organisms, starting with producers and moving through herbivores and carnivores.

Food webs–an interwoven series of food chains.

Producer–an organism that makes its own food using the energy from the sun. Most producers are plants.

Consumer–an organism that gets its energy from eating other organisms.

Decomposer–an organism that feeds on dead organisms.

Predator–an animal that kills and eats other animals to obtain energy.

Prey–an animal that is hunted and eaten by a predator.

Symbiotic relationship–a condition where two organisms live together for mutual benefit.

2. Describe the scavenger hunt and take students outside

Tell students they will be going on a scavenger hunt to look for examples of the different components and relationships within an ecosystem. Give each student a copy of the Student Activity Sheet and be sure all students have a pencil or pen. (See Modifications section for ideas about how to conduct the scavenger hunt with very young students.) Divide students into groups of four and tell the groups they will be working together to find the items on the scavenger hunt.

Take students outside. Describe the boundaries for the scavenger hunt and remind students to leave natural areas undisturbed. Tell students to meet you at a designated area when they are finished or when they need help, and begin the scavenger hunt.

3. Review findings

Return to the classroom. Review each item on the scavenger hunt list, asking students what examples they were able to find.

Questions to Ask During the Activity

1. What was the easiest thing to find on the scavenger hunt?

2. What was the hardest thing to find on the scavenger hunt?

3. Was there anything on the list that you did not find?

4. Are there other types of ecosystems where the items on the scavenger hunt would be easier or harder to find?

Preguntas sobre el tema de la actividad

1. ¿Qué fue lo más fácil de encontrar en la búsqueda ecológica?

2. ¿Qué fue lo más difícil de encontrar en la búsqueda ecológica?

3. ¿Hubo algo de la lista que no hayas podido encontrar?

4. ¿Hay otros tipos de ecosistemas donde habría sido más fácil o más difícil encontrar los elementos de la búsqueda ecológica?

Modifications

For grades K-3, select one or two versions of the scavenger hunt. With younger students who are not yet able to read or write, give each student a sheet of paper and a pencil. Using Student Activity Sheet 2, read one item on the scavenger hunt and have students look for an example of the item. When they have found an example, tell them to make a drawing of the item on their paper. Read several more items from the scavenger hunt, one at a time, giving students time to search in between. Return to the classroom and discuss the items they found.

Extensions

Have students take a copy of the Student Activity Sheet home. With their family, ask students to look for the scavenger hunt items near their home. In the classroom, compare the ecosystem at the school with the ones near students' homes.

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First Edition. Albuquerque, NM, 1996.

STUDENT ACTIVITY SHEET
Ecosystem Scavenger Hunt (4-8)

Without disturbing the plants and animals, see how many of the scavenger hunt items you can find and write your discoveries on the line below each item.

1. Find an example of how a plant *directly* supports the life of an animal.

____

2. Find an example of how a plant *indirectly* supports the life of an animal.

____

3. Find evidence that an animal lives here.

____

4. Find an example of a predator.

____

5. Find an example of a prey animal.

____

6. Find evidence of a food chain and write down, in order, the organisms in this food chain.

____

____

7. Find evidence of a symbiotic relationship (two organisms that live together and benefit from the relationship).

____

8. Describe how both organisms benefit from the symbiotic relationship.

____

9. Find an example of how an insect has damaged a plant.

____

10. Find an example of a plant that has been damaged by disease.

____

11. Find an example of something that is decomposing.

____

12. Find an example of how wildlife and humans are sharing this environment.

____

13. Find an example of an environmental problem in this area.

____

14. Explain how humans are dealing with the environmental problem.

____

STUDENT ACTIVITY SHEET
Ecosystem Scavenger Hunt (K-3)

Without disturbing the plants and animals, see how many of the scavenger hunt items you can find. Write or draw your findings in the box next to each item.

Scavenger Hunt 1

A producer.		Something recycled.	
Something older than you.		An animal sign.	
Something younger than you.		A decomposer.	
Something left over from last winter.		Something yellow, red, or blue.	
Something that feels smooth.		Something that shouldn't be here.	

STUDENT ACTIVITY SHEET

Ecosystem Scavenger Hunt (K-3)

Without disturbing the plants and animals, see how many of the scavenger hunt items you can find. Write or draw your findings in the box next to each item.

Scavenger Hunt 2

A seed.		Something that shows an insect was here.	
Something that smells good.		A leaf with smooth edges.	
Something younger than you.		The largest living thing.	
An animal home.		Something really weird.	
Something that feels fuzzy.		Something that shouldn't be here.	

STUDENT ACTIVITY SHEET
Ecosystem Scavenger Hunt (K-3)

Without disturbing the plants and animals, see how many of the scavenger hunt items you can find. Write or draw your findings in the box next to each item.

Scavenger Hunt 3

A producer.		Something recycled.	
Something older than you.		An animal sign.	
The tiniest living thing.		Something really weird.	
Something with wings and six legs.		Something yellow, red, or blue.	
Something that feels smooth.		Something that shouldn't be here.	

STUDENT ACTIVITY SHEET

Ecosystem Scavenger Hunt (K-3)

Without disturbing the plants and animals, see how many of the scavenger hunt items you can find. Write or draw your findings in the box next to each item.

Scavenger Hunt 4

A producer.		Something that stores water.	
Something that is older than you.		A leaf with rough edges.	
A seed.		Something being decomposed.	
Something that shows a consumer was here.		Something really weird.	
Something that feels fuzzy.		Something that shouldn't be here.	

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Búsqueda ecológica (4-8)

Sin perturbar ni a las plantas ni a los animales, trata de encontrar la mayor cantidad posible de tesoros ecológicos y anota tus descubrimientos en la línea correspondiente.

1. Encuentra un ejemplo de cómo una planta colabora *directamente* con la vida de un animal.

____

2. Encuentra un ejemplo de cómo una planta colabora *indirectamente* con la vida de un animal.

____

3. Encuentra alguna prueba de que un animal habita en esta área.

____

4. Encuentra un ejemplo de un predador.

____

5. Encuentra un ejemplo de un animal de presa.

____

6. Encuentra alguna prueba de la existencia de una cadena alimentaria y anota en orden los organismos que forman parte de esta cadena.

____

____

7. Encuentra alguna prueba de una relación simbiótica (dos organismos que viven juntos y se benefician de su relación).

____

8. Describe cómo se benefician de la relación simbiótica ambos organismos.

____

9. Encuentra un ejemplo de cómo un insecto ha dañado a una planta.

____

10. Encuentra un ejemplo de una planta que haya sido dañada por una enfermedad.

____

11. Encuentra un ejemplo de algo que se esté descomponiendo.

____

12. Encuentra un ejemplo de cómo la vida silvestre y los seres humanos comparten este medio ambiente.

____

13. Encuentra un ejemplo de un problema del medio ambiente en esta área.

____

14. Explica por qué los seres humanos están enfrentando problemas del medio ambiente.

____

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Búsqueda de tesoros ecológicos (K-3)

Sin perturbar ni a las plantas ni a los animales, trata de encontrar la mayor cantidad posible de tesoros ecológicos y anota tus descubrimientos en la línea correspondiente.

Búsqueda ecológica 1

Un productor.		Algo reciclado.	
Algo más viejo que tú		Un indicio de un animal.	
Algo más joven que tú.		Un descomponedor.	
Algo que haya quedado del último invierno.		Algo amarillo, rojo o azul.	
Algo que se siente suave al tacto.		Algo que no debería estar aquí.	

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Búsqueda de tesoros ecológicos (K-3)

Sin perturbar ni a las plantas ni a los animales, trata de encontrar la mayor cantidad posible de tesoros ecológicos y anota tus descubrimientos en la línea correspondiente.

Búsqueda ecológica 2

Una semilla.		Un indicio de que un insecto estuvo aquí.	
Algo que huele bien.		Una hoja con bordes lisos.	
Algo más joven que tú.		El ser vivo más grande.	
El hogar de un animal.		Algo realmente raro.	
Algo que se siente velloso.		Algo que no debería estar aquí.	

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Búsqueda de tesoros ecológicos (K-3)

Sin perturbar ni a las plantas ni a los animales, trata de encontrar la mayor cantidad posible de tesoros ecológicos y anota tus descubrimientos en la línea correspondiente.

Búsqueda ecológica 3

Un productor.		Algo reciclado.	
Algo más viejo que tú.		Un indicio de un animal.	
El ser vivo más pequeño.		Algo realmente raro.	
Algo con alas y seis patas.		Algo amarillo, rojo o azul.	
Algo que se siente suave al tacto.		Algo que no debería estar aquí.	

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE
Búsqueda de tesoros ecológicos (K-3)

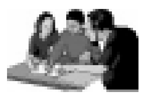
Sin perturbar ni a las plantas ni a los animales, trata de encontrar la mayor cantidad posible de tesoros ecológicos y anota tus descubrimientos en la línea correspondiente.

Búsqueda ecológica 4

Un productor.		Algo que almacena agua.	
Algo más viejo que tú.		Una hoja con bordes irregulares.	
Una semilla.		Algo que se está descomponiendo.	
Un indicio que un consumidor ha estado aquí.		Algo realmente raro.	
Algo que se siente velloso.		Algo que no debería estar aquí.	

SMALL ECOSYSTEMS ON CAMPUS

Pequeños ecosistemas en la escuela

Grades		
3–8	*2–4*	*75 minutes*

Purpose

Students will plot, study, and compare small ecosystems on campus.

Materials

For each group:
- 4 paper clips
- String (5 meters long)
- Thermometer
- 1 meter stick
- 500 ml of water
- Hand lenses
- Tin can with both ends cut off (all cans must be the same size)
- Student Activity Sheet

For you:
- Stopwatch or watch with second hand

Concepts

- An ecosystem is a community of living things that interact with each other and with non-living components in the environment.
- Ecosystems can be large or small.

Conceptos

- Un ecosistema es una comunidad de seres vivos que interactúan tanto entre ellos como con los componentes no vivos del medio ambiente.
- Los ecosistemas pueden ser grandes o pequeños.

Safety

Remind students not to touch insects, spiders, or other animals in the study area. Students should wear sunscreen and protective clothing. Define the boundaries that students are not to cross.

Vocabulary

Ecosystem
Biotic
Abiotic
Adaptation

Vocabulario

Ecosistema
Biótico
Abiótico
Adaptación

In Advance

Gather materials and identify some areas outside for your students to work.

Procedure

1. Review concepts

Begin by asking students to define an **ecosystem** and name some examples of ecosystems. Tell them that an ecosystem can be very large or very small. Explain that they will be working in groups to study tiny ecosystems and compare their study plot with those of other groups.

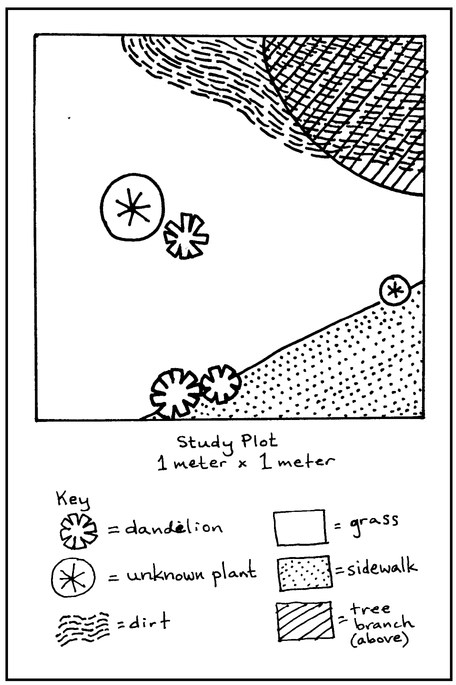
2. Review the Student Activity Sheets

Divide the class into groups of 2-4 students. Give each group a copy of the Student Activity Sheet. Review the items they will be studying and recording on the Student Activity Sheet.

3. Take students outside and demonstrate how to set up a study plot

Take the class and all the materials outside to the area you have selected. Review the rules for handling living organisms and describe the boundaries they need to stay within.

Tell students they will be selecting their study plot at random. Demonstrate that one way to do this is to throw a small rock over your shoulder and center the plot around the rock. Using the meter stick, form a square of string, one meter-long on each side. Anchor the string to the ground with the paper clips. Now have students make their own study plot.



Sample of a study plot

4. Gather data

Following the procedure on the Student Activity Sheet, have students gather information on all but the soil absorption rate. When they are ready to test the soil absorption rate, use your stopwatch or watch to count the seconds when students pour the water into the can.

5. Compare information

Return to the classroom and use the "Questions to Ask During the Activity" section to guide a discussion about the comparison of different small ecosystems.

Questions to Ask During the Activity

1. Describe your ecosystem and list all the **biotic** (living) and **abiotic** (non-living) factors you observed.

2. What are some biotic and abiotic factors that make the small ecosystems different? (Different animals and plants may inhabit different areas, depending on soil moisture and slight differences in temperature and light.)

3. How are the different animals and plants **adapted** to their environment?

4. Do all (or most of) the ecosystems have some living things in common? If so, what are they?

5. Which soil absorbed the water most quickly? Which one was slowest?

6. What differences in the ecosystem affected the rate of water absorption?

7. Which ecosystem had the greatest variety of living things? Why do you think that is?

8. What would change in your small ecosystem if an environmental factor were to change?

9. How can human activity change the ecosystem? Can you see any evidence of human activity within your study plot?

Preguntas sobre el tema de la actividad

1. Describe tu ecosistema y haz una lista de todos los factores **bióticos** (vivos) y **abióticos** (no vivos) que observaste.

2. Nombra algunos de los factores bióticos y abióticos que otorgan diferentes características a ecosistemas pequeños. (Diferentes plantas y animales pueden habitar en distintas áreas, dependiendo de la humedad del suelo y de leves diferencias en la temperatura y en la luz.)

3. ¿Cómo se **adaptan** las diferentes plantas y animales a su medio ambiente?

4. ¿Tienen todos los ecosistemas (o la mayoría de ellos) seres vivos en común? Si es así ¿cuáles son?

5. ¿Qué suelo absorbió el agua más rápidamente? ¿Cuál fue el más lento?

6. ¿Qué diferencias en el ecosistema afectaron la velocidad de absorción del agua?

7. ¿Qué ecosistema tenía la mayor variedad de seres vivos? ¿Por qué crees que es así?

8. ¿Qué cambios observarías en tu pequeño ecosistema si cambiara un factor del medio ambiente?

9. ¿De qué manera pueden cambiar el ecosistema las actividades de los seres humanos? ¿Has observado alguna evidencia de actividad humana en tu pequeño terreno?

Why It Happens/More on the Topic

An ecosystem is a community of living things (biotic) that interact with each other and with non-living (abiotic) components of the environment. The biotic and abiotic factors in an ecosystem are constantly affecting one another. Water, sunlight, temperature, soil composition, water quality, and air quality all affect the types and numbers of living things in that area. In turn, living things have an impact on the non-living environment by affecting water, soil, and air.

Algo más sobre el tema…

Un ecosistema es una comunidad de seres vivos (bióticos) que interactúan tanto entre ellos como con los componentes no vivos (abióticos) del medio ambiente. Los factores bióticos y abióticos en un ecosistema están constantemente produciendo efectos unos sobre otros. El agua, la luz del sol, la temperatura, la composición del suelo, la calidad del agua y del aire afectan el tipo y el número de seres vivos en esa área. A su vez, los seres vivos producen un impacto sobre los componentes no vivos del medio ambiente, lo cual afecta el agua, la tierra y el aire.

Modifications

If your school campus is dry and well-used, there may not be a lot of variety of living organisms. Consider taking a field trip to the bosque, mountains, or a park to conduct the small ecosystem study.

Extensions

Have students repeat this activity at home with parent involvement. Families can make observations about the temperature, moisture, and biotic features of their study plot throughout the day. Then have students bring their data to the classroom so students can compare what they discovered.

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First Edition. Albuquerque, NM, 1996.

STUDENT ACTIVITY SHEET

Small Ecosystems on Campus

Follow the directions below to gather and record data from your small study plot in the charts below.

1. Carefully put a thermometer about 3 cm (about an inch) into the soil and let it sit for about 5 minutes before recording the temperature reading in Chart 1 below. Also take the temperature of the air at the level of a medium-sized plant and record.

2. In Chart 1, describe the dampness of the soil and the amount of light reaching your study plot. Also describe any other non-living factors you notice.

3. Count and record the various living things in your study plot in Chart 2. If you don't know the names of the animals or plants you see, draw a picture in the chart.

4. When the whole class is ready, you will be finding out how fast the soil can absorb water. To prepare for this experiment, put one end of your can about 3 cm into the soil. When your teacher is ready with the stopwatch, you should quickly pour the water into the can and time how many seconds it takes for the water to soak into the soil. Record this number on Chart 1.

CHART 1

Environmental Factor	Observations
Temperature of soil	
Temperature of air	
Dampness of soil	
Amount of light	
Time for water to be absorbed by soil	

CHART 2

Description of **Animal**	Number found	Description of **Plant**	Number found

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Pequeños ecosistemas en la escuela

Recolecta los datos de tu pequeño terreno y anótalos en la tabla siguiente, de acuerdo con las instrucciones.

1. Cuidadosamente, inserta un termómetro aproximadamente 3 cm. (alrededor de una pulgada) debajo de la tierra y déjalo ahí por cinco minutos. Luego anota la temperatura en la Tabla 1. Además, toma la temperatura del aire a la altura de una planta mediana y anótala.

2. En la Tabla 1, describe la humedad del suelo y la cantidad de luz que llega a tu terreno. También describe cualquier otro factor no vivo que hayas notado.

3. Cuenta y anota en la Tabla 2, los organismos que existen en tu terreno. Si no sabes los nombres de los animales y plantas que ves, haz un dibujo en la tabla.

4. Cuando toda la clase esté lista, realizarán un experimento para descubrir con qué rapidez pueden absorber agua los distintos tipos de suelo. Para prepararte para este experimento, coloca un extremo de tu tarro a aproximadamente 3 cm. de la tierra. Cuando tu maestro esté listo con el cronómetro, vaciarás rápidamente el agua en el tarro y contarás cuántos segundos tarda la tierra en absorber el agua. Anota tus resultados en la Tabla 1.

TABLA 1

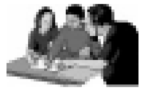
Factor del medio ambiente	Observaciones
Temperatura de la tierra	
Temperatura del aire	
Humedad de la tierra	
Cantidad de luz	
Tiempo que demora en absorberse el agua en la tierra	

TABLA 2

Descripción del **animal**	Número de animales que has encontrado	Descripción de la **planta**	Número de plantas que has encontrado

SUCCESSION IN POND WATER

Sucesión en agua de estanque

Grades		
6–8	*2*	*1–3 weeks:* *10–20 mins./day*

Purpose

Students will observe ecological succession when dried pond vegetation is placed in tap water.

Materials

Large, tall jars with loose fitting lids (one per group)
Aged tap water (let tap water stand uncovered for at least 24 hours)
Dried leaves and other vegetation from a pond
Microscopes
Glass slides and cover slips (three per group)
Eye droppers
Student Activity Sheet

Concepts

- Succession is the change in the variety and numbers of organisms in a community over time.
- Primary succession is sucession in an area where no previous organisms existed.
- Pioneer species are organisms that are the first living things to live in an area.
- A climax community is the final stage of succession.
- When a climax community is partially disturbed and succession resumes, it is called secondary succession.

Conceptos

- Sucesión es el cambio en la variedad y en el número de organismos en una comunidad a través del tiempo.
- Sucesión primaria es una sucesión en un área donde no existían organismos previamente.
- Las especies pioneras son los organismos que constituyen los primeros seres vivos en un área.
- Una comunidad clímax es la etapa final de una sucesión.
- Cuando una comunidad clímax se altera parcialmente y la sucesión se reanuda, ésta se llama sucesión secundaria.

Safety

Review safety procedures for handling microscopes and slides. Have students wash hands thoroughly after handling pond vegetation.

Vocabulary

Succession
Primary succession
Secondary succession
Climax community
Pioneer species

Vocabulario

Sucesión
Sucesión primaria
Sucesión secundaria
Comunidad clímax
Especies pioneras

In Advance

Collect and dry plants (leaves, twigs, algae, etc.) and pebbles from a pond. Gather other materials and organize a set of supplies for each group of students. Age tap water by allowing it to stand at least 24 hours.

Procedure

1. *Discuss succession*

Using the "Why It Happens" section for this activity, introduce the ecological concept of **succession**. Have students give examples of how succession might progress in forest or beach ecosystems. While most examples of succession take place over hundreds of years, they will be watching an example of succession that takes only a few weeks.

2. *Set-up*

Divide students into pairs and give each pair a large jar, aged tap water, dried pond vegetation, three glass slides, three cover slips, an eye dropper, and a microscope. (Groups can share microscopes if necessary.) Also give each pair a copy of the Student Activity Sheet. Tell older students to follow the procedure outlined on the Student Activity Sheet. With younger students, you may want to read each step and have students follow the instructions as you go.

3. *Observe*

Over the next several weeks, have students follow the procedure on the Student Activity Sheet to observe the changes in their water. Be sure students are recording their observations.

4. Discuss observations

When you are finished making observations, have students compare the changes they noticed in their water. Use the "Questions to Ask During the Activity" to guide the class discussion.

The water and pond vegetation can be collected and returned to the pond.

Questions to Ask During the Activity

1. What organisms did you see in your water samples?

2. Which types were the most and least common?

3. Were the most organisms found in the top, middle, or bottom of the jar?

4. Were some organisms present in the samples from the beginning to the end of the study? If so, which ones?

5. If the water samples changed over time, describe what changed.

6. Why do you think the community changed over time?

Preguntas sobre el tema de la actividad

1. ¿Qué organismos observaste en tus muestras de agua?

2. ¿Qué tipos de organismos fueron los más comunes y los menos comunes?

3. ¿Dónde encontraste más organismos: en la superficie, en la mitad o en el fondo del frasco?

4. ¿Hubo algún organismo presente en las muestras durante todo el experimento? Si lo hubo, ¿cuál fue?

5. Si el agua de las muestras cambió con el tiempo, describe qué fue lo que cambió.

6. ¿Por qué crees que la comunidad cambió con el tiempo?

Why It Happens/More on the Topic

In the beginning of this activity, students observe samples of water with nothing living in it. When the pond vegetation is placed in the water, the organisms living in the vegetation are introduced to the water. Over several weeks, the populations of these microorganisms change. Other species, such as rotifers, worms, and algae affect the existing populations of organisms. When the makeup of a community changes over time like this, it is called succession. Sometimes the entire population of a community is replaced with other organisms.

Primary succession is succession in an area where no previous organisms existed. This is the type of succession observed in the tap water and also on a newly formed volcano, a new pond, or on bare rock.

The first living things to arrive in an area are called **pioneer species**. Lichens and algae are typical pioneer species because they make their own food and can grow well in harsh environments. Once pioneer species have become established, other plants and animals begin to arrive and the community develops and changes. The final stage of succession is called the **climax community**. If the climax community is disturbed by fire, storms, or human activities such as farming, ranching, construction, or logging, another type of succession occurs called **secondary succession**. When an area has been disturbed, but there are still living things, secondary succession progresses until the climax community is established again.

Algo más sobre el tema...

Al comienzo de esta actividad, los estudiantes observaron muestras de agua sin ningún organismo vivo. Al agregar vegetación del estanque al agua, también se introdujeron los organismos que viven normalmente en la vegetación. Después de varias semanas, la población de estos microorganismos cambió. Otras especies, tales como rotíferos, gusanos y algas afectaron a las poblaciones de organismos existentes. Cuando la composición de una comunidad cambia a través del tiempo, como ocurrió aquí, hablamos de sucesión. A veces toda la población de una comunidad es reemplazada por otros organismos.

Sucesión primaria es la sucesión en un área donde no existían organismos previamente. Éste es el tipo de sucesión que se observó en el agua de grifo y también en formaciones volcánicas recientes, en un nuevo estanque o en una roca al descubierto.

Algo más sobre el tema (continuación)

Los primeros seres vivos que llegan a un área se llaman **especies pioneras**. Los líquenes y las algas son especies pioneras típicas porque fabrican su propio alimento y pueden crecer bien en ambientes inhóspitos. Una vez que las especies pioneras se han establecido, comienzan a llegar otras plantas y animales y la comunidad se desarrolla y cambia. La etapa final de una sucesión se llama **comunidad clímax**. Si la comunidad clímax se altera por incendios, tormentas o actividades de los seres humanos, tales como agricultura, ganadería, construcción o tala de árboles, se produce otro tipo de sucesión llamada **sucesión secundaria**. Cuando un área ha sido alterada pero aún contiene seres vivos, la sucesión secundaria progresa hasta que se vuelve a establecer la comunidad clímax.

Modifications

With younger students (including grades 3-5), read each step of the procedure on the Student Activity Sheet and have students follow along when setting up the study and making observations. They may also need more assistance with preparing their slides and using the microscope.

Extensions

Take a field trip to a natural area that was recently disturbed by fire or construction. Have students write down (or draw) the plants and animals they find in the disturbed area and nearby areas that are not disturbed. Have students make predictions about what will happen to the disturbed area if it is left alone again.

References

The New Mexico Museum of Natural History and Science. Proyecto Futuro Life Science Curriculum. First Edition. Albuquerque, NM, 1996.

STUDENT ACTIVITY SHEET
Succession in Pond Water

Procedure:

1. Fill your jar two-thirds full with the aged tap water.

2. Add a handful of the dried pond vegetation.

3. Place the jar in an area that has plenty of light, but not direct sunlight. The water should stay at a constant room temperature and direct sunlight will make the water too warm.

4. Cover the jar loosely with the lid. It should not be airtight! If any water evaporates over the coming weeks, you can add more aged tap water.

5. Every day, take three samples from the water with an eyedropper. Take one sample from the water surface, one from the middle, and one from the bottom of the jar. Rinse the eye dropper between each sample. Place each water sample on its own slide. Carefully place a cover slip on the slides and look at them under the microscope.

6. Write your observations on the Data Table provided. If you prefer, you can make drawings of the organisms you see through the microscope. Also look for organisms in the jar that can be seen without a microscope. Observe and write down changes to the water's appearance and smell each day.

Data Table

Date	Organisms

ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Sucesión en agua de estanque

Procedimiento

1. Llena dos tercios de tu frasco con agua del grifo que has dejado reposar por 24 horas.

2. Agrega un puñado de vegetación seca de estanque.

3. Coloca el frasco en un área con mucha luz, pero sin luz directa del sol. El agua debe estar a una temperatura ambiente constante y la luz directa del sol calentaría demasiado el agua.

4. Cubre el frasco con la tapa, pero ¡no lo cierres herméticamente! Si se evapora parte del agua durante las próximas semanas, puedes agregar más agua del grifo que has dejado reposar por 24 horas.

5. Todos los días, toma tres muestras de agua con un gotero. Toma una muestra de la superficie del agua, una del medio del frasco y otra del fondo. Enjuaga el gotero entre cada muestra. Coloca cada muestra de agua en su propio portaobjeto. Cuidadosamente, coloca un cubreobjeto sobre cada portaobjeto y obsérvalos bajo el microscopio.

6. Escribe tus observaciones en la Tabla de datos. Si prefieres, puedes hacer dibujos de los organismos que observaste a través del microscopio. También busca en el frasco algún organismo que pueda verse sin un microscopio. Todos los días, observa y anota los cambios en el aspecto y en el olor del agua.

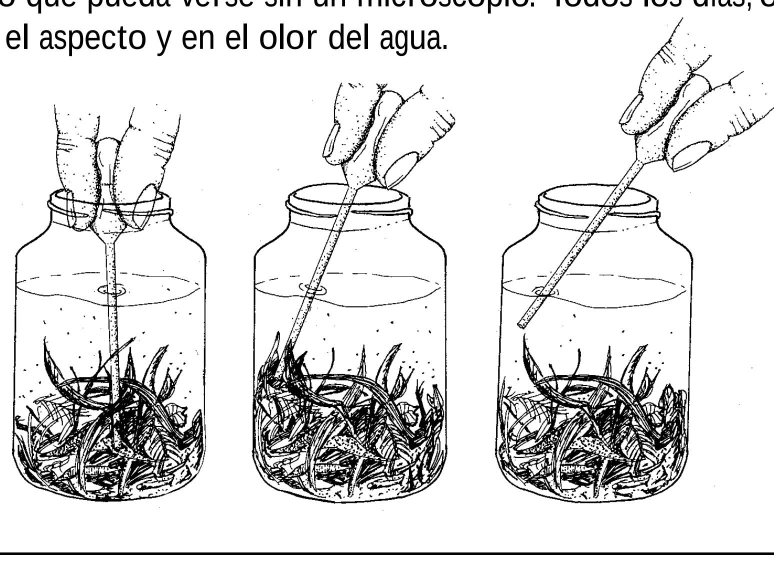
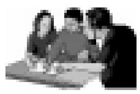


Tabla de Datos

Fecha	Organismos

BIODIVERSITY
Biodiversidad

Grades		
3–8	5	60 minutes

Purpose

Students will investigate the three levels of biodiversity—genetic diversity, species diversity, and ecosystem diversity—by observing the variety of leaves on the school campus.

Materials

Small pieces of paper
Pen or pencil
A variety of leaves (can be collected by the students outside)

Concepts

- Genetic diversity is the variety of genes within a species of organism.
- Species diversity is the number and kinds of organisms on Earth.
- Ecosystem diversity is the variety of ecosystems in the world.
- Biodiversity is important for a variety of reasons. (See “Why It Happens” section in this activity.)

Conceptos

- La diversidad genética es la variedad de genes dentro de una determinada especie de organismos.
- La diversidad de especies es el número y tipos de organismos en la Tierra.
- La diversidad de ecosistemas es la variedad de los ecosistemas en el mundo.
- La biodiversidad es importante por muchas razones. (Ver “Algo más sobre el tema…” en esta actividad.)

Safety

Be sure to select an outside site that doesn’t have poisonous plants or other hazards. Designate boundaries that students are not to cross.

Vocabulary

Biodiversity
Species diversity
Genes
Genetic diversity
Ecosystem diversity

Vocabulario

Biodiversidad
Diversidad de especies
Genes
Diversidad genética
Diversidad de ecosistemas

In Advance

Select a safe outdoor site where students can collect leaves.

Procedure

1. *Gather leaves*

Tell students that they will be going outside to gather a variety of leaves. Take students outside to the area you have identified. Have students gather at least one example of five different types of leaves. Remind them that pine needles are also leaves.

2. *Return to the classroom and discuss biodiversity*

Have students spread their leaves on their desk. Define the word **biodiversity** and explain that there are several kinds of biodiversity. The variety of leaves they have on their desk is an example of **species diversity**.

Now, divide the class into groups of 5 students. Have each group organize their leaves into piles of the same species. Tell the students to look carefully at the leaves that are from one species of plant. Are the leaves identical? What differences do they notice? The leaves will vary in part because of events that have occurred during the life of the leaf, but also because of genetic differences. **Genetic diversity** is the variety of **genes** within a species. Genes are the codes that are passed from one generation to the next. The characteristics of each individual are determined by that individual's genetic makeup.

Finally, ask students if they gathered leaves in a tropical rainforest or near an ocean if they would find the same leaves. Most likely they would find a very different set of leaves representing entirely different species. Rainforests, temperate forests, deserts, and oceans are examples of the variety of Earth's ecosystems or **ecosystem diversity**.

3. *Discuss the importance of biodiversity*

Give each student a small piece of paper and something to write with. Tell the class to write down one reason why they think it is important to conserve biodiversity. Collect the pieces of paper.

Read the first piece of paper and write a summary statement on the chalkboard. As you read the rest of the papers, organize the summaries into categories. Some possible categories might include: medical or economic reasons (new medicines, foods, and other products); maintaining ecological processes (oxygen production, pollination, flood control, etc.); recreation (hiking, camping, fishing, etc.); inspiration and beauty; and the right to exist (other species have the right to exist). Discuss the various reasons why biodiversity is important and why many people are concerned about protecting it. If some categories were not represented by the students' statements, be sure to discuss those as well.

Questions to Ask During the Activity

1. What are some examples of genetic diversity in humans? (Eye color, hair color, and height are all examples of genetic diversity in humans.)

2. What are some examples of ecosystem diversity in New Mexico? (Grasslands, desert, and forest.)

Preguntas sobre el tema de la actividad

1. ¿Cuáles son algunos ejemplos de diversidad genética en los seres humanos? (El color de los ojos, el color del pelo y la altura son ejemplos de diversidad genética en el ser humano.)

2. ¿Cuáles son algunos ejemplos de diversidad de ecosistemas en Nuevo México? (Praderas, desiertos y bosques.)

Why It Happens/More on the Topic

Biological diversity is the variety of life on Earth. There are three levels of biodiversity. Species diversity refers to the variety of species. Ecosystem diversity is the variety of ecosystems, habitats, and communities in the world. Tropical rainforests, deserts, temperate forests, grasslands, and coral reefs are examples of ecosystem diversity. Genetic diversity is the variety of genetic information found within individual organisms, species, and populations of organisms.

Biodiversity is important for a number of reasons. Animals and plants help maintain the balance of gases in the atmosphere; plants help to prevent erosion and flooding by absorbing and slowing down moving water; wetlands filter sediments and pollutants from water; animals pollinate a variety of plants including food crops; plants and animals are the source of new medicines, foods, and other products; plants and animals enhance outdoor recreation experiences; and biodiversity is a source of inspiration to artists, writers, scientists, and even inventors.

Algo más sobre el tema...

La diversidad biológica es la variedad de vida en la Tierra. Hay tres niveles de biodiversidad. La diversidad de especies se refiere a la variedad de especies. La diversidad de ecosistemas es la variedad de ecosistemas, hábitat y comunidades en el mundo. Las selvas tropicales húmedas, los desiertos, los bosques templados, las praderas y los arrecifes de coral son ejemplos de la diversidad de los ecosistemas. La diversidad genética es la variedad de la información genética que se encuentra dentro de organismos individuales, especies y poblaciones de organismos.

La biodiversidad es importante por muchas razones. Los animales y las plantas ayudan a mantener el equilibrio de gases en la atmósfera; las plantas ayudan a prevenir la erosión y las inundaciones debido a que absorben el agua y reducen su desplazamiento; los pantanos filtran sedimentos y contaminantes del agua; los animales polinizan una variedad de plantas, incluyendo cultivos de alimentos; las plantas y los animales son fuente de nuevos medicamentos, alimentos y otros productos; las plantas y los animales hacen más agradables las experiencias recreativas al aire libre; y la biodiversidad es una fuente de inspiración para artistas, escritores, científicos e incluso inventores.

Modifications

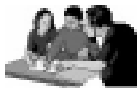
Younger students will need more detailed explanations of the three levels of biodiversity. Rather than having younger students write down a reason for protecting biodiversity, have them draw a picture and explain their reason to the rest of the class.

Extensions

Have students go on an “ecosystem services” scavenger hunt. Examples of ecosystem services they can look for include pollination, pest control (some animals keep “pest” populations in check), decomposition, water purification (wetlands help filter pollutants and sediments), erosion and flood control (plants absorb and slow down water), and the maintenance of gases in the atmosphere (plants release oxygen and absorb carbon dioxide and animals do the opposite).

IT'S A SMALL WORLD

Es un mundo pequeño

Grades		
K–8	3 equal teams	Setup: 60 mins Discussion: variable

Purpose

Students will set up a terrarium and observe how conditions mimic those of the Earth as a whole. Students will also discuss how people are changing those conditions and the consequences of those changes.

Materials

Glass aquarium
Plastic wrap or tight-fitting lid
Small house plants
Horticultural charcoal
Non-sterilized potting soil
Pebbles
Vermiculite (if not in the potting soil)
Aquarium sand
Peat moss
Water
Ruler
Nylon stockings
Scissors
Shovel
Containers for mixing soil

Concepts

- An ecosystem is a community of living things that interact with each other and with non-living components in the environment.
- Changing one thing in an ecosystem often affects other parts of the ecosystem.

Conceptos

- Un ecosistema es una comunidad de seres vivos que interactúan tanto entre sí como con los componentes no vivos del medio ambiente.
- Aún cuando se modifique una sola cosa en un ecosistema, a menudo esto afecta otras partes del ecosistema.

Vocabulary

Transpiration
Condensation
Deforestation
Producer
Primary consumer
Secondary consumer
Predator
Ozone
Pollutant
Endangered species
Climate change

Vocabulario

Transpiración
Condensación
Deforestación
Productor
Consumidor primario
Consumidor secundario
Predador
Ozono
Contaminante
Especies en peligro de extinción
Cambios climáticos

In Advance

Gather materials. With younger students, pre-mix potting soil, vermiculite, peat moss, sand, and charcoal.

Procedure

1. *Introduce the activity*

Begin the activity by telling students that a model can be a good observation tool, especially when the model represents something as complex as an ecosystem. Established terrariums can be used to observe and test a variety of natural events.

2. *Set-up terrarium*

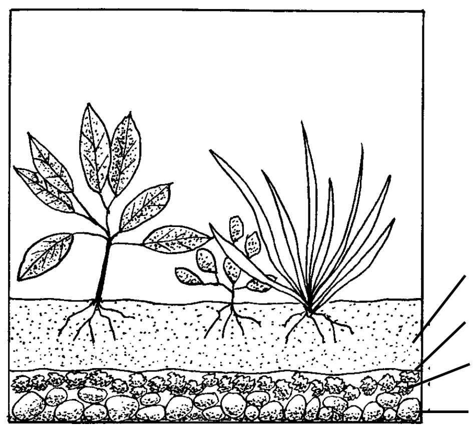
Divide the class into three teams and assign one of the following steps to each of the teams.

Group 1: Wash the pebbles and charcoal. Cover the bottom of the aquarium with a 2.5 cm layer of pebbles and cover the pebbles with a 0.5 cm layer of charcoal. Cut up some nylon stockings and use the material to cover the charcoal and pebble layers. This will keep soil from getting into the drainage area formed by the charcoal and pebbles.

Group 2: Mix together 6 parts potting soil, 2 parts vermiculite, 2 parts peat moss, 1 part aquarium sand, and 1 part charcoal. Cover the drainage area on the bottom of the terrarium with 4 cm of the soil mixture.

Group 3: Make little holes in the soil for each of the plants. Be sure to leave space in between the plants to allow for growth. Put a small amount of water in the holes. Shake as much soil as possible from the roots of the plants, then put each plant into one of the holes. Cover the roots with the soil and sprinkle some water on the soil. Place other objects (rocks, a stick, etc.) on the soil to decorate the terrarium.

Cover the terrarium with a tight-fitting lid or plastic wrap.



3. Maintaining the terrarium

The terrarium should not be kept in direct sunlight, but should be near a window. To keep plants from growing in one direction, turn the terrarium around every so often. If no water is accumulating on the lid, add some water to the soil. If the terrarium is too wet, the lid can be removed for several hours.

4. Experiment with the terrarium

Once the terrarium is established, it can be used for a variety of observations and experiments. Here are some ideas:

Observe **transpiration** and **condensation**. Inside the closed terrarium, the water that transpires from the plants is trapped inside. When enough water condenses on the lid, it will "rain" back down onto the plants and soil. The same thing happens in ecosystems like tropical rainforests!

Try "**deforesting**" the terrarium by removing most of the plants, then replace the lid. What happens to the mini-water cycle created in the terrarium? How does that relate to what happens when an ecosystem in the "real" world is deforested?

Introduce some grasshoppers or other plant-gobbling insect to the terrarium. What happens when an ecosystem has **producers** and **primary consumers**, but no **predators**? How does that relate to the "real" world when predators, like wolves, are removed from an ecosystem?

Move the terrarium into an area that receives direct sunlight. In the "real" world, **ozone** has been depleted from the atmosphere, causing more of the sun's rays to reach the Earth's surface. Now many regions of the world receive more intense sunlight. This may be affecting sun-sensitive amphibians and plants, and contributing to an increased incidence of sunburns and skin cancers in people. See how intense sunlight affects the terrarium ecosystem over the span of a few weeks.

Introduce a **pollutant** to the terrarium. Try a mixture of water and laundry soap, or a bit of used motor oil, or even salt. What happens to the plants in the terrarium ecosystem? What happens in the real world when these pollutants contact plants?

Questions To Ask During the Activity

1. How is the terrarium similar to an ecosystem outside? (Both have plants, soil, nutrients, and water. Water is cycled through both systems through transpiration and condensation.)

2. How is the terrarium different from an ecosystem outside? (Most ecosystems are not as closed off as the terrarium. Animals, plants, and people, enter and leave real ecosystems. Real ecosystems also have lakes, rivers, oceans, a variety of animals, changes in weather, etc.)

Preguntas sobre el tema de la actividad

1. ¿En qué se parece el terrario a un ecosistema al aire libre? (Ambos tienen plantas, tierra, nutrientes y agua. El agua se recicla en ambos sistemas mediante transpiración y condensación.)

2. ¿En qué se diferencia el terrario de un ecosistema al aire libre? (La mayoría de los ecosistemas no están encerrados como el terrario. Los animales, las plantas y las personas pueden entrar y salir de los ecosistemas reales. Los ecosistemas reales también tienen lagos, ríos, océanos, una variedad de animales, cambios climáticos, etc.)

Modifications

Set up several terrariums and use each one for a different experiment.

Extensions

Have students search for more information on environmental issues that are affecting different ecosystems. Deforestation, ozone depletion, pollution, **endangered species**, **climate change**, and human population growth are all affecting how natural ecosystems function. Using the information they gathered, have students plan and conduct an action project that addresses one of these issues.

References

Bosak, Susan V. Science Is...A Source Book of Fascinating Facts, Projects, and Activities. Markham, Ontario, Canada: Scholastic Canada, 1991.