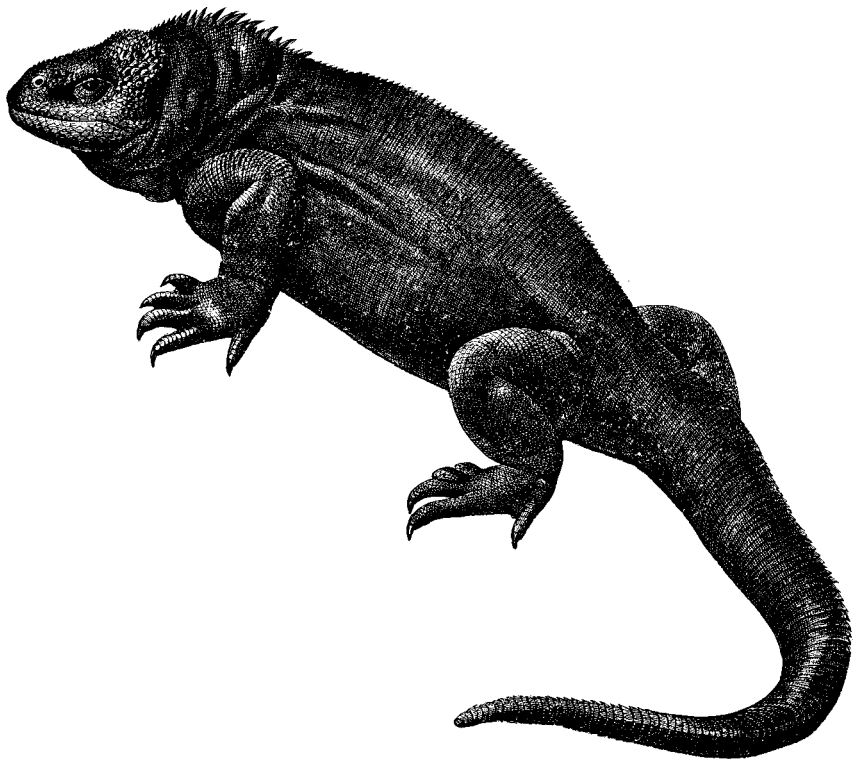
Introduction to
ANIMALS: VERTEBRATES



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 desposítan 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

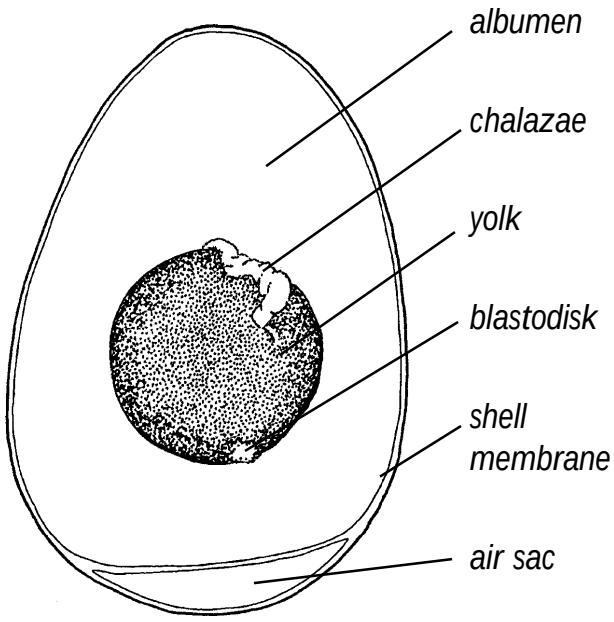
hard because they are made of **calcium carbonate**. As the chick grows, the chick uses some of the calcium. When the chick is ready to hatch, the shell is thinner than it was when the egg was laid.

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

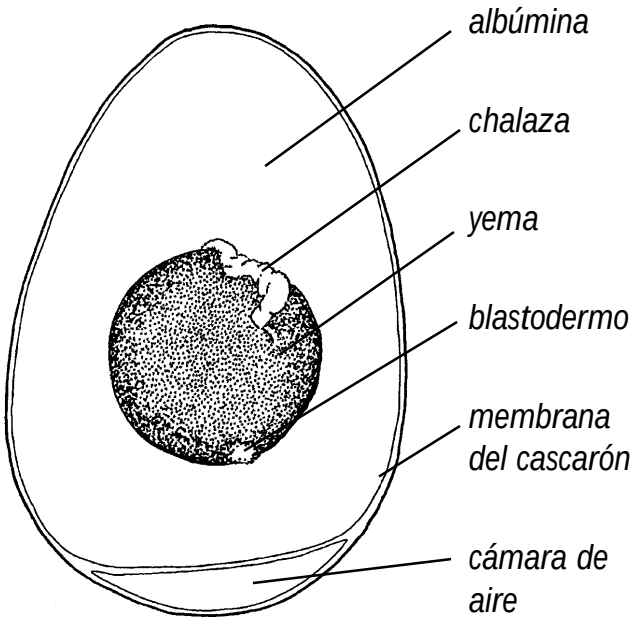
Forma y tamaño - La forma ovalada del huevo le permite rodar en círculos y al rodar vuelve a la posición original. Con esta adaptación se le hace más difícil caerse fuera del nido.

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.

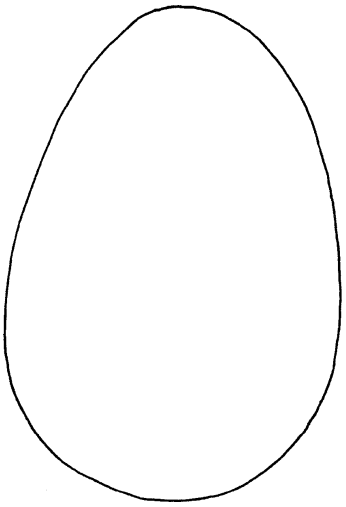
References

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:

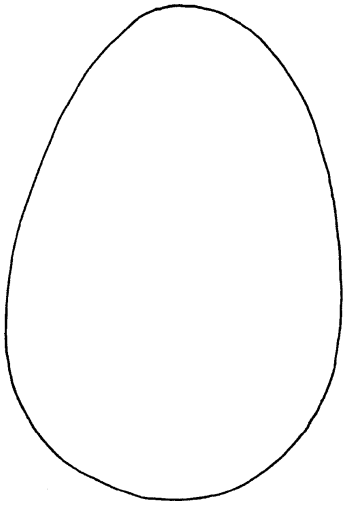
Yolk:

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

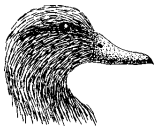
Bird Beak Banquet/Papilla para los picos de los pájaros

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

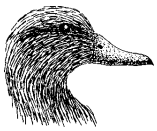
Record your "feeding" results in the chart below:

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

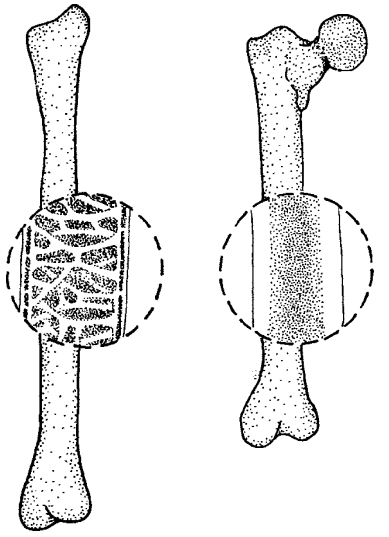
In Advance

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

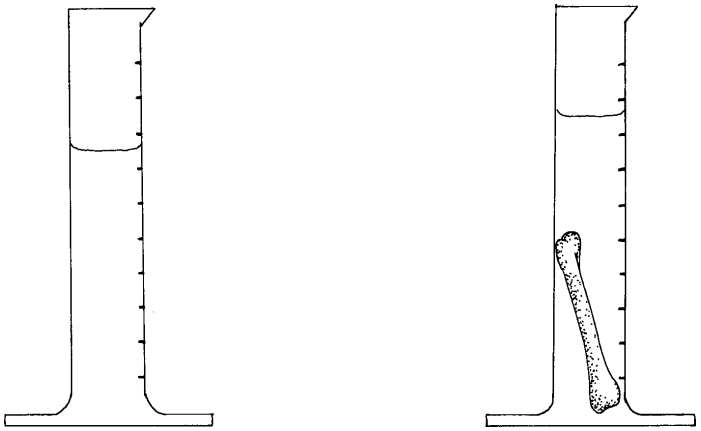
Have each group weigh their bones (separately) on the balance and record their mass (in grams) on the Student Activity Sheet.

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.

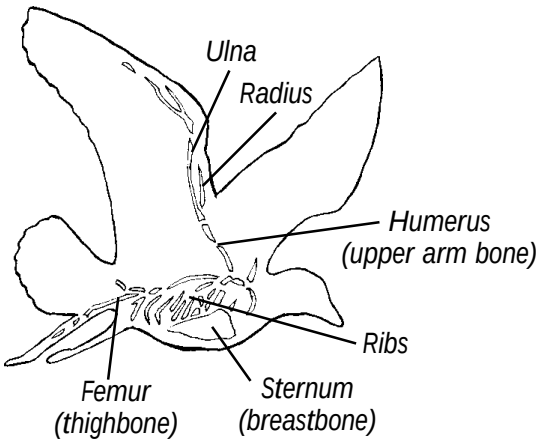
STUDENT ACTIVITY SHEET

Bone Density

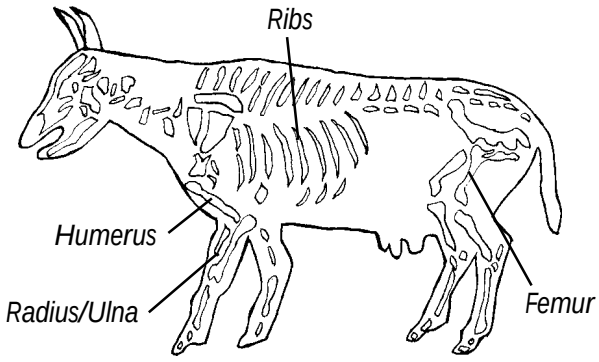
1. Which bones will be the most dense? Which will be the least dense? Write your hypothesis below.

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

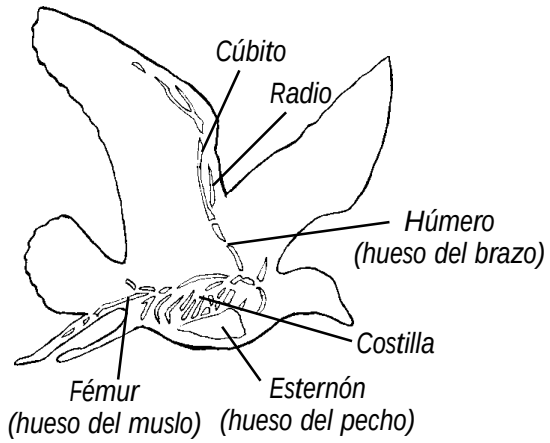
ACTIVIDADES PRÁCTICAS PARA EL ESTUDIANTE

Densidad ósea

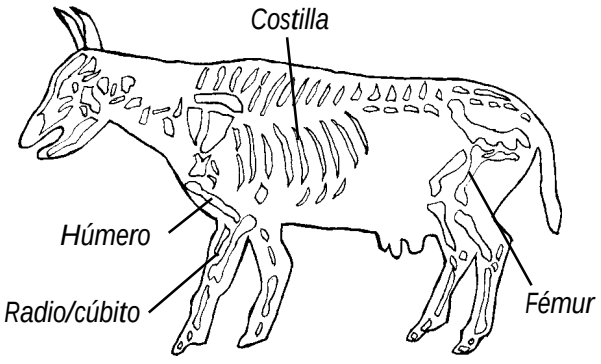
1. ¿Cuáles son los huesos más densos? ¿Cuáles son los menos densos? Escribe tu hipótesis abajo.

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

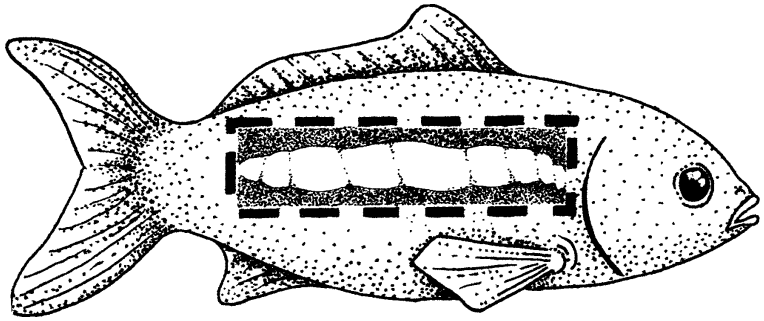
Vocabulario
Vejiga natatoria
Adaptación

In Advance
Gather materials and fill bucket with water.

Procedure

1. Introduce activity

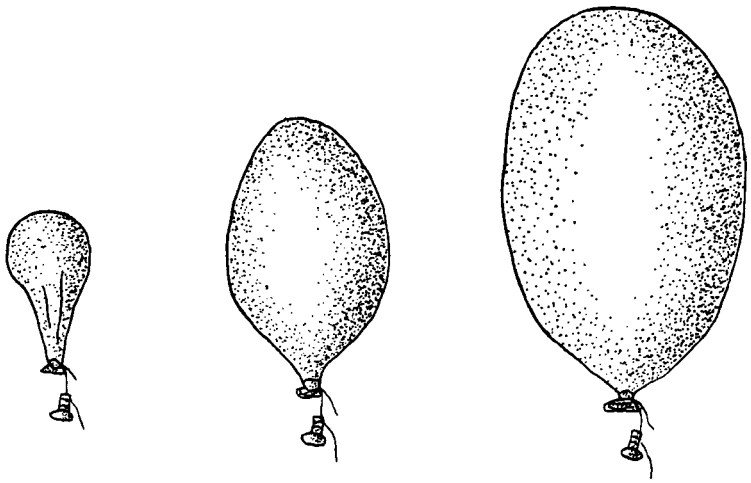
Begin by asking students if they can think of some ways bony fish are **adapted** to living in the water. Besides being streamlined and using gills to breathe, bony fish have a way of moving vertically through the water without expending a lot of energy. Bony fish have a **swim bladder** located just 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.

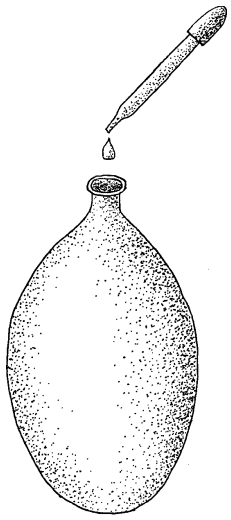
Procedure

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.

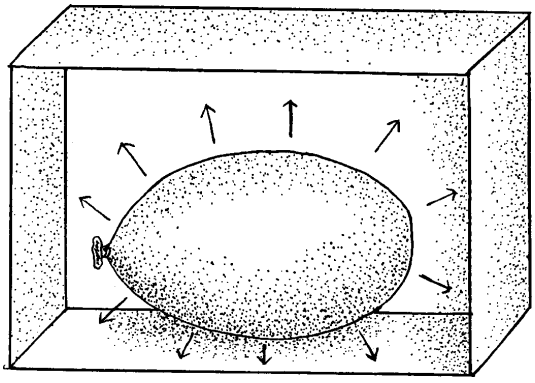
2. Set-up

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

Característica	***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**