Introduction to
FUNGI

BACKGROUND INFORMATION—FUNGI

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Lichens: A Special Relationship

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

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

People and Fungi

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

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

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

References

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

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

INFORMACIÓN BÁSICA—LOS HONGOS

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

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

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

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

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

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

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

químicas simples. Estas sustancias químicas, por ejemplo, el carbono, el nitrógeno y los minerales vuelven a la tierra y son utilizados nuevamente por otros organismos.

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

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

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

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

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

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

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

Liquen: Una relación especial

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

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

La gente y los hongos

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

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

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

GROWING BREAD MOLD FUNGUS

Cultivo del moho negro del pan

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

Purpose

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

Materials

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

Concepts

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

Conceptos

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

Safety

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

Vocabulary

Fungus
Spore
Mycelium
Decomposer
Organic matter
Control (experimental)
Variable

Vocabulario

Hongo
Espora
Micelio
Saprófito
Materia orgánica
Control (experimental)
Variable

In Advance

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

Procedure

1. Introduce activity

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

2. Set-up

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

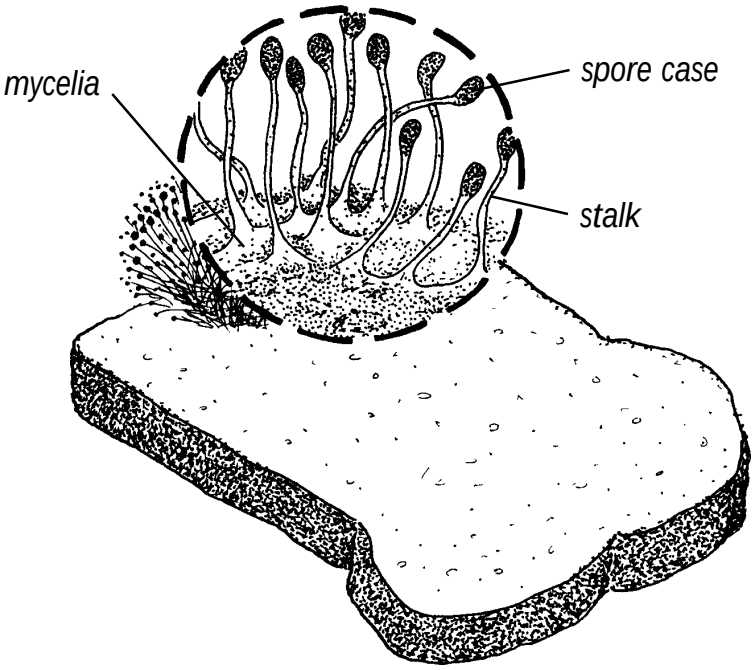
The next day, have each group cover one exposed slice of bread with plastic wrap. This slice should be labeled, "dry, warm" and placed in a warm area of the classroom. Then, instruct students to sprinkle several drops of water over the remaining two slices to moisten (but not soak) the bread. Cover each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

3. Predict

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

4. Observe

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



Questions to Ask During the Activity

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

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

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

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

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

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

Preguntas sobre el tema de la actividad

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

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

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

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

Preguntas (continuación)

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

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

Why it Happens/More on the Topic

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

Algo más sobre el tema…

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

Modifications

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

For older students: Give students information on the conditions needed to grow bread mold fungus. Then, without telling them the steps to this activity, have each group design their own experiment to test the best conditions for growing bread

mold fungus. They will need to identify the experimental control and variables. Provide each group with the materials they need to conduct their experiment.

Extensions

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

References

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

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

GROWING BREAD MOLD FUNGUS

Student Activity Sheet

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

_____

_____

_____

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

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

CULTIVO DEL MOHO NEGRO DEL PAN

Actividades prácticas para el estudiante

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

_____

_____

_____

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

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

A FUNGUS IS NOT A PLANT

Los hongos no son plantas

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

Purpose

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

Materials (for each group)

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

Concepts

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

Conceptos

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

Vocabulary

Transpiration
Xylem
Roots
Stems
Leaves

Vocabulario

Transpiración
Xilema
Raíces
Tallos
Hojas

In Advance

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

Procedure

1. Introduce Activity

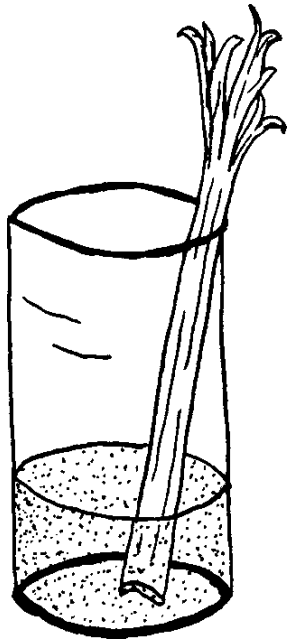
Ask students if they can describe some of the differences between plants and fungi that might affect the way water flows through them. In the **roots**, **stems**, and **leaves** of a plant, there are small tubes (**xylem**) that help pull water and food through the plant. Ask students to predict how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

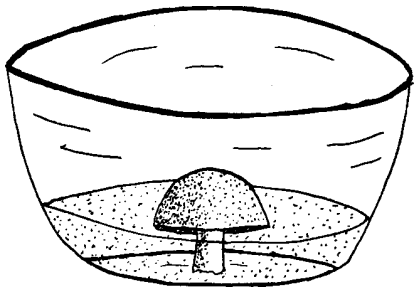
2. Set-up

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

3. Observe

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





Questions to Ask During the Activity

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

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

Preguntas sobre el tema de la actividad

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

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

Why it Happens/More on the Topic

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

Algo más sobre el tema…

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

Modifications

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

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

Extensions

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

References

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

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

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

A FUNGUS IS NOT A PLANT

Student Activity Sheet

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

Day	Celery Stalk	Mushroom
1		
2		
3		
4		
5		

LOS HONGOS NO SON PLANTAS

Actividades prácticas para el estudiante

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

Día	Tallo de apio	Hongo
1		
2		
3		
4		
5		

A FUNGUS AMONGUS

Hongos por doquier

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

Purpose

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

Materials (for each group)

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

Concepts

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

Conceptos

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

Vocabulary

Fungus
Hyphae
Stalk (mushroom)
Cap (mushroom)
Mycelia
Gill
Spores

Vocabulario

Hongo
Hifas
Estípite o cabillo (del hongo)
Sombrero (del hongo)
Micelio
Laminillas
Esporas

In Advance

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

Procedure

1. Introduce the activity

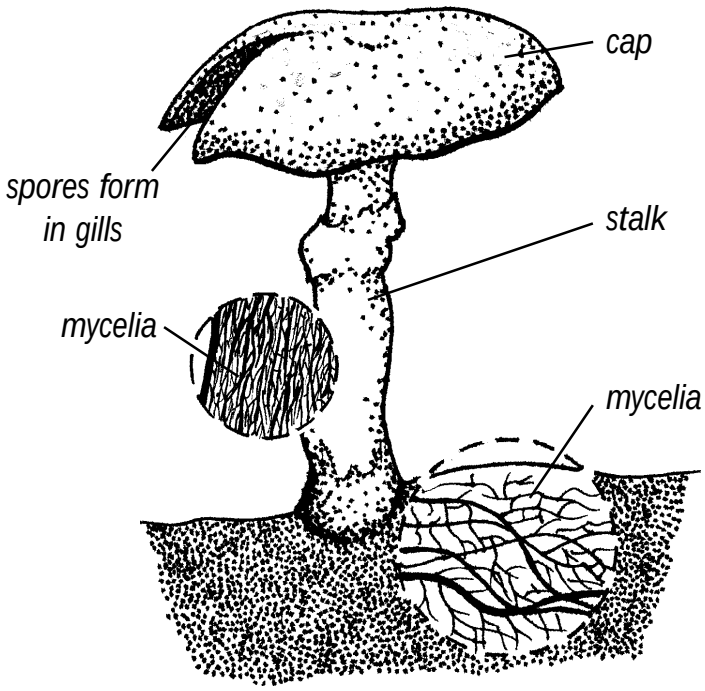
Tell students they will be taking a closer look at the structures of a mushroom fungus, then capturing some of the spores. Explain that what we see as a mushroom is the fruiting body of a much larger underground fungus. Divide students into groups of 2 or 3. Give each group a mushroom to dissect and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

2. Observe

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

3. Dissect

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



4. Make a "mushroom print"

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

5. Observe the "mushroom print"

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

Questions to Ask During the Activity

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

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

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

Preguntas sobre el tema de la actividad

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

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

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

Extensions

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

References

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

A FUNGUS AMONGUS
Student Activity Sheet

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

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

HONGOS POR DOQUIER
Actividades prácticas para el estudiante

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

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

BUDDING IN A BOTTLE

Gemación en una botella

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

Purpose

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

Materials

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

Concepts

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

Conceptos

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

Safety

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

Vocabulary

Fungus
Yeast
Budding
Organic matter

Vocabulario

Hongo
Levadura
Gemación
Materia orgánica

In Advance

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

Procedure

1. Introduce activity

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

2. Set-up

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

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

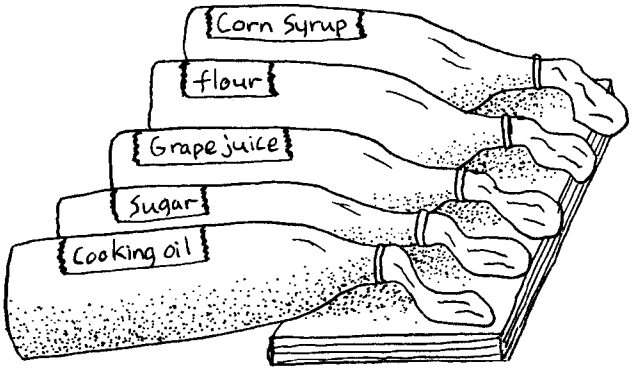
Corn syrup bottle
60 ml corn syrup
30 ml yeast solution

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

Grape juice bottle
60 ml grape juice
30 ml yeast solution

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

Cooking oil bottle
60 ml cooking oil
30 ml yeast solution



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

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

3. Predict

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

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

4. Observe

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

Questions to Ask During the Activity

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

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

Preguntas sobre el tema de la actividad

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

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

Why It Happens/More on the Topic

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

Algo más sobre el tema…

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

Modifications

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

Extensions

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

References

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

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

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

RISING BREAD

El pan sube, sube…

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

Purpose

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

Materials (for each group)

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

Concepts

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

Conceptos

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

Vocabulary

Yeast

Vocabulario

Levadura

In Advance

Gather materials needed for the activity.

Procedure

1. Set-up

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

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

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

2. Predict

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

3. Observe

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

Questions to Ask During the Activity

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

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

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

Preguntas sobre el tema de la actividad

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

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

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

Why it Happens/More on the Topic

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

Algo más sobre el tema…

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

Modifications

For younger students, measure the bread ingredients in advance.

Extensions

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

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

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

References

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

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A FUNGUS AMONGUS

Hongos por doquier

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

Purpose

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

Materials (for each group)

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

Concepts

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

Conceptos

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

Vocabulary

Fungus
Hyphae
Stalk (mushroom)
Cap (mushroom)
Mycelia
Gill
Spores

Vocabulario

Hongo
Hifas
Estípite o cabillo (del hongo)
Sombrero (del hongo)
Micelio
Laminillas
Esporas

In Advance

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

Procedure

1. Introduce the activity

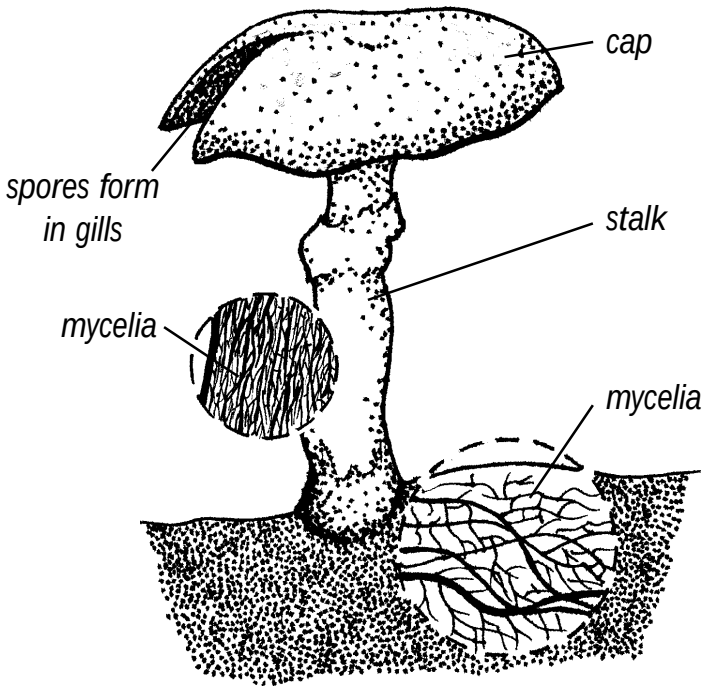
Tell students they will be taking a closer look at the structures of a mushroom fungus, then capturing some of the spores. Explain that what we see as a mushroom is the fruiting body of a much larger underground fungus. Divide students into groups of 2 or 3. Give each group a mushroom to dissect and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

2. Observe

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

3. Dissect

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



4. Make a "mushroom print"

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

5. Observe the "mushroom print"

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

Questions to Ask During the Activity

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

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

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

Preguntas sobre el tema de la actividad

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

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

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

Extensions

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

References

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

A FUNGUS AMONGUS
Student Activity Sheet

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

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

HONGOS POR DOQUIER
Actividades prácticas para el estudiante

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

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