Glencoe Science

Chapter Resources

Plant Reproduction

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Reproducible Student Pages

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Section Focus Transparency 1: Wolfgang Kaehler/CORBIS; **Section Focus Transparency 2:** Dwight Kuhn; **Section Focus Transparency 3:** (t) Thomas Eisner, (b) Thomas Eisner

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Reproducible Student Pages

Reproducible Student Pages

■ Hands-On Activities

■ Meeting Individual Needs

Extension and Intervention

■ Assessment

■ Transparency Activities

Hands-On Activities

Observing Asexual Reproduction

Procedure

1. Using a pair of **scissors**, cut a stem with at least two pairs of leaves from a **coleus or another house plant**.
2. Carefully remove the bottom pair of leaves.
3. Place the cut end of the stem into a **cup that is half-filled with water** for two weeks. Wash your hands.
4. Remove the new plant from the water and plant it in a small **container** of **soil**.

Data and Observations

Analysis

1. Draw and label your results in the Data and Observations section above.
2. Predict how the new plant and the plant from which it was taken are genetically related.

TRY AT HOME Mini LAB

Modeling Seed Dispersal

Procedure

1. Find a **button** you can use to represent a seed.
2. Examine the seeds pictured in **Figure 18** in your text and invent a way that your button seed could be dispersed by wind, water, on the fur of an animal, or by humans.
3. Bring your button seed to class and demonstrate how it could be dispersed.

Analysis

1. Explain how your button seed was dispersed.

2. On the lines below, write a paragraph describing your model. Also describe other ways you could model seed dispersal.

Comparing Seedless Plants

Lab Preview

Directions: *Answer these questions before you begin the Lab.*

1. Why is it important to be careful when using coverslips?

2. What power of the microscope will you use to observe the spores?

All seedless plants have specialized structures that produce spores. Although these sporophyte structures have a similar function, they look different. The gametophyte plants also are different from each other. Do this lab to observe the similarities and differences among three groups of seedless plants.

Real-World Question

How are the gametophyte stages and the sporophyte stages of liverworts, mosses, and ferns similar and different?

Materials

live mosses, liverworts, and ferns with gametophytes and sporophytes
magnifying lens
forceps
dropper
microscope slides and coverslips (2)
microscope
dissecting needle
pencil with eraser

Goals

- **Describe** the sporophyte and gametophyte forms of liverworts, mosses, and ferns.
- **Identify** the spore-producing structures of liverworts, mosses, and ferns.

Safety Precautions

Procedure

1. Obtain a gametophyte of each plant. With a magnifying lens, observe the rhizoids, leafy parts, and stemlike parts, if any are present.
2. Obtain a sporophyte of each plant and use a magnifying lens to observe it.
3. Locate and remove a spore structure of a moss plant. Place it in a drop of water on a slide.
4. Place a coverslip over it. Use the eraser of a pencil to gently push on the coverslip to release the spores.
WARNING: *Do not break the coverslip.*
Observe the spores under low and high power.
5. Make labeled drawings of all observations in the Data and Observations section on the next page.
6. Repeat steps 3 and 4 using a fern.

LAB (continued)

Data and Observations

Drawings:

Conclude and Apply

1. **Compare** the gametophyte's appearance to the sporophyte's appearance for each plant.

2. **List** a structure(s) common to all three plants.

3. **Hypothesize** about why each plant produces a large number of spores.

Communicating Your Data

Prepare a bulletin board that shows differences between the sporophyte and gametophyte stages of liverworts, mosses, and ferns. **For more help, refer to the Science Skill Handbook.**

Design Your Own

Germination Rate of Seeds

Lab Preview

Directions: *Answer these questions before you begin the Lab.*

1. What variables might affect a seed during germination?

2. What safety symbols are associated with this lab?

Many environmental factors affect the germination rate of seeds. Among these are soil temperature, air temperature, moisture content of soil, and salt content of soil. What happens to the germination rate when one of these variables is changed? Can you determine a way to predict the best conditions for seed germination?

Real-World Question

How do environmental factors affect seed germination?

Form a Hypothesis

Based on your knowledge of seed germination, state a hypothesis about how environmental factors affect germination rates.

Possible Materials

seeds
water
salt
potting soil
plant trays or plastic cups
**seedling warming cables*
thermometer
graduated cylinder
beakers
**Alternate materials*

Goals

- **Design** an experiment to test the effect of an environmental factor on seed germination rate.
- **Compare** germination rates under different conditions.

Safety Precautions

WARNING: *Some kinds of seeds are poisonous. Do not place any seeds in your mouth. Be careful when using any electrical equipment to avoid shock hazards.*

Test Your Hypothesis

Make a Plan

1. As a group, agree upon and write your hypothesis and decide how you will test it. Identify which results will confirm the hypothesis.
2. **List** the steps you need to take to test your hypothesis. Be specific, and describe exactly what you will do at each step. List your materials.
3. **Prepare** a data table in your Science Journal to record your observations.
4. Reread your entire experiment to make sure that all of the steps are in a logical order.
5. **Identify** all constants, variables, and controls of the experiment.

LAB (continued)

Follow Your Plan

1. Make sure your teacher approves your plan and your data table before you proceed.
2. Use the same type and amount of soil in each tray.
3. While the experiment is going on, record your observations accurately and complete the data table.

Analyze Your Data

1. **Compare** the germination rate in the two groups of seeds.

2. **Compare** your results with those of other groups.

3. Did changing the variable affect germination rates? Explain.

4. Make a bar graph in the space below of your experimental results.

Conclude and Apply

1. **Interpret** your graph to estimate the conditions that give the best germination rate.

2. **Describe** the conditions that affect germination rate.

Communicating Your Data

Write a short article for a local newspaper telling about this experiment. Give some ideas about when and how to plant seeds in the garden and the conditions needed for germination.

LAB 1 Laboratory Activity

Observing the Effects of Drugs on Seed Growth

Drugs change the way in which living things carry out everyday functions, such as growth and repair. It would be very hard to experiment on humans or other animals to show that this is true. It is possible to experiment with drugs and certain living things, such as plants. The living things used in this experiment are seeds.

Strategy

You will test the effect of four different drugs on the growth of two types of seeds. You will compare how each seed type responded to each of four drugs.

Materials

small beakers (5)
labels (10)
scissors
ruler
cheesecloth
tobacco (4)
twist ties (2)
spoon
ground coffee (caffeinated)
radish seeds (50)
pinto bean seeds (50)
graduated cylinder
ethyl alcohol
aspirin
petri dishes (5)
paper towels

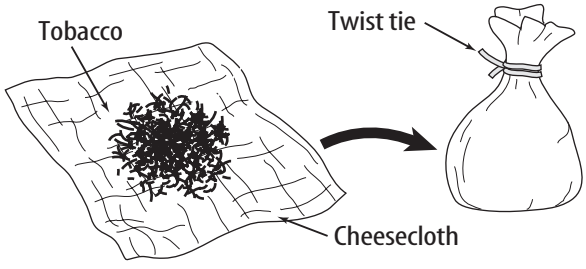
WARNING: *Some kinds of seeds are poisonous. Do not place any seeds in your mouth. Keep all food and chemicals away from your face and mouth.*

Procedure

Part A—Soaking Seeds

1. Label five small beakers as follows: water, alcohol, aspirin, nicotine, caffeine. Add your name to each label.
2. Use scissors to cut two 12 cm × 12 cm pieces of cheesecloth.
3. Obtain a small amount of tobacco from your teacher. Place all the tobacco into the center of one cheesecloth square. Wrap the tobacco in the cheese cloth. Tie the ends of the cheesecloth together with a twist tie. See Figure 1.
4. Prepare a second cheesecloth bag. In this bag, place one spoonful of ground coffee instead of tobacco.

Figure 1



5. Place 10 radish seeds and 10 pinto seeds in each of the five labeled beakers.
6. Using the graduated cylinder, measure 50 mL of ethyl alcohol, then add it to the beaker labeled "alcohol." Carefully rinse the graduated cylinder. Measure, then add, 50 mL of water to each of the other four beakers. Place the coffee, the tobacco, and the aspirin tablet into their labeled beakers.
7. Allow the seeds to soak overnight in the beakers of liquid.

Part B—Preparing Petri Dishes

1. Label the tops of five petri dishes as follows: water, alcohol, aspirin, nicotine, and caffeine. **NOTE:** *The top of the petri dish is wider than the bottom.* Add your name to each label.
2. Stack five paper towels together. On top of these towels, make five separate circles by tracing around the bottom of the petri dish five times.
3. Using scissors, cut out each set of circles (all five layers) and place one set in the bottom of each petri dish. See Figure 2.

Laboratory Activity 1 (continued)

Figure 2

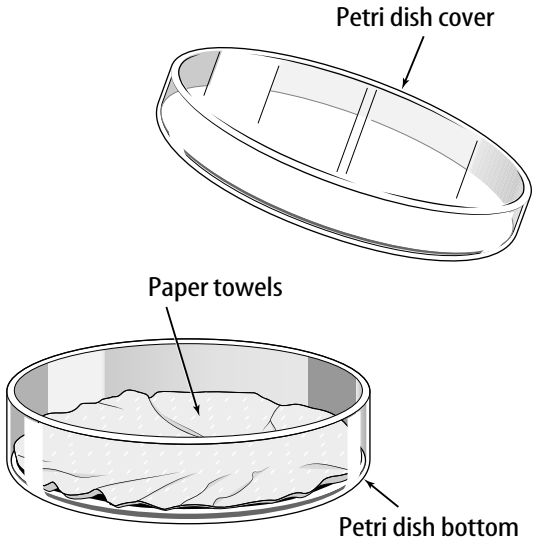
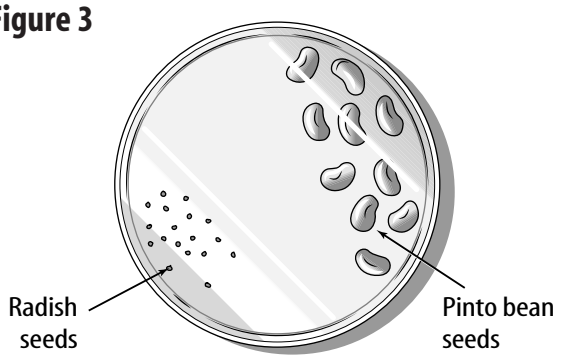


Figure 3



Part C—Observing Seed Germination

After a 24-h period:

1. Put the matching beakers and labeled petri dishes beside each other.
2. Remove the cover of one petri dish and pour about half the liquid from its matching beaker onto the paper towels. **NOTE**: *The tobacco and coffee bags should stay in the beakers.*
3. Carefully remove the seeds from the same beaker and place them on the paper towels. Separate the two seed types as in Figure 3. Replace the cover of the petri dishes.
4. Repeat steps 2 and 3 for each of the other four beakers.
5. Examine all seeds in each petri dish. Look for signs of seed growth. See Figure 4 in order to tell if your seeds are growing. A small root will stick out from the seed if it is alive and growing.
6. Record in Table 1 how many seeds of each type are growing in each petri dish. Consider today as Day 1 in the experiment.
7. Place the petri dishes in a place indicated by your teacher.
8. Observe the seeds for four more days. Each day, record in Table 1 the total number of radish seeds and pinto bean seeds growing in each petri dish.

Figure 4

Seed	Not growing	Growing
Radish		
Bean		

Laboratory Activity 1 (continued)

Data and Observations

Table 1

	Water		Aspirin		Alcohol		Nicotine		Caffeine	
Day	Radish	Bean	Radish	Bean	Radish	Bean	Radish	Bean	Radish	Bean
1										
2										
3										
4										
5										

Questions and Conclusions

1. a. What different kinds of seeds were used in this experiment?

_____

b. What different drugs were used in this experiment?

_____

2. What was the purpose of this experiment?

_____

3. Using your results for Day 5, list the number of radish seeds that were growing in

a. water _____ **c.** aspirin _____ **e.** caffeine _____

b. ethyl alcohol _____ **d.** nicotine _____

4. a. Do the different drugs used seem to affect the number of radish seeds that grew?

b. Support your answer by comparing the number of radish seeds that grew in the drugs to the number that grew in water.

_____

_____

5. Using your results for Day 5, list the number of pinto bean seeds that were growing in

a. water _____ **c.** aspirin _____ **e.** caffeine _____

b. ethyl alcohol _____ **d.** nicotine _____

Laboratory Activity 1 (continued)

6. a. Do the different drugs used seem to affect the number of pinto bean seeds that grew? _____

b. Support your answer by comparing the number of pinto bean seeds that grew in the drugs to the number that grew in water.

7. Write a short paragraph that sums up your findings in this experiment.

8. a. Might all living things show the same type of reaction to these different drugs as did the seeds?

b. How could you find this out?

c. Why might this type of experiment be difficult to carry out on animals?

Strategy Check

_____ Can you test the effect of drugs on the growth of seeds?

_____ Can you compare how two types of seeds responded to each of four drugs?

LAB 2 Laboratory Activity

Parts of a Seed

Seeds are important to plants because they aid in reproduction. When a seed is opened, you can usually find a miniature plant (embryo) inside that is surrounded by a food supply. If planted, the embryo grows into a new plant. Some seeds can be easily split into equal halves or cotyledons (the stored food), while others cannot be split. Those seeds that can be split evenly are called dicotyledons (*di* means two), while those that cannot be split are called monocotyledons (*mono* means one).

Strategy

You will observe and identify the parts of a lima bean seed.
You will learn the functions of seed parts.
You will examine and compare other seeds with a lima bean.
You will learn the difference between a monocotyledon and a dicotyledon seed.

Materials

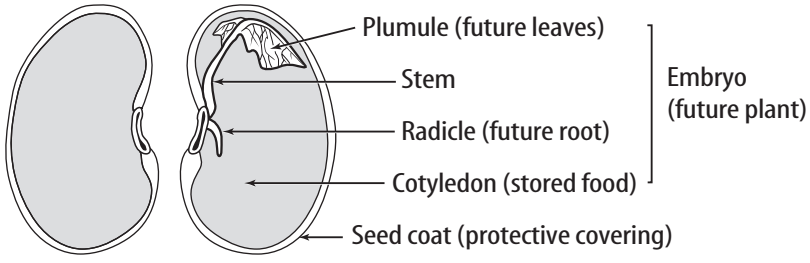
scalpel
seeds (each soaked in water for 24 hours)
- lima bean
- peanut
- corn
- sunflower
- pea

WARNING: *Use care when handling sharp objects. Some kinds of seeds are poisonous. Do not place any seeds in your mouth.*

Procedure

1. Use your fingernail to carefully peel off the thin outer covering or seed coat from a soaked lima bean. Split the seed in half and identify the parts shown in Figure 1.
2. Remove the seed coat from the following soaked seeds: peanut, corn, sunflower, pea. Split each seed in half. Those seeds that do not open easily after the seed coat is removed should be sliced open lengthwise using a scalpel. **WARNING:** *Use care when cutting with a scalpel to avoid injury to yourself and others.*
3. Identify the seed parts.

Figure 1



Laboratory Activity 2 (continued)

Data and Observations

Table 1

Seed Structure					
Type of seed	Seed coat (hard or soft)	Easily opened cotyledons (yes or no)	Number of cotyledons (one or two)	Seed category (monocotyledon or dicotyledon)	Plumule and radicle (yes or no)
1. Lima bean					
2. Peanut					
3. Corn					
4. Sunflower					
5. Pea					

Questions and Conclusions

1. What is the function of the seed coat and the cotyledons?

2. Why is it important that all seeds have a supply of stored food?

3. How does the ease of splitting open a monocotyledon seed compare with that of splitting open a dicotyledon seed?

4. Were there any seeds without a plumule and radicle?

5. What would you expect to grow if a seed without a plumule and radicle were planted?

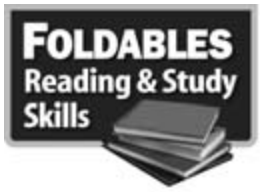
Strategy Check

_____ Can you identify the parts of a lima bean seed?

_____ Can you list the functions of seed parts?

_____ Can you compare other seeds with a lima bean?

_____ Can you identify the difference between a monocotyledon and a dicotyledon seed?



Plant Reproduction

Directions: Use this page to label your Foldable at the beginning of the chapter.

Sexual

Both

Asexual

involves the formation of sex cells

does not involve sex cells

produces offspring genetically identical to the parent organism

produces offspring genetically different from both parent organisms

offspring produced without seed

offspring grow from seed

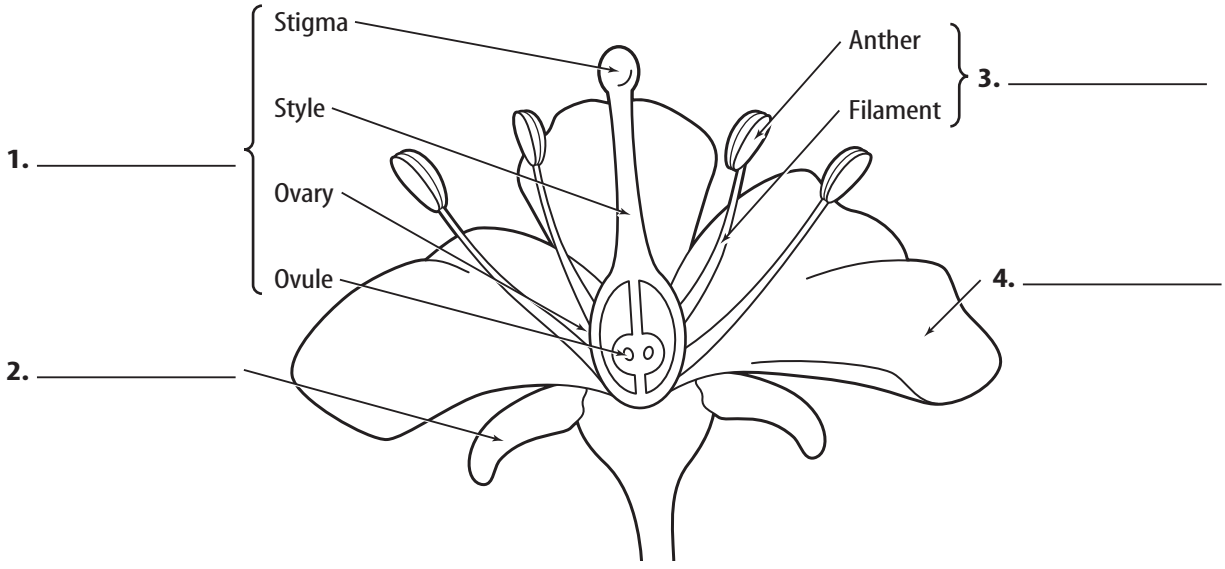
Hands-On Activities

Directed Reading for Content Mastery

Overview
Plant Reproduction

Directions: *Read the following information, then label the flower.*

Flowers contain the reproductive organs of angiosperms. The male organ is the stamen. It includes the anther and the filament. The female organ is the pistil. It is made of three parts: the stigma, the style, and the ovary, which contains the ovules. The brightly colored petals attract insects and the sepals protect the growing flower.



Directions: *Use the above information to answer the questions below.*

5. Which part of the stamen contains pollen grains? _____

6. Which part of the pistil is sticky and attracts pollen grains? _____

Directions: *Complete the following sentences using the correct terms.*

7. New potato plants sprouting from the eyes of cut-up potatoes are an example of _____ reproduction.

8. _____ are vascular seedless plants. _____ are nonvascular.

Meeting Individual Needs

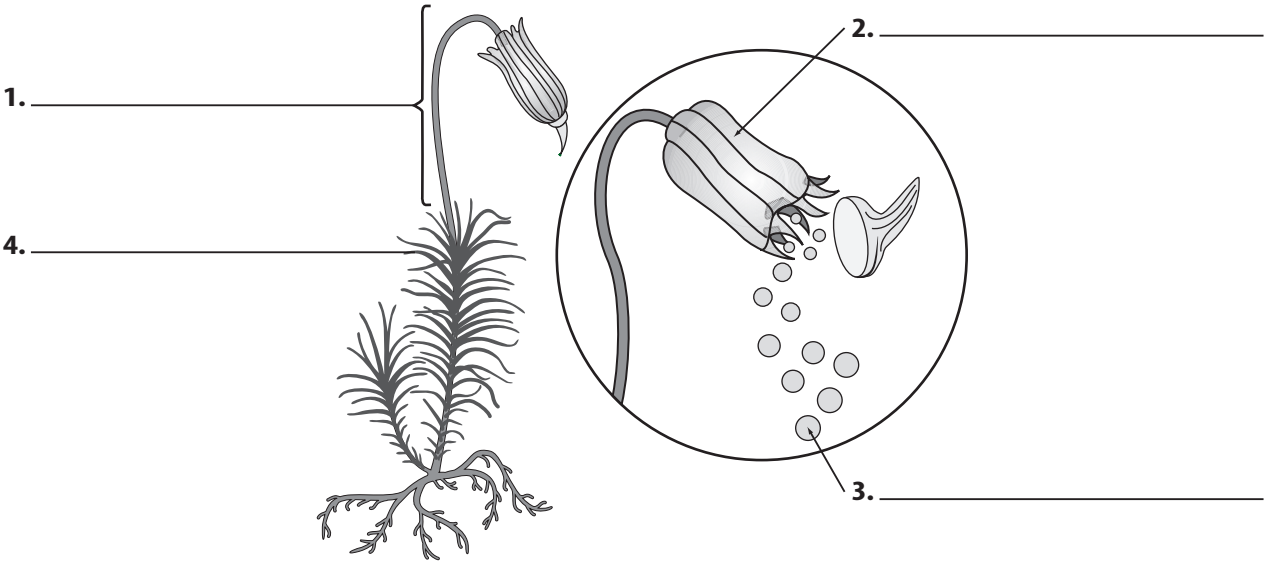
Name Date Class

Directed Reading for Content Mastery

Section 1 ▪ Introduction to Plant Reproduction
Section 2 ▪ Seedless Reproduction

Directions: *Study the following diagram of the moss sporophyte stage. Then label the parts using the terms listed below.*

spore **gametophyte** **sporophyte** **capsule (or spore case)**



Directions: *Complete the following sentences using the terms listed below.*

rhizome **prothallus** **sori** **fronds**
nonvascular **chlorophyll** **cell**

5. Fern leaves are called _____.
6. Fern leaves grow from an underground stem called a _____.
7. Fern spores are produced in structures called _____.
8. A fern spore can grow into a small, green heart-shaped gametophyte plant called a _____.
9. Mosses are _____ plants.
10. In nonvascular plants water and substances move from cell to _____.
11. A prothallus contains _____ and can make its own food.

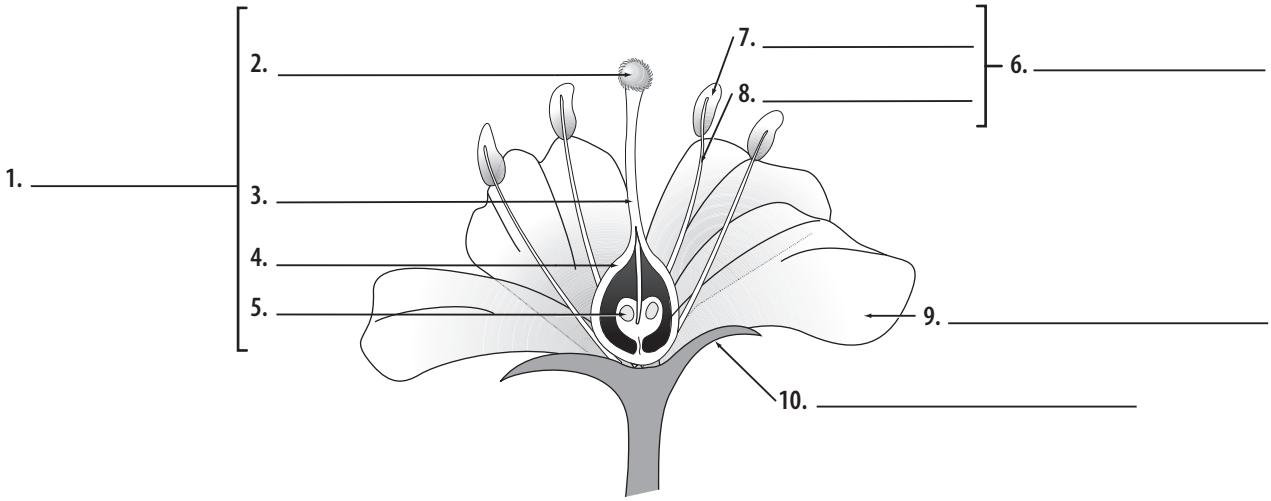
Meeting Individual Needs

Directed Reading for Content Mastery

Section 3 ▪ Seed Reproduction

Directions: *Use the following terms to label the parts of the flower.*

ovary	**stigma**	**style**	**ovule**	**stamen**
pistil	**anther**	**petal**	**sepal**	**filament**



Directions: *Use the following terms to complete the paragraph about pollination below. One term is used two times.*

ovary	**seed**	**stigma**	**pollen**	**stamen**
sperm	**wind**	**animals**	**egg**	**pistil**

Pollination involves the transfer of **11.** _____ grains from a flower's stamen to its stigma. The **12.** _____ is the male reproductive organ. The **13.** _____ is the female reproductive organ. The grains are carried by rain, **14.** _____, or **15.** _____. They land on the sticky **16.** _____ of a plant's pistil. A pollen tube grows from the **17.** _____ grain down through the style and into the **18.** _____ to an ovule. The **19.** _____ travels down the pollen tube and fertilizes the **20.** _____. Following fertilization, the female part develops into a(n) **21.** _____.

Meeting Individual Needs

Name Date Class

Directed Reading for Content Mastery

Key Terms
Plant Reproduction

Directions: *Draw a line to connect the term on the left to its description on the right.*

1. prothallus	**a.** when cells form having a haploid number of chromosomes
2. gametophyte stage	**b.** the start of the growth of a plant
3. ovary	**c.** where eggs are produced
4. germination	**d.** a small, green, heart-shaped plant that grows from a fern spore
5. pistil	**e.** part of the plant's male reproductive organ that contains sperm
6. pollen grain	**f.** structures in which fern spores are produced
7. pollination	**g.** the swollen base of the pistil where ovules are formed
8. rhizome	**h.** female reproductive organ of flowering plants
9. stamen	**i.** fern leaf
10. sporophyte stage	**j.** male reproductive organ of flowering plants
11. spore	**k.** when cells form having a diploid number of chromosomes
12. frond	**l.** haploid cells produced when cells in reproductive organs undergo meiosis
13. sori	**m.** transfer of pollen grains from the male to female reproductive organs of plants
14. ovule	**n.** underground stems of plants such as ferns

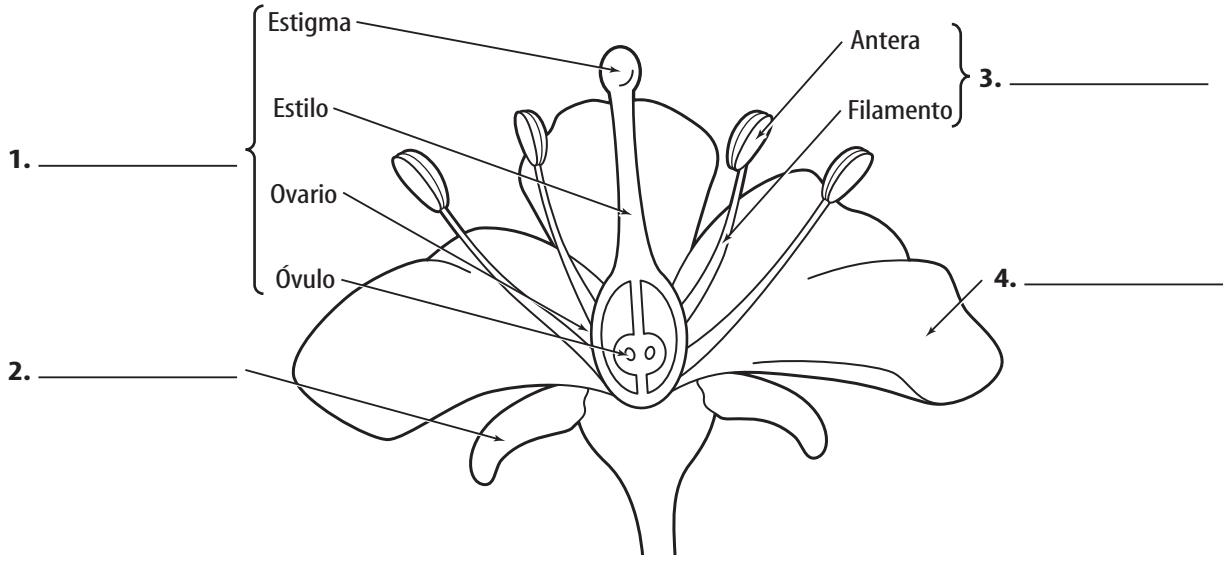
Meeting Individual Needs

Lectura dirigida para Dominio del contenidio

Sinopsis Reproducción de las plantas

Instrucciones: *Lee la siguiente información y luego rotula la flor.*

Las flores contienen los órganos reproductores de las gimnospermas. El órgano masculino es el estambre, que incluye la antera y el filamento. El órgano femenino es el pistilo, que se compone de tres partes: el estigma, el estilo y el ovario; éste último contiene el óvulo. Los pétalos coloreados atraen insectos y los sépalos protegen la flor en crecimiento.



Instrucciones: *Usa la información anterior para responder las preguntas.*

5. ¿Qué parte del estambre contiene los granos de polen? _____

6. ¿Qué parte del pistilo es pegajosa y atrae los granos de polen? _____

Instrucciones: *Completa las siguientes oraciones usando los términos correctos.*

7. Las nuevas papas que crecen a partir de ojos de papa son un ejemplo de reproducción _____.

8. Las(Los) _____ son plantas vasculares sin semillas. Las(Los) _____ son plantas no vasculares.

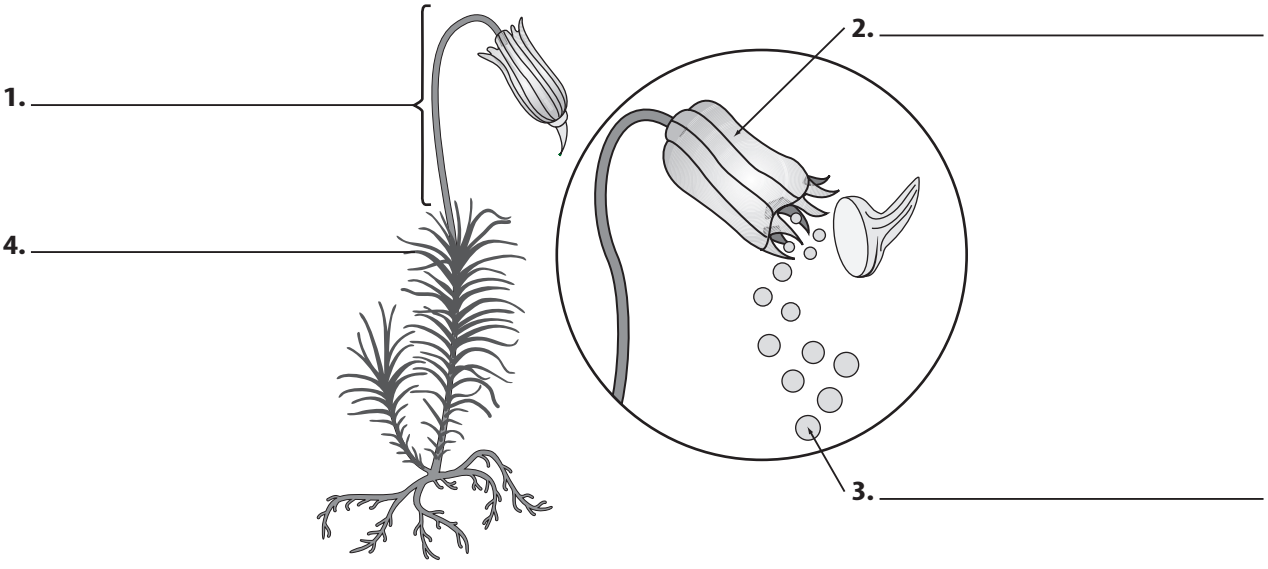
Satisface las necesidades individuales

Lectura dirigida para Dominio del contenido

Sección 1 ▪ Introducción a la reproducción vegetal
Sección 2 ▪ Reproducción sin semillas

Instrucciones: *Estudia el diagrama de la etapa esporofítica de un musgo. Rotula luego las partes con los términos siguientes.*

espora **gametofito** **esporofito** **cápsula (o cubierta de las esporas)**



Instrucciones: *Completa las oraciones usando los términos siguientes.*

rizoma **prótalo** **soro** **frondas**
no vasculares **clorofila** **célula**

5. Las hojas de los helechos se conocen como _____.
6. Las hojas de los helechos nacen de un tallo subterráneo llamado _____.
7. Las esporas de los helechos se producen en estructuras llamadas _____.
8. La espora de un helecho crece y forma un gametofito verde, pequeño y con forma de corazón llamado un(a) _____.
9. Los musgos son plantas _____.
10. En las plantas no vasculares, el agua y las sustancias se mueven de célula a _____.
11. El prótalo contiene _____, por lo que puede producir su propio alimento.

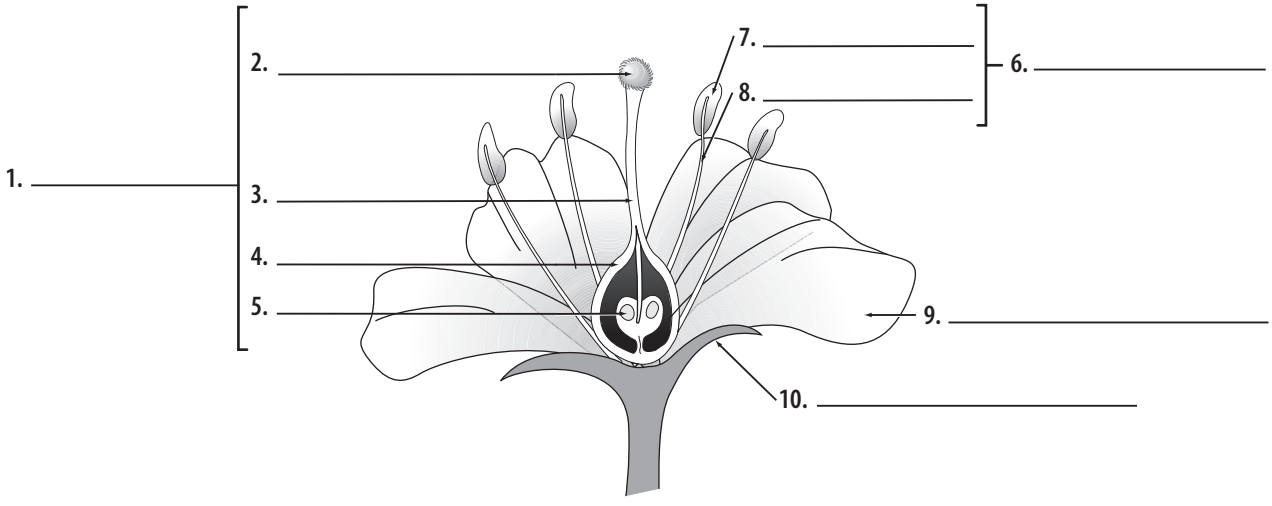
Satisface las necesidades individuales

Lectura dirigida para Dominio del contenido

Sección 3 ▪ Reprodución con semillas

Instrucciones: *Usa los términos para rotular las partes de la flor.*

ovario	**estigma**	**estilo**	**óvulo**	**estambre**
pistilo	**antera**	**pétalo**	**sépalo**	**filamento**



Instrucciones: *Usa los términos para completar el párrafo sobre la polinización. Uno de los términos se usa dos veces.*

ovario	**semilla**	**estigma**	**polen**	**estambre**
espermatozoide	**viento**	**animales**	**huevo**	**pistilo**

La polinización implica la transferencia de granos de **11.** _____ del estambre de una flor al estigma. El(La) **12.** _____ es el órgano reproductor masculino. El(La) **13.** _____ es el órgano reproductor femenino. Los granos pueden ser llevados por la lluvia, el(la) **14.** _____, o el(la) **15.** _____. Caen sobre el(la) **16.** _____ pegajoso(a) del pistilo de la planta. Un tubo del polen crece desde el grano de **17.** _____ a lo largo del estilo hasta el(la) **18.** _____ del óvulo. El(La) **19.** _____ viaja a lo largo del tubo del polen y fertiliza el(la) **20.** _____. Después de la fertilización, la parte femenina se desarrolla y forma un(a) **21.** _____.

Satisface las necesidades individuales

Lectura dirigida para Dominio del contenido

Términos claves
Reproducción de las plantas

Instrucciones: *Une con una línea el término a la izquierda con su descripción a la derecha.*

1. prótalo

2. etapa gametofítica

3. ovario

4. germinación

5. pistilo

6. grano de polen

7. polinización

8. rizoma

9. estambre

10. etapa esporofítica

11. espora

12. fronda

13. soros

14. óvulo

a. cuando se forman células que tienen un número haploide de cromosomas

b. inicio del crecimiento de una planta

c. donde se producen los huevos

d. planta pequeña, verde, con forma de corazón que crece de la espora de un helecho

e. parte del órgano reproductor masculino de una planta que contiene espermatozoides

f. estructuras en las que se producen las esporas de los helechos

g. base henchida del pistilo en donde se forman los óvulos

h. órgano reproductor femenino de las plantas que producen flores

i. hojas de los helechos

j. órgano reproductor masculino de las plantas que producen flores

k. cuando se forman células con un número diploide de cromosomas

l. células haploides producidas cuando las células en los órganos reproductores sufren meiosis

m. transferencia de granos de polen del órgano masculino al órgano femenino de las plantas

n. tallos subterráneos de plantas como los helechos

Satisface las necesidades individuales

Name Date Class

SECTION 1 Reinforcement

Introduction to Plant Reproduction

Directions: *Write the correct term in the spaces beside each definition. Unscramble the boxed letters to answer question 10.*

1. sex cells formed by meiosis with only half of the chromosomes ___ ___ ___ ☐ ___ ___ ___
2. plants release these into their surroundings to produce offspring ___ ___ ___ ___ ☐ ___
3. the joining of two haploid cells begins this stage ___ ___ ___ ___ ___ ___ ___ ☐ ___ ___
4. when an egg and sperm combine ☐ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
5. depending on the species of plant, these organs can be on the same or different plants ___ ___ ___ ___ ___ ___ ___ ☐ ___ ___ ___ ___
6. after fertilization, this plant produces berries ___ ___ ___ ☐ ___
7. this stage is begun when cells in reproductive organs undergo meiosis and produce haploid cells ___ ___ ___ ☐ ___ ___ ___ ___ ___ ___ ___
8. asexual _____ does not require the production of sex cells ___ ___ ___ ___ ___ ___ ___ ___ ___ ☐ ___ ___
9. have a full set of chromosomes ___ ___ ___ ___ ___ ___ ___ ☐ ___ ___ ___ ___
10. something all organisms have in common _____

Directions: *Answer the following questions on the lines provided.*

11. Describe sexual reproduction in plants.

_____

_____

_____

_____

12. Describe asexual reproduction in plants.

_____

_____

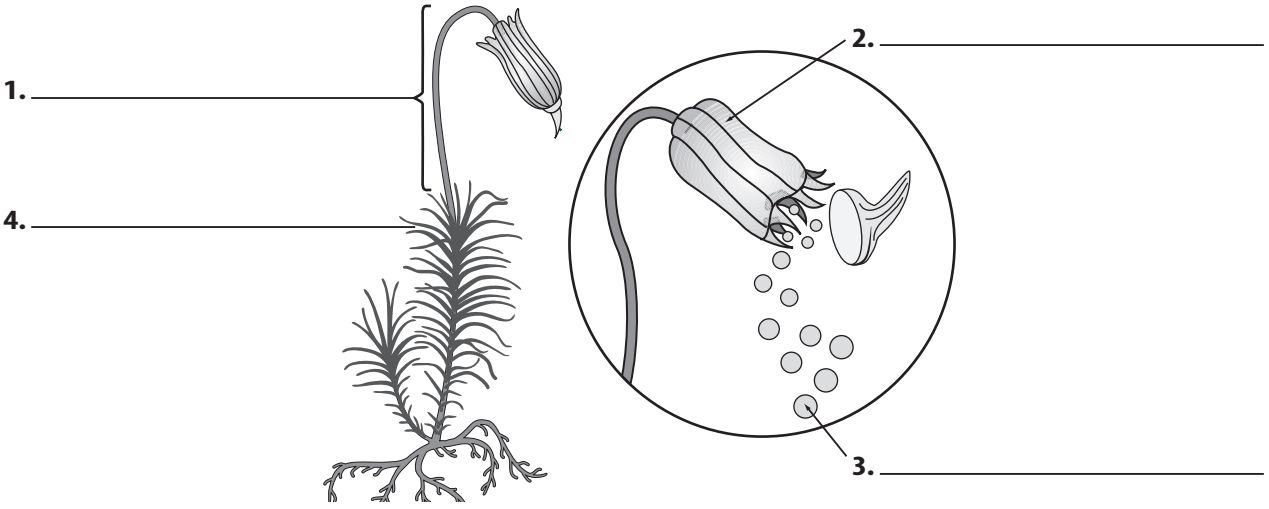
_____

Meeting Individual Needs

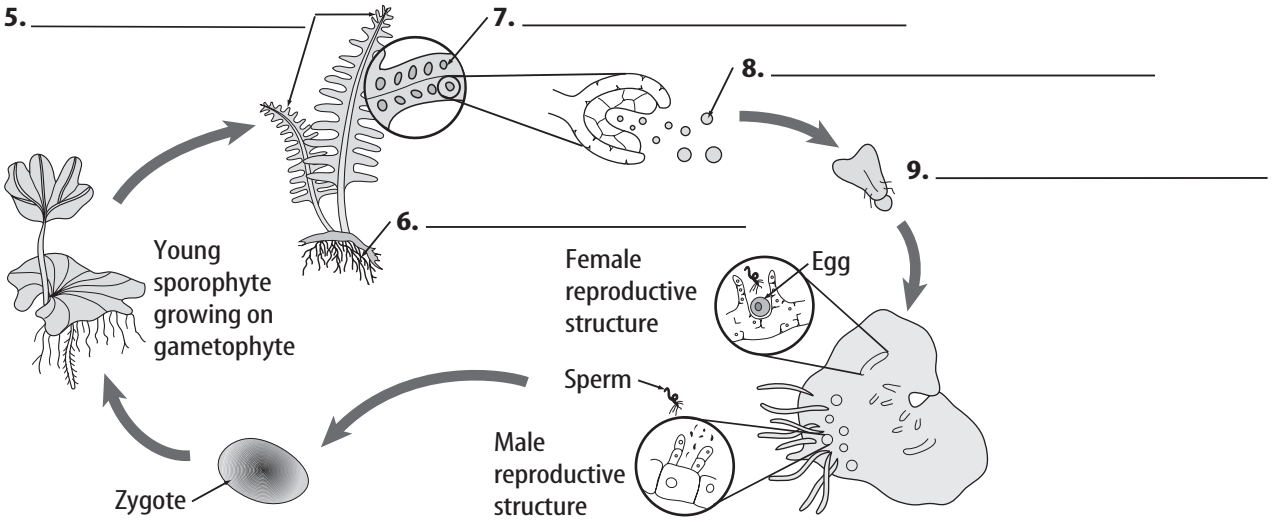
SECTION 2 Reinforcement

Seedless Reproduction

Directions: *Label the structures related to moss reproduction.*



Directions: *Label the structures in the fern's reproductive cycle.*



Directions: *Answer the following questions on the lines provided.*

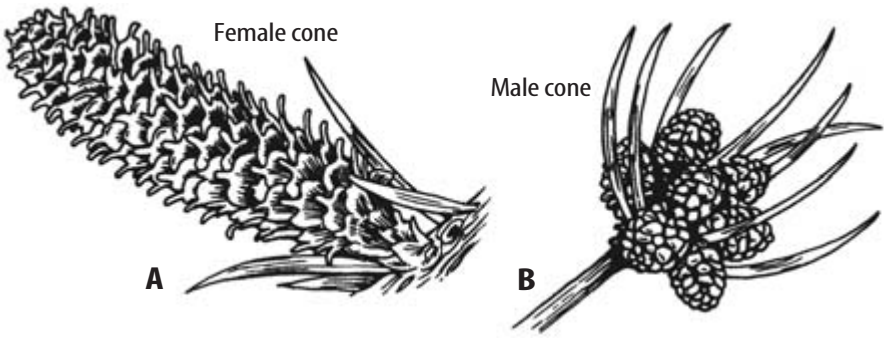
10. Why do mosses need water for fertilization?

11. Describe how ferns can reproduce asexually.

Name Date Class

SECTION 3 Reinforcement

Seed Reproduction



Directions: *Use the illustrations above to answer the questions.*

1. Which cone produces pollen grains?

_____

2. Which cone produces seeds?

_____

3. In which cone is the egg fertilized?

_____

4. What type of seed plant produces the above cones?

_____

Directions: *Write the term that matches the following descriptions.*

5. transfer of pollen from stamen to ovules: _____

6. the male reproductive organ of angiosperms: _____

7. the female reproductive organ of angiosperms: _____

8. produces pollen grains: _____

9. part of the flower in which sperm form: _____

10. the top of the pistil that catches the pollen grains: _____

11. grows from the pollen grain to the ovule: _____

12. a young plant growing within the seed: _____

13. part of the flower that becomes part of the fruit: _____

14. a seed that does not germinate for a period of time: _____

15. organisms that aid in the pollination of flowers: _____

16. ways that seeds get from the flower to the ground for germination: _____

17. the early growth of a plant from a seed: _____

SECTION 1 Enrichment

The Ancient Cycads

Cycads are probably the most ancient seed-bearing plants on Earth. Scientists know that they lived long before the dinosaurs—almost 300 million years ago—and that they made up a good percentage of the forests where dinosaurs lived. But unlike the dinosaurs, cycads aren't extinct.

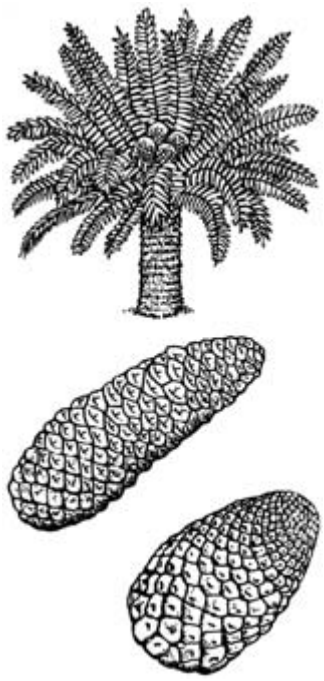
Not a Palm Tree

People often call cycads palms, because that's what they look like. They have a long trunk, no branches, and a plume of feather-like leaves at the top. But palms have no growth rings while cycads do.

In fact, no matter what a cycad looks like, botanists say that cycads are most closely related to cone-bearing plants like pines. That's because cycads produce male and female cones. Unlike most cone-bearing plants, cycad male cones and female cones are on separate plants. A plant that produces separate male and female plants is called *dioecious.* (You may be familiar with another dioecious plant, mistletoe.)

Spreading Pollen

Once botanists thought that cycads depend on the wind to spread pollen. However, cycads grow in the lower levels in forests, where there would be little wind, so that idea didn't sound correct. Today, botanists hypothesize that cycads depend on small beetles and bees to carry the pollen from one cycad to another.



Operation Jurassic

Cycads can thrive in many places. Nonetheless, cycads are endangered. They take a long time to reproduce and then grow slowly. (That may be one reason why they live so long—some as long as 2,500 years!) Their biggest threat is loss of habitat. Another is poaching. In South Africa, steps are being taken to protect cycads and the places where they grow. In 1998, the government set up Operation Jurassic to stop people from stealing wild cycads and selling them illegally. Smuggling and collecting cycads has become a huge business.

1. What is meant by dioecious?

_____

2. Explain why the cycads are endangered.

_____

_____

Meeting Individual Needs

Name Date Class

SECTION 2 Enrichment

Spore Banks

Although ferns are fairly easy to grow from spores, destruction of rain forests and other natural habitats is threatening their survival. That's why the American Fern Society, the Royal Botanic Garden Edinburgh (RBGE) in the United Kingdom, and the British Pteridological Society, among others, have established fern spore banks. Growing ferns is the goal of these organizations.

How Spore Banks Work

These spore banks not only safeguard endangered fern species, they also make available hundreds of species of ferns to people who want to grow ferns. Fern owners collect and donate fern spores to the spore bank. Then, for a small fee, people purchase spore packets and cultivate them.

Collecting Spores

To collect spores for donation, take a mature fern frond with sori and place it on a piece of clean, white paper. Put it in a dry, room-temperature place. Within a few days the spores fall onto the paper. Some collectors also use a dry paintbrush to release any remaining spores from the frond. The spores will look like black, brown, or yellow powder. The powder contains both spores and sporangia as well as chaff or waste.

The most common way of collecting spores is to hold the paper at an angle and gently tap it until the chaff is released. The spores will stay stuck to the paper. They can then be removed from the paper, placed in a paper packet, labeled, and mailed to the spore bank. Some societies recommend sterilizing the spores by pouring boiling water over them. They say this kills the spores of other plants or fungi that might be included with the fern spores. Others say to briefly soak the frond in a mild bleach solution before collecting the spores.

Pros and Cons

Since spore banks operate on a donation-only basis, the packet label might not be reliable. Well-meaning donors can make mistakes in identifying fern species. In addition, the sterilization process isn't always correctly done. If a cultivator purchases a spore bank packet and tries to grow a fern without success, it's probably because the spores contained too much chaff. However, the advantage of getting spores from a spore bank can outweigh the disadvantages. Many spore banks have rare and unusual species. The RBGE has close to 6,000 species of ferns from around the world. The RBGE cultivates the rarest species for conservation and research purposes, as well as for possible reintroduction of the ferns into other habitats.

1. Why have spore banks been established?

2. What would happen if you tried to grow a fern from spores but the spores contained too much chaff? Explain.

3. Why do you think spore banks sell their spores for a "nominal fee"?

Meeting Individual Needs

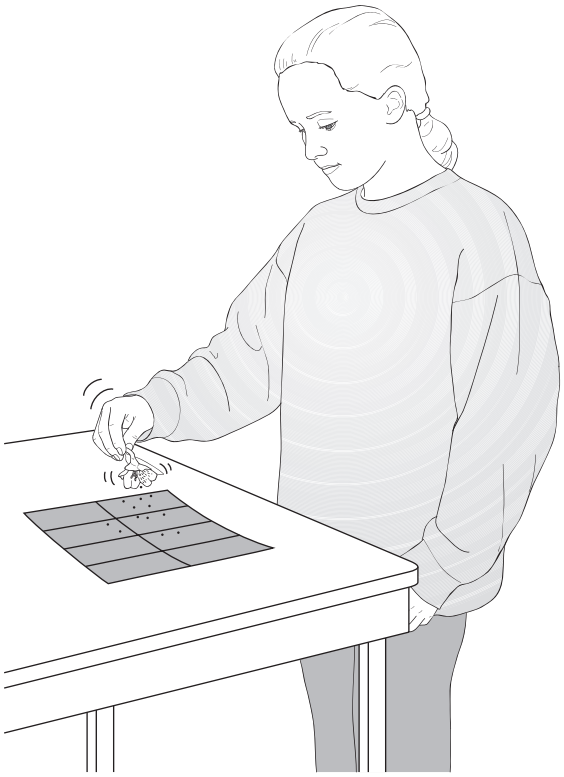
Name Date Class

SECTION 3 Enrichment

How much pollen does a flower make?

Materials

dark construction paper (3 sheets)
ruler
pencil
flowers (3)
magnifying lens



Procedure

1. Use your ruler to divide each sheet into eight equal parts.
2. Obtain three flowers from a local flower shop or from your yard.
3. Take one flower and one sheet of divided construction paper. Place the paper on a table. Turn the flower upside down and shake the pollen from the flower over the entire paper.
4. With the magnifying lens, count the number of grains of pollen in one section of the sheet. Then multiply that number by eight to get the estimated total number of grains that fell from the flower.
5. Repeat this process for each of the other two flowers.
6. Add the three totals together and then divide by three to obtain the average number of pollen grains that fell from each flower.

Conclude and Apply

1. What was the average number of pollen grains that fell from each flower?

_____

2. From what part of the flower did these pollen grains fall?

_____

3. Why would a flower make so many pollen grains?

_____

_____

_____

Meeting Individual Needs

Note-taking Worksheet

Plant Reproduction

Section 1 Introduction to Plant Reproduction

A. Plants can _____ both sexually and asexually.

1. In _____ reproduction a new plant can be grown from a leaf, stem, or root.

2. In _____ reproduction a sperm cell fertilizes an egg cell to form a zygote.

a. Some plants have both male and female _____ organs; these plants can reproduce by themselves or with sex cells from other plants of the same type.

b. Some plant species have male and female organs on _____ plants.

B. Plants have a _____-stage life cycle.

1. The _____ begins when sex cells produce haploid cells called **spores**.

2. The _____ begins with fertilization.

Section 2 Seedless Reproduction

A. Seedless plants do not produce _____.

1. The _____ of seedless plants grow into plants that produce sex cells.

2. All nonvascular and some vascular plants are _____.

B. _____ plants have a life cycle that illustrates typical sexual reproduction in nonvascular seedless plants.

1. The gametophyte stage produces _____.

2. The sporophyte stage produces _____.

3. When spores are _____ and land in an appropriate environment, they can grow into new gametophyte stage plants.

4. Nonvascular plants can also reproduce _____ if a piece of gametophyte stage plant breaks off and settles in an appropriate environment.

C. Most vascular seedless plants are _____.

1. Fern sporophyte plants have leaves called _____, which grow from an underground stem called a _____.

2. Fern _____ are produced in **sori**, which are usually on the underside of fronds.

Note-taking Worksheet (continued)

3. A fern spore that lands in a favorable environment grows into a gametophyte plant called a _____.
4. _____ form in the prothallus.
5. When fertilization occurs, the _____ starts the sporophyte stage.
6. Ferns may reproduce _____ when rhizomes form new branches and are separated from the main plant.

Section 3 Seed Reproduction

A. Pollen and _____ help many plants reproduce.

1. A **pollen** _____ has a covering and contains gametophyte parts that can produce sperm.
2. _____ occurs when pollen grains are transferred to the female part of the plant.
3. Following fertilization, the female part produces a _____ which contains an embryo, stored food, and a protective coat.
4. Plants can develop more quickly from a seed than from a spore because a seed contains a(n) _____ and stored _____.

B. _____ develop seeds in cones.

1. A pine tree or shrub is a sporophyte plant that produces male and female _____.
2. A female cone has two _____ which produce eggs.
3. _____ cones produce and release pollen.
4. When pollen blows into a _____ cone, fertilization and seed formation can occur.
5. Seed release by a female cone can take two or three years.

C. _____ produce flowers which are used for sexual reproduction.

1. The _____ is the male reproductive organ.
2. The _____, the female reproductive organ, contains the **ovary** at its base.
3. The _____ of a plant's flowers can give clues about how the plant is pollinated.

Note-taking Worksheet (continued)

4. After pollination and _____, a zygote forms and grows into the plant embryo.
5. Parts of the _____ develop into the seed coat and store food for the embryo.
   a. Some seeds store food in _____.
   b. Other seeds store food in _____ tissue.

D. Seeds are _____ by wind, gravity, animals, and water.

1. _____ occurs when the seed coat swells and breaks open and a plant grows from the seed.
2. Environmental conditions affect germination.

Assessment

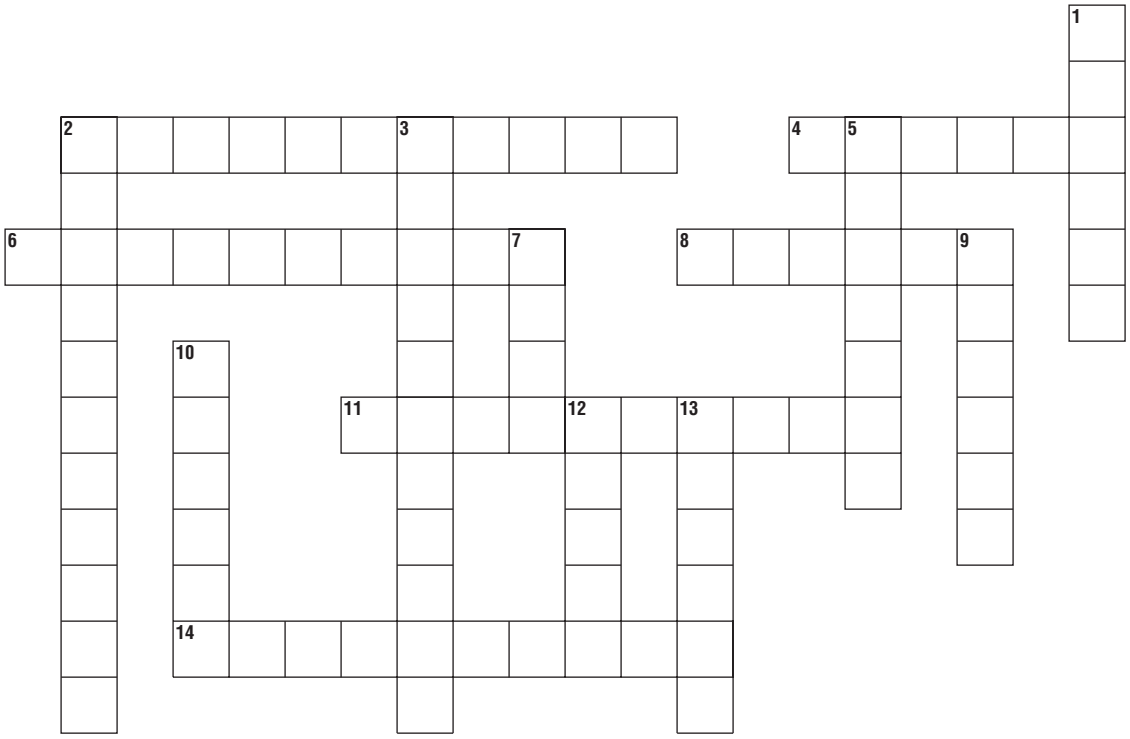
Name Date Class

Chapter Review

Plant Reproduction

Part A. Vocabulary Review

Directions: *Use the clues below to complete the puzzle.*



Across

2. The form of a moss plant that produces sex cells

4. The leaves of a fern

6. Gametophyte of a fern

8. Pollen _____—develop from some spores in seed plants

11. Plant that produces flowers

14. Includes stalk and capsule where spores are produced

Down

1. Female reproductive organ of a flower

2. Process that a seed undergoes to become a plant

3. Transfer of pollen grains from the stamen to the ovules

5. The underground stem on a fern

7. The structures where a fern produces spores

9. Male reproductive organ of a flower; consists of an anther and a filament

10. Contain an egg cell, food-storage tissue, and a sticky fluid

12. Swollen base of pistil; where ovules form

13. _____ grains—contain the sperm-producing parts in seed plants

Assessment

Chapter Review (continued)

Part B. Concept Review

Directions: *Complete the life cycles of gymnosperms and angiosperms by filling in the blanks.*

Gymnosperms

1. _____ develop, and release a sticky fluid.

2. _____ develop on male cone. **3.** _____ is blown by the wind. A **4.** _____ grows to an ovule. **5.** _____ unites with an ovule, and a **6.** _____ forms. The **7.** _____ mature open, and release seeds.

Angiosperms

Stigma and **8.** _____ develop, and the male organ forms **9.** _____. **10.** _____ gets to the **11.** _____ by wind, insects, birds, and mammals. The **12.** _____ grows to an ovule, and **13.** _____ unites with an ovule. **14.** The _____ part of the seed develops. The seeds develop into **15.** _____ and are dispersed.

Directions: *Study the diagram of the flower below and write the name of the structure after its function.*

16. brightly colored part _____

17. covers the bud _____

18. male reproductive organ _____

19. stalk of male organ _____

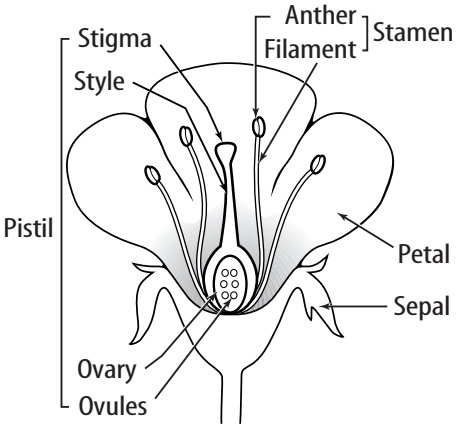
20. where pollen grains form _____

21. female reproductive organ _____

22. sticky area _____

23. stalk of female organ _____

24. where ovules are formed_____



Directions: *Answer the following question on the lines provided.*

25. Why is it important to a plant's life cycle for it to produce flowers that are colorful and smell good and to produce sweet-tasting fruit?

_____

_____

Assessment

Name Date Class

Chapter Test

Plant Reproduction

I. Testing Concepts

Directions: *In the blank at the left, write the letter of the term that best completes each statement.*

_____ **1.** Each _____ contains an egg cell, food-storage tissue, and a sticky fluid.
a. embryo **b.** egg **c.** ovule **d.** rhizome

_____ **2.** When all plant structures have a _____ set of chromosomes, it is called the gametophyte stage.
a. haploid **b.** diploid **c.** large **d.** similar

_____ **3.** A stamen consists of a(n) _____.
a. flower
b. stem
c. pistil and an anther
d. anther and a filament

_____ **4.** For mosses, the _____ supplies the _____ with nutrients.
a. gametophyte; sporophyte
b. sporophyte; gametophyte
c. root; frond
d. sun; sporophyte

_____ **5.** The leaves of ferns are called _____.
a. rhizomes **b.** sori **c.** fronds **d.** petals

_____ **6.** A _____ is the underground stem of a fern.
a. rhizome **b.** sori **c.** frond **d.** petal

_____ **7.** The process that a seed undergoes to become a plant is _____.
a. asexual reproduction
b. germination
c. prothallus
d. fertilization

_____ **8.** Some seeds have _____, which attach to fur and feathers.
a. pollen grains **b.** tiny hooks **c.** thick husks **d.** spores

_____ **9.** _____ all produce flowers.
a. Rhizomes **b.** Sori **c.** Angiosperms **d.** Gametophytes

_____ **10.** The _____ is the male reproductive organ of a flower.
a. filament **b.** stamen **c.** anther **d.** ovary

_____ **11.** Reproduction during which one organism produces genetically identicle offspring is called _____.
a. sexual reproduction
b. asexual reproduction
c. seeding
d. pollination

_____ **12.** Millions of years ago, most plants on Earth were _____.
a. vascular seedless plants
b. gymnosperms
c. angiosperms
d. rhizomes

Chapter Test (continued)

Directions: *Match the description in the first column with the item in the second column by writing the correct letter in the space provided. Some items in the second column may not be used.*

_____ **13.** underground stem of a fern

_____ **14.** leaf of a fern

_____ **15.** spore-producing structures on the underside of fern fronds

_____ **16.** phase in which spores are produced by meiosis

_____ **17.** a fern gametophyte

_____ **18.** the swollen base of the pistil in angiosperms, where ovules form

_____ **19.** the supply of stored food in the embryo of beans or peanuts

_____ **20.** form the outside of a bud and cover the petals

_____ **21.** a mature ovule

a. sori
b. cotyledons
c. ovary
d. rhizome
e. environmental conditions
f. gametophyte
g. ovule
h. sporophyte
i. sepals
j. haploid cells
k. frond
l. seed
m. prothallus

II. Understanding Concepts

Skill: Sequencing

Directions: *Complete the following by filling in the blanks.*

A moss sporophyte includes a stalk and capsule where numerous spores are produced by the process of **1.** _____. When a haploid spore lands on wet soil or rocks, it germinates into a threadlike structure. Within a few days, a small **2.** _____ moss plant begins to grow here. Sometimes it produces only male or female sex cells, but often both types are produced. During a heavy dew or rain the male sex cells swim to the egg. When they unite, they form a diploid zygote. It develops into an embryo, which in turn develops into a **3.** _____, and the cycle begins again.

In the life cycle of a fern, the gametophyte and sporophyte are independent of each other and can produce their own food. Ferns produce spores in structures called **4.** _____ on the lower sides of mature fronds. A spore lands on damp soil or rocks and grows into a **5.** _____, which is the gametophyte plant. It produces **6.** _____ that unite to form the **7.** _____. It then develops into the sporophyte, as in the mosses. But in ferns, the gametophyte also produces new **8.** _____, which grow into the separate sporophyte fern plants that you are familiar with.

Chapter Test (continued)

Skill: Classifying

Directions: *Study the life cycles shown below, and write the organism's name in the title.*

9. The _____ Life Cycle
- Sorus releases spores.
- Spores germinate into gametophytes.
- Gametophytes produce sex cells.
- Sex cells unite to form zygote.
- Zygote is the beginning of the sporophyte stage.

10. The _____ Life Cycle
- Sporophytes produce spores.
- Spores land in wet soil or rocks.
- Gametophytes grow.
- Male sex cells swim to female sex cells.
- Zygote divides to form embryo.
- Embryo develops into sporophyte.

III. Applying Concepts

Directions: *Sequence the life cycle stages of gymnosperms and angiosperms by numbering them in order, beginning with the development of sexual organs, which is already numbered 1.*

Gymnosperms

1 **1.** ovules develop, release sticky fluid; pollen grains develop on male cone

_____ **2.** sperm swims to ovule, fertilizing it

_____ **3.** pollen blown by wind to stigma

_____ **4.** pollen tube grows to ovule

_____ **5.** zygote forms

_____ **6.** cones mature, open, release seed

Angiosperms

1 **7.** ovules develop; male organ forms pollen grain

_____ **8.** seeds develop into fruit and are dispersed

_____ **9.** pollen gets to stigma by wind, insects, birds, mammals

_____ **10.** sperm unites with ovule

_____ **11.** pollen tube grows to ovule

_____ **12.** embryo part of seed develops

Chapter Test (continued)

Directions: *Match each reproductive organ of a flower with its description by writing the correct letter in the space provided.*

_____ **13.** female reproductive organ	**a.** anther
_____ **14.** sticky area where pollen grain lands	**b.** filament
_____ **15.** stalk of female reproductive area	**c.** ovary
_____ **16.** forms the ovules	**d.** pistil
_____ **17.** male reproductive organ	**e.** stamen
_____ **18.** stalk of male reproductive organ	**f.** stigma
_____ **19.** forms the pollen grains	**g.** style

IV. Writing Skills

Directions: *Answer the following questions using complete sentences.*

1. Describe the methods of seed dispersal in plants.

2. Describe a plant that you think would be beneficial if its germination period were short and a plant that you think would be harmful if its germination period were short. Include why you think one would be beneficial, while the other might be harmful.

3. Why are flowers important to the life cycle of some plants, but not others?

Transparency Activities

Name Date Class

SECTION 1 Section Focus Transparency Activity

It's a Jungle Out There

If you traveled from Alaska to Key West, Florida, you would expect to see many different plants. There's one place, however, where you could see more plants per square kilometer than any place else on Earth—a tropical rain forest.

1. **What factors make the rain forest a good environment for plant growth and reproduction?**
2. **Why are the upper layers of a rain forest so dense, while the lowest levels may be almost bare?**
3. **Why is the destruction of rain forests an important concern?**

SECTION 2 Section Focus Transparency Activity

It's Raining, It's Sporing

While flowering plants use seeds to reproduce, mosses use a different strategy. As seen below, one part of moss reproduction involves releasing spores into the environment. Each spore is capable of growing into a new plant.

1. **Judging from the picture, how are moss spores dispersed?**
2. **Why does the moss produce so many spores?**

Name Date Class

SECTION 3

Section Focus Transparency Activity

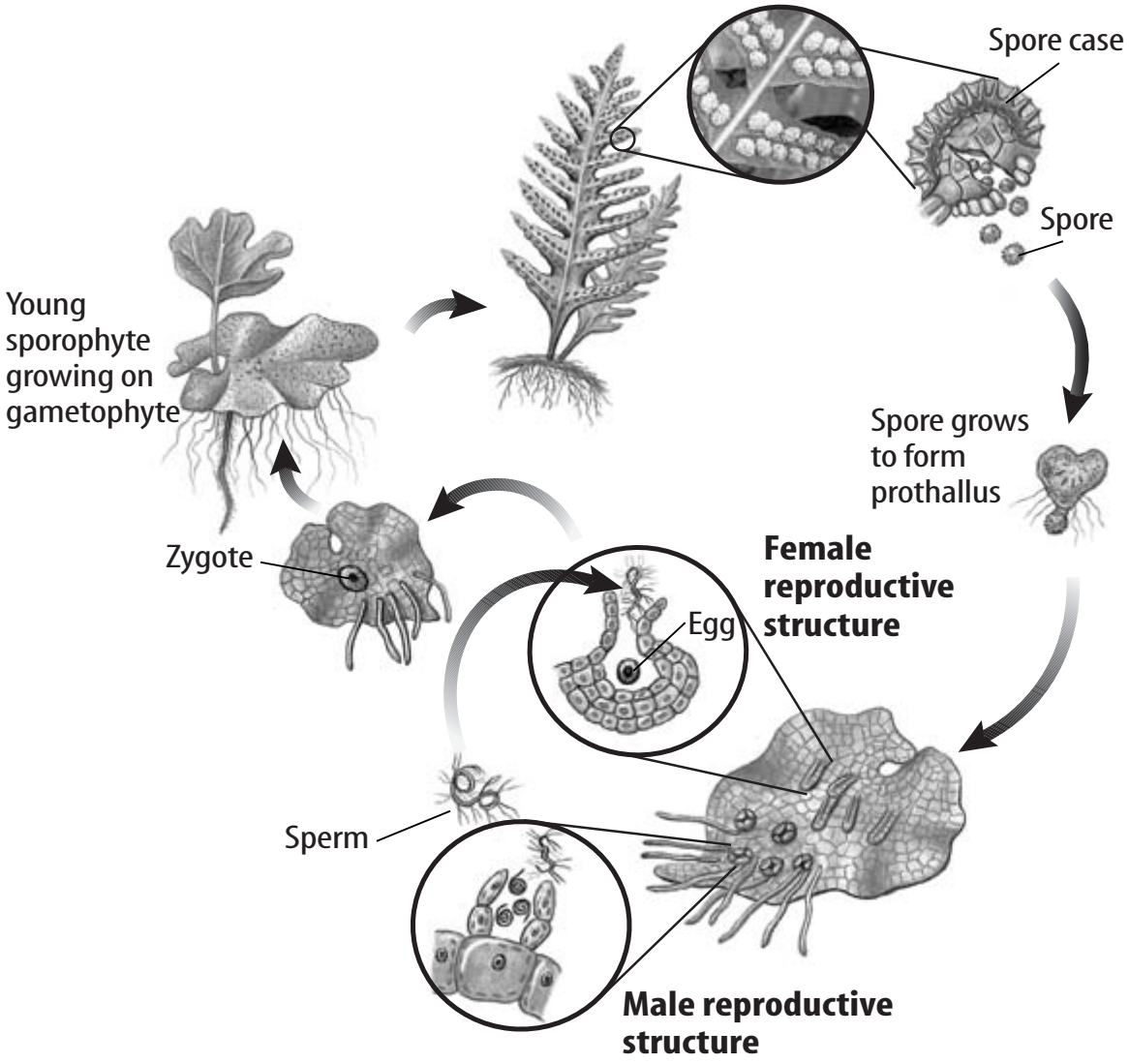
A Bee's-Eye View

A beautiful bright yellow flower you might notice in a field looks different to a bee. Bees can see ultraviolet light. To them the flower includes markings not visible to the human eye.

1. How do the bee's actions benefit the flower?
2. How do the ultraviolet markings help the bee? The flower?

SECTION 2 Teaching Transparency Activity

Fern Life Cycle



Teaching Transparency Activity (continued)

1. What does nonvascular mean?

2. Into what do fern spores form during the initial stage of their life cycle?

3. What does the prothallus contain?

4. What is the underground stem called?

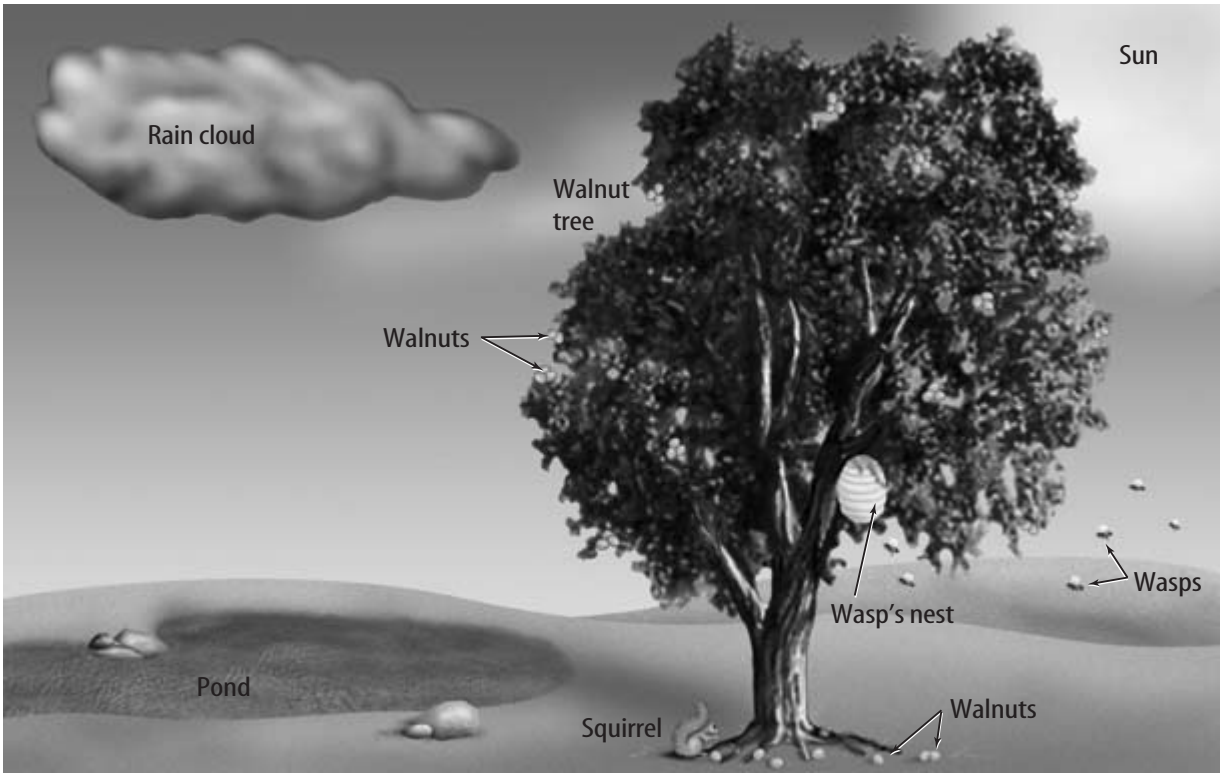
5. How do sporophytes make food?

6. What are the two reproductive structures of the fern plant?

Assessment Transparency Activity

Plant Reproduction

Directions: *Carefully review the diagram and answer the following questions.*



1. Which component of the ecosystem above is least likely to aid in germination of the walnuts?

A Rain **B** Squirrel **C** Wasps **D** Sunlight

2. Which component of the ecosystem shown above is most likely to aid in seed dispersal of the walnut tree?

F Rain **G** Squirrel **H** Wasps **J** Sunlight

3. If there were no squirrels in this ecosystem, the ratio of young walnut trees growing far from the main tree to those growing close to the main tree would most likely ___.

A increase
B stay the same
C increase, then decrease
D decrease