Plant Responses and Growth

Reading Preview

Key Concepts

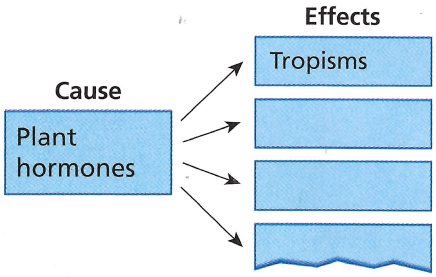
- What are three stimuli that produce plant responses?
- How do plants respond to seasonal changes?
- How long do different angiosperms live?

Key Terms

- tropism • hormone
- auxin • photoperiodism
- short-day plant
- long-day plant
- critical night length
- day-neutral plant • dormancy
- annual • biennial • perennial

Target Reading Skill

Relating Cause and Effect As you read through the paragraphs under the heading Hormones and Tropisms, identify four effects of plant hormones. Write the information in a graphic organizer like the one below.



Go Online SCILINKS NSTA

For: Links on plant responses
Visit: www.SciLinks.org
Web Code: scn-0154

Lab zone Discover Activity

Can a Plant Respond to Touch?

1. Your teacher will give you two plants. Observe the first plant. Gently touch a leaf with the tip of a pencil. Observe what happens over the next three minutes. Record your observations.
2. Repeat Step 1 with the second plant. Record your observations.
3. Wash your hands with soap and water.

Think It Over
Inferring What advantage might a plant have if its leaves responded to touch?

The bladderwort is a freshwater plant with small yellow flowers. Attached to its floating stems are open structures called bladders. When a water flea touches a sensitive hair on a bladder, the bladder flicks open. Faster than you can blink, the water flea is sucked inside, and the bladder snaps shut. The plant then digests the trapped flea.

A bladderwort responds quickly—faster than many animals respond to a similar stimulus. You may be surprised to learn that some plants have lightning-quick responses. In fact, you might have thought that plants do not respond to stimuli at all. But plants do respond to some stimuli, although they usually do so more slowly than the bladderwort.

Tropisms

Animals usually respond to stimuli by moving. Unlike animals, plants commonly respond by growing either toward or away from a stimulus. A plant's growth response toward or away from a stimulus is called a **tropism** (TROH piz um). If a plant grows toward the stimulus, it is said to show a positive tropism. If a plant grows away from a stimulus, it shows a negative tropism. **Touch, light, and gravity are three important stimuli to which plants show growth responses, or tropisms.**

Touch Some plants, such as bladderworts, show a response to touch called thigmotropism. The prefix *thigmo-* comes from a Greek word that means "touch." The stems of many vines, such as grapes and morning glories, show a positive thigmotropism. As the vines grow, they coil around any object that they touch.

Light Have you ever noticed plants on a windowsill with their leaves and stems facing the sun? All plants exhibit a response to light called phototropism. The leaves, stems, and flowers of plants grow toward light, showing a positive phototropism. By growing towards the light, a plant receives more energy for photosynthesis.

Gravity Plants also respond to gravity. This response is called gravitropism. Roots show positive gravitropism—they grow downward. Stems, on the other hand, show negative gravitropism—they grow upward.

Hormones and Tropisms Plants are able to respond to touch, light, and gravity because they produce hormones. A **hormone** produced by a plant is a chemical that affects how the plant grows and develops.

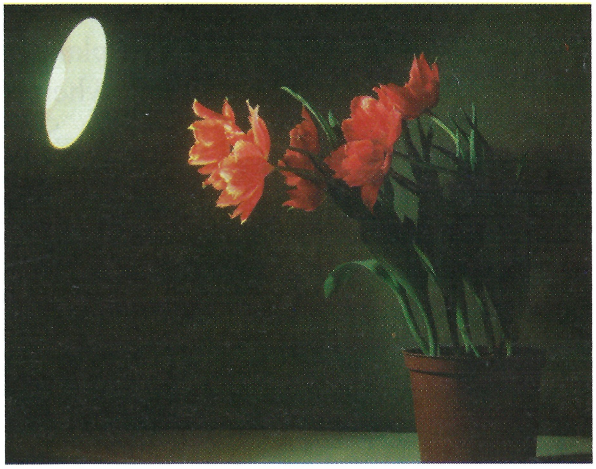
One important plant hormone is named **auxin** (AWK sin). Auxin speeds up the rate at which a plant's cells grow. Auxin controls a plant's response to light. When light shines on one side of a plant's stem, auxin builds up in the shaded side of the stem. The cells on the shaded side begin to grow faster. Eventually, the cells on the stem's shaded side are longer than those on its sunny side. So the stem bends toward the light.

In addition to tropisms, plant hormones also control many other plant activities. Some of these activities are germination, the formation of flowers, stems, and leaves, the shedding of leaves, and the development and ripening of fruit.

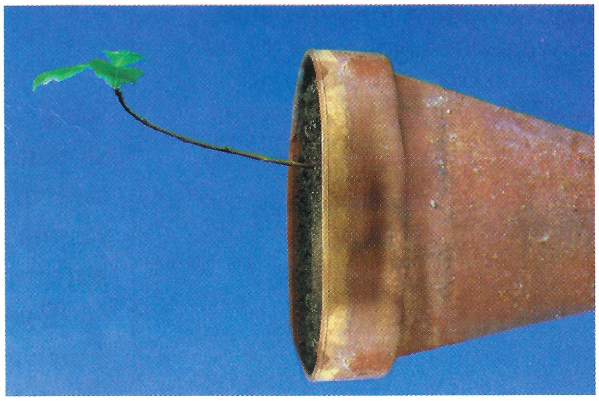
Reading Checkpoint **What is one role that the plant hormone auxin plays?**

FIGURE 26
Tropisms
Touch, light, and gravity are three stimuli to which plants show growth responses, or tropisms.

▲ **Touch** A vine coiling around a wire shows positive thigmotropism.



▲ **Light** A plant's stems and flowers growing toward light show positive phototropism.



▲ **Gravity** A plant's stem growing upward, against the pull of gravity, shows negative gravitropism.

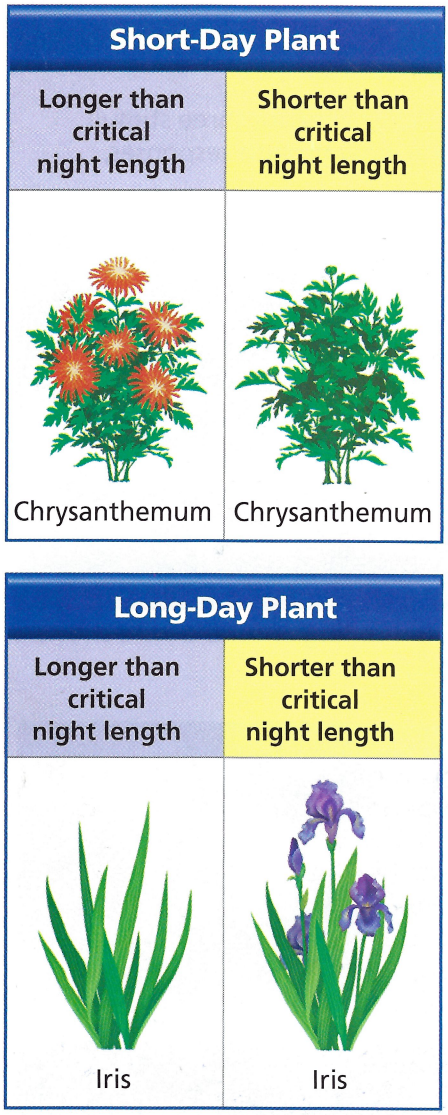


FIGURE 27
Short-Day and Long-Day Plants
A short-day plant flowers when nights are longer than the critical night length. A long-day plant flowers when nights are shorter than the critical night length.
Applying Concepts *Is an iris or chrysanthemum more likely to flower in early summer?*

Seasonal Changes

People have long observed that plants respond to the changing seasons. Some plants bloom in early spring, while others don't bloom until summer. The leaves on some trees change color in autumn and then fall off by winter. **Plant responses to seasonal changes include photoperiodism and dormancy.**

Photoperiodism What environmental factor triggers a plant to flower? The amount of darkness a plant receives determines the time of flowering in many plants. A plant's response to seasonal changes in length of night and day is called **photoperiodism.**

Plants differ in how they respond to the length of nights. **Short-day plants** flower when nights are *longer* than a critical length. **Long-day plants** flower when nights are *shorter* than a critical length. This critical length, called the **critical night length,** is the number of hours of darkness that determines whether or not a plant will flower. For example, if a short-day plant has a critical night length of 11 hours, it will flower only when nights are longer than 11 hours.

Short-day plants bloom in the fall or winter, when nights are growing longer. Chrysanthemums and poinsettias are short-day plants. In contrast, long-day plants flower in the spring or summer, when nights are getting shorter. Long-day plants include irises and lettuce.

Other plants, such as dandelions, rice, and tomatoes, are **day-neutral plants.** Their flowering cycle is not sensitive to periods of light and dark.

Dormancy As winter draws near, many plants prepare to go into a state of dormancy. **Dormancy** is a period when an organism's growth or activity stops. Dormancy helps plants survive freezing temperatures and the lack of liquid water.

With many trees, the first change is that the leaves begin to turn color. Cooler weather and shorter days cause the leaves to stop making chlorophyll. As chlorophyll breaks down, yellow and orange pigments become visible. In addition, the plant begins to produce new red pigments. The brilliant colors of autumn leaves result.

Over the next few weeks, all of the remaining sugar and water are transported out of the tree's leaves. The leaves then fall to the ground, and the tree is ready for winter.

Reading Checkpoint **What is dormancy?**

Life Spans of Angiosperms

Angiosperms are classified as annuals, biennials, or perennials based on the length of their life cycles. Flowering plants that complete a life cycle within one growing season are called **annuals.** Most annuals have herbaceous stems. Annuals include marigolds, petunias, wheat, and cucumbers.

Angiosperms that complete their life cycle in two years are called **biennials** (by EN ee ulz). In the first year, biennials germinate and grow roots, very short stems, and leaves. During their second year, biennials lengthen their stems, grow new leaves, and then produce flowers and seeds. Once the flowers produce seeds, the plant dies. Parsley, celery, and foxglove are biennials.

Flowering plants that live for more than two years are called **perennials.** Most perennials flower every year. Some perennials, such as peonies, have herbaceous stems. The leaves and stems of these plants die each winter, and new ones are produced each spring. Most perennials, however, have woody stems that live through the winter. Maple trees are examples of woody perennials.

Reading Checkpoint How long does a biennial live?

▲ **Annual:** Morning glory

◀ **Biennial:** Foxglove

Perennial: Peony ▶

FIGURE 28
Life Spans of Angiosperms
Annuals live for one year. Biennials live for two years, and perennials live for many years.

Section 5 Assessment

Target Reading Skill **Relating Cause and Effect** Refer to your graphic organizer about plant hormones to help you answer Question 1.

Reviewing Key Concepts

1. a. **Describing** Describe three tropisms that take place in plants.
   b. **Explaining** How does auxin control a plant's response to light?
   c. **Developing Hypotheses** The stems of your morning glory plants have wrapped around your garden fence. Explain why this has occurred.
2. a. **Defining** What is photoperiodism? What is winter dormancy?
   b. **Comparing and Contrasting** How do short-day plants and long-day plants differ?
   c. **Sequencing** List in order the changes that a tree undergoes as winter approaches.
3. a. **Defining** How do annuals, biennials, and perennials differ?
   b. **Applying Concepts** Is the grass that grows on most lawns an annual, a biennial, or a perennial? Explain.

Lab zone At-Home Activity

Sun Seekers With a family member, soak some corn seeds or lima bean seeds in water overnight. Then push them gently into some soil in a paper cup until they are just covered. Keep the soil moist. When you see the stems break through the soil, place the cup in a sunny window. After a few days, explain to your family member why the plants grew in the direction they did.

Chapter 8 Study Guide

1 The Plant Kingdom

Key Concepts

- Nearly all plants are autotrophs. All plants are eukaryotes that contain many cells, all of which are surrounded by cell walls.
- Land plants must have ways to obtain water and other nutrients from their surroundings, retain water, transport materials in their bodies, support their bodies, and reproduce.
- Scientists informally group plants as nonvascular plants and vascular plants.
- Plants have complex life cycles that include the sporophyte stage and the gametophyte stage.

Key Terms

cuticle
vascular tissue
zygote
nonvascular plant
vascular plant
sporophyte
gametophyte

2 Plants Without Seeds

Key Concepts

- Mosses, liverworts, and hornworts are low-growing plants that live in moist environments where they can absorb water and other nutrients directly from their environment.
- Ferns, horsetails, and club mosses have vascular tissue and do not produce seeds. They reproduce by releasing spores.

Key Terms

rhizoid
frond

3 The Characteristics of Seed Plants

Key Concepts

- Seed plants have vascular tissue and use pollen and seeds to reproduce.
- If a seed lands in an area where conditions are favorable, it can begin to develop into a plant.
- Roots anchor a plant in the ground and absorb water and minerals. Stems carry substances between roots and leaves, provide support, and hold up the leaves. Leaves capture the sun's energy for photosynthesis.

Key Terms

phloem
xylem
pollen
seed
embryo
cotyledon
germination
root cap
cambium
transpiration

4 Gymnosperms and Angiosperms

Key Concepts

- Every gymnosperm produces naked seeds. In addition, many gymnosperms have needle-like or scalelike leaves, and deep-growing roots.
- During gymnosperm reproduction, pollen falls from a male cone onto a female cone. In time, sperm and egg cells join in an ovule on the female cone.
- All angiosperms produce flowers and fruits.
- All flowers function in reproduction.
- During angiosperm reproduction, pollen falls on a flower's stigma. In time, sperm and egg cells join in the flower's ovule.
- Angiosperms are divided into two major groups: monocots and dicots.

Key Terms

gymnosperm
cone
ovule
pollination
angiosperm
flower
sepal
petal
stamen
pistil
ovary
fruit
monocot
dicot

5 Plant Responses and Growth

Key Concepts

- Plant tropisms include responses to touch, light, and gravity.
- Plant responses to seasonal changes include photoperiodism and dormancy.
- Angiosperms are classified as annuals, biennials, or perennials.

Key Terms

tropism
hormone
auxin
photoperiodism
short-day plant
long-day plant
critical night length
day-neutral plant
dormancy
annual
biennial
perennial

Review and Assessment

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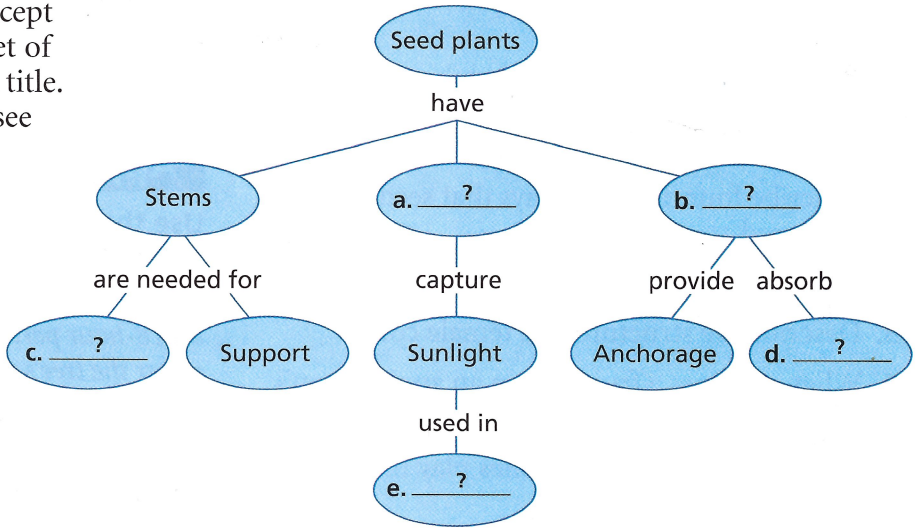
Organizing Information

Concept Mapping Copy the concept map about seed plants onto a sheet of paper. Then complete it and add a title. (For more on Concept Mapping, see the Skills Handbook.)



Reviewing Key Terms

Choose the letter of the best answer.

1. The familiar green, fuzzy moss is the
   a. frond.
   b. rhizoid.
   c. gametophyte.
   d. sporophyte.
2. The leaves of ferns are called
   a. rhizoids.
   b. sporophytes.
   c. fronds.
   d. cuticles.
3. The process by which a seed sprouts is called
   a. pollination. **b.** fertilization.
   c. dispersal. **d.** germination.
4. In woody stems, new xylem cells are produced by the
   a. bark. **b.** cambium.
   c. phloem. **d.** pith.
5. What kind of tropism do roots display when they grow downward into the soil?
   a. positive gravitropism
   b. negative gravitropism
   c. phototropism
   d. thigmotropism

If the statement is true, write *true*. If it is false, change the underlined word or words to make the statement true.

6. Vascular tissue is a system of tubelike structures through which water and food move.
7. Stems anchor plants in the soil.
8. The needles of a pine tree are actually its leaves.
9. Gymnosperm seeds are dispersed in fruits.
10. Flowering plants that live for more than two years are called annuals.

Writing in Science

Firsthand Account Write a story from the viewpoint of a seedling. Describe how you were dispersed as a seed and how you grew into a seedling.

Discovery Channel School

Seed Plants
Video Preview
Video Field Trip
Video Assessment

Review and Assessment

Checking Concepts

11. Name one adaptation that distinguishes plants from algae.
12. In what ways do mosses and club mosses differ from each other? In what ways are they similar?
13. Describe four different ways that seeds can be dispersed.
14. Explain the role that stomata play in leaves.
15. Describe the structure of a female cone.
16. What role does a fruit play in an angiosperm's life cycle?
17. What role do plant hormones play in phototropism?

Thinking Critically

18. **Comparing and Contrasting** How does the sporophyte generation of a plant differ from the gametophyte generation?
19. **Applying Concepts** A friend tells you that he has seen moss plants that are about 2 meters tall. Is your friend correct? Explain.
20. **Relating Cause and Effect** When a strip of bark is removed all the way around the trunk of a tree, the tree dies. Explain why.
21. **Predicting** Pesticides are designed to kill harmful insects. Sometimes, however, pesticides kill helpful insects as well. What effect could this have on angiosperms?
22. **Comparing and Contrasting** Which of the plants below is a monocot? Which is a dicot? Explain your conclusions.

Math Practice

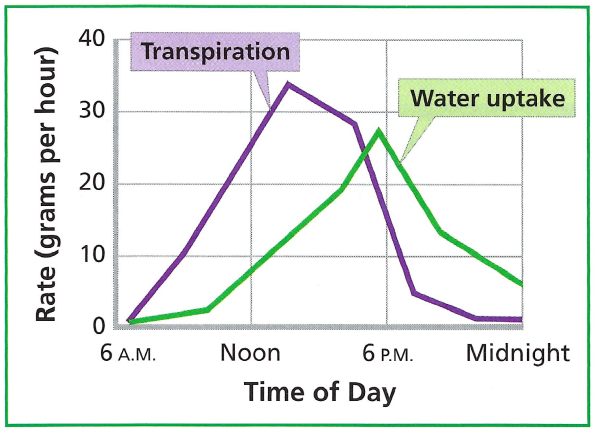
23. **Multiples** Use what you know about multiples to determine which flower is a monocot and which is a dicot: a flower with nine petals; a flower with ten petals. Explain.

Applying Skills

Use the data in the graph below to answer Questions 24–26.

A scientist measured transpiration in an ash tree over an 18-hour period. She also measured how much water the tree's roots took up in the same period.

Transpiration and Water Uptake



24. **Interpreting Data** At what time is the rate of transpiration highest? At what time is the rate of water uptake highest?
25. **Inferring** Why do you think the transpiration rate increases and decreases as it does during the 18-hour period?
26. **Drawing Conclusions** Based on the graph, what is one conclusion you can reach about the pattern of water loss and gain in the ash tree?

Lab zone Chapter Project

Performance Assessment Present your exhibit to your classmates. Describe your original exhibit and how you changed it based on the feedback you received. Explain what you learned by doing this project. What factors are most important in creating a successful educational exhibit for children?