Chapter 27 Organizer

Refer to pages 4T-5T of the Teacher Guide for an explanation of the National Science Education Standards correlations.

Section	Objectives	Activities/Features
Section 27.1 **Mollusks** National Science Education Standards UCP.1, UCP.2, UCP.3, UCP.5; C.4, C.5, C.6 (1 session, $\frac{1}{2}$ block)	1. **Identify** the characteristics of mollusks. 2. **Compare** the adaptations of gastropod, bivalve, and cephalopod mollusks.	**Inside Story:** A Clam, p. 743 **Problem-Solving Lab 27-1,** p. 744 **MiniLab 27-1:** Identifying Mollusks, p. 746
Section 27.2 **Segmented Worms** National Science Education Standards UCP.1, UCP.2, UCP.4, UCP.5; A.1, A.2; C.3, C.5, C.6; E.1, E.2; F.6; G.1, G.3 (2 sessions, 1 block)	3. **Describe** the characteristics of segmented worms and their importance to the survival of these organisms. 4. **Compare and contrast** the classes of segmented worms.	**Problem-Solving Lab 27-2,** p. 749 **MiniLab 27-2:** A Different View of an Earthworm, p. 750 **Inside Story:** An Earthworm, p. 751 **Careers in Biology:** Microsurgeon, p. 752 **Design Your Own BioLab:** How do earthworms respond to their environment? p. 754 **Earth Science Connection:** Mollusks as Indicators, p. 756

Need Materials? Contact Carolina Biological Supply Company at 1-800-334-5551 or at **http://www.carolina.com**

MATERIALS LIST

BioLab

p. 754 live earthworms, paper towels, glass pan, sandpaper, culture dishes, thermometer, hand lens or stereomicroscope, dropper, penlight, ice, metric ruler, black paper, cotton swabs

MiniLabs

p. 746 dichotomous key transparency, overhead projector, marine shells

p. 750 cross-section diagrams of earthworm, longitudinal diagrams of earthworm

Alternative Lab

p. 744 land snails, clear plastic deli trays, wax marking pencil, lamp with 60-watt bulb, crushed ice, ring stand, black paper, sandpaper, metric ruler

Quick Demos

p. 742 land snail, petri dish, pencil, lettuce

p. 742 whole squid, knife

Key to Teaching Strategies

- L1 Level 1 activities should be appropriate for students with learning difficulties.
- L2 Level 2 activities should be within the ability range of all students.
- L3 Level 3 activities are designed for above-average students.
- ELL ELL activities should be within the ability range of English Language Learners.
- COOP LEARN Cooperative Learning activities are designed for small group work.
- P These strategies represent student products that can be placed into a best-work portfolio.
- These strategies are useful in a block scheduling format.

Mollusks and Segmented Worms

Teacher Classroom Resources

Section	Reproducible Masters	Transparencies
Section 27.1 **Mollusks**	**Reinforcement and Study Guide,** pp. 119-121 L2 **BioLab and MiniLab Worksheets,** p. 121 L2 **Laboratory Manual,** pp. 191-198 L2 **Content Mastery,** pp. 133-134, 136 L1	**Section Focus Transparency 67** L1 ELL **Basic Concepts Transparency 48** L2 ELL **Reteaching Skills Transparency 40** L1 ELL
Section 27.2 **Segmented Worms**	**Reinforcement and Study Guide,** p. 122 L2 **Concept Mapping,** p. 27 L3 ELL **Critical Thinking/Problem Solving,** p. 27 L3 **BioLab and MiniLab Worksheets,** pp. 122-124 L2 **Content Mastery,** pp. 133, 135-136 L1	**Section Focus Transparency 68** L1 ELL

Assessment Resources

Chapter Assessment, pp. 157-162
MindJogger Videoquizzes
Performance Assessment in the Biology Classroom
Alternate Assessment in the Science Classroom
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 27 quiz

Additional Resources

Spanish Resources ELL
English/Spanish Audiocassettes ELL
Cooperative Learning in the Science Classroom COOP LEARN
Lesson Plans/Block Scheduling

NATIONAL GEOGRAPHIC Teacher's Corner

Index to National Geographic Magazine
The following articles may be used for research relating to this chapter:
"Money From the Sea," by Phil Nuytten, January 1993.
"The Pearl," by Fred Ward, August 1985.
"My Chesapeake—Queen of Bays," by Allan C. Fisher, Jr., October 1980.

GLENCOE TECHNOLOGY

The following multimedia resources are available from Glencoe.

Biology: The Dynamics of Life
CD-ROM ELL
Exploration: *Mollusks*
BioQuest: *Biodiversity Park*
Exploration: *The Five Kingdoms*
Videodisc Program
Scallop Escape

The Infinite Voyage
To the Edge of the Earth

The Secret of Life Series
Mulluscan Body Plan
Earthworm
Earthworm Segment

Getting Started Demo

Display several seashells and have students speculate about what kinds of animals might have lived in them. Explain that the animals that lived in the shells are classified as mollusks. L1

Theme Development

The theme of **unity within diversity** is evident throughout the chapter. When comparing and contrasting these animal groups, similarities are pointed out while the unique characteristics of classes and species are emphasized. The theme of **evolution** is stressed through discussions of the origins of mollusks and the increasing complexity of the specialization of the body plans of mollusks and segmented worms.

0:00 Out of Time?

If time does not permit teaching the entire chapter, use the BioDigest at the end of the unit as an overview.

Chapter 27

Mollusks and Segmented Worms

What You'll Learn

- You will distinguish among the classes of mollusks and segmented worms.
- You will compare and contrast the adaptations of mollusks and segmented worms.

Why It's Important

Mollusks are an important food source for many animals, including humans. Some mollusks are filter feeders that clean impurities out of their watery environment. Earthworms turn, aerate, and fertilize the soil in which they live.

Getting Started

Observing a Snail

Gently hold a snail in your hand. Describe the texture of the snail's muscular foot. *How does a snail move?*

interNET CONNECTION To find out more about mollusks and segmented worms, visit the Glencoe Science Web Site. **www.glencoe.com/sec/science**

Mucus is an important adaptation for earthworms, as well as for slugs and snails. In addition to allowing earthworms to move through soil, mucus holds two earthworms together as they mate.

Section 27.1

Prepare

Key Concepts

Students will study the general characteristics of mollusks and the traits that distinguish organisms in the three mollusk classes.

Planning

- Gather assorted sea shells for the Getting Started Demo.
- Order live land snails and purchase squid and live clams for the Quick Demos, Portfolio, and the Alternative Lab.
- Purchase surgical gloves for the Building a Model.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 67** on the overhead projector and have students answer the accompanying questions. L1 ELL

Section

27.1 Mollusks

SECTION PREVIEW

Objectives

Identify the characteristics of mollusks.

Compare the adaptations of gastropod, bivalve, and cephalopod mollusks.

Vocabulary

mantle
radula
open circulatory system
closed circulatory system
nephridia

If you are a shell collector, a walk on the beach as high tide begins to recede can reveal bountiful treasures. The shell sizes, shapes, and colors are clues to the many different kinds of animals that once inhabited these structures. How could the marine animal that lived in the fan-shaped shell be related to the common garden slug?

Shells (above) and a garden slug (inset)

What Is a Mollusk?

Slugs, snails, and animals that once lived in shells in the ocean or on the beach are all mollusks. These organisms belong to the phylum Mollusca. Members of this phylum range from the slow moving slug to the jet-propelled squid. Although most species live in the ocean, others live in freshwater and moist terrestrial habitats. Some aquatic mollusks, such as oysters and mussels, live firmly attached to the ocean floor or to the bases of docks or wooden boats. Others, such as the octopus, swim freely in the ocean. Land-dwelling slugs and snails can be found crawling slowly over leaves on the forest floor.

Examples of three classes of mollusks are shown in ***Figure 27.1.***

Word Origin

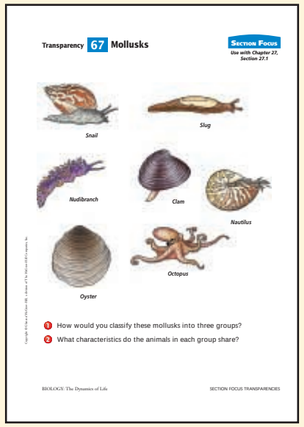
mollusk
From the Latin word *molluscus*, meaning "soft." Mollusks are animals with two body openings, a muscular foot, and a mantle.

Figure 27.1
With 100 000 described species, phylum Mollusca is second in size only to insects and their relatives.

A Snails, slugs, their shell-less relatives, and other one-shelled animals such as this limpet make up the largest class of mollusks.

B Oysters, clams, and scallops such as this one have two hinged shells.

C Predatory squids and octopuses are mollusks that do not have an external shell.



Multiple Learning Styles

Look for the following logos for strategies that emphasize different learning modalities.

- ***Kinesthetic*** Portfolio, pp. 745, 749; Meeting Individual Needs, p. 751
- ***Visual-Spatial*** Quick Demo, p. 742; Display, p. 745; Reteach, pp. 747, 753; Visual Learning, p. 752
- ***Intrapersonal*** Biology Journal, p. 742
- ***Linguistic*** Biology Journal, p. 748
- ***Logical-Mathematical*** Meeting Individual Needs, p. 746
- ***Naturalist*** Project, p. 746

Assessment Planner

Portfolio Assessment
Portfolio, TWE, pp. 745, 749
Assessment, TWE, pp. 747

Performance Assessment
Alternative Lab, TWE, p. 744
MiniLabs, SE, pp. 746, 750
BioLab, SE, pp. 754-755
BioLab, TWE, pp. 754-755
MiniLabs, TWE, pp. 746, 750

Knowledge Assessment
Assessments, TWE, pp. 744, 747
Problem-Solving Labs, TWE, pp. 744, 749
Section Assessments, SE, pp. 747, 753
Chapter Assessment, SE, pp. 757-759

Skill Assessment
MiniLabs, TWE, pp. 746, 750
Assessments, TWE, pp. 752, 753

Resource Manager

Section Focus Transparency 67 and Master L1 ELL

2 Teach

Quick Demo

Visual-Spatial Divide the class into groups. Give each group a live land snail on one half of a petri dish. Ask students to record their observations of the snail. Instruct students to observe the snail through the underside of the dish. Have them gently touch the antenna of the snail with the eraser end of a pencil and observe and describe its reaction. Finally, have them place the snail on a piece of lettuce to see if they can observe the snail feeding. Discuss all observations as a class.

L2 ELL COOP LEARN

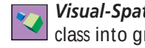
Quick Demo

Obtain a whole squid from a fish market. Point out the head and tentacles of the squid. Cut the squid open to reveal its transparent cuttlebone. Explain that many scientists consider the cuttlebone to be a remnant of a shell. L1

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Exploration: *Mollusks*
Disc 4

VIDEODISC
The Secret of Life
Molluscan Body Plan



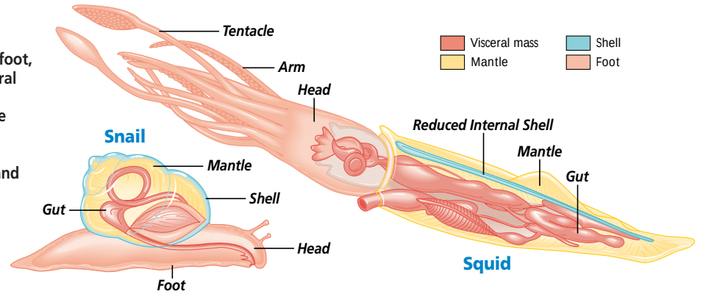


Figure 27.2
A mollusk has a soft body composed of a foot, a mantle, and a visceral mass that contains internal organs. Some mollusks also have a shell. Compare the structures of a snail and a squid.

A Snails have a well-defined and developed head area in addition to a large foot.

B The foot area of the squid appears to have been modified into arms and tentacles that are used for capturing and holding prey.

Some mollusks have shells, and others, including slugs and squids, are adapted to life without a hard covering. All mollusks have bilateral symmetry, a coelom, two body openings, a muscular foot for movement, and a mantle. The **mantle** (MANT uhl) is a thin membrane that surrounds the internal organs of the mollusk. In shelled mollusks, the mantle secretes the shell.

Although mollusks look different from one another on the outside, they share many internal similarities. You can see the similarities and the differences in these body areas in ***Figure 27.2*** as you compare a snail and a squid. How does a clam buried in sand obtain its food? Find out in the *Inside Story* on the next page.

Figure 27.3
Look at the clam shell in this photo and locate a small hole on its edge. This tiny hole was made by the radula of a mollusk that ate the clam, leaving its shell behind to tell the tale of the clam's fate.

How mollusks obtain food

Have you ever watched a snail clean algae from the sides of an aquarium? Snails, like many mollusks, use a rasping structure called a radula to obtain food. A **radula** (RAJ uh luh), located within the mouth of a mollusk, is a tonguelike organ with rows of teeth. The radula is used to drill, scrape, grate, or cut food. ***Figure 27.3*** shows the results of the use of a radula. Octopuses and squids use their radulas to pull food they have captured into their mouths. Other mollusks are grazers, some are predators, and some are filter feeders. Bivalves do not have radulas; they obtain food by filtering it out of the water.

Reproduction in mollusks

Most mollusks have separate sexes and reproduce sexually. Eggs and sperm are released at the same time into the surrounding water, where external fertilization takes place. Many gastropods that live on land are hermaphrodites. The ability to produce both eggs and sperm is an adaptation commonly found in slow-moving animals because it increases the likelihood of fertilization.

BIOLOGY JOURNAL

Locating Mollusks

Intrapersonal Provide students with a blank outline map of the world. Have them conduct research to find out where five species of mollusks are commonly found. For example, the Atlantic bay scallop is commonly found from North Carolina to the West Indies and Brazil. Ask students to develop a key to indicate these locations on their maps. Have them locate both freshwater and saltwater species. Encourage students to combine their findings with those of two others in the class. If possible, provide students with nature and wildlife atlases to aid in their research. L3 ELL

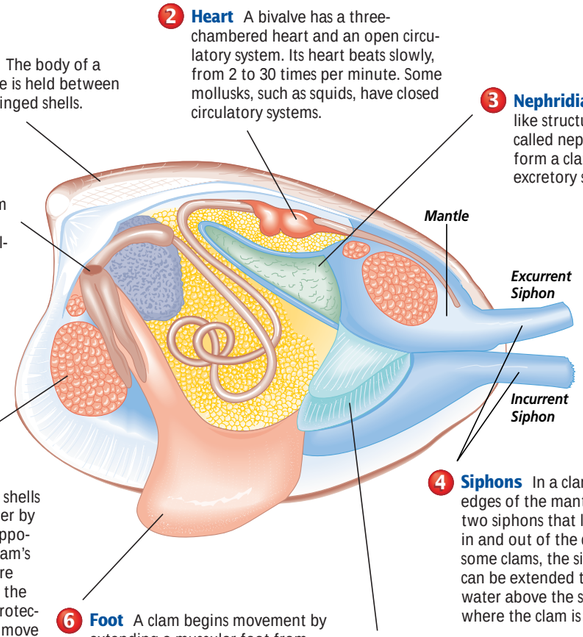
INSIDE STORY

A Clam

Clams are bivalve mollusks. Bivalves include mussels, scallops, oysters, and other mollusks with two hinged shells. Clams, like oysters, can cover a foreign object, such as a grain of sand or a parasite, that has become lodged between its shell and its mantle with layers of shell that eventually form a pearl.

Coquina clams

Critical Thinking ***What function do gills have in digestion in a clam?***



Cultural Diversity

Pearl Cultivation

In your lessons on mollusk biology, discuss with students how pearls are formed and describe the pearl cultivation industry in Japan. Since 1893, pearl farming has been one of Japan's most famous industries.

To add interest, introduce students to the AMA women of Japan. The AMA is a group of diving women who collect pearls and valuable mollusks from the ocean. Diving women have operated in Japan for more than 2000 years. The divers take their name from the word *ama*, which in the ancient Japanese language meant "ocean" or "sky." The AMA of Japan have been known to dive to depths greater than 50 meters hundreds of times daily without the use of snorkels or air tanks.

INSIDE STORY

Purpose
Students study the functions of the organs of a bivalve mollusk.

Teaching Strategies
- Ask students to explain the functions of the clam's incurrent and excurrent siphons. L2
- Explain that the clam moves by extending its foot from the opening between the two shells.

Visual Learning
- Have students examine the captions and make a simple drawing in their journals that shows the path that food takes in a clam. L1 ELL

Critical Thinking
Gills filter food particles from the water.

Building a Model
Fill a surgical glove with water. Squeeze the water in one of the fingers and have students observe how the water moves freely into the other parts of the glove. Explain that the glove roughly models an open circulatory system in which blood moves freely into open spaces surrounding organs. L1

GLENCOE TECHNOLOGY

VIDEODISC
Biology: The Dynamics of Life
Scallop Escape (Ch. 32)
Disc 1, Side 2, 11 sec.

Problem-Solving Lab 27-1

Purpose

Students will study the life cycle of larval development in a freshwater mussel.

Process Skills

think critically, analyze data, interpret scientific drawings

Teaching Strategies

Remind students that all mollusks do not follow the pattern of reproduction and development illustrated here.

Thinking Critically

1. sperm
2. fertilization
3. They die.
4. They mature into adult mussels.
5. Although the animal produces many glochidia, most do not find a suitable host and thus do not survive to adult stage.

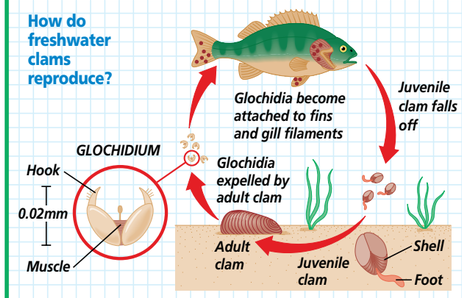
Assessment

Knowledge Provide students with a sample of glochidia but do not tell them what they are looking at. Have them examine glochidia under the microscope and identify what the organism is. Preserved glochidia are available from biological supply houses. Use the Performance Task Assessment List for Making Observations and Inferences in **PASC,** p. 17. L2 ELL

Problem-Solving Lab 27-1

Observing and Inferring

How do freshwater clams reproduce?



Analysis

Examine the life cycle of the freshwater clam *Anodonta*. Freshwater clams are either male or female. Immature larvae, called glochidia, are formed within female clams' reproductive systems, then released in the surrounding water.

Thinking Critically

1. What cell type must enter a female clam's body in order for glochidia to form?
2. What reproductive process must occur prior to the formation of glochidia?
3. Glochidia attach to and feed off of a specific fish host. Predict what happens to glochidia if no host is available.
4. How do glochidia change while attached to their host?
5. It is estimated that a single clam can release over 1 000 000 glochidia. How might this be an adaptation to a life cycle that includes a parasitic stage?

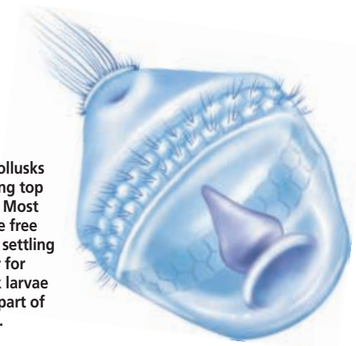


Figure 27.4
Larvae of most mollusks resemble a spinning top with tufts of cilia. Most of these larvae are free swimming before settling to the ocean floor for adult life. Mollusk larvae are an important part of many food chains.

Find out more about reproduction in mollusks by reading the *Problem-Solving Lab* on this page.

Although members of the phylum Mollusca have different appearances as adults, they all share similar developmental patterns. The larval stages of all mollusks are similar, as you can see in ***Figure 27.4.***

Some marine mollusks have free-swimming larvae that propel themselves by cilia. In addition to larvae, most marine snails and bivalves have another developmental stage called a veliger in which the beginnings of a foot, shell, and mantle can be seen.

Nervous control in mollusks

Mollusks have simple nervous systems that include a brain and associated nerves that coordinate their movement and behavior. Most mollusks have paired eyes that range from simple cups that detect light to the complex eyes of octopuses that have irises, pupils, and retinas that function as well as those of humans.

Circulation in mollusks

Mollusks have a well-developed circulatory system that includes a three-chambered heart. In most mollusks, the heart pumps blood through an open circulatory system. In an **open circulatory system,** the blood moves through vessels and into open spaces around the body organs. This adaptation exposes body organs directly to blood that contains nutrients and oxygen, and removes metabolic wastes. Some mollusks, such as octopuses, move nutrients and oxygen through a closed circulatory system. In a **closed circulatory system,** blood moves through the body enclosed entirely in a series of blood vessels. A closed system provides an efficient means of gas exchange within the body.

Figure 27.5
Shelled gastropods vary from petite, thin-shelled species to large animals with thick shells.

A **The pink conch is a large gastropod with a thick shell.**

B **The smooth dove shell is a small, delicate gastropod. These organisms can be found in the Florida Keys and West Indies.**

Respiration in mollusks

Most mollusks have respiratory structures called gills. Gills are specialized parts of the mantle that consist of a system of filamentous projections that contain a rich supply of blood for the transport of gases. Gills increase the surface area through which gases can diffuse. In land snails and slugs, the mantle cavity appears to have evolved into a primitive lung.

Excretion in mollusks

Mollusks are the oldest known animals to have evolved excretory structures called nephridia. **Nephridia** (nih FRIHD ee uh) are organs that remove metabolic wastes from an animal's body. Mollusks have one or two nephridia that collect wastes from the coelom. Wastes are discharged into the mantle cavity, and expelled from the body by the pumping of the gills.

Diversity of Mollusks

Within the large phylum of mollusks, there are seven classes. The three classes that include the most common and well-known species are Gastropoda, Bivalvia, and Cephalopoda.

Gastropods: One-shelled mollusks

The largest class of mollusks is Gastropoda, or the stomach-footed mollusks. The name comes from the way the animal's large foot is positioned under the rest of its body. Most species of gastropods have a single shell. Other gastropod species, such as slugs, have no shell.

Shelled gastropods include snails, abalones, conches, periwinkles, whelks, limpets, cowries, and cones. They can be found in freshwater, saltwater, or moist terrestrial habitats. Shelled gastropods may be plant eaters, predators, or parasites. ***Figure 27.5*** shows two examples of shelled gastropods.

Instead of being protected by a shell, the body of a slug is protected by a thick layer of mucus. Colorful sea slugs, also called nudibranchs, are protected in another way. When certain species of sea slugs feed on jellyfishes, they incorporate the poisonous nematocysts of the jellyfish into their own tissues without causing these cells to discharge. Any fishes trying to eat the sea slugs are repelled when the nematocysts discharge into the unlucky predator. The bright colors of these gastropods warn predators of the potential danger, as shown in ***Figure 27.6.***

Figure 27.6
Sea slugs such as this *Chromodoris* species live in the ocean. They eat hydras, sea anemones, and sea squirts.

Visual Learning

Ask students to examine the photos of the conch and dove shell and speculate about why people want shells as souvenirs. Ask them how the practice of collecting rare live mollusks for the sale of their shells might be curtailed.

Display

Visual-Spatial Have students bring in gastropod shells from collections they have at home. Make a display of the shells. Provide shell identification keys and books and have students try to identify the shells and tell which are plant eaters, predators, and parasites. L2 ELL

Portfolio

Observing Filter Feeding

Kinesthetic Have students place a live clam in a beaker of water so that 6 cm of water covers the clam. Place 2 drops of carmine powder suspension near the siphons. Ask students to explain what happens to the carmine suspension, and have them place their explanations in their portfolios. L2 ELL P

Alternative Lab

Comparing Snail Speeds

Purpose

Students will compare the speed at which snails move under various environmental conditions.

Materials

land snails, clear plastic deli trays or large deli containers, wax marking pencil, lamp with 60-watt bulb, crushed ice, ring stand, black construction paper, sandpaper, metric ruler

Procedure

Give students the following directions.

1. Make a table for distances traveled by the snail on a smooth surface, a rough surface, in cold conditions, and in warm conditions.
2. Make a hypothesis about the conditions under which the snail will move the fastest.
3. With the wax marking pencil, mark an X in the middle of your tray. Place the snail on this X and measure how far it travels in 3 minutes.
4. Place a piece of black construction paper over the tray so that the snail is in the dark. Measure distance traveled in 3 minutes.
5. Cover the bottom of the tray with sandpaper that has been marked in its center with an X. Measure the distance the snail travels in 3 minutes.
6. Place the lamp on a ring stand about 30 cm from the snail. After 3 minutes, begin timing. Measure the distance the snail travels in 3 minutes.
7. Place your container with the snail on top of another tray containing crushed ice. After 5 minutes, measure the distance the snail travels in 3 minutes.

Expected Results

Snails will move fastest on a smooth surface in warm conditions.

Analysis

1. Was your hypothesis supported by the data? *Yes, if they hypothesized that the snail would move fastest when warm, in light, and on a smooth surface.*
2. What feature of snails aids their gliding movement? *mucus*

Assessment

Performance Have students design and conduct an experiment that would test to see if land snails prefer light or darkness. Use the Performance Task Assessment List for Designing an Experiment in **PASC,** p. 23. L1

MiniLab 27-1

Purpose
Students will use a dichotomous key to identify mollusks based on their shells.

Process Skills
observe and infer, compare and contrast, classify, use a dichotomous key

Teaching Strategies
- Make an overhead transparency of a dichotomous key. Use the transparency to demonstrate how a dichotomous key is used.
- Ask students who collect shells to bring in their shell collections and identify the shells for their classmates.

Expected Results
Students will classify the pictured shells using the dichotomous key provided.

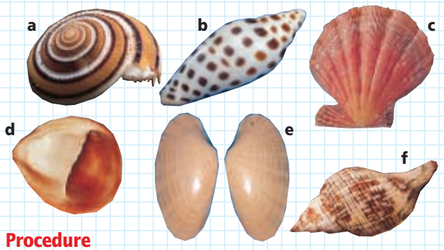
Analysis
1. A dichotomous key divides a group into smaller and smaller groups until each organism is identified.
2. easy: 1, 2, 3, 4; more difficult, 5, because it requires more interpretation and closer comparison
3. one or two shells

Assessment
Skill Give students a simple dichotomous key for several shells. Ask them to use the key to identify the shells. Use the Performance Task Assessment List for Making and Using a Classification System in **PASC,** p. 49. L1

Resource Manager
- **Reteaching Skills Transparency 40 and Master** L1 ELL
- **Biolab and MiniLab Worksheets,** p. 121 L2
- **Reinforcement and Study Guide,** pp. 119-121 L2
- **Content Mastery,** p. 134 L1
- **Laboratory Manual,** pp. 191-198 L2

MiniLab 27-1 Comparing and Contrasting

Identifying Mollusks Have you ever taken a walk on the beach and filled your pockets with shells, and as you examined them later, wondered what they were? Use the following dichotomous key to determine the names of the shells.



Procedure
1. To use a dichotomous key, begin with a choice from the first pair of descriptions.
2. Follow the instructions for the next choice. Notice that either a scientific name can be found at the end of each description, or directions will tell you to go on to another numbered set of choices.

1A	One shell	Gastropods see 2
1B	Two shells	Bivalves see 3
2A	Flat coil	Sundial shell: *Architectonica nobilis*
2B	Thick coil	see 4
3A	Shelf inside shell	Common Atlantic slipper: *Crepidula fornicata*
3B	No shelf inside shell	see 5
4A	Spotted surface	Junonia shell: *Scaphella junonia*
4B	Lined surface	Banded tulip shell: *Fasciolaria hunteria*
5A	Polished surface	Sunray shell: *Macrocallista mimbosa*
5B	Rough surface	Lion's paw shell: *Lyropecten nodosus*

Analysis
1. Why is a dichotomous key used for a variety of organisms?
2. What shell features were easy to pick out using the key? What features were more difficult?
3. What general feature was used to identify shells?

Bivalves: Two-shelled mollusks

Two-shelled mollusks such as clams, oysters, and scallops belong to the class Bivalvia, illustrated in ***Figure 27.7.*** Most bivalves are marine, but a few species live in freshwater habitats. Bivalves occur in a range of sizes. Some are less than 1 mm in length and others, such as the tropical giant clam, may be 1.5 m long. Bivalves have no distinct head or radula. Most use their large, muscular foot for burrowing in the mud or sand at the bottom of the ocean or a lake. A ligament, like a hinge, connects their shells; strong muscles allow the shell to open and close over the soft body. See if you can identify the shells pictured in the *MiniLab* by using the dichotomous key given.

One of the main differences between gastropods and bivalves is that bivalves are filter feeders that obtain food by filtering small particles from the surrounding water. Bivalve mollusks have several adaptations for filter feeding, including cilia that beat to draw water in through an incurrent siphon. As water moves over the gills, food and sediments become trapped in mucus. Cilia that line the gills push food particles to the stomach. Cilia also act as a sorting device. Large particles, sediment, and anything else that is rejected is transported to the mantle where it is expelled through the excurrent siphon, or to the foot, where it is eliminated from the animal's body.

Figure 27.7
In bivalves the mantle forms two siphons, one for incoming water and one for water that is excreted.

PROJECT

Classifying Mollusks Used as Food

Naturalist Have students photocopy a menu from a local seafood restaurant. Ask students to construct a key to identify the gastropods, bivalves, and cephalopods listed on the menu. Have students summarize the importance of mollusks as a food source. L2 ELL

MEETING INDIVIDUAL NEEDS

Gifted

Logical-Mathematical Ask students to design an experiment to compare the strength of muscles in bivalves such as clams and scallops. Remind them to plan to collect quantitative data. L3

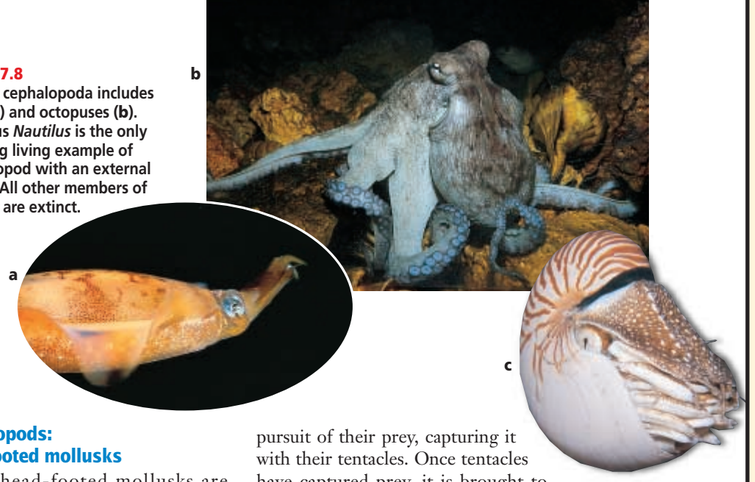


Figure 27.8
The class cephalopoda includes squids (a) and octopuses (b). The genus *Nautilus* is the only remaining living example of a cephalopod with an external shell (c). All other members of this class are extinct.

Cephalopods: Head-footed mollusks

The head-footed mollusks are in the class Cephalopoda. All cephalopods are marine organisms. This class includes the octopus, squid, cuttlefish, and chambered nautilus, as shown in ***Figure 27.8.*** The only cephalopod with a shell is the chambered nautilus, but some species, such as the cuttlefish, have a reduced internal shell. Scientists consider the cephalopods to have the most complex structures and to be the most recently evolved of all mollusks.

In cephalopods, the foot has evolved into tentacles with suckers, hooks, or adhesive structures. Cephalopods swim or walk over the ocean floor in pursuit of their prey, capturing it with their tentacles. Once tentacles have captured prey, it is brought to the mouth and bitten with the beaklike jaws. Then the food is pulled into the mouth by the radula.

Like bivalves, cephalopods have siphons that expel water. These mollusks can expel water forcefully in any direction, and move quickly by jet propulsion. Squids can attain speeds of 20 m per second using this system of movement. You may be aware that cephalopods use jet propulsion to escape from danger. They also can release a dark fluid to cloud the water. This "ink" helps to confuse their predators so they can make a quick escape.

Section Assessment

Understanding Main Ideas
1. Describe how mucus is important to some mollusks.
2. What adaptations make cephalopods effective predators?
3. Compare filter feeding with obtaining food by using a radula.
4. Compare how squids and sea slugs protect themselves.

Thinking Critically
5. How are the methods of movement for the snail, clam, and squid related to the structure of each one's foot?

SKILL REVIEW
6. **Classifying** Construct a key to identify the three classes of mollusks discussed. For more help, refer to *Organizing Information* in the **Skill Handbook.**

Section Assessment

1. Mucus enables mollusks to stick to surfaces and slide easily through or on materials in their habitats. Some mollusk mucus contains poisons.
2. jet propulsion-type swimming, tentacles with suckers, large eyes with a well-developed nervous system, radula for tearing apart prey
3. A filter feeder takes in water and filters out food. The radula is a tongue-like organ that scrapes food from surfaces.
4. Squids protect themselves by their ability to move quickly away from danger. Sea slugs are protected by their toxic mucous covering.
5. The muscular foot of the snail secretes mucus on which the snail glides slowly. The clam can burrow into sand with its muscular foot. The squid's foot is modified into tentacles that help obtain food.
6. Students' keys should include information found in the chapter under headings dealing with gastropods, bivalves, and cephalopods.

Assessment
Knowledge Ask students to do library or Internet research to find out why octopuses are the most intelligent invertebrates. Ask how a nervous system supports the level of intelligence shown by octopuses. L2

3 Assess

Check for Understanding
Have students explain how mollusks are more complex than other animals they have studied.

Reteach
Visual-Spatial Have students make a table describing mollusk traits with these headings: Phylum, Representative Organisms, Symmetry, Habitat, Food Getting, Taking in Oxygen, Reproduction, and Protection. L2

Extension
Ask students to prepare illustrated reports on pearl cultivation. L1

Assessment
Portfolio Ask students to write a description of a habitat that is suited to a specific mollusk from each group. Have students explain how each organism is adapted to its habitat. L2

4 Close

Discussion
Discuss the economic importance of mollusks. Include uses of mollusks as food, algae feeders in aquariums, and as souvenirs.

Prepare

Key Concepts

Students will learn the characteristics of segmented worms that enable them to survive in their environments. The classes of segmented worms will be compared and the traits of animals that are more complex than those studied in previous chapters will be emphasized.

Planning

- Set up an earthworm farm for the Quick Demo.
- Gather large jars and large earthworms for the Portfolio.
- Gather live earthworms, glass pans, sandpaper, penlights, culture dishes, droppers, ice, warm tap water, thermometers, and hand lenses or stereomicroscopes for the BioLab.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 68** on the overhead projector and have students answer the accompanying questions. L1 ELL

SECTION PREVIEW

Objectives

Describe the characteristics of segmented worms and their importance to the survival of these organisms.

Compare and contrast the classes of segmented worms.

Vocabulary

setae
gizzard

Section

27.2 Segmented Worms

Do earthworms have a front and a back end? Yes, they do. In fact, if you have ever watched one move, you know that it crawls by first stretching the front of its body forward, and then pulling the back of its body up to the front. A worm in motion looks a little like an accordion playing.

Earthworm

What Is a Segmented Worm?

Segmented worms are classified in the phylum Annelida. They include the earthworms, leeches, and bristleworms, shown in ***Figure 27.9.*** Segmented worms are bilaterally symmetrical and have a coelom and two body openings. Some have a larval stage that is similar to the larval stages of certain mollusks, suggesting a common ancestor.

The basic body plan of segmented worms is a tube within a tube. The internal tube, suspended within the coelom, is the digestive tract. Food is taken in by the mouth, an opening in the anterior end of the worm, and wastes are released through the anus, an opening at the posterior end.

Most segmented worms have tiny bristles called **setae** (SEE tee) on each segment. The setae help segmented worms move by providing a way to anchor their bodies in the soil so each segment can move the animal along.

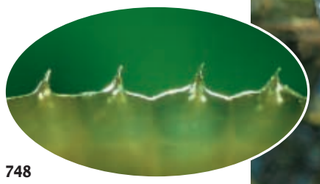
Segmented worms can be found in most environments, except in the frozen soil of the polar regions and the dry sand and soil of the deserts. You may be familiar with the earthworms in your garden, but these are just one of about 12 000 species of segmented worms that live in soil, freshwater, and the sea. Can you identify a segmented worm? Find out by reading the *Problem-Solving Lab* on this page.

WORD Origin

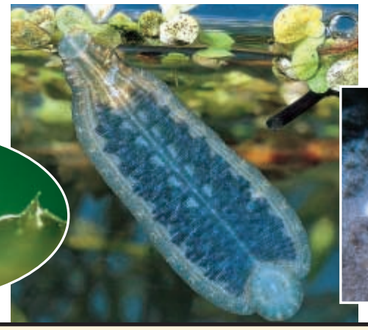
annelid
From the Latin word *anellus*, meaning "tiny ring." The bodies of annelids, the segmented worms, look like stacks of tiny rings.

Figure 27.9
The phylum Annelida contains about 12 000 species, which are placed in three classes.

A Earthworms have only a few setae on each segment. An earthworm does not have a distinct head.



B Leeches live in marine, freshwater, or terrestrial habitats. All leeches have 32 segments.



C Bristleworms have distinct heads, eyes, and tentacles. They are mostly marine animals.

Segmentation supports diversified functions

The most distinguishing characteristic of segmented worms is their cylindrical bodies that are divided into a series of ringed segments, as seen in the worms in ***Figure 27.10.*** This segmentation continues internally as each segment is separated from the others by a body partition. Segmentation is an important adaptation for movement because each segment has its own muscles, allowing shortening and lengthening of the body.

If you examine each segment of most annelids, you find that the body is made up of identical segments. Segmentation, however, also allows for specialization of body tissues. Groups of segments may be adapted for a particular function. Certain segments have modifications for functions such as sensing and reproduction.

Nervous system in segmented worms

Segmented worms have simple nervous systems in which organs in anterior segments have become modified for sensing the environment. Some sensory organs are sensitive to light, and eyes with lenses and retinas have evolved in certain species. In some species there is a brain located in an anterior segment. Nerve cords connect the brain to nerve centers called ganglia, located in each segment. You can find out how earthworms respond to their environment in the *BioLab* at the end of this chapter.

Problem-Solving Lab 27-2 Classifying

When is it an annelid? You are on a zoological research expedition to South America. As the invertebrate specialist, you are asked by your fellow scientists to classify a number of animals.

Analysis

Data Table

Animal	Characteristics
A	externally segmented body, no internal segments
B	no coelom, but has internal segments
C	lives in water, has two body openings, sexes are separate
D	backbone present, has digestive, circulatory, excretory systems
E	both male and female reproductive organs present
F	externally segmented body, has internal segments

Thinking Critically

Which are annelids, which are not, and which require more study to decide? Explain your answer for each animal.

Figure 27.10
Segmentation is easily seen in earthworms (a). The giant earthworm of Australia can be more than 3 m long (b).

BIOLOGY JOURNAL

Earthworm Importance

TECH PREP

Linguistic Ask a group of students to interview a farmer or an agriculture professor about the importance of earthworms in agriculture. Have them present their findings to the class in an illustrated report. Ask other class members to take notes on the presentation. L2

GLENCOE TECHNOLOGY

VIDEODISC
The Secret of Life
Earthworm

Portfolio

Earthworm Terrariums

Kinesthetic Ask each group of students to prepare a large jar as a terrarium for earthworms. Have them place rocks on the bottom for drainage. Then, have students alternate layers of moist sand and topsoil on top of the rocks. Have them add about six to eight worms to the jar, then cover the top layer of soil with dead leaves and grass. Instruct students to tape black paper to the outside of the jar. After several days, have them remove the paper and observe what happened to the leaves, grass, and soil layers. Have them also describe any tunnels they observe. L1 ELL P COOP LEARN

2 Teach

Problem-Solving Lab 27-2

Purpose

Students will have to judge if certain traits are or are not associated with the phylum Annelida.

Process Skills

apply concepts, think critically, compare and contrast, draw a conclusion

Teaching Strategies

- Be sure that students have read the entire section on annelids before attempting to do this lab.
- Review any terms that may not be familiar to students.
- Review the concept of a body cavity called a coelom.

Thinking Critically

A— no, all annelids have internal segmentation
B— no, all annelids have a coelom
C— undecided; traits may apply to other phyla as well as Annelida
D— no, annelids are not vertebrates
E— undecided; traits may apply to other phyla as well as annelids
F— yes, true only of annelids

Assessment

Knowledge Ask students to list traits that are specific to Annelida and no other phyla. Ask students to list traits that are common to other phyla as well as Annelida. Use the Performance Task Assessment List for Making and Using a Classification System in **PASC,** p. 49. L2

Resource Manager

Section Focus Transparency 68 and Master L1 ELL

MiniLab 27-2

Purpose
Students will use a diagram of an earthworm's internal anatomy to draw cross-section views.

Process Skills
analyze data, interpret scientific drawings, observe and infer

Teaching Strategies
- Review the meaning of a cross-section view. Use a cucumber to show a longitudinal view. Then make cuts through the cucumber to illustrate cross-sectional slices.
- Point out to students that the segments are numbered.
- Make copies of an outline diagram of incomplete worm cross-sectional views for student use.

Expected Results
Student diagrams will reflect their ability to translate information from a longitudinal view to a cross-sectional view.

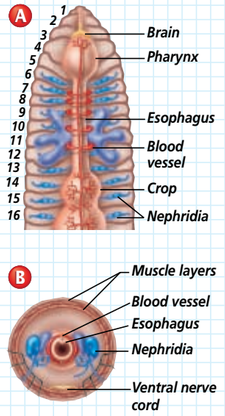
Analysis
Segment 8 will show: muscles, esophagus, heart, dorsal and ventral blood vessels, and nerve cord. Segment 12 will show all the parts from Segment 8 plus the seminal vesicle and calciferous gland.

Assessment
Skill Have students make cross-section diagrams of segments 3, 16, and 21. Use the Performance Task Assessment List for Scientific Drawing in **PASC,** p. 55. L2 ELL

Resource Manager
BioLab and MiniLab Worksheets, p. 122 L2

MiniLab 27-2 Interpreting Scientific Diagrams

A Different View of an Earthworm What does an earthworm look like internally? You could look at it many different ways—from the dorsal or ventral side, along the length of the animal (a longitudinal view), or in cross section through a segment.



Procedure
1. Diagram A illustrates a longitudinal dorsal view of the internal organs of an earthworm. Note that the segments are numbered.
2. Use Diagram B as a guide to how a cross-section slice appears through segment 9.

Analysis
Make your own cross-section diagrams of segments 8 and 12. Label all the parts shown in your diagrams.

worm's body through the anus. Segmented worms also have two nephridia in each segment that collect waste products and transport them through the coelom and out of the body. Find out what an earthworm eats by reading the *Inside Story.*

Reproduction in segmented worms

Most segmented worms are hermaphrodites. During mating, two worms exchange sperm. Each worm forms a capsule for the eggs and sperm. The eggs are fertilized in each worm's capsule, then the capsule slips off the worm and is left behind in the soil. In two to three weeks, young worms emerge from the eggs. Earthworms and leeches both reproduce in this way.

However, bristleworms and their relatives have separate sexes and reproduce sexually, although mating occurs in only a few species. Usually eggs and sperm are released into the seawater, where fertilization takes place. Young bristleworms hatch in the sea.

Diversity of Segmented Worms

The phylum Annelida is divided into three classes: class Oligochaeta, earthworms; class Polychaeta, bristleworms and their relatives; and class Hirudinea, leeches.

Earthworms

Earthworms are the most well-known annelids because they can be seen easily by most people. Although earthworms have a definite anterior and posterior section, they do not have a distinct head. Earthworms have only a few setae on each segment. What does an earthworm look like internally? You can find out in the *MiniLab* on this page.

Circulation and respiration

Segmented worms have a closed circulatory system. Blood carrying oxygen to and carbon dioxide from body cells flows through vessels to reach all parts of the body. Segmented worms must live in water or in wet areas on land because they also exchange gases directly through their moist skin.

Digestion and excretion

Segmented worms have a complete internal digestive tract that runs the length of the body. Food taken in by the mouth passes to the **gizzard,** a sac with muscular walls and hard particles that grind soil before the soil passes into the intestine. Undigested material and solid wastes pass out the

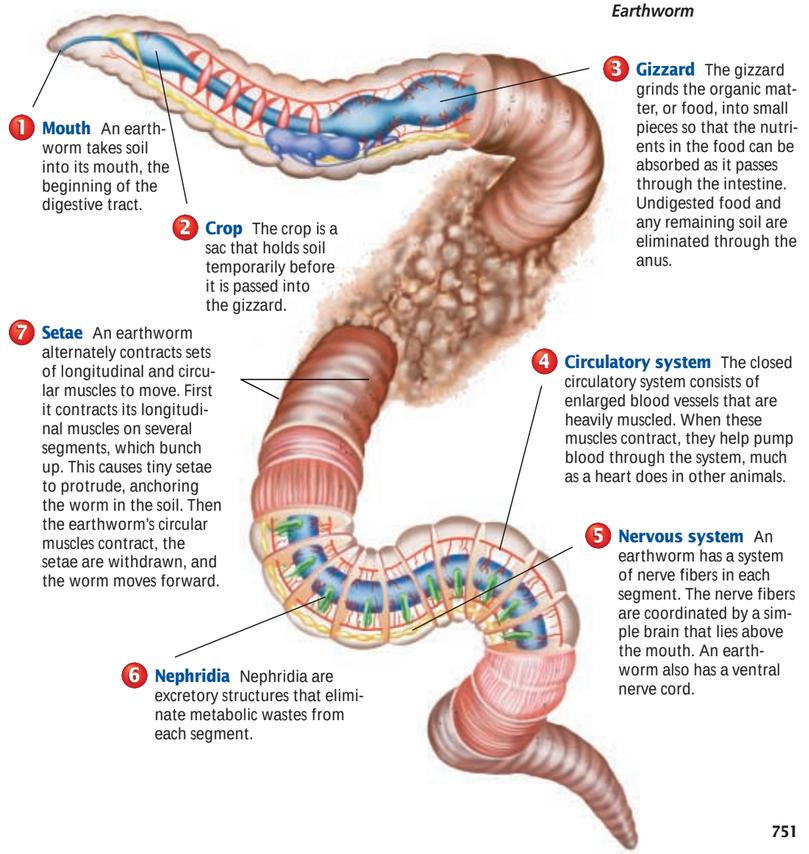
Inside Story

An Earthworm

As an earthworm burrows through soil, it loosens, aerates, and fertilizes the soil. Burrows provide passageways for plant roots and improve drainage of the soil.

Critical Thinking ***In what way is segmentation an important advantage in earthworm movement?***

Earthworm



1 Mouth An earthworm takes soil into its mouth, the beginning of the digestive tract.

2 Crop The crop is a sac that holds soil temporarily before it is passed into the gizzard.

3 Gizzard The gizzard grinds the organic matter, or food, into small pieces so that the nutrients in the food can be absorbed as it passes through the intestine. Undigested food and any remaining soil are eliminated through the anus.

4 Circulatory system The closed circulatory system consists of enlarged blood vessels that are heavily muscled. When these muscles contract, they help pump blood through the system, much as a heart does in other animals.

5 Nervous system An earthworm has a system of nerve fibers in each segment. The nerve fibers are coordinated by a simple brain that lies above the mouth. An earthworm also has a ventral nerve cord.

6 Nephridia Nephridia are excretory structures that eliminate metabolic wastes from each segment.

7 Setae An earthworm alternately contracts sets of longitudinal and circular muscles to move. First it contracts its longitudinal muscles on several segments, which bunch up. This causes tiny setae to protrude, anchoring the worm in the soil. Then the earthworm's circular muscles contract, the setae are withdrawn, and the worm moves forward.

Inside Story

Purpose
Students will examine the internal structures of the earthworm and their functions.

Teaching Strategies
- Ask students to write a paragraph that explains how earthworm bodies show more complexity than the bodies of flatworms and roundworms. L2
- Obtain a plastic model of an earthworm. Point out each structure discussed in the Inside Story on the model.
- Challenge your advanced students to make a table that compares earthworms with the free-living flatworms and roundworms. Students should include the following in their tables: digestion, locomotion, circulation, excretion, and sensory functions. L3

Visual Learning
- Make photocopies of the Inside Story diagram without the labels and captions. Have students label and describe the functions of each structure on the photocopy as it is discussed. L1 ELL

Critical Thinking
Earthworms have setae and muscles in each segment. They move by anchoring the setae in the ground, then contracting their muscles. The earthworm moves by alternately contracting and relaxing the muscles in each segment.

Resource Manager
Critical Thinking/Problem Solving, p. 27 L3
Concept Mapping, p. 27 L1 ELL

Internet Address Book

internet CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

_____

_____

_____

_____

GLENCOE TECHNOLOGY

VIDEODISC
The Infinite Voyage:
To the Edge of the Earth
Exploring the Galapagos Islands (Ch. 4)
8 min.

Meeting Individual Needs

Visually Impaired/Learning Disabled

Kinesthetic For students who are visually impaired, provide an earthworm for them to hold while you point out the main features of its structure and behavior. Ask the students to explain how the earthworm's shape and texture make it adapted for life in the soil. L1 ELL

GLENCOE TECHNOLOGY

VIDEODISC
The Secret of Life
Earthworm Segment

Careers in Biology

Courses in high school: advanced science and mathematics courses
College: bachelor's degree, medical degree, hospital residency, training in microsurgery

Career Issue

Skill in microsurgery allows surgeons to perform amazing repairs and corrections. Discuss with students whether all surgeons should be required to complete training in microsurgery.

For More Information

For more information about becoming a surgeon or microsurgeon, students might write to:

American College of Surgeons
55 East Erie Street
Chicago, IL 60611

Visual Learning

Visual-Spatial Ask students to compare the fan worm in Figure 27.11 with the earthworm in Figure 27.10. Use the photo of the fan worm to emphasize that not all segmented worms live in terrestrial habitats. L1

Assessment

Skill Have students examine Figure 27.12 and create a circle graph that includes all the species of segmented worms and mollusks within the 360° circle. Ask them to indicate the portion of the total number of species each group contains by drawing lines inside the circle. When they have completed the graph, ask students to identify what percentage of the total is represented by gastropods and by cephalopods. Ask them to make a hypothesis about the reason for the relative sizes of these two groups. L2

Careers in Biology

Microsurgeon

Would you like to be able to reattach an accident victim's hand? Then you might consider a career as a microsurgeon.

Skills for the Job

Microsurgeons use high-powered microscopes and three-dimensional computer technology to see and repair tiny nerves and blood vessels. A microsurgeon in ophthalmology might repair a retina, while other microsurgeons remove tumors deep within a brain, or transplant organs. Microsurgeons who reattach hands, feet, and ears often use leeches after surgery to improve blood flow through the reattached body part. Microsurgeons must complete four years of college, four years of medical school, three to five years of a residency program, and special training in microsurgery. They must also pass an examination to become certified.

interNET CONNECTION For more careers in related fields, be sure to check the Glencoe Science Web Site.
www.glencoe.com/sec/science

WORD Origin

parapodia
From the Greek words *para*, meaning "before," and *podion*, meaning "foot." Polychaete worms move using fleshy, paddlelike flaps called parapodia.

Earthworms eat their way through soil. As they eat, they turn the soil and provide spaces for air to flow through soil. As soil passes through the organs of their digestive tract, nutrients are extracted from food and undigested materials pass out of the worm. The wastes of an earthworm are called castings. Castings help fertilize soil.

Figure 27.11
The fan worm traps food in the mucus on its "fans." Disturbances in the water, such as a change in the direction of the current or the passing by of an organism, cause these worms to quickly withdraw into their tubes.

Bristleworms and their relatives

Bristleworms and their relatives are members of the phylum Polychaeta. Polychaetes are primarily marine organisms. Each segment of a polychaete has many setae, hence the name (polychaete means "many bristles"). This class includes bristleworms, lug worms, plumed worms, sea mice, and fan worms, shown in ***Figure 27.11.*** Each body segment of a polychaete also has a pair of appendages called parapodia, which can be used for swimming or crawling over corals and the bottom of the sea. Parapodia also function in gas exchange. A polychaete has a head with well-developed sense organs, including eyes. Eyes range from simple eyespots to larger eyes carried on stalks.

Leeches

Leeches are segmented worms with flattened bodies and no setae. Although these animals can be found in many different habitats, most leeches live in freshwater streams or rivers. Unlike earthworms, most species are parasites that suck blood or other body fluids from the bodies of their hosts, which include ducks, turtles, fishes, and people. Front and rear suckers enable leeches to attach themselves to their hosts.

You may cringe at the thought of being bitten by a leech, but the bite is not painful. This is because the saliva of the leech contains chemicals that act as an anesthetic. Other chemicals prevent the blood from clotting. A leech can ingest two to five times its own weight in one meal. Once fed, a leech will drop off its host. It may not eat again for a year.

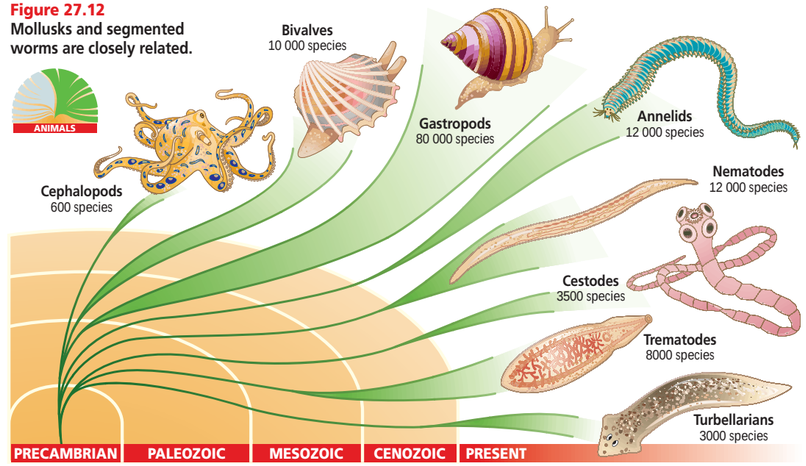
TechPrep

Ask students to visit a bait shop and find out where and how the shop gets bristle worms and earthworms, how they care for them, and what kinds of fishes are caught using these worms as bait. Have students go fishing with these worms as bait and report to the class. L1

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
BioQuest: *Biodiversity Park*
Disc 3, 4

Figure 27.12
Mollusks and segmented worms are closely related.



Origins of Mollusks and Segmented Worms

Fossil records show that mollusks lived in great numbers as long as 500 million years ago. Gastropod, bivalve, and cephalopod fossils have been found in early Paleozoic deposits. Some species, such as the chambered nautilus, appear to have changed very little from related species that lived long ago. Find out how fossil mollusks are used to date rocks in the *Earth Science Connection* at the end of this chapter.

Annelids probably evolved in the sea, perhaps from larvae of ancestral flatworms. The fossil record for segmented worms is limited because segmented worms have almost no hard body parts. Tubes constructed by polychaetes are the most common fossils of this phylum. Some of these tubes appear in the fossil record as early as 620 million years ago, as you can see in ***Figure 27.12***.

Section Assessment

Understanding Main Ideas
1. What is the most distinguishing characteristic of members of the phylum Annelida? Why is it important?
2. Describe how bristleworms reproduce.
3. How do earthworms improve soil fertility?
4. Why are leeches classified in phylum Annelida?

Thinking Critically
5. Polychaetes actively swim, burrow, and crawl. How do parapodia support the active life that most polychaetes pursue?

Skill Review
6. **Interpreting Scientific Illustrations** Using the *Inside Story,* interpret how the two types of muscles in the earthworm are used to move the animal through the soil. For more help, refer to *Thinking Critically* in the **Skill Handbook.**

Section Assessment

1. segmentation; each segment has its own muscles that lengthen and shorten for efficient movement; groups of segments may take on specific functions
2. Bristleworms and their relatives have separate sexes and reproduce sexually. Eggs and sperm are released into the water, where fertilization takes place.
3. As the earthworm burrows through the soil, it loosens, aerates, and fertilizes the soil.
4. Leeches have segmented bodies just like other annelids.
5. Parapodia can be used for swimming or crawling and in gas exchange.
6. Circular muscles contract to move the worm forward. Longitudinal muscles contract to pull the worm's body along.

3 Assess

Check for Understanding

Show students cross-section slides of planarians, earthworms, nematodes, tapeworms, and leeches. Ask them to distinguish the segmented worms from the other worms. Have them explain their choices. L2

Reteach

Visual-Spatial Ask students to draw a large diagram that shows an earthworm's nervous, circulatory, muscular, digestive, and execretory systems. Have them label each structure and identify the system or systems to which it belongs. L2 ELL

Extension

Ask students to interview a microsurgeon who uses leeches to increase the flow of blood to reattached body parts such as ears, fingers, and toes. Have them write about their interview as if it were going to appear in a magazine. They should ask the microsurgeon for information about the chemicals in leech saliva that dilate blood vessels to increase blood flow. L3

Assessment

Skill Have students create a table that compares the characteristics of the three classes of annelids. L1

4 Close

Discussion

Discuss with students the characteristics that make annelids more evolutionarily advanced than flatworms or mollusks.

Resource Manager

Basic Concepts Transparency 48 and Master L1 ELL
Reinforcement and Study Guide, p. 122 L2
Content Mastery, pp. 133, 135-136 L1

DESIGN YOUR OWN BioLab

Time Allotment
One or two class periods

Process Skills
observe and infer, compare and contrast, recognize cause and effect, form a hypothesis, interpret data, design an experiment, separate controls and variables

Safety Precautions
- Remind students to treat the earthworms in a humane manner at all times.
- Make sure that students wash their hands both before and after the experiment.

Preparation

- Keep earthworms in the refrigerator overnight, but remove them two hours prior to the lab.

Possible Hypotheses
Students may hypothesize that the worms will move toward the dark, move faster on a rough surface, choose a moist surface over a dry surface, and prefer cool versus warm conditions.

Resource Manager

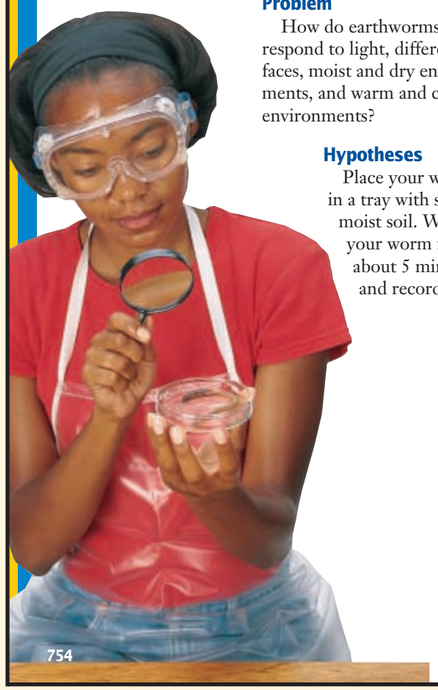
BioLab and MiniLab Worksheets, p. 123 L2

DESIGN YOUR OWN BioLab

How do earthworms respond to their environment?

An earthworm spends its time eating its way through soil, digesting organic matter, and passing inorganic matter through the digestive system and out of its body. Because earthworms are dependent on soil for food and shelter, they respond to stimuli in a way that will ensure a continuous supply of food and a safe place in which to live. These responses are genetically controlled. In this BioLab, you will design an experiment to determine the responses of earthworms to various stimuli.

Preparation



Problem
How do earthworms respond to light, different surfaces, moist and dry environments, and warm and cold environments?

Hypotheses
Place your worm in a tray with some moist soil. Watch your worm for about 5 minutes, and record what you observe. Make a hypothesis based on your observations about what the worm might do under conditions of light and dark, rough and smooth surfaces, moist and dry surfaces, and warm and cold conditions. Limit your investigation as time requires.

Objectives
In this BioLab, you will:
- **Measure** the sensitivity of earthworms to different stimuli, including light, water, and temperature.
- **Interpret** earthworm responses according to terms of adaptations that promote their survival.

Possible Materials
live earthworms
glass pan
culture dishes
thermometer
dropper
ice
black paper
hand lens or stereomicroscope
paper towels
sandpaper
warm tap water
water
penlight
ruler
cotton swabs

Safety Precautions
Be sure to treat the earthworm in a humane manner at all times. Wet your hands before handling earthworms. Always wear goggles in the lab.

Skill Handbook
Use the **Skill Handbook** if you need additional help with this lab.

Plan the Experiment

1. As a group, make a list of possible ways you might test your hypothesis. Keep the available materials in mind as you plan your procedure.
2. Be sure to design an experiment that will test one variable at a time. Plan to collect quantitative data. Make sure to incorporate a control.
3. Record your procedure and list materials and amounts you will need. Design and construct a data table for recording your findings.

Check the Plan
Discuss the following points with other group members.

1. What data will you collect, and how will they be recorded?
2. Does each test have one variable and a control? What are they?
3. Each test should include measurements of some kind. What are you measuring in each test?
4. How many trials will you run for each test?
5. Assign roles for this investigation.
6. ***Make sure your teacher has approved your experimental plan before you proceed further.***
7. Carry out your experiment.
CAUTION: ***Return earthworms to the container the teacher has provided.***

Analyze and Conclude

1. **Checking Your Hypothesis** Which surface did the worm prefer? Explain.
2. **Interpreting Observations** In which temperature was the worm most active? Explain.
3. **Observing and Inferring** How did the earthworm respond to light? Of what survival value is this behavior?
4. **Observing and Inferring** How did the earthworm respond to dry and moist environments? Of what survival value is this behavior?
5. **Drawing Conclusions** Were your hypotheses supported by your data? Why or why not?

Going Further
Project Based on your experiment, design another experiment that would help to answer a question that arose from your work. You might want to try other variables similar to the ones you used, or you might choose to investigate a completely different variable.

internet CONNECTION To find out more about segmented worms, visit the Glencoe Science Web Site.
www.glencoe.com/sec/science

Plan the Experiment

Teaching Strategies
- To save time, have groups test only one or two variables and share their data.
- Ask students to gently rub their fingers up and down the length of the ventral surface of the worms to feel their setae.
- Review the terms *anterior*, *posterior*, *dorsal*, and *ventral*. Ask students to use these terms when recording their observations.

Possible Procedures
- To test which surface enables a worm to move fastest, students may decide to measure how far the worm moves in a given period on surfaces such as sandpaper, the bottom of the dry glass pan, the bottom of a wet glass pan, and on wet and dry paper towels.
- To test the worm's reaction to light, the bottom of a pan may be covered with soil. Part of the pan may be covered with a piece of black construction paper while a penlight is shone on the other side. The amount of time a worm spends in the light and dark sides of the container may then be measured.
- To determine the worm's preference for heat or cold, the glass pan could be placed on top of two culture dishes—one containing warm tap water and the other containing ice.

Data and Observations
Most likely, earthworms will avoid light and extremes of temperature, move quickly on a rough surface, and prefer a moist surface.

DESIGN YOUR OWN BioLab

Analyze and Conclude

Student answers may vary.
1. a rough surface; the worm moves more easily on a rough surface
2. an intermediate temperature; an earthworm is ectothermic so its level of activity depends upon the surrounding temperature
3. moved away from light; earthworms are safer from predators in the soil where it is dark
4. preferred a moist environment; earthworm's skin must remain moist or the animal will dry out and die
5. Students who made hypotheses that the worms would prefer moist environments, intermediate temperatures, darkness, and rough surfaces most likely would have their hypotheses supported by data.

Assessment
Performance Ask students to design and then carry out an experiment to determine how earthworms respond to gravity. Use the Performance Task Assessment List for Designing an Experiment in **PASC**, p. 23. L2

Going Further
Have students design similar experiments for other invertebrates and compare their results with those obtained for the earthworm. L3

Earth Science Connection

Purpose

Students will learn how mollusks can be used to determine ancient climates and environments as well as radiometric ages.

Teaching Strategies

- Provide students with an assortment of fossil mollusk shells as well as living examples of these organisms. Allow students to use hand lenses to observe the diversity in these organisms, especially the shells. If actual specimens are not readily available, provide students with color photographs of mollusks. Challenge students to classify the examples based on the relationship between the organisms' shells and soft body parts. Students should be able to identify organisms as belonging to the gastropod, bivalve, or cephalopod groups. L2 ELL
- Explain, if necessary, the method of absolute dating. Certain radioactive elements decay at a constant rate called a half-life. By measuring the amount of the original element left and the amount of its decay product, the age of a specimen can be determined.
- Have a volunteer explain the observation made by Darwin. Students should recount that the shells were deposited in a body of water, probably an ocean. Earth processes, including uplift, caused this area of land, which was once below sea level, to be raised thousands of feet above the ocean's surface.

Connection to Biology

Most students should be able to deduce that ammonites are, in fact, excellent index fossils because they are readily preserved as fossils and lived for a geologically relatively short period of time.

Earth Science Connection

Mollusks as Indicators

"Finally, the shells in the Peuquenes or oldest ridge, prove, as before remarked, that it has been upraised 14 000 feet since a Secondary period…"
—Charles Darwin, in *The Voyage of the Beagle*

Although a few species of mollusks live on land, most mollusks are marine or freshwater organisms. How is it, then, that on one of his journeys to South America, Charles Darwin found aquatic mollusk shells thousands of feet above sea level? This observation by the famous naturalist helped to support Darwin's hypothesis that Earth has changed over time.

Mollusks once ruled earth Mollusks first appear in Earth's fossil record more than 500 million years ago. By 30 million years later, these shelled creatures had become the dominant life form on Earth. Thousands of species of mollusks evolved to fill available niches. Yet, numerous species of mollusks became extinct at the close of the Mesozoic era 66 million years ago. Today, the estimated number of mollusk species ranges between 50 000 and 130 000.

The present is the key to the past Because mollusks are generally well preserved in the fossil record, abundant, easy to recognize, and widely distributed geographically, they are excellent index fossils. Index fossils, together with their modern relatives, can be used to hypothesize about ancient climates and environments.

Mollusk shells can also provide information about the biotic, physical, and chemical changes that occur in an ecosystem. Modern mollusks, for example, have been used to determine the source and distribution of various aquatic pollutants.

Mollusks as timekeepers Mollusks can also be thought of as marine timekeepers. A mollusk shell grows only along one edge. The pigmented patterns produced by the animal along this growing edge rarely change. Thus, the pattern produced is not only specific to the species but also is a space and time record of the shell-producing process of that particular organism.

Mollusk shells can also be used to determine an exact age because these structures contain the radioactive element strontium. By measuring the amounts of different isotopes of strontium in the shell, scientists are able to compute the exact age of the organism, and, by extension, the exact age of the rocks containing the shell.

Connection to Biology

The fossil record shows that various species of ammonites lived from about 230 million years ago to about 66 million years ago. Ammonites are now extinct. Do you think these mollusks are good index fossils? Explain your answer.

interNET CONNECTION To find out more about mollusks and other index fossils, visit the Glencoe Science Web Site.
www.glencoe.com/sec/science

Fossilized mollusk shells

Internet Address Book

interNET CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

_____

_____

_____

_____

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Exploration: *The Five Kingdoms*
Disc 3

Chapter 27 Assessment

Summary

Section 27.1
Mollusks

Main Ideas
- Mollusks have bilateral symmetry, a coelom, and two body openings. Many also have shells and similar larvae.
- Most gastropods have a shell, mantle, radula, open circulatory system, gills, and nephridia. Gastropods without shells are protected by a covering of mucus.
- Bivalve mollusks have two shells and are filter feeders. They have no radula.
- Cephalopods have tentacles with suckers, a beaklike mouth with a radula, and a closed circulatory system. They include the octopus, squid, and chambered nautilus.

Vocabulary
closed circulatory system (p. 744)
mantle (p. 742)
nephridia (p. 745)
open circulatory system (p. 744)
radula (p. 742)

Section 27.2
Segmented Worms

Main Ideas
- The phylum Annelida includes the earthworms, bristleworms and their relatives, and leeches. They are bilaterally symmetrical and have a coelom and two body openings; some have larvae that look like the larvae of mollusks. Their bodies are cylindrical and segmented.
- Earthworms have complex digestive, excretory, muscular, and circulatory systems.
- Bristleworms and their relatives are mostly marine species. They have many setae and parapodia that are used for crawling along.
- Leeches are flattened, segmented worms. Most are aquatic parasites.
- Fossil remains of mollusks show that they first lived 500 million years ago. Fossil records show that segmented worms first appeared 620 million years ago.

Vocabulary
gizzard (p. 750)
setae (p. 748)

Understanding Main Ideas

1. When an earthworm passes soil through its digestive tract, the soil does NOT go through the _____.
   a. stomach **c.** gizzard
   b. nephridia **d.** crop
2. Which of the following does NOT use a radula for feeding?
   a. snail **c.** oyster
   b. slug **d.** squid
3. Which of the following animals have setae?
   a. snails **c.** earthworms
   b. clams **d.** squids

GLENCOE TECHNOLOGY

VIDEOTAPE
MindJogger Videoquizzes
Chapter 27: *Mollusks and Segmented Worms*
Have students work in groups as they play the videoquiz game to review key chapter concepts.

Resource Manager

Chapter Assessment, pp. 157-162
MindJogger Videoquizzes
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 27 quiz

Chapter 27 Assessment

Main Ideas

Summary statements can be used by students to review the major concepts of the chapter.

Using the Vocabulary

To reinforce chapter vocabulary, use the Content Mastery Booklet and the activities in the Interactive Tutor for Biology: The Dynamics of Life on the Glencoe Science Web Site:
www.glencoe.com/sec/science

THE PRINCETON REVIEW ***All Chapter Assessment questions and answers have been validated for accuracy and suitability by The Princeton Review.***

Understanding Main Ideas

1. b
2. c
3. c

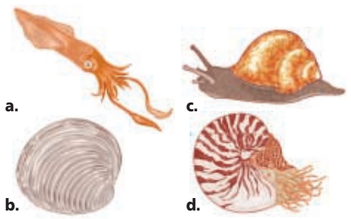
4. c
5. b
6. a
7. d
8. c
9. c
10. c
11. open spaces
12. closed
13. external shell
14. larvae
15. segmented worms
16. Nephridia
17. mollusks
18. sperm
19. leeches
20. anesthetic

Applying Main Ideas

21. Cnidarian tentacles contain stinging cells that immobilize prey, and octopus tentacles have suckers for capturing prey.
22. Sponges and bivalves are filter feeders that strain food from water currents.
23. Snails scrape algae from surfaces with their radulas.
24. Gastropods can withdraw into their shells. Bivalves can close up their shells. Cephalopods, such as squids, can swim very fast, and the octopus can use its tentacles for defense.

Chapter 27 Assessment

4. The _____ is a thin membrane that surrounds the internal organs of a mollusk.
   a. foot **c.** mantle
   b. shell **d.** siphon
5. Oysters, clams, and scallops are _____.
   a. gastropods **c.** cephalopods
   b. bivalves **d.** nematodes
6. Snails, slugs, and limpets are _____.
   a. gastropods **c.** bivalves
   b. cephalopods **d.** cestodes
7. A _____ is the tonguelike organ that assists gastropods to obtain food.
   a. foot **c.** siphon
   b. shell **d.** radula
8. Which of the following word pairs are most closely related?
   a. filter feeding—radula
   b. scraping algae—siphon
   c. predation—tentacle
   d. nephridia—gizzard
9. Which of the following is a gastropod?



10. Animals with bilateral symmetry, a coelom, two body openings, a muscular foot, and a mantle are _____.
    a. segmented worms **c.** mollusks
    b. flatworms **d.** roundworms

Test-Taking Tip

What does the test expect of me?
Find out what concepts, objectives, or standards are being tested beforehand and keep those concepts in mind as you solve the questions. Stick to what the test is trying to test.

11. In an open circulatory system, the blood moves through vessels and into _____ around the body organs, whereas in a closed circulatory system, the blood remains in vessels.
12. The cephalopods circulate blood in a(n) _____ circulatory system.
13. This example of a cephalopod is the only animal of that group with a(n) _____.

14. Segmented worms and mollusks both have bilateral symmetry, a coelom, and similar _____.
15. Animals distinguished by cylindrical bodies and ringed segments are _____.
16. _____ are excretory structures that remove wastes from an earthworm's body.
17. Annelids are probably most closely related to _____ because they have similar larvae.
18. During mating, two earthworms exchange _____.
19. Segmented worms with flattened bodies, suckers, and no bristles are called _____.
20. The saliva of leeches contains chemicals that act as a(n) _____.

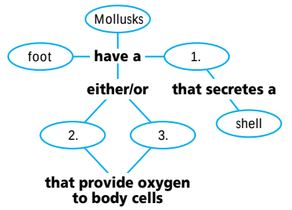
Applying Main Ideas

21. Compare how a cnidarian and an octopus use their tentacles to capture food.
22. Describe how sponges and bivalves have a similar way of obtaining food.
23. Why is it a good idea to keep a snail in an aquarium?
24. Compare the protective adaptations of gastropods and cephalopods.

25. Compare nephridia in mollusks and segmented worms.

Thinking Critically

26. **Observing and Inferring** Explain why the phylogeny of worms is not as well understood as the phylogeny of mollusks.
27. **Recognizing Cause and Effect** Explain how bivalves in salt marshes are important for the health of the other species that live there.
28. **Observing and Inferring** Suppose there are so many *Anodonta* clams in a stream that the fish population is reduced. How could you control the clam population without harming the fish?
29. **Recognizing Cause and Effect** Bivalves called scallops can escape from predators by clapping their shells together and forcibly expelling water. What structures in a bivalve allow scallops to behave in this manner?
30. **Concept Mapping** Complete the concept map by using the following vocabulary terms: mantle, closed circulatory system, open circulatory system.

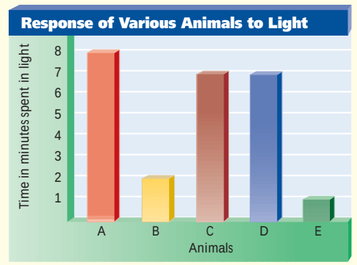


CD-ROM

For additional review, use the assessment options for this chapter found on the ***Biology: The Dynamics of Life Interactive CD-ROM*** and on the Glencoe Science Web Site.
www.glencoe.com/sec/science

Assessing Knowledge & Skills

The graph below shows how a number of different animals respond to light.



Using a Graph Study the graph and answer the following questions.

1. Which animals spend more time in the light?
   a. A, C, D **c.** A, B, C, D, E
   b. B, E **d.** C, D
2. Which animals do not spend as much time in the light?
   a. A, C, D **c.** A, B, C, D, E
   b. B, E **d.** C, D
3. Which animals might be nocturnal?
   a. A, C, D **c.** A, B, C, D, E
   b. B, E **d.** C, D
4. Which animals might live under a rock?
   a. A, C, D **c.** A, B, C, D, E
   b. B, E **d.** C, D
5. To which animal group might an earthworm belong?
   a. A **c.** C
   b. B **d.** D
6. **Making a Graph** Make a graph of the following data. Animal A spends 20 minutes in the dark. Animal B spends 15 minutes in the dark. Animal C spends two minutes in the dark. Animal D spends seven minutes in the dark.

Chapter 27 Assessment

25. Nephridia remove metabolic wastes from an animal's body. In segmented worms there are nephridia in each segment. Mollusks usually have one or two nephridia.

Thinking Critically

26. Soft-bodied worms do not fossilize as readily as mollusks, which have hard shells.
27. Bivalves filter organic matter from the water and break it down to smaller units that can be used by marsh grasses and algae.
28. Answers will vary. Students may suggest introducing a clam predator or a chemical to kill glochidia.
29. abductor muscles, incurrent and excurrent siphons
30. 1. Mantle, 2. Open circulatory system, 3. Closed circulatory system

Assessing Knowledge & Skills

1. a
2. b
3. b
4. b
5. b
6. **Response of Various Animals to Dark**