### Chapter 27 Organizer

Refer to pages 45-51 of the Teacher Guide for an explanation of the National Science Education Standards correlations.

#### Section 27.1: Mollusks

- **National Science Education Standards**: UCP, C, F, G
- **Objectives**:
  1. Identify the characteristics of mollusks.
  2. Compare the adaptations of gastropod, bivalve, and cephalopod mollusks.
- **Activities/Features**:
  - Inside Story: A Clam, p. 743
  - Problem-Solving Lab 27-2, p. 749
  - MiniLab 27-1: Identifying Mollusks, p. 746

#### Section 27.2: Segmented Worms

- **National Science Education Standards**: UCP, C, F, G
- **Objectives**:
  1. Identify segmented worms and their importance to the survival of these organisms.
  2. Compare and contrast the classes of segmented worms.
- **Activities/Features**:
  - 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. 762
  - Design Your Own BioLab: How do earthworms respond to their environment?, p. 754
  - Earth Science Connection: Worms respond to their environment?, p. 754

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### 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

- **Quick Demos**
  - p. 742 land snail, petri dish, pencil, lettuce
  - p. 742 whole squid, knife

- **Minilabs**
  - p. 746 dichotomous key transparency, overhead projector, marine shells
  - p. 750 cross-section diagrams of earthworm, longitudinal diagrams of earthworm

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### Additional Resources

- **Spanish Resources**
- **English/Spanish Audiocassettes**
- **Brazilian Portuguese**
- **Teacher’s Corner**
- **BDOL Interactive CD-ROM, Chapter 27 quiz**
- **NATIONAL GEOGRAPHIC**
- **Index to National Geographic Magazine**
- **The Following articles may be used for research related to this chapter:**
  - *Money From the Sea,* by Phil Nuytten
  - *The Pearl,* by Fred Ward, August 1985
  - *My Chesapeake—Queen of Bays,* by Allan C. Fisher, Jr., October 1980
  - *To the Edge of the Earth* (The Infinite Voyage)
  - *Scallop Escape* (The Secret of Life Series)
- **CD-ROM**
  - *The Infinite Voyage*
  - *To the Edge of the Earth*
  - *The Secret of Life Series*
  - *Molluscan Body Plan*
  - *Earthworm* (Earthworm Segment)
Section 27.1 Mollusks

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.

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

- Oysters, clams, and scallops such as this one have two hinged shells.
- Snails, slugs, their shell-less relatives, and other one-shelled animals such as this limpet make up the largest class of mollusks.
- Predatory squids and octopuses are mollusks that do not have an external shell.

Vocabulary
- Mollusks
- From the Latin molluscus, meaning "soft."

Objectives
- Identify the characteristics of mollusks.
- Compare the adaptations of gastropods, bivalves, and cephalopods.

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 discussion of the origins of mollusks and the increasing complexity of the specialization of the body plans of mollusks and segmented worms.

What Is a Mollusk?

You will distinguish among the classes of mollusks and segmented worms.

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.

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

Portfolio Assessment

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

Performance Assessment

Alternative Lab, TWE, p. 744
MiniLab, 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, 749
Problem-Solving Labs, TWE, pp. 744, 749
Section Assessments, SE, pp. 747, 753
Chapter Assessment, SE, pp. 757-759

Preparation

Bellringer

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

Gather asorted shells for the Getting Started Demo.

Order live land snails and purple squid and live clams for the Quick Demo, 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.

1 Focus

Bellringer

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

Intrapersonal

Provide students with a blank outline map of the world. Have them conduct research to find out where five species of molluscs are commonly found. For example, the Atlantic holly 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.

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 over the course of the day. Have them note the color, size, and structure of the snail's shell. Ask students to compare their observations with those of other groups.

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.

Quick Demo

Place the snail on a piece of lettuce. Instruct students to observe the snail for at least five minutes. Have them record their observations as a class.

Quick Demo

Divide the class into groups. Give each group a small snail. Have them observe the snail as a class. Finally, have them conduct research to find out where three species of molluscs 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.

MOLLUSKS AND SEGMENTED WORMS

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.

Snails have a well-defined and developed head area in addition to a large foot. 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 (mantle) 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 27.2a 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.

Locating Mollusks

Intrapersonal

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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.

Quick Demo

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Problem-Solving Lab 27.1

Purpose
Students will study the life cycle of larval development in a fresh-water 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 mus-

5. Although the animal pro-

duces many glochidia, most do not find a suitable host and thus do not survive to adult stage.

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 into the surrounding water.

Thinking Critically
1. What must enter a female clam’s body in order for glochidia to form?
2. What reproductive process must occur prior to the forma-
tion of glochidia?
3. Glochidia attach to 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 100,000 glochidia. How might this be an adaptation to a life cycle that includes a parasitic stage?

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 system exposes body organs directly to blood that contains nutrients and oxygen, and removes metabolic wastes. Some mollusks, such as octopuses, move nutrients and oxy-
gen through a closed circulatory sys-
tem. In a closed circulatory system, blood moves through the body enclosed in vessels which act as blood vessels. A closed system provides an efficient means of gas exchange within the body.

Respiration in mollusks
Most mollusks have respiratory structures called gills. Gills are special-
ized parts of the mantle that con-
sist of a system of filamentous projec-
tions that contain a rich supply of blood for the transport of gases. Gills increase the surface area through which gas exchange can occur. In land snails and slugs, the mantle cav-
ity appears to have evolved into a primitive lung.

Excretion in mollusks
Mollusks are the oldest known ani-

mals to have evolved excretory struc-
tures called nephridia. Nephridia (ni-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 dis-
charged into the mantle cavity, and expelled from the body by the pump-

ing action of the mantle.

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

Gastropods: One-shelled mollusks
The largest class of mollusks is Gastropods, or the stomach-footed mollusks. The name comes from the way the animal’s large foot is posi-
tioned under the rest of its body. Most species of gastropods have a single body. 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 habi-
tats. 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 mucous. Colorful sea slugs, such as 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 consuming these cells. To discharge these cells, a slug may rub a fish against it, releasing the nematocysts into the fish’s tissues. The bright colors of these gastropods warn predators of the potential dan-
ger, as shown in Figure 27.6.

Visual Learning
Ask students to examine the pho-
tos of the cone and dove shell and speculate about why people want shells as souvenirs. Ask them how the practice of collect-
ing rare live mollusks for the sale of their shells might be curtailed.
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.

Procedure
1. To use a dichotomous key, begin with a choice from the first pair of descriptors.
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.

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?
3. What features were more difficult?
4. What general feature was used to identify shells?

Figure 27.7

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

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 muscular foot is 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 help them breathe. 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 can also 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
1. How are the methods of movement for the snail, clam, and squid related to the structure of each one’s foot?

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

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

Assessment
Know 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 L3

Assessment
Check for Understanding Have students explain how mollusks are more complex than other animals they have studied. L1 L2

Reatch
Spatial Have students make a table describing mollusk traits with these headings: Phylum, Representative Organisms, Symmetry, Habitat, Feeding, Taking in Oxygen, Reproduction, and Protection. L2 L3

Extension
Portfolio Ask students to prepare a report on mollusks and cephalopods found in their area. Ask students to explain how each organism is adapted to its habitat. L2 L3

Close
Discussion Discuss the economic importance of mollusks. Include uses of mollusks as food, algae feeders in aquaria, and as souvenirs.
**Section 27.2 Segmented Worms**

**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. Segment 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 buds called setae (def tusk) 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.

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.

**Earthworm Terrariums**

A technique 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 place 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.
An Earthworm

A

n earthworm burrows through soil, it looses, 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?

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

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.

4

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

5

Gizzard
The gizzard grinds organic matter, far 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.

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.

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.

Diversity of Segmented Worms

The phylum Annelida is divided into three classes: class Oligochaeta, earthworms; class Polychaeta, bristleworms; 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.
Mollusks and segmented worms are closely related.

Polychaetes

Figure 27.12

Gastropods

Bristleworms and their relatives

Leeches

Figure 27.11

Earthworms

Figure 27.11

Leeches are segmented worms with flattened bodies and no setae. Although these animals can be found in many different habitats, most live in freshwater rivers or streams. Unlike earthworms, most species are parasites that suck blood or other body fluids from the bodies of their hosts, which include ducks, turtles, fish, and people. If you are bitten by a leech, it may not be painful. This is because the saliva contains anticoagulants in leech saliva that dilate blood vessels to anticoagulate the host’s blood. You may or may not notice the leech, but it remains attached to the host. 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.

3 Assess

Check for Understanding

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

Retach

Visual-Spatial

Ask students to draw a large diagram that shows an earthworm’s nervous system, circulatory, muscular, digestive, and excretory systems. Have them label each structure and identify the system or systems to which it belongs.

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.

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

CD-ROM

Biology: The Dynamics of Life

BioQuest: Biodiversity Park

8

Disc 3.4

528 

529

Section Assessment

How do parapodia support the active life that mollusks pursue?

Skill Review

6. Interpreting Scientific Illustrations Using Science Notes

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. gastropods

2. Bivalves

3. Cephalopods

4. echinoderms

5. annelids

6. Arthropods

7. protists

8. fungi

9. bacteria
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.

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

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:
1. Measure the sensitivity of earthworms to different stimuli, including light, water, and temperature.
2. Interpret earthworm responses according to terms of adaptations that promote their survival.
3. Collect and record earthworm data on the sensitivity of earthworms to different stimuli.

Possible Materials
- Live earthworms
- Glass pan
- Culture dishes
- Warm tap water
- Water thermometer
- Sandpaper
- Ice ruler
- Black paper
- Hand lens or stereomicroscope
- Paper towels
- Ruler
- Cotton swabs

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 may be placed on top of two culture dishes—one containing warm tap water and the other containing ice.

Possible Proofs
- 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 may be placed on top of two culture dishes—one containing warm tap water and the other containing ice.

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.

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

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.

Analyzing and Concluding
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?
- How did the earthworm respond to dry and moist environments? Of what survival value is this behavior?
4. Drawing Conclusions
Were your hypotheses supported by your data? Why or why not?

Analyzing and Concluding
1. Analyze and Conclude
- Carry out your experiment.
- Conduct your experiment.
- Use the Performance Task Assessment.
- To find out more about segmented worms, visit http://www.glencoescience.com/glencoescience.

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.

Student answers may vary.

Possible Proofs
- 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 may be placed on top of two culture dishes—one containing warm tap water and the other containing ice.

Possible Proofs
- 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.
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**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 mollusk shells.
- 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.

**Mollusks as Indicators**

“Finally, the shells in the Paequenes or oldest ridge, proice, as before remarked, that it has been uplifted 14,000 feet since a Secondary period…”

—Charles Darwin, *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 made 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 evolve 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.

Index fossils 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**

Mollusk shells 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.

**The fossil record shows that various species of ammonites lived from about 210 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.**

**Fossilized mollusk shells**

**Connection to Biology**

The fossil record shows that various species of ammonites lived from about 210 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.

To find out more about mollusks and other index fossils, visit the Glencoe Science Web Site.

www.glencoe.com/sec/science

**Chapter 27 Assessment**

**Main Ideas**

- Mollusks have bilateral symmetry, a coelom, and two body openings.
- Many also have shells and similar larvac.
- Most gastropods have a shell, mantis, radula, open circulatory system, gills, and nephridia.
- Gastropods without shells are protected by a covering of mucous.

- Brachiopods 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.

- 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 larvac 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**

- closed circulatory system (p. 744)
- mantle (p. 742)
- nephridia (p. 745)
- open circulatory system (p. 745)
- radula (p. 142)

**Understanding Main Ideas**

1. When an earthworm passes soil through its digestive tract, the soil does NOT go through the ...

   a. stomach  b. gizzard  c. mouth

2. Which of the following does NOT use a radula for feeding?

   a. snail  b. slug  c. oyster  d. squid

3. Which of the following animals have setae?

   a. snails  b. leeches  c. earthworms  d. squid

**Internet Address Book**

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

- www.glencoe.com/sec/science

**Chapter 27 Answer Key**

1. (a) stomach  
2. (c) oyster  
3. (b) leeches

**Chapter 27 Technology**

- Mindjogger Videoguides
- BDOL Interactive CD-ROM, Chapter 27

**Resource Manager**

Chapter Assessment, pp. 157-162
Mindjogger Videoguides
Computer Test Bank

**SUMMARY**

- Mollusks have bilateral symmetry, a coelom, and two body openings. Many also have shells and similar larvac.
- Most gastropods have a shell, mantis, radula, open circulatory system, gills, and nephridia. Gastropods without shells are protected by a covering of mucous.
- Brachiopods 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.

- 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 larvac 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.
27. A ____ is the tonguelike organ that assists gastropods to obtain food.

28. The mantles_______ the only animal of that group with a(n)_______.

29. Animals distinguished by cylindrical bodies and ringed segments are ________.

30. Cephalopods circulate blood in a(n) ________.

31. Filter feeding—radula

32. Predation—tentacle

33. Locomotive system, 3. Closed circulatory system

34. Cephalopod is the only animal of ________.

35. Annelids are probably most closely related to ________, because they have similar bilateral symmetry, a coelom, and similar wastes from an earthworm's body.

36. Glochidia ________ are excretory structures that remove wastes from an earthworm's body.

37. Nephridia are excretory structures that remove wastes from an earthworm's body.

38. The mantle_______ the only animal of that group with a(n)_______.

39. Animals distinguished by cylindrical bodies and ringed segments are ________.

40. Which of the following word pairs are most closely related?
   a. cilia—flagella
   b. flatworms—roundworms
   c. cephalopods—gastropods
   d. nematodes—cestodes

Think Critically

41. Explain how bivalves in salt marshes are important to body cells.

42. Which of the following is a gastropod?
   a. squid
   b. octopus
   c. snail
   d. clam

43. Which of the following is a gastropod?
   a. snail
   b. clam
   c. octopus
   d. squid

44. Segmented worms and mollusks both have ________, a coelom, and similar_______.

45. Animals distinguished by cylindrical bodies and ringed segments are ________.

46. Which of the following word pairs are most closely related?
   a. cilia—flagella
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48. Animals distinguished by cylindrical bodies and ringed segments are ________.

49. Animals distinguished by cylindrical bodies and ringed segments are ________.

50. Animals distinguished by cylindrical bodies and ringed segments are ________.

Thinking Critically

51. Suppose there are so many bivalve clams in a stream that the fish population is reduced. How could you control the clam population without harming the fish?

52. Observing and Inferring Explain why the phylogeny of worms is not as well understood as the phylogeny of mollusks.

53. Recognizing Cause and Effect Explain how bivalves in salt marshes are important for the health of the other species that live there.

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61. Chapter 27 Assessment


63. CD-ROM

64. Biology: The Dynamics of Life Interactive CD-ROM and on the Glencoe Science Web Site: www.glencoe.com/sec/science

65. Response of Various Animals to Light


67. CD-ROM

68. Response of Various Animals to Dark

69. Response of Various Animals to Light

70. Response of Various Animals to Dark

71. Response of Various Animals to Light

72. Response of Various Animals to Dark

73. Response of Various Animals to Light

74. Response of Various Animals to Dark

75. Response of Various Animals to Light

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79. Response of Various Animals to Light

80. Response of Various Animals to Dark

81. Response of Various Animals to Light

82. Response of Various Animals to Dark