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.

Understanding the Photo
Mucus is an important adaptation for some mollusks. These snails secrete a layer of mucus to reduce friction as they move along.

Biology Online
Visit ca.b dol.glencoe.com to
• study the entire chapter online
• access Web Links for more information and activities on mollusks and segmented worms
• review content with the Interactive Tutor and self-check quizzes
Mollusks

**What is a mollusk?**

Slugs, snails, squids, and some animals that live 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, live much of their lives firmly attached to the ocean floor or to submerged docks or parts of boats. Others, such as the octopus, swim freely in the ocean. Land-dwelling slugs and snails can be found slowly moving over leaves on the forest floor. Examples of mollusks are shown in **Figure 27.1**.

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**Figure 27.1**

With at least 110,000 described species, phylum Mollusca is second in size only to insects and their relatives.

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

**B** Predatory squids and octopuses are mollusks that have tentacles and do not have an external shell.
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. Evaluate Compare the similarities and differences in the structures of a snail and a squid.

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, a digestive tract with two openings, a muscular foot, and a mantle. The mantle (MANT tuhl) is a 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 similarities on the inside. You can see the similarities and the differences in these body areas in Figure 27.2 as you compare a snail and a squid.

**Word Origin**

mollusk from the Latin word molluscus, meaning "soft"; Mollusks are animals with a digestive tract with two openings, a muscular foot, and a mantle.

**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 (RA juh 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. How does a radula cut food? Find out in Figure 27.4. Octopuses and squids are predators that use their radulas to tear up the food that they capture with their tentacles. Other mollusks are grazers and some are filter feeders. Bivalves do not have radulas; they filter food from the water.

**Reproduction in mollusks**

Mollusks reproduce sexually and most have separate sexes. In most aquatic species, eggs and sperm are released at the same time into the water, where external fertilization takes place. Many gastropods that live on land, and a few bivalves, are hermaphrodites and produce both eggs and sperm. Fertilization is internal.
Snails belong to the largest class of mollusks, the gastropods. Gastropods include periwinkles, conches, whelks, limpets, abalones, and slugs. A snail moves by gliding along on a thin layer of mucus secreted by a gland in the foot. You may have seen the silvery trails of a snail in a garden. Critical Thinking What other functions does mucus have for a snail?

Shell The snail’s shell is secreted by the mantle and is attached to its body by one or more muscles. A snail can protect its body by pulling its head and foot inside the shell.

Foot A snail’s foot is a well-developed, flat, muscular organ. The snail moves by contracting and expanding its foot to create a rippling motion which moves it forward.

Heart A snail has a two-chambered heart and an open circulatory system. Some mollusks, such as squids, have closed circulatory systems.

Radula A snail obtains food by using its radula, a tonguelike organ with rows of teeth. The radula can drill, scrape, grate, or cut food. As the anterior end of the radula wears down, the posterior end continues to grow, providing a continual supply of new teeth.

Tentacles A snail has two pairs of tentacles on its head. The eyes are on the tip of the longer pair. The snail uses its shorter pair to smell and feel.

Lung In terrestrial species, the gill has been replaced by lungs that can function in both water and air.
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. One larval stage of most mollusks is similar, as you can see in Figure 27.5.

Some marine mollusks have free-swimming larvae that propel themselves by cilia. 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 coordinate their movement and behavior. Some more advanced mollusks have a brain. 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 similar to the eyes of humans.

**Circulation in mollusks**

Mollusks have a well-developed circulatory system that usually includes a two- or 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.
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 FRIH dee uh) are organs that remove metabolic wastes from an animal's body. Mollusks have one or two nephridia that collect wastes from the coelom, which is located around the heart only. Wastes are discharged into the mantle cavity, and expelled from the body by the pumping of the gills.

Diversity of Mollusks

Phylum Mollusca is large and diverse. Three mollusk classes—Gastropoda, Bivalvia, and Cephalopoda—include the most common and well-known species.

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 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 27.6 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 27.7.
**Bivalves: Two-shelled mollusks**

Two-shelled mollusks such as clams, oysters, and scallops belong to the class Bivalvia, illustrated in **Figure 27.8**. 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 two shells, called valves; strong muscles allow the valves 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 gill cilia that beat to draw water in through an incumbent siphon. As water moves over the gills, food and sediments become trapped in mucus. Cilia that line the gills push food particles to the mouth. Cilia also act as sorting devices. Large particles, sediment, and anything else that is rejected is transported to the mantle where it is expelled through

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**MiniLab 27.1**

**Compare and Contrast**

**Identifying Mollusks** Have you ever collected shells from a beach and wondered what they were? Use the following dichotomous key to determine the names of the shells.

![Shell Diagram](image)

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

**Analysis**

1. **Infer** How is a dichotomous key used to identify a variety of organisms?
2. **Evaluate** What shell features were easy to pick out using the key? What features were more difficult?

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**Figure 27.8**

In bivalves, the mantle forms two siphons, one for incoming water and one for water that is excreted.
the excurrent siphon, or to the foot, where it is eliminated from the animal’s body.

**Cephalopods: Head-footed mollusks**

The head-footed mollusks are marine organisms in the class Cephalopoda. This class includes the octopus, squid, cuttlefish, and chambered nautilus, as shown in Figure 27.9. 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 beaklike jaws. Then the food is torn and 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. Squids and octopuses also can release a dark fluid to cloud the water. This “ink” helps to confuse their predators so they can make a quick escape.
What is a segmented worm?

Segmented worms are classified in the phylum Annelida. They include leeches and bristleworms, shown in Figure 27.10, as well as earthworms. 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.
Earthworms are just one of about 15,000 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 ringed segments, as seen in the worm in Figure 27.11. In most species, 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.

Segmentation 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

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.

Circulation and respiration

Segmented worms have a closed circulatory system. Blood carrying oxygen to and carbon dioxide from body cells

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**Problem-Solving Lab 27.2**

**Classify**

*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.

**Solve the Problem**

**Data Table**

<table>
<thead>
<tr>
<th>Animal</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Externally segmented body, no internal segments</td>
</tr>
<tr>
<td>B</td>
<td>No coelom, but has internal segments</td>
</tr>
<tr>
<td>C</td>
<td>Lives in water, has two body openings, sexes are separate</td>
</tr>
<tr>
<td>D</td>
<td>Backbone present, has digestive, circulatory, excretory systems</td>
</tr>
<tr>
<td>E</td>
<td>Both male and female reproductive organs present</td>
</tr>
<tr>
<td>F</td>
<td>Externally segmented body, has internal segments</td>
</tr>
</tbody>
</table>

**Thinking Critically**

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

*Figure 27.11*

Segmentation is easily seen in earthworms. The giant earthworm of Australia can be more than 3 m long.

*Infer* Why is segmentation an important adaptation?
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.

**Reproduction in segmented worms**

Earthworms and leeches are hermaphrodites, producing both eggs and sperm. During mating, two worms exchange sperm. Each worm forms a capsule for the eggs and sperm. The eggs are fertilized in the 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.

Bristleworms and their relatives have separate sexes and reproduce sexually. Usually eggs and sperm are released into the seawater, where fertilization takes place. Bristleworm larvae hatch in the sea and become part of the plankton. Once segment development begins, the worm settles to the bottom.

**Diversity of Segmented Worms**

The phylum Annelida includes 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.
An Earthworm

Figure 27.12
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

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

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

C 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.

D 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.

E Nervous system An earthworm has a system of nerve fibers in each segment. These are connected by ventral nerve cords to a simple brain located near the mouth.

F Nephridia Nephridia are excretory structures that eliminate metabolic wastes from nearly every segment.

G 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.
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.

For more careers in related fields, visit ca.bdl.glencoe.com/careers

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 create spaces for air and water to flow through soil. As soil passes through their digestive tracts, nutrients are extracted and undigested materials pass out of the worms. Castings, the wastes of an earthworm, help fertilize soil.

Bristleworms and their relatives

The class Polychaeta includes bristleworms and their relatives—fanworms, shown in Figure 27.13, lug worms, plumed worms, and sea mice. Polychaetes are primarily marine organisms. Most body segments of a polychaete have many setae, hence the name. Polychaete means “many bristles.” Most body segments of a polychaete also have 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.

Leeches

Leeches are segmented worms with flattened bodies and usually no setae. Most leeches live in freshwater streams or rivers. Unlike earthworms, many species are parasites that suck blood or other body fluids from the bodies of their hosts, which include ducks, turtles, fishes, and humans. 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 months.
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 Precambrian 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 determine the age of rocks in the Connection to Earth Science 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 540 million years ago, as you can see in Figure 27.14.

Understanding Main Ideas
1. What is the most distinguishing characteristic of annelids? 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?

6. Interpret Scientific Illustrations Using Figure 27.12, interpret the function of the muscular system in the earthworm as the animal moves through the soil. For more help, refer to Interpret Scientific Illustrations in the Skill Handbook.
How do earthworms respond to their environment?

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
- sandpaper
- glass pan
- warm tap water
- culture dishes
- water
- thermometer or temperature probe
- penlight
- ruler
- dropper
- cotton swabs
- ice
- hand lens or stereomicroscope
- black paper
- paper towels

Safety Precautions
CAUTION: 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
If you need help with this lab, refer to the Skill Handbook.
**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. **Make sure your teacher has approved your experimental plan before you proceed further.**
6. Carry out your experiment.
7. **Cleanup and Disposal** Return earthworms to the container your teacher has provided. Wash your hands thoroughly with soap and water. Make wise choices about whether other lab materials should be disposed of or cleaned for reuse.

**Analyze and Conclude**

1. **Check Your Hypothesis** Which surface did the worm prefer? Explain.

2. **Interpret Observations** At which temperature was the worm most active? Explain.

3. **Observe and Infer** How did the earthworm respond to light? How did it respond to dry and moist environments? Of what survival value are these behaviors?

4. **Draw Conclusions** In general, what conditions do earthworms prefer?

5. **Error Analysis** Analyze where errors may have occurred in your experiment.

**Apply Your Skill**

**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.

**Web Links** To find out more about segmented worms, visit ca.bdol.glencoe.com/segmented_worms
Mollusks as Indicators

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 about 65 million years ago. Today, the number of mollusk species is estimated at 110,000.

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

Research Ammonites were early mollusks that lived from about 230 million years ago to about 65 million years ago. Ammonites are now extinct. Research to find out if these mollusks are good index fossils. Explain your answer.

To find out more about mollusks and other index fossils, visit ca.bдол.glencoe.com/earth_science
**Section 27.1**

**Mollusks**

**Key Concepts**

- Mollusks have bilateral symmetry, a coelom, and a digestive tract with two openings. Many also have shells.
- Most gastropods, such as snails, have a shell, mantle, radula, an open circulatory system, gills, and nephridia. Gastropods without shells, such as slugs, are protected by a covering of mucus.
- Bivalve mollusks have paired shells, called valves, and are filter feeders. They have no radula. Clams and scallops are bivalves.
- Cephalopods have tentacles with suckers, beaklike jaws, a mouth with a radula, and a closed circulatory system. Cephalopods include the octopus, squid, and chambered nautilus.

**Vocabulary**

- closed circulatory system (p. 724)
- mantle (p. 722)
- nephridia (p. 725)
- open circulatory system (p. 724)
- radula (p. 722)

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**Section 27.2**

**Segmented Worms**

**Key Concepts**

- The phylum Annelida includes the earthworms, bristleworms and their relatives, and leeches. Annelids 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 over 500 million years ago. Fossil records show that segmented worms first appeared 540 million years ago.

**Vocabulary**

- gizzard (p. 730)
- setae (p. 728)
1. membrane that surrounds the internal organs of a mollusk
2. sac with muscular walls and hard particles that grind soil before it passes into the intestine
3. in some mollusks, the rasping, tonguelike organ used to drill, scrape, grate, or cut food
4. organs that remove metabolic wastes from an animal's body
5. system where blood moves through vessels into open spaces around the body organs

6. When an earthworm passes soil through its digestive tract, the soil does NOT go through the _______.
   A. stomach          C. gizzard
   B. nephridia        D. crop

7. Which of the following animals have setae?
   A. snails
   B. clams
   C. earthworms
   D. squids

8. Which of the following is a gastropod?
   A.          C.
   B.          D.

9. Which of the following word pairs are most closely related?
   A. filter feeding—radula
   B. scraping algae—siphon
   C. predation—tentacle
   D. nephridia—gizzard

10. Which of the following does NOT use a radula for feeding?
    A. snail          C. oyster
    B. slug           D. squid

11. Leeches that suck blood or other body fluids from their hosts are considered to be _______.
    A. parasites        C. filter feeders
    B. grazers         D. predators

12. Open Ended Compare the protective adaptations of gastropods and cephalopods.

13. Open Ended Interpret the function of a bristleworm’s reproductive system and relate it to its life in the aquatic biome.

14. Open Ended Compare the adaptations for survival in two different mollusks: a snail living on land and an octopus living in the ocean.

15. Analyze Fill in the table with key adaptations of the animals.

<table>
<thead>
<tr>
<th></th>
<th>Gastropods</th>
<th>Bivalves</th>
<th>Cephalopods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getting food</td>
<td></td>
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<tr>
<td>Circulation</td>
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<td>Protection</td>
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<tr>
<td>Locomotion</td>
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</tbody>
</table>

16. Real World BioChallenge Natural pearls are made by oysters in response to foreign material, such as a grain of sand lodging inside the shell. Pearls have been used as jewelry for centuries. Find out about the history of pearls and present-day pearl culture at ca.bdl.glencoe.com. Visit a jeweler and ask to see and photograph marine and freshwater pearls. Prepare a poster or a multimedia presentation with your findings and present it to your class.
17. Infer A leech’s saliva contains chemicals that act as an anesthetic. How does this benefit the leech?

18. Hypothesize What would happen to a farmer’s field if all the earthworms were removed?

Part 1  Multiple Choice
Use the map to answer questions 19–21.

19. The zebra mussel, a non-native mollusk, was first discovered in North America (Michigan and Ohio) in 1988. By 2001, zebra mussels had spread as far south as
   A. Florida C. Georgia
   B. Louisiana D. Texas

20. By 2001, zebra mussels from Michigan and Ohio had invaded _______ additional states.
   A. 12 C. 14
   B. 8 D. 18

21. In 2001, you would NOT find zebra mussels in _______.
   A. Kansas B. Oklahoma
   C. West Virginia D. Wisconsin

Study the diagram and answer question 22.

22. Nerve cells send the chemical messages that produce pain. In the diagram, the chemical pain messages are squares activated by calcium, the round figures. Scientists studying the venom from sea slugs have found that in small quantities, the venom stops the pain signal from being sent. You might infer that the venom interrupts the signal at _______.
   A. calcium’s entrance B. the pain message exit
   C. the receiving cell D. all of the above

Part 2  Constructed Response/Grid In
Record your answers or fill in the bubbles on your answer document using the correct place value.

23. Open Ended When temperatures increase and soil becomes drier, what happens to earthworms?

24. Grid In If a farmer’s field has 75 earthworms per square meter, how many earthworms are in 4.5 square meters?