

# Echinoderms

## Reading Preview

### Key Concepts

- What are the main characteristics of echinoderms?
- What are the major groups of echinoderms?

### Key Terms

- echinoderm
- endoskeleton
- water vascular system
- tube feet

## Target Reading Skill

**Previewing Visuals** When you preview, you look ahead at the material to be read. Preview Figure 24. Then write two questions that you have about the diagram in a graphic organizer like the one below. As you read, answer your questions.

### Water Vascular System

Q. What are tube feet?

A.

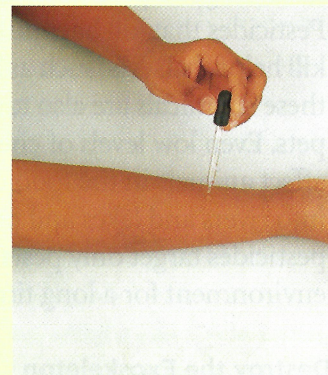
Q.

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## Discover Activity

### How Do Sea Stars Hold On?

1. Use a plastic dropper and water to model how a sea star moves and clings to surfaces. Fill the dropper with water, and then squeeze out most of the water.
2. Squeeze the last drop of water onto the inside of your arm. Then, while squeezing the bulb, touch the tip of the dropper into the water drop. With the dropper tip against your skin, release the bulb.
3. Hold the dropper by the tube and lift it slowly, paying attention to what happens to your skin.



### Think It Over

**Predicting** Besides moving and clinging to surfaces, what might sea stars use their suction structures for?

While exploring a rocky beach one day, you see what looks like a dill pickle at the bottom of a tide pool. You think it might be a plant or a rock covered with green slime. But as you look more closely, the pickle begins to crawl very slowly. This amazing creature is a sea cucumber, a relative of sea stars.

## Characteristics of Echinoderms

Sea cucumbers, sea stars, sea urchins, and sand dollars are all **echinoderms** (ee KY noh durmz), members of the phylum Echinodermata. **Echinoderms are invertebrates with an internal skeleton and a system of fluid-filled tubes called a water vascular system.** All echinoderms live in salt water.

**Body Structure** The skin of most echinoderms is stretched over an internal skeleton, or **endoskeleton**, made of hardened plates. These plates give the animal a bumpy texture. Adult echinoderms have a unique kind of radial symmetry in which the body parts, usually in multiples of five, are arranged like spokes on a wheel.



**Movement** The internal system of fluid-filled tubes in echinoderms is called the **water vascular system**. You can see a sea star's water vascular system in Figure 24. Portions of the tubes in this system can contract, or squeeze together, forcing water into structures called **tube feet**. This process is something like how you move water around in a water balloon by squeezing different parts of the balloon.

The tube feet stick out from the echinoderm's sides or underside. The ends of tube feet are sticky. When filled with water, they act like small, sticky suction cups. The stickiness and suction enable the tube feet to grip the surface beneath the echinoderm. Most echinoderms use their tube feet to move along slowly and to capture food.

**Reproduction and Life Cycle** Almost all echinoderms are either male or female. Eggs are usually fertilized in the water, after a female releases her eggs and a male releases his sperm. The fertilized eggs develop into tiny, swimming larvae that look very different from the adults. The larvae eventually undergo metamorphosis and become adult echinoderms.

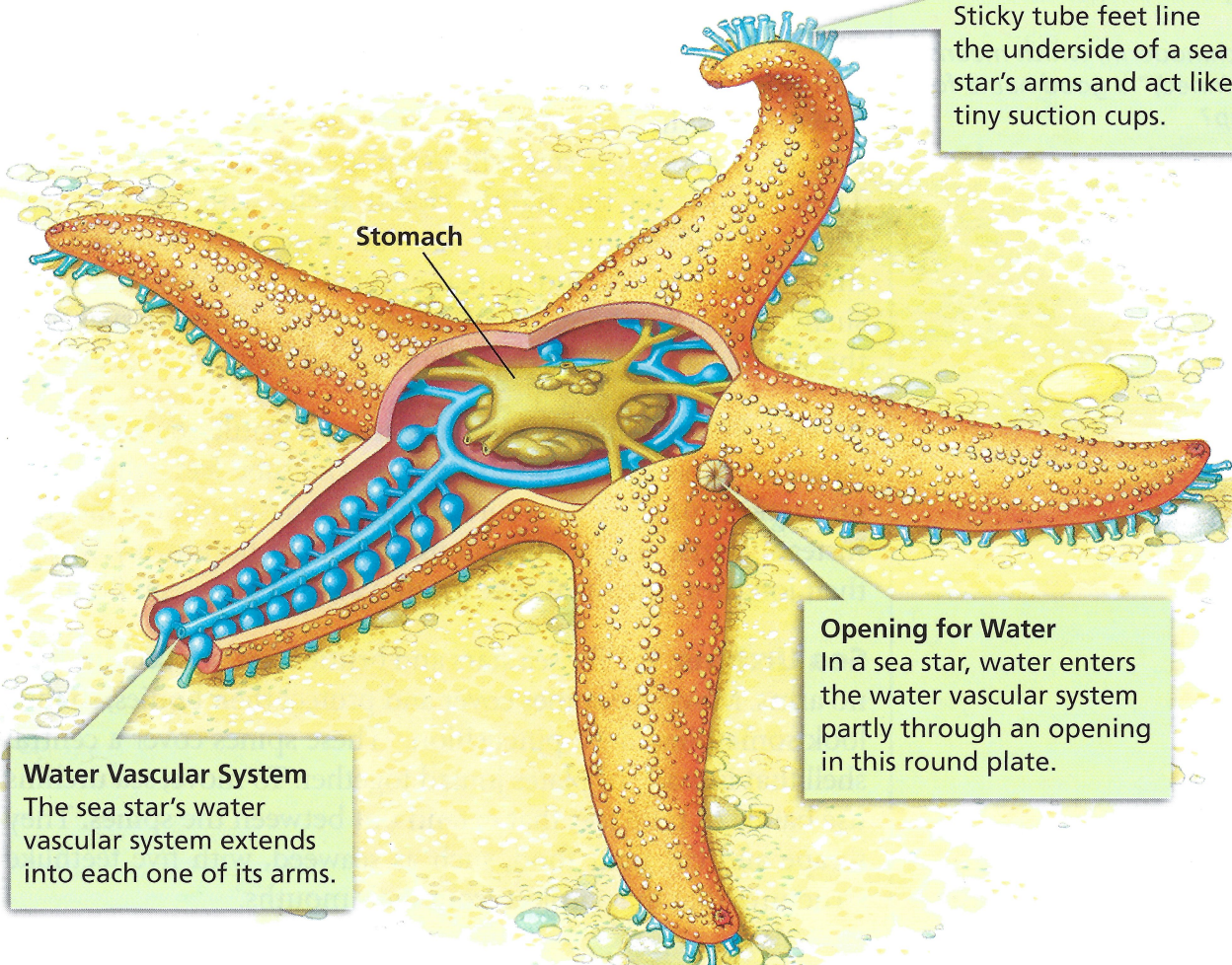


What are the functions of an echinoderm's tube feet?

Go online  
**active art**

For: Water Vascular System activity  
Visit: PHSchool.com  
Web Code: cep-2025

**FIGURE 24**  
**A Water Vascular System**  
Echinoderms, such as this sea star, have a water vascular system that helps them move and catch food.  
**Interpreting Diagrams** Where does water enter the water vascular system?

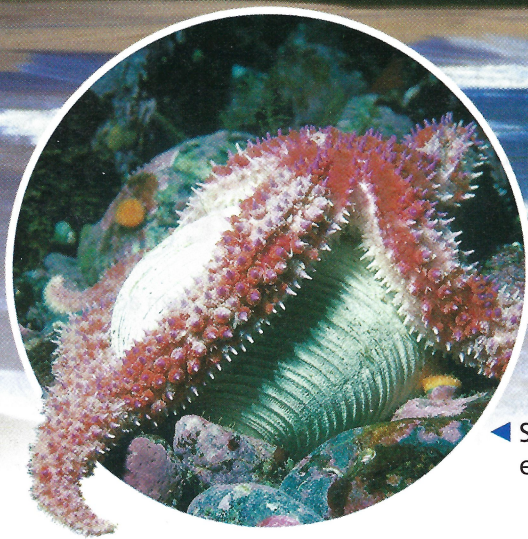


**Tube Feet**  
Sticky tube feet line the underside of a sea star's arms and act like tiny suction cups.

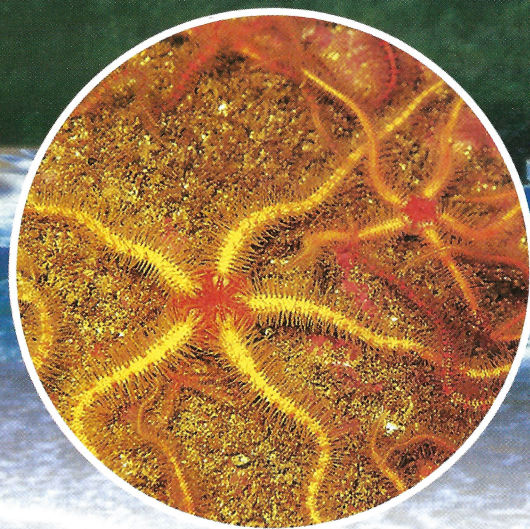
**Opening for Water**  
In a sea star, water enters the water vascular system partly through an opening in this round plate.

**Water Vascular System**  
The sea star's water vascular system extends into each one of its arms.





◀ Sea star eating a clam



▲ Brittle stars slithering on the ocean floor

FIGURE 25

## Diversity of Echinoderms

Echinoderms are diverse in their appearance, but all have radial symmetry and are found in the ocean. **Interpreting Photographs** Why is echinoderm, which means "spiny skinned," a good name for this group?

## Diversity of Echinoderms

There are four major groups of echinoderms: sea stars, brittle stars, sea urchins, and sea cucumbers. The members of these groups share many characteristics, but look quite different. They also have different ways of feeding and moving.

**Sea Stars** Sea stars are predators that eat mollusks, crabs, and even other echinoderms. Sea stars use their tube feet to move across the ocean bottom. They also use their tube feet to capture prey. A sea star will grasp a clam with all five arms. Then it pulls on the tightly closed shells with its tube feet. When the shells open, the sea star forces its stomach out through its mouth and into the opening between the clam's shells. Digestive chemicals break down the clam's tissues, and the sea star sucks in the partially digested body of its prey.

**Brittle Stars** Unlike a sea star's arms, a brittle star's arms are long and slender, with flexible joints. The tube feet, which have no suction cups, are used for catching food but not for moving. Instead, brittle stars slither along the ocean bottom by waving their long arms in a snakelike motion against the ocean floor.

**Sea Urchins** Unlike sea stars and brittle stars, sea urchins have no arms. Moveable spines cover and protect their bodies, so they look something like a pincushion. These spines cover a central shell that is made of plates joined together. To move, sea urchins use bands of tube feet that extend out between the spines. They scrape and cut their food, such as seaweed, with five teethlike structures that they project from their mouths.





▲ Sea urchins eating seaweed



▲ Sea cucumber crawling on the ocean floor

**Sea Cucumbers** As you might expect from their name, sea cucumbers look a little bit like the cucumbers you eat. These animals can be red, brown, blue, or green. Underneath their leather-like skin, their bodies are soft, flexible, and muscular. Sea cucumbers have rows of tube feet on their underside, enabling them to crawl slowly along the ocean floor where they live. At one end of a sea cucumber is a mouth surrounded by tentacles. The sea cucumber, which is a filter feeder, can lengthen its tentacles to sweep food toward its mouth.



How does a sea cucumber move?

## Section 5 Assessment

- Target Reading Skill Previewing Visuals** Refer to your questions and answers about Figure 24 to help you answer Question 1 below.
- Reviewing Key Concepts**
1. a. **Reviewing** What characteristics do echinoderms have?
  - b. **Summarizing** How does an echinoderm use its tube feet to grip a surface?
  - c. **Inferring** Why is movement using tube feet slow?
2. a. **Identifying** Identify the four major groups of echinoderms.
  - b. **Comparing and Contrasting** Compare and contrast how sea stars and sea urchins feed.
  - c. **Predicting** Would a sea star be able to eat clams without using its tube feet? Explain.

### Writing in Science

**Comparison Paragraph** In a paragraph, compare and contrast how sea stars, brittle stars, and sea urchins move.



## 1 Mollusks

### Key Concepts

- In addition to a soft body often covered by a shell, a mollusk has a thin layer of tissue called a mantle that covers its internal organs, and an organ called a foot.
- The three major groups of mollusks are gastropods, bivalves, and cephalopods.
- Gastropods are mollusks that have a single external shell or no shell at all.
- Bivalves are mollusks that have two shells held together by hinges and strong muscles.
- A cephalopod is an ocean-dwelling mollusk whose foot is adapted to form tentacles around its mouth.

### Key Terms

mollusk	gill	radula
open	gastropod	bivalve
circulatory system	herbivore	omnivore
	carnivore	cephalopod

## 2 Arthropods

### Key Concepts

- The major groups of arthropods are crustaceans, arachnids, centipedes and millipedes, and insects.
- Arthropods are invertebrates that have an external skeleton, a segmented body, and jointed attachments called appendages.
- A crustacean is an arthropod that has two or three body sections, five or more pairs of legs, and two pairs of antennae.
- Arachnids are arthropods with two body sections, four pairs of legs, and no antennae.
- Centipedes and millipedes are arthropods with two body sections and many pairs of legs.

### Key Terms

arthropod	antenna	arachnid
exoskeleton	crustacean	abdomen
molting	metamorphosis	

## 3 Insects

### Key Concepts

- Insects are arthropods with three body sections, six legs, one pair of antennae, and usually one or two pairs of wings.
- An insect's mouthparts are adapted for a highly specific way of getting food.
- Each insect species undergoes either complete metamorphosis or gradual metamorphosis.

### Key Terms

insect	pupa
thorax	gradual
complete metamorphosis	metamorphosis
metamorphosis	nymph

## 4 Insect Ecology

### Key Concepts

- Insects play key roles in food chains because of the many different ways that they obtain food and then become food for other animals.
- Two ways insects interact with other living things are by moving pollen among plants and by spreading disease-causing organisms.
- To try to control pests, people use chemicals, traps, and living things, including other insects.

### Key Terms

food chain	
ecology	pollinator
producer	pesticide
consumer	biological control
decomposer	

## 5 Echinoderms

### Key Concepts

- Echinoderms are invertebrates with an internal skeleton and a system of fluid-filled tubes called a water vascular system.
- There are four major groups of echinoderms: sea stars, brittle stars, sea urchins, and sea cucumbers.

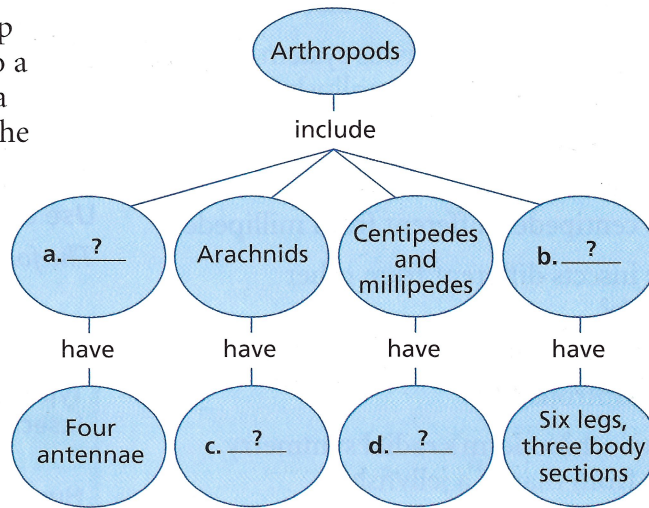
### Key Terms

echinoderm	water vascular system
endoskeleton	tube feet



## Organizing Information

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



## Reviewing Key Terms

Choose the letter of the best answer.

- An animal that eats other animals is a(n)
  - carnivore.
  - omnivore.
  - filter feeder.
  - herbivore.
- Mollusks with two shells are known as
  - cephalopods.
  - gastropods.
  - bivalves.
  - sea stars.
- An arthropod's antennae are located on its
  - head.
  - thorax.
  - abdomen.
  - mantle.
- To obtain oxygen from their environments, mollusks and crustaceans use which organ?
  - radula
  - lungs
  - gills
  - legs
- The shedding of an outgrown exoskeleton is called
  - complete metamorphosis.
  - incomplete metamorphosis.
  - molting.
  - reproduction.
- At which stage of development would an insect be enclosed in a cocoon?
  - egg
  - larva
  - pupa
  - adult
- One example of a biological control is
  - catching pest insects in traps.
  - making and selling honey by raising bees in hives.
  - killing pest insects with pesticides.
  - introducing a pest insect's natural predator.
- An echinoderm has
  - a radula.
  - tube feet.
  - antennae.
  - an exoskeleton.

## Writing in Science

**News Report** As a television reporter, you are covering a story about a giant squid that has washed up on the local beach. Write a short news story describing the discovery. Be sure to describe how scientists classified the animal as a squid.



Mollusks, Arthropods,  
and Echinoderms  
Video Preview  
Video Field Trip  
▶ Video Assessment



# Review and Assessment

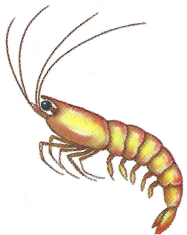
## Checking Concepts

9. Explain how a snail uses its radula.
10. How is a cephalopod's nervous system different from that of other mollusks?
11. Describe four things that a crayfish can do with its appendages.
12. How are centipedes different from millipedes?
13. How are insects different from other arthropods?
14. Identify two reasons why insects sometimes must be controlled.
15. How is an echinoderm's radial symmetry different from that of a jellyfish?

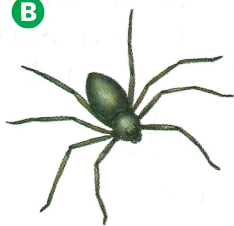
## Thinking Critically

16. **Comparing and Contrasting** Compare and contrast bivalves and cephalopods.
17. **Classifying** Which phylum does each of the animals below belong to? Explain your answer.

A



B



18. **Applying Concepts** Explain why the development of a lion, which grows larger as it changes from a tiny cub to a 90 kg adult, is not metamorphosis.
19. **Drawing Conclusions** A rancher imports dung beetles from Africa to help control manure build-up from cattle. Later, he observes that the pastures are producing more grass for the cattle to eat. What conclusion could the rancher draw about the dung beetles?
20. **Making Judgments** Do you think pesticides should be used to kill insect pests? Explain.
21. **Comparing and Contrasting** How is a spider's method of obtaining food similar to that of a sea star? How is it different?

## Math Practice

22. **Percentage** Of approximately 150,000 species of mollusks, 27 percent are gastropods. About how many species of gastropods are there?

## Applying Skills

Use the data table to answer Questions 23–25. The following data appeared in a book on insects.

Flight Characteristics

Type of Insect	Wing Beats (per second)	Flight Speed (kilometers per hour)
Hummingbird moth	85	17.8
Bumblebee	250	10.3
Housefly	190	7.1

23. **Graphing** Use the data to make two bar graphs: one showing the three insect wing-beat rates and another showing the flight speeds.
24. **Interpreting Data** Which of the three insects has the highest wing-beat rate? Which insect flies the fastest?
25. **Drawing Conclusions** Based on the data, is there a relationship between the rate at which an insect beats its wings and the speed at which it flies? Explain. What factors besides wing-beat rate might affect flight speed?

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## Chapter Project

**Performance Assessment** Prepare a display to show how you set up your experiment and what your results were. Construct and display graphs to show the data you collected. Include pictures of the mealworms in each stage of development. Write your conclusion of how the experimental conditions affected the growth and development of the mealworms. Also suggest some possible explanations for your results.