

Discussions that ensue from thought-provoking questions provide a good way to assess the overall depth of student understanding. The following are some suggested discussion questions.

1. Discuss with students why invertebrates have more differences than similarities.
2. Discuss the different types of symmetry that can be found in the animal world. Have students come up with examples within and outside the animal kingdom.
3. Ask students why they think some animals can reproduce asexually and others cannot.

Follow-up Activities

- Using the Australian Great Barrier Reef as a starting point, have some students depict the anatomy, reproduction and feeding behaviors of coral polyps, as well as their geographic location and formation. Ask other students to explain the biodiversity of the coral reef ecosystem with images and words. Another group can describe the economic and ecological importance of coral reefs to both humans and ecosystems. Other students can summarize the threats that reefs are facing and possible solutions to these problems.
- In groups of two or three, assign students a marine invertebrate to study. Ask students to research the complex and often bizarre life cycles of these animals, reporting back to the class as a whole.
- Have students create a Venn diagram of the many types of invertebrates and the characteristics that they share in reproduction, locomotion, structure, protection, diet and habitat.
- As a creative writing exercise, have students compose a fictional story about the day in the life of a given invertebrate, utilizing research to include detailed, factual information about their chosen animal.
- Have students create a three-column display, showing visual examples and explaining the differences between invertebrates without exoskeletons, invertebrates with exoskeletons and vertebrates.

Internet Resources

- www.cabrilloaq.org/index.htm
The Cabrillo Marine Aquarium has background information on the marine life of southern California, including invertebrates.
- www.aqua.org/animals/species/jellies.html
The National Aquarium in Baltimore presents "Jellyfish Drifters," a detailed look at this diverse group of invertebrates.
- www.aqua.org/animals/species/procto.html
This page from the National Aquarium in Baltimore focuses on cephalopods like the octopus, squid and cuttlefish.
- coa.acnatsci.org/conchnet/edutrack.html
The Academy of Natural Sciences sponsors this site about mollusks and the study of their shells.

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- www.ucmp.berkeley.edu/porifera/porifera.html
An informative site on sponges, featuring sections on their life history and fossil record, as well as links to other specialized sites.
- www.yucky.com/worm/
Get together with Wendell the Worm at "Yucky Worm World," and learn informative facts about the many different species of worms found around the world.

Suggested Print Resources

- Conniff, Richard. *Spineless Wonders*. Henry Holt, New York, NY; 1997.
- Doris, Ellen. *Invertebrate Zoology*. Thames & Hudson, New York, NY; 1993.
- Woods, Samuel G. *Sorting Out Worms and Other Invertebrates: Everything You Wanted to Know About Insects, Corals, Mollusks, Sponges and More!* Blackbirch Marketing, Woodbridge, CT; 1999.
- Wu, Norbert. *A City Under the Sea: Life in a Coral Reef*. Atheneum Press, New York, NY; 1996.

TEACHER'S GUIDE CONSULTANT

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Marine & Other Invertebrates

Grades 5–8

Students in grade 5-8 classrooms possess a wide range of background knowledge. Student response to this video program is sure to be varied, so the teachers for these grades need all the help they can get! This guide has been designed to help science teachers in grades 5-8 by providing a brief synopsis of the program, pre-viewing and follow-up questions, activities, vocabulary and additional resources.

Before Viewing: Extensive research tells how important it is for the teacher to discover what the students know — or think they know — about a topic, before actually starting a new unit. Therefore, after prompting discussion with the pre-viewing questions, lead your class to create a "Everything We Think We Know About..." list. You may also wish to preview key vocabulary words, and have students raise additional questions they hope will be answered.

After Viewing: Have your students share video excerpts that fascinated or surprised them, then challenge your students to prove or disprove the accuracy of the facts they put on their "Everything We Think We Know About..." list. Discuss what else they learned and use the follow-up questions and activities to inspire further discussion. Encourage students to research the topic further with the Internet and reading resources provided.

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Program Summary

Most animals we think of are vertebrates like us — that is, animals with internal backbones as part of their skeletons. Invertebrates, on the other hand, are animals without backbones. Although all invertebrates share this one characteristic, in every other way they are very diverse. Because of this, we can conclude that the invertebrate groups — including sponges, jellyfish, worms, snails, octopi, insects, crabs and sea stars — have more differences than similarities.

The most basic invertebrates are sponges, which belong to the phylum Porifera. Sponges don't have organs, are not able to move and are often mistaken for plants. But they are actually animals, made up of different types of cells that cooperate as a group in order to survive. Jellyfish, anemones and corals belong to the phylum of invertebrates known as Cnidaria. These creatures are characterized by having basic organs and stinging tentacles, but no legs, head or gills; their bodies absorb oxygen directly from the water.

Worms are also invertebrates, and they can be described as three basic types — flatworms, roundworms and segmented worms. Probably the most diverse group of invertebrates are mollusks, which include land animals such as the snail and slug, as well as marine animals like the clam and the octopus. Invertebrates in the phylum Arthropoda are the most plentiful group, and includes all insects, spiders and crustaceans (lobsters, crabs, shrimp and barnacles). Last but not least, there are the echinoderms, a group that includes sea urchins, sand dollars, sea stars and sea cucumbers.

Like other invertebrates, their systems are not only amazing, but they also teach us much about our environment as well as ourselves.

Vocabulary

The following words are included for teacher reference or for use with students. They are listed in the order in which they appear in the video.

vertebrates — Animals with internal backbones made up of small bones called vertebrae. These bones provide support for the animal's muscles and organs, while providing protection for the animal's spinal nerves.

invertebrates — Animals that lack an internal backbone, from microscopic worms to giant squid. Invertebrates are a very diverse collection of animals, comprising 90 percent of the animals in the world.

radial symmetry — Having a body arrangement where parts are set around a central point, like a wheel's axle and spokes. Starfish have radial symmetry.

bilateral symmetry — Having a body arrangement where both sides of an animal are the same. Most animals, including humans, exhibit bilateral symmetry.

Porifera — The primitive group of invertebrates known as sponges, which have many pores or body openings, but no organs.

freshwater — A term that describes anything living in water that does not contain salt.

marine — A term that describes anything living in an ocean or any other body of salt water.

spongin — The elastic-like fibers that make up the structure of some sponges.

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spicules — The rigid, spiky, needle-like particles that make up the supportive structure of some sponges.

Cnidaria — The group of marine invertebrates characterized by radial symmetry, stinging tentacles surrounding a mouth and no head, legs or gills. Cnidarians include jellyfish, anemones and corals.

medusa — A cnidarian body form that is usually free-floating and shaped like an umbrella with tentacles pointing down.

polyp — A cnidarian body form that is attached to the ocean surface by a stalk with tentacles pointing upward, such as corals and anemones.

nematocysts — Tiny, harpoon-like stinging cells found in the tentacles of jellyfish and other cnidarians.

worm — Any of a number of unrelated invertebrate animals that usually have soft, long bodies without legs. Flatworms, roundworms and segmented worms represent the three different types of worms.

mollusks — One of the most diverse group of invertebrates that includes snails, slugs, clams and squids. All mollusks have soft bodies, a mouth and an anus, and many are covered by a shell.

gastropods — The largest group of mollusks, including snails, slugs, nudibranchs and sea hares, that crawl around on a wide, fleshy foot. Gastropods can be found on land, in freshwater and in the ocean.

bivalves — Mollusks whose bodies are surrounded by a shell comprised of two halves, including clams, mussels, scallops and oysters.

cephalopods — Highly advanced mollusks like the octopus, nautilus and squid whose tentacles are located right next to their heads.

arthropods — The largest group of invertebrates with hard exoskeletons and jointed feet, including insects, spiders and crustaceans.

exoskeletons — The external, protective covering of arthropods and some other invertebrates.

crustaceans — Arthropods like crayfish, lobsters, crabs, shrimp and barnacles that live mostly in aquatic environments.

echinoderms — Marine invertebrates such as the sea urchin, the sand dollar and the sea star whose arms are usually arranged around a central axis in patterns of five.

planula — Free-swimming microscopic jellyfish larva.

ephyra — Free-swimming juvenile jellyfish.

regeneration — A type of asexual reproduction that involves the growth of an entire organism from a fragment. Many worms and starfish can regenerate from fragments.

budding — A form of asexual reproduction in which a new individual develops from a specialized area of a parent organism. Sponges, jellyfish and anemones can reproduce by budding.

Pre-viewing Discussion

Before students generate their list of "Everything We Think We Know About..." for this topic, stimulate and focus their thinking by raising these questions so that their list will better reflect the key ideas in this show:

1. What is an invertebrate?

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2. Do all invertebrates have the same characteristics?
3. What are some animals that are invertebrates?

After the class has completed their "Everything We Think We Know About..." list, ask them what other questions they have that they hope will be answered during this program. Have students listen closely to learn if everything on their class list is accurate and to hear if any of their own questions are answered.

Focus Questions

1. What is the one defining characteristic that all invertebrates share?
2. How do invertebrates differ from vertebrates?
3. What are some differences among invertebrates?
4. Which are there more of on Earth — invertebrates or vertebrates?
5. What is radial symmetry?
6. What is bilateral symmetry? Name some animals with bilateral symmetry
7. What kind of animals belong to the group Porifera? Describe them.
8. If you were bathing with a natural sponge, would you prefer one made of spongin or spicules? Why?
9. What animals are known as the cnidarians?
10. What is a nematocyst?
11. What is the difference between a medusa form and a polyp?
12. What is a coral reef?
13. What do all worms have in common? Name three common types of worms.
14. What are parasites?
15. What environmental conditions do earthworms prefer?
16. What does the word "gastropod" mean? Where do gastropods live?
17. What is the meaning of the word "bivalve"? What mollusks are bivalves?
18. What are "cephalopods"? How large are they?
19. What kinds of animals are known as arthropods?
20. What are the main characteristics of all arthropods?
21. What are some features of the animals known as echinoderms?
22. What are "moon jellies"? Explain the different life stages of a moon jelly.
23. How is regeneration different from asexual budding?

Follow-up Discussion

Research indicates that students will retain their previous misconceptions about a topic, in preference to new information, until they actively recognize and correct their own errors. Therefore, it is important to have your students re-examine the facts/beliefs they put on their "Everything We Think We Know About..." list. It might also be helpful to review the list by marking each entry with a "+" or "-" to show which facts were correct and which were incorrect.

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