

- Discuss the advantages that sharks possess in having cartilage rather than bone.
- Sharks have always held a fascination for students. Have the class research and then debate an extreme issue like: "Sharks are deadly killers and they should all be destroyed."

### Follow-up Activities

- After studying different types of fish adaptations for swimming/moving, speed, eating, defense, breathing and reproducing, have small teams create the "perfect" fish by drawing and explaining the advantages of the combination of adaptations selected.
- Creative writing activity: If you could be any fish in the sea, which would it be and why? Draw or find an illustration to accompany your essay.
- Research the life cycle of salmon and have students create a mural depicting the journey that salmon take during their growth from spawn to adult.
- Set up a 20-gallon classroom aquarium for different species of fresh water tropical fish. Have teams of students observe closely over time to draw conclusions about eating habits, defense behaviors and location preferences within the tank.
- Have students research and draw a fish native to their local area, providing information about size, coloration, predators and prey.

### Internet Resources

- [www.sharkfriends.com/info1.html](http://www.sharkfriends.com/info1.html)  
This site addresses shark evolution and classification as well as the behavior of the ocean's most successful predators.
- [www.hboi.edu/marine/biolum2/biolum.html](http://www.hboi.edu/marine/biolum2/biolum.html)  
This site explains how some fish glow and why bioluminescence is so common among fish of the deep.
- [www.aquarium.ucsd.edu/](http://www.aquarium.ucsd.edu/)  
This site from the Birch Aquarium at the Scripps Institute of Oceanography has excellent pages about seahorses, sharks and other ocean creatures.
- [www.marinebiology.org/fish.htm](http://www.marinebiology.org/fish.htm)  
This site answers questions about the ways in which fish swim, eat, breathe and sense in their environment.
- [www.wh.who.edu/faq/](http://www.wh.who.edu/faq/)  
National Marine Fisheries Web page for students gives basic and bizarre information about fish and other marine and aquatic creatures.

### Suggested Print Resources

- Allen, Thomas. *The Shark Almanac*. Lyons Press, New York, NY; 1999.
- Bailey, Jill. *How Fish Swim (Nature's Mysteries)*. Benchmark Books, New York, NY; 1997.
- Landau, Elaine. *Sea Horses*. Children's Press, New York, NY; 1999.
- Paxton, John. *Encyclopedia of Fishes*. Academic Press, San Diego, CA; 1998.

### TEACHER'S GUIDE CONSULTANT

Conrad M. Follmer

25 years as a K-5 Science & Math Coordinator for a Pennsylvania public school system, currently an independent consultant to elementary schools.

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## Fish

### 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

For millions of years, fish have populated the waters of our planet, evolving into roughly 25,000 known species that are currently divided into three major classes — Agnatha, or jawless fish; Chondrichthyes, or cartilaginous fish; and Osteichthyes, or bony fish. Jawless fish, which include lampreys and hagfish, are primitive animals that use their sucking mouths to attach to other creatures for sustenance. The cartilaginous fish, including sharks, rays and ratfish, have skeletons comprised of cartilage instead of bone. More than 90 percent of all fish living today are classified as bony fish, sharing basic characteristics despite coming in various shapes and sizes.

Despite their select groupings, all fish share common characteristics which make them unique. All fish are cold-blooded, aquatic creatures with backbones. Most fish have scales covering their bodies, use fins for movement and breathe oxygen through the use of gills. Bony fish also possess an organ called a swim bladder, which allows them to float at various depths. The swim bladder in some fish is modified to such a degree that it can serve as a lung, allowing a fish like the walking catfish to leave the water for short periods of time.

Fish also have specific adaptations that help them survive in their particular environment, including fin arrangement, size and coloration. Like other animals in the animal kingdom, fish possess the senses of smell (nares), touch (lateral line), hearing and sight.

Reproduction is critical to the continuation of fish species, and some of the Earth's aquatic creatures have very unusual methods of caring for their young. A visit to the Birch Aquarium in La Jolla, California, demonstrates how male seahorses give birth while explaining the unique defense mechanism that they use against predators.

## 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.

**bony fish** — (Members of the Class Osteichthyes) Fish with a skeleton made of bone; the largest of the three groups of fish, including roughly 90% of today's fish species.

**cartilaginous fish** — (Members of the Class Chondrichthyes) Fish with a skeleton made of cartilage, such as sharks, rays and ratfish.

**jawless fish** — (Members of the Class Agnatha) The most primitive group of living fish with sucking mouths, which attach to other fish; examples are lampreys and hagfish.

**aquatic** — A term that commonly describes animals or plants that live in water.

**vertebrates** — Animals that have an internal backbone as part of their skeleton.

**gills** — The organ through which fish take in oxygen, as the water flows through the mouth and across feathery gill filaments.

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**gill cover** — The bones of the fish's head that cover the gills.

**gill filaments** — The fleshy, threadlike part of the gills that are filled with blood vessels where gas exchange takes place.

**capillaries** — Tiny blood vessels that form a network throughout a fish's body.

**cold-blooded** — A term that describes animals that cannot control their own body temperature so they assume the temperature of their environment.

**swim bladders** — Oxygen sacs within the body cavity of most bony fish that enable a fish to maintain its depth without floating or sinking.

**buoyancy** — The tendency of a body to float or rise when submerged in water.

**fins** — Fish limb adaptations that are used to control movements in all directions (see: anal, dorsal, pectoral and ventral fins).

**anal fin** — The fin on the underside (belly) of a fish that is nearest to the tail.

**dorsal fins** — The fin or fins on the top (dorsal) side of a fish. Some fish have only one dorsal fin while others have two dorsal fins.

**pectoral fins** — The pair of fins located directly behind the head of the fish.

**ventral or pelvic fins** — A set of fins on the underside (belly) of a fish that are usually placed between the pectoral fins and the anal fin.

**scales** — Small flat plates that fit together to form the skin covering of fish to provide protection against parasites, predators and scrapes.

**denticles** — Tiny scales on sharks that are shaped like teeth and feel like sandpaper.

**plankton** — The microscopic plant and animal organisms that are found in the seas and serve as food for many creatures.

**nares** — The nostril-like openings of fish that are very sensitive to chemicals and odors in the water.

**lateral line** — A line of sensory organs running along the side of a fish, helping to navigate and to sense the approach of other creatures.

## 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 are the main characteristics of fish?
2. How many types of fish exist today?
3. Is a shark a fish?

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. Roughly how many species of fish are living today?
2. What are the three main groups of fish and how are they different from each other?
3. What features make fish unique?
4. What are gills and how do they work?
5. How do fish float and adjust their buoyancy?
6. How do fins help fish adapt to their environments?
7. Does every species of fish have the same fin arrangement? Why or why not?
8. How do scales protect a fish?
9. What does the shape of a fish's mouth and teeth tell us?
10. Do fish have a good sense of smell?
11. What is the "lateral line"? What does it do?
12. How do fish communicate?
13. Why do some fish species become extinct?
14. What is the key quality that a species must have in order to survive?
15. What are some ways that fish reproduce?
16. Is a seahorse truly a fish?
17. How are seahorses unique?
18. How are sharks different from bony fish?
19. Do all fish have swim bladders? How do fish without swim bladders adapt to different depths?
20. What types of ocean pollution did the program discuss?
21. What is a "food chain"?
22. How does pollution affect fish?

## 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.

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. What are some advantages and disadvantages of being a small fish in a large pond? What are some advantages and disadvantages of being a large fish in a small pond?
2. How would having a lateral line like a fish be helpful to humans?
3. Compare and contrast a fish's environmental conditions and the effects of pollution to that of a land animal. *(Continued)*