



**Education Dept.**  
Georgia Aquarium  
225 Baker Street NW  
Atlanta, GA 30313  
404.581.4198

# Sharks In-Depth

## Teachers Guide

Grade 6-8<sup>th</sup>

**Program Description:** There is much more to know about sharks than what we see on the surface. Acquire a deeper knowledge of sharks and how scientists learn about them. During this program, students will examine how sharks impact their environment and how humans impact sharks.

### Enduring Understandings:

- ◆ Despite their often negative reputation, sharks are an important part of our marine ecosystems.
- ◆ Climate and global currents affect shark migration and habitat (6<sup>th</sup> grade focus).
- ◆ There are many different types of sharks and they are classified by scientists based on various physical characteristics.
- ◆ Sharks have various adaptations to deal with water pressure and hydrodynamics and to sense their prey (8<sup>th</sup> grade focus).
- ◆ Humans can have a positive or negative impact on the health of aquatic ecosystems.
- ◆ Shark populations are in decline and humans have had major impacts on them.

### Objectives:

#### Students will:

- ◆ Learn how research can improve our knowledge and understanding of animals and ecosystems.
- ◆ Discuss climate, currents, and their effect on shark migration and habitat.
- ◆ Discuss shark adaptations to water pressure, hydrodynamics, and how they sense their prey.
- ◆ Explore how sharks are classified into different groups.
- ◆ Investigate how living things are connected and the impact of humans on aquatic ecosystems.

### Georgia Performance Standards Addressed:

#### Sixth Grade

**S6CS5. Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.**

a. Observe and explain how parts are related to other parts in systems such as weather systems, solar systems, and ocean systems including how the output from one part of a system (in the form of material, energy, or information) can become the input to other parts. (For example: El Nino's effect on weather)

**S6CS6. Students will communicate scientific ideas and activities clearly.**

- c. Organize scientific information using appropriate tables, charts, and graphs, and identify relationships they reveal.

**S6CS8. Students will investigate the characteristics of scientific knowledge and how it is achieved.**

- c. As prevailing theories are challenged by new information, scientific knowledge may change and grow.

**S6E4. Students will understand how the distribution of land and oceans affects climate and weather.**

- a. Demonstrate that land and water absorb and lose heat at different rates and explain the resulting effects on weather patterns.

**ELA6LSV1. The student participates in student-to-teacher, student-to-student, and group verbal interactions. The student:**

- b. Asks relevant questions.
- c. Responds to questions with appropriate information.
- e. Displays appropriate turn-taking behaviors.
- h. Responds appropriately to comments and questions.
- i. Volunteers contributions and responds when directly solicited by teacher or discussion leader

**Seventh Grade**

**S7CS5.** Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.

- a. Observe and explain how parts can be related to other parts in a system such as predator/prey relationships in a community/ecosystem.

**S7CS8.** Students will investigate the characteristics of scientific knowledge and how that knowledge is achieved.

Students will apply the following to scientific concepts:

- c. As prevailing theories are challenged by new information, scientific knowledge may change.

**S7L1.** Students will investigate the diversity of living organisms and how they can be compared scientifically.

- b. Classify organisms based on physical characteristics using a dichotomous key of the six kingdom system

**S7L4.** Students will examine the dependence of organisms on one another and their environments.

- c. Recognize that changes in environmental conditions can affect the survival of both individuals and entire species.
- d. Categorize relationships between organisms that are competitive or mutually beneficial.

**ELA7LSV1.** The student participates in student-to-teacher, student-to-student, and group verbal interactions. The student:

- b. Asks relevant questions.
- c. Responds to questions with appropriate information.
- e. Displays appropriate turn-taking behaviors.

- h. Responds appropriately to comments and questions.
- i. Volunteers contributions and responds when directly solicited by teacher or discussion leader.

### **Eighth Grade**

**S8CS8. Students will be familiar with the characteristics of scientific knowledge and how it is achieved.**

- c. As prevailing theories are challenged by new information, scientific knowledge may change.

**S8P3. Students will investigate the relationship between force, mass, and the motion of objects.**

- b. Demonstrate the effect of balanced and unbalanced forces on an object in terms of gravity, inertia, and friction.

**ELA8LSV1.** The student participates in student-to-teacher, student-to-student, and group verbal interactions. The student:

- b. Asks relevant questions.
- c. Responds to questions with appropriate information.
- e. Displays appropriate turn-taking behaviors.
- h. Responds appropriately to comments and questions.
- i. Volunteers contributions and responds when directly solicited by teacher or discussion leader.

### **Before coming to the aquarium, the student should:**

- ◆ Understand predator-prey relationships.
- ◆ Have a basic understanding of how scientists classify animals.
- ◆ Have a basic understanding of the concept of pollution and its impact on aquatic ecosystems.

**Vocabulary:** pollution, predator, prey, adaptation, ecosystem, habitat, research, classification, conservation, species, endangered species, and friction (8<sup>th</sup> grade only).

### **Pre-activity:**

- ◆ Shark Myths

### **Post-visit activity:**

- ◆ Sharks in Decline

# Shark Myths

**Objective:** Students will explore some common shark myths and discuss their own beliefs about sharks.

## Materials:

- List of shark myths (for teacher)
- Large cards or pieces of construction paper (one for each student)
  - Each card should have a “T” drawn or printed on one side, an “F” on the other
- A space large enough for the class to line up side by side and walk forward 10-20 paces

## Background

When we think of sharks, one image comes to mind more often than any other: “Jaws”, a vicious, man-eating, indiscriminate killer. This reputation is widespread but hardly deserved. In reality, sharks come in many shapes and sizes, eat many different types of prey, and occupy many different places in the food web. Even large predatory sharks play a very important role in our marine ecosystems, and attacks on humans by sharks are much less common than most people believe.

## Procedure:

1. Give each student a T/F card and have students line up side by side in one line.
2. Explain to the students that you are going to read a statement about sharks. If they believe the statement is true, they should hold up their card with the “T” side facing forward. If they believe it is false, they should hold up the “F” side facing forward.
3. Once all the students are holding up their cards, read out the correct answer. Ask each student who answered correctly to take one step forward. Everyone else remains in place.
4. Repeat until you have read out all of the shark myths (or as many as you have time for).

## Wrap-Up

Discuss with the students their own feelings about sharks. What do they think of when they think about sharks? Are they interesting? Scary? Do we need sharks? Or would the world be better off without them? Did they learn anything during the activity that surprised them? After learning more about sharks, have they changed their minds about them at all?

## True or False?

1. Sharks eat all the time.

**False.** A shark's eating habits depends on its metabolism and the availability of food. Some sharks can go for weeks or even months without eating.

2. Sharks can sense food without seeing or smelling it.

**True.** Just like humans, sharks can see, hear, smell, taste, and feel. Sharks, however, can also detect vibrations and electrical fields in the water, and do not have to rely on any one sense to find their prey.

3. When a shark loses a tooth, it is replaced by another one.

**True.** Sharks teeth are constantly being replaced. Sharks often have several rows of teeth in their mouths that move into place as the front teeth are shed. Some sharks may lose and replace thousands of teeth in their life!

4. Sharks have to swim continuously in order to breathe.

**False.** While some sharks must move forward to get water to their gills, others can rest on the ocean floor and use either their mouths or special openings called spiracles to pump water over their gills.

5. Most sharks are harmful to people.

**False.** While there are almost 400 known species of shark (and new species still being described), most species are harmless to humans, either because they are incapable of harming humans or because they will never come into contact with them.

6. The largest shark eats the smallest prey.

**True.** The largest species of shark is the whale shark. Whale sharks are filter feeders and eat krill and other plankton. In contrast, one of the world's smallest sharks, the cookie-cutter shark, feeds off of large fish and whales, using its sharp teeth to remove small pieces of flesh.

7. All sharks are fast swimmers.

**False.** Although some sharks can swim quickly (more than 20 mph) for short distances, most sharks swim very slowly, averaging less than 6 miles an hour.

8. Sharks will eat just about anything they can get into their mouth.

**False.** While there are a few species of shark that are not at all picky about what they eat, most sharks have a more specialized diet, and some have adapted to eat specific foods, such as shellfish, plankton, or stingrays.

9. Shark skeletons are made of cartilage.

**True.** Sharks and rays have skeletons made out of cartilage instead of bone.

10. Sharks can't live in freshwater.

**False.** Due to their incredible ability to regulate salinity in their bodies, bull sharks are able to swim far upstream from the ocean into rivers and lakes!

11. You are more likely to be struck by lightning than to be killed by a shark.

**True.** In the U.S., lightning strikes kill an average of 45 people per year, while sharks kill an average of .5 people per year.

11. Sharks' biggest predators are humans.

**True.** Injuries to humans by sharks are much less common than most people realize. Worldwide, an average of 10 people per year are killed by sharks. In contrast, nearly 100 million sharks are killed by humans each year, for recreation, for their meat, or for their fins.

12. Sharks have very small brains and are incapable of learning.

**False.** Sharks have relatively large and complex brains and they can be trained.

### **Resources:**

Stevens, J. (1999). *Sharks*. New York: Checkmark Books.

Ling, Lisa. "Shark Fin Soup Alters an Ecosystem". *CNN.com Planet in Peril*. 15 December 2008. 24 July 2009. <<http://www.cnn.com/2008/WORLD/asiapcf/12/10/pip.shark.finning/index.html>>

"Shark Attacks: A Comparison with the Number of Lightning Fatalities in Coastal States of the United States". *Florida Museum of Natural History*. 24 July 2009.

<<http://www.flmnh.ufl.edu/fish/Sharks/attacks/relarisklightning.htm>>

"Ultimate Shark Quiz". *Discovery Channel*. 24 July 2009.

<<http://dsc.discovery.com/convergence/sharkweek/ultimate-quiz/ultimate-quiz.html?campaign=dsc-int-hp-p5-sw-5>>

# Sharks in Decline

## Objectives:

Students will:

- Describe several methods by which sharks are captured.
- Discuss some of the advantages and disadvantages of each method.

**Vocabulary:** bycatch, conservation, consumer, gill nets, longlines, species, trawl nets

**Time:** 2 sessions, 1 night for homework

## Materials:

- Bandanas or other strips of cloth
- 3 Nerf balls or other soft objects that can be thrown safely
- 2 12-foot ropes/clothesline
- 8 to 12 clothespins
- Notebook paper
- 8 or more 7-inch embroidery hoops
- 4 mesh bags or fabric with holes of different sizes (such as bags for onions, bait, or hosiery)
- Mixture of dry beans (1/4 pound each of lima, pinto, kidney, lentil, and black beans)
- 4 large (10-inch diameter) plastic containers
- Copies of handouts (one for each student)
  - Fishing Worksheet A – can be found online here:  
<http://www.pbs.org/emptyoceans/educators/activities/docs/Sharks-worksheet-a.pdf>
  - Fishing Worksheet B – can be found online here:  
<http://www.pbs.org/emptyoceans/educators/activities/docs/Sharks-worksheet-b.pdf>
  - Educator Page: Answers to Fishing Worksheet B – can be found online here:  
<http://www.pbs.org/emptyoceans/educators/activities/docs/Sharks-answers-to-b.pdf>

## Background

When shark-attack stories make the news day after day, people start to think that sharks are becoming more aggressive or that their populations are growing. However, sharks are not increasing in numbers or ferocity. In fact, sharks are suffering significant population declines. Scientists estimate that some species of coastal sharks have declined by between 50 and 75 percent in just the last 20 years. One reason that shark populations have declined so rapidly is that many common fishing methods accidentally capture sharks in addition to the targeted fish. Another reason is that a growing market for meat, fins, and other shark products has made these fish a direct target of fishers who previously did not capture sharks, or at least did not keep them if they were caught.

But these practices might not take such a dramatic toll on sharks if it were not for some basic aspects of sharks' reproductive biology. Sharks are slow growing, late-maturing animals that do not reproduce very quickly. And they are extremely susceptible to population declines if large numbers of them are killed. This activity contains a series of simulations that explore different fishing methods and how they intentionally or unintentionally lead to the capture of sharks. Then the activity highlights why some fishing methods are so disruptive to shark populations, particularly in light of sharks' reproductive biology.

### **Before you begin:**

1. Before beginning any of the simulations, push desks to the sides of the room, leaving a large open space in the middle.
2. Gather the materials for the simulations.
3. Copies Charts A, B, C, and D from Fishing Worksheet A onto the board, and make a copy of Fishing Worksheets A and B for each student.

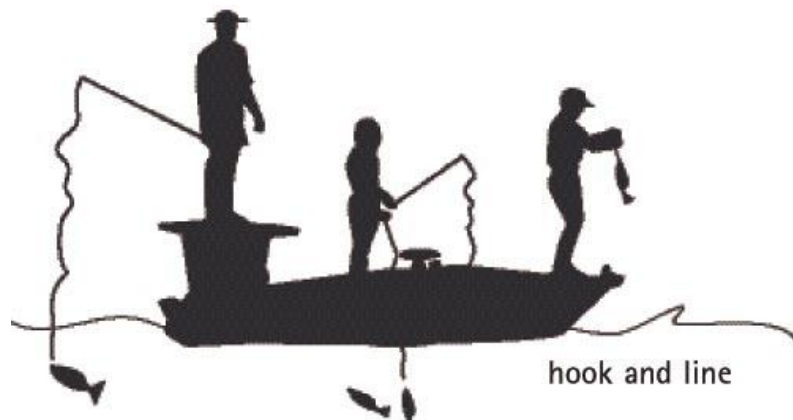
### **Procedure:**

1. Discuss fishing. Ask students if they have any idea how people catch fish in the open ocean. Have a few students share what they know about the topic, then tell them that you are going to conduct a series of classroom exercises to show different fishing methods and their effectiveness in catching targeted species.

Write the following list on the board:

- a. Hook and line
- b. Gill nets and drift gill nets
- c. Longlines
- d. Trawling

#### 2. Simulation A: Hook and Line



The hook and line fishing method is used by sport fishers as well as by some commercial fishers. In this simulation, some of your students are going to be fishing for yellowfin tuna using a hook and line. The other students are going to be the tuna, sharks, and other sea creatures. Ask three volunteers to be fishers. Have the fishers stand aside while you divide the remaining members of the class as follows:

- a. Three to four pairs of students (with arms linked) = adult tuna
- b. Three to four individual students = juvenile tuna
- c. Three to four pairs of students (with arms linked) = adult sharks
- d. Three to four individual students = juvenile sharks

e. Remaining students = other fish

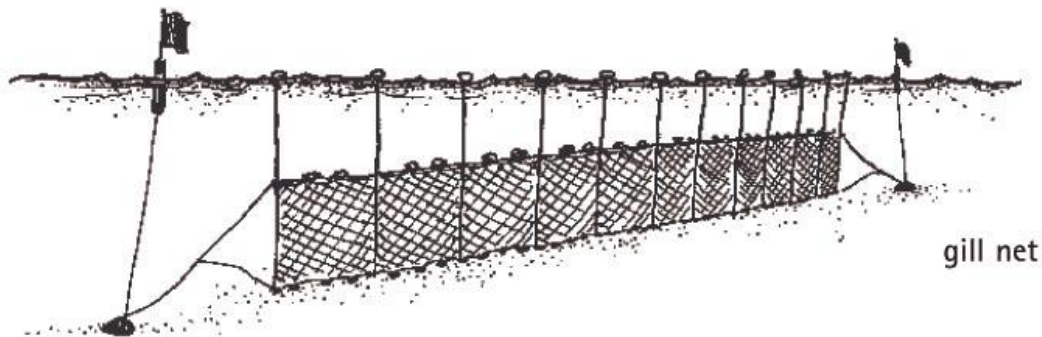
Tie a bandana or strip of cloth around the arm of every tuna. You need not label the other students, but they should remember what identity they have been assigned.

Now present the rules of the game. The fishers will have one minute to “fish” for a tuna from the group. Since it would not be safe to throw a hook and line at their classmates, they will “fish” by throwing the Nerf ball or other soft object. To make things harder for the fishers, they have to be touching a desk with a part of their body when they throw the ball. None of the fish may run. Any fish the fishers hit is considered “caught,” and should go stand next to the fishers. If the fish is not an adult tuna, the fishers should “throw” the fish back into the group and toss the ball again. Whichever fisher has caught the most adult tuna when the minute is over wins the game.

To begin the game, group the fish in the middle of the room. Then tell the fishers to begin. As the fishers catch their fish, record the results on the board on Chart A. (Be sure to count every fish caught, even if the fish is thrown back.) You might want to do another round of fishing if time permits. To do this, “restock” the waters and select new fishers.

Afterward, have the students copy the results from the board onto Fishing Worksheet A and analyze the results. How many fish were caught that were not adult tuna? Tell the students that sharks are generally able to survive when they are caught using a hook and line and then thrown back. That being the case, what was the expected total shark mortality in these simulations? (Answers will vary, but it is unlikely that many would die.)

### 3. Simulation B: Gill Nets and Drift Gill Nets



Explain to the students that some commercial fishers use gill nets to catch fish in the open ocean. Gill nets allow the head and gill covers of a fish, but not its fins or other parts of its body, to fit through the net holes. The gill covers get caught in the net and prevent the fish from wriggling loose. So any fish that are larger at the gills than the holes in the net will get stuck. Once pulled onto the deck of a fishing boat, the fish will quickly die. You might point out that, in addition to being directly targeted by commercial fishers, a lot of sharks are accidentally caught in gill nets by fishers that are targeting tuna.

Some gill nets are fixed in one place and collect fish until they are hauled in. Others are allowed to float through the open water. The floating gill nets are called drift nets. Sometimes drift nets get lost and can float for years gathering fish, and other sea creatures.

To simulate gill net fishing, select one student to be the fisher. Have that person place the two ropes down on the floor to create three equal-sized "lanes." Then have that person secretly designate one lane to be where the gill net will be. (Be sure the person tells you which lane he or she has selected before the other students start "swimming.")

Meanwhile, divide the rest of the students as follows (you need not label them, but they should remember the identity they have been assigned):

- a. One-fourth of the students = adult tuna
- b. One-fourth of the students = juvenile tuna
- c. One student = sea turtle
- d. One student = dolphin
- e. Two to four students = small fish
- f. One-half of remaining students = adult sharks
- g. Other one-half of remaining students = juvenile sharks

Now gather the students at one end of the classroom, and tell them they have to walk to the other end. When they reach the ropes, they should continue down one of the three lanes. Tell them that the fisher has placed a gill net across one of these lanes, but since fish cannot see gill nets, neither can the students. Tell them that they cannot change their lane once they have selected it.

The marine creatures should "swim" from one end of the room to the other, and they should stay in their lanes at the other end of the room. Then have the fisher announce which lane had the gill net, and have him or her count up the catch. All the small fish would have been able to swim through the netting in the gill net. The remaining creatures should be considered caught.

Run through the simulation again if time permits, recording both simulations on Chart B. Have the students copy the figures onto Fishing Worksheet A, Chart B and compare with the results logged on Chart A.

#### 4. Simulation C: Longlines



Explain to the group that longlines are just what they sound like: long, thin cables or monofilament strands that stretch as far as 64 kilometers (40 miles) across the ocean. You can help your students understand by comparing the distance to a place about 64 km (40 miles away) from your classroom. Tell the students that on a longline, there is a float attached to the cable every hundred meters (few hundred feet) and a baited hook every meter (few feet). Longlines are often used to capture tuna and billfish such as swordfish. But they also unintentionally catch many sharks.

Choose two people to be longline fishers. Give them one rope, the clothespins, and 10 or more pieces of paper. Then have them go out into the hall and clip the paper on the rope in whatever distribution they want. Tell them that they will learn how to "fish" with their longline when they get back into the room. While the fishers are out of the room, divide the group as follows (again, you need not label them, but the students need to remember the identity they have been assigned):

- a. One-fourth of students = adult tuna
- b. One-fourth of students = juvenile tuna
- c. Two students = sea turtles
- d. One student = dolphin
- e. One-half of remaining students = adult sharks
- f. Other one-half of remaining students = juvenile sharks

Tell the fish to stand around the room in any configuration they want. The only thing they may not do is stand directly behind another fish. Tell the fish you have not yet decided which side of the room (front or back) the fishers will start from, so there is no point in bunching up at the back of the class.

Bring the two fishers in and have them stand at the front or back of the room with their rope stretched out across the classroom. Explain that the papers on their longline are meant to represent their baited hooks. They should hold the rope so that the papers will pass over the heads of some fish and brush against others. Then have them walk slowly down the length of the classroom, being sure not to shift their longline just to hit a particular fish. The fish may not duck or shift their bodies to avoid one of the "hooks." Every time a fish is brushed by a piece of paper, that student should remove the paper. (In real life, once a hook has caught a fish, no other fish can be caught on it.) Then the fish that are caught should go to the front of the room and identify themselves. Repeat the simulation if time permits. Discuss the outcome of the fishing, record it on Chart C (with students copying the figures to Fishing Worksheet A , Chart C), and compare the results with those recorded on Charts A and B.

#### 5. Simulation D: Trawling



Explain that trawl nets are large, heavy nets that are dropped to the ocean floor, and then dragged just above or along the ocean bottom to catch shrimp and other fish. The nets are then hauled to the surface and emptied onto the deck of a fishing boat. Fishers sort through the catch, throwing back what they do not want. While trawl nets make it relatively inexpensive to catch lots of fish, they also catch many unwanted animals, which often do not survive. Dragging the heavy trawl nets along the ocean bottom also damages sensitive seafloor habitats.

Organize the class into four teams. Give each team at least two embroidery hoops with different sized mesh and a container filled with beans.

In this simulation, your students will play the part of shrimp fishers. Tell the students to assume that the different beans are different species of fish. Ask each team to choose one variety of bean to represent shrimp and another to represent sharks. Remember that shrimp are quite small relative to most other marine animals, including mammals, fish, and other crustaceans.

The team members should take turns selecting a net and dragging the net through the beans. After each turn, have that person count the results of his or her catch. How many shrimp did that person catch? How much of the catch was bycatch? Tell the students to record their results on Chart D and Fishing Worksheet A. Encourage different team members to try out different size nets, which may mean trading nets with other teams until they have used all four net sizes.

6. Discuss simulations. Ask the students if they have any questions about the simulations. In each simulation: Were they surprised by how many sharks and other fish were caught, even though they were not the targeted species? Explain that this unwanted catch is called bycatch. Some students may express dismay that fishers are responsible for killing so many marine mammals and fish that they do not use. You might explain that people are working to minimize this bycatch, but that it is difficult and expensive to change common and ingrained practices.

7. Assign Fishing Worksheet B for homework. Use the worksheets as a means of assessing each student's understanding of the concepts. Then return the sheets to the students and set aside a class period to review and discuss the answers. (Answers to Fishing Worksheet B are provided at the end of the activity.)

8. Discuss status of sharks. Tell your students that because of current fishing practices, many kinds of sharks are experiencing huge population declines. In fact, scientists estimate that humans kill at least 100 million sharks every year.

- What are some ways that people could try to reduce this number? (Answer: Set limits on shark catches, set limits on the size of sharks that fishers may catch, reduce consumer demand for shark fins, or change fishing methods.)
- Why might these changes be difficult to implement? (Answer: It is hard to rally public concern for sharks; many sharks move from one country's waters to another's, so fishing limits set by one or two countries will not guarantee that sharks are protected; current fishing methods are profitable to the commercial fishing industry, so any changes are likely to be resisted.)

9. Research shark conservation. As a wrap-up to the activity, have your students research current efforts in shark conservation. They should search the Web, contact environmental organizations, check the newspaper for articles, and so on. Allow students to share their findings with the rest of the class.

### **Assessment:**

Use Fishing Worksheet B to assess students' understanding.

**Needs Improvement** – Provides incomplete or insufficient answers.

**Satisfactory** – Adequately answers each question.

**Excellent** – Provides thoughtful responses to each question.

### **Extension:**

Have your students look into the reproductive biology of several shark species. Do sharks reproduce in the same way that other species of fish do? Or are sharks' reproductive habits closer to those of large mammals? Explain.

### **Source:**

PBS. "Sharks in Decline". Marine Fisheries and Aquaculture Series. 3 August 2009.  
<http://www.pbs.org/emptyoceans/educators/activities/sharks-in-decline.html>

**Credit:**

Activity adapted from Oceans of Life – An Educator’s Guide to Exploring Marine Biodiversity, a resource of World Wildlife Fund’s *Windows on the Wild* biodiversity education program. For more information on WOW please visit [www.worldwildlife.org](http://www.worldwildlife.org)