“We have overfished the seas systematically everywhere we have gone. We must act now, not 20 years from now . . . if we are to prevent further degradation of the marine environment.”

—Elliot Norse, President, Marine Conservation Biology Institute
Read a recent article about sharks and you'll probably come away convinced that your next ocean swim will end with a deadly attack. But what those articles don't always say is that sharks rarely attack people. What's more, the frightening reports obscure a much bigger issue: Shark populations are actually declining rapidly worldwide. In this case study, your students will learn more about the diversity of shark species, the causes and costs of their decline, and the way attitudes and values of people around the world influence shark conservation.
“Despite their fierce image, sharks are among the most vulnerable creatures in the ocean.”

—Ocean Conservancy
It's a hot summer day at the beach. Ready to cool off, you wade into the ocean and dip under the waves. You swim five, ten, twenty feet. And then it happens. For a split second, you think about sharks. What if a giant killer is lurking in the dark waters beneath you? What if you see a triangular fin heading your way? Your heart thumps and your spine tingles. Even though you know you shouldn't be so afraid, there's no fighting your imagination now. Spooked to the core, you turn in for shore. So much for an ocean swim. You hope the shower feels safe.

If you're like a lot of people, you may find sharks terrifying. But you might be surprised to learn that sharks don't really deserve their horror-movie reputation. They aren't prowling the ocean waters hunting for the next person to attack. In fact, these days it's the other way around: Humans are prowling the ocean waters hunting for sharks!

**Background Information**

For every person killed by sharks, an estimated 10 million sharks are killed by people.
Catching Sharks Catches On

The annual capture of sharks has been rising steadily in recent years. That may come as a surprise to those of us who have never seen a shark product, much less a shark. But three activities—recreational (sport) fishing, commercial fishing, and accidental catch—are contributing to the decline of shark populations.

Recreational Fishing: In growing numbers, people on both the Atlantic and Pacific coasts are paying for the thrill of trying to catch a shark. The sharks’ tremendous fighting spirit gives people all the excitement they’ve been seeking in this extreme sport (see “The Magnificent Mako”). White sharks, commonly referred to as “great whites,” historically have been considered a prize catch for sport fishers. But the National Marine Fisheries Service has banned targeted fishing of great whites because they have declined so dramatically. They are naturally rare, so they’re easily overfished in the few areas where they are known to live.

In terms of numbers, recreational fishing isn’t the biggest threat to shark populations. But it does present certain problems. One is that offshore fishers aim for big trophy sharks, such as makos. Makos grow faster than some other sharks and mature early, so large individuals have high reproductive potential. Capturing them means a great loss in terms of their potential offspring. In addition to offshore fishing, a lot of recreational fishing takes place near the shore, which is often a location for shark nurseries. That means that fishers may be taking pregnant females or juvenile sharks that haven’t had a chance to reproduce at all. One good option for sport fishers is to practice “catch and release” when fishing for sharks.

Commercial Fishing: Many markets for shark products have expanded in recent years, driving commercial shark fishing to an all-time high. For example, the meat of thresher, porbeagle, and other sharks is now on the menu at many restaurants, replacing more traditional seafood that has become too rare or expensive. Restaurants in California have even been known to try to pass off the tasty meat of mako sharks as swordfish—a popular ocean fish that is depleted in some regions.
Interest in other shark products is spurring commercial shark fishing too. Shark livers are used as a source of lubricants, vitamins, and cosmetics. Shark skin—once a popular material for cowboy boots—is still made into leather products. And powdered shark cartilage, considered by some people to be a powerful cure-all for everything from sore eyes to cancer, sells for as much as $100 per bottle, even though there is no reliable evidence that the powder is effective in fighting disease.

What’s more, the market has skyrocketed for one small part of the shark: its fins. In Hong Kong and other places around the world, diners pay up to $90 for a bowl of shark-fin soup. When catching fish for their fins, many fishers will simply slice off the shark’s fins and throw the shark back into the water alive. These injured sharks soon drown or die of starvation, infection, or predation.
Accidental catch: Fishers don’t always catch sharks on purpose. Many times their nets and hooks accidentally snare sharks, as well as other fish, sea turtles, and marine mammals. When the species that are caught are unwanted, they are called *bycatch*. (Blue sharks, for example, are considered bycatch because their meat has very little commercial value.)

One of the biggest causes of accidental bycatch of sharks is *longline* fishing for tuna and swordfish. Longlines are thin cables or monofilament lines that may stretch as far as 40 miles across ocean waters. They have a float every few hundred feet and a baited hook every few feet. Unfortunately, longlines aren’t very discriminating: Approximately 25 percent of all animals caught with longlines are discarded, and of those, up to 75 percent are sharks.

In 1989, about 80 percent of the sharks caught in the northwestern Atlantic as bycatch were killed and dumped back into the ocean. Today, as the value of shark meat and fins has grown, fishers keep more of the sharks they catch. But, of course, that doesn’t increase the sharks’ survival rates—it just reduces waste. Even worse, many sharks that are caught are immature and have not lived long enough to produce young.

“*Sharks around the world are facing a bleak future. In order to turn this tide, people will need to not only stop fearing sharks, but care enough to take action on their behalf.*”

–Sonja Fordham,
Shark Fisheries Specialist,
The Ocean Conservancy

The species that fishers catch and *keep*, even though they aren’t the targeted species, are called *incidental catches*. For example, people fishing for tuna keep the makos and thresher sharks that get caught in their longlines or nets because the sharks are just as valuable at market as swordfish and tuna.

As you might have guessed, all these activities spell bad news for sharks. Scientists estimate that some species of coastal sharks in the Atlantic waters of the United States have declined by as much as 80 percent over the last 20 years. These numbers would create concern about any fish population. But in the case of sharks, they’re especially troublesome. While sharks may be some of the top predators of the sea, they’re not good at bouncing back when their numbers get low. To understand why, it’s important to know more about sharks and their life cycles.
A Shark’s Life
Sharks, along with skates and rays, belong to a group of fish called elasmobranchs. Elasmobranchs are distinguished from other fish mainly by their skeletons, which are made of cartilage rather than dense bone.

Most sharks have a few key characteristics in common. They have five or more gill slits on each side, unlike most fish, which have a gill cover, or operculum. They have leathery skin covered with tiny, sharp scales. Most sharks have tails that are asymmetrical—the upper lobe extends out over the lower lobe. (Lammid sharks, white sharks, and makos have symmetrical tails.) And sharks don’t have swim bladders to keep them buoyant, which means they have to swim to keep from sinking. (Pelagic sharks, such as makos, also have to keep swimming in order to breathe, but not all sharks swim constantly. Angel sharks, like other demersal species, live at or near the bottom and can rest on the ocean floor.)

Variety of Lifestyles: Beyond those few simple facts, it’s hard to generalize about sharks. That’s because there are so many species of sharks—nearly 500 by last count—and the variation among those species is tremendous. (See pages 202-203 for examples of different shark species.) Some sharks live in fresh water, some live in coastal areas, and some live only in the deep sea. One of the smallest sharks, the spined pygmy shark, is only 8 to 10 inches long; the largest, the whale shark, can grow to be more than 40 feet!

Interestingly, not all sharks reproduce in the same way. Some, including horn sharks and cat sharks, release their fertilized eggs into the sea, leaving them completely unguarded. (The eggs are protected inside tough, leathery egg cases.) Others, such as lemon sharks and hammerheads, retain the fertilized eggs, hatch them internally, and nourish them through placetas until they are old enough to be born. Still others, such as cookie-cutter sharks, retain the fertilized eggs, which hatch internally but receive no nourishment from the mother. Instead they must survive by eating unfertilized eggs and their smaller siblings! Despite these dramatic differences in reproductive strategies, all sharks have relatively long, slow life cycles.

All animal species go through their life cycles at different rates. At one end of the spectrum are insects such as fruit flies that can hatch, mature, reproduce, and die in a matter of days. At the other end are species such as elephants and people that take many years to mature, reproduce, and die. Sharks are more like elephants than insects. Most shark species grow slowly and mature late. In fact, dusky sharks don’t reach their breeding age until they are more than 20 years old. Many shark species reproduce only every other year. Some sharks carry their young for two years. And many produce only a small number of young at a time.
Long Life Cycle Is No Longer an Advantage: When species live in unstable environments, it’s advantageous for them to have a short life, mature early, and produce many young. This helps populations bounce back quickly when, for natural reasons, many individuals die. Sharks, on the other hand, evolved in a relatively stable environment, so they can invest more of their energy in living longer, fertilizing internally, and producing fewer and larger offspring. One advantage is that their young are born large enough to avoid their few predators and start feeding immediately on the fish, crustaceans, and cephalopods that form the bulk of their diet.

Unfortunately, sharks no longer have a stable, relatively predator-free environment. Overfishing by humans has reduced the numbers of many fish that sharks depend on for survival, making it harder for them to find food. And humans have become the predator that many sharks never had.

If sharks matured quickly and reproduced more rapidly, they might have a better chance of surviving the impact of these human activities. But sharks, like other species, cannot suddenly change their life cycles. Moreover, even swordfish—which release millions of young at a time—have been rapidly depleted by humans because females are being caught before they are sexually mature. So it’s easy to see why late-maturing, slow-growing, small-litter-producing sharks are especially vulnerable. In the late 1990s, scientists estimated that sharks off the Atlantic Coast were being killed twice as quickly as they were reproducing.

What Good Are Sharks?
Many people would agree that sharks are remarkable to observe. Their sleek bodies, sculptured fins, and gaping jaws inspire not just fear, but also awe. Still, their real value is the role they play within their ecosystem.

Some sharks, such as basking sharks, feed by opening their mouths wide and straining small fish and invertebrates from the water. Others, such as makos, chase down tuna, swordfish, and other large fish. Great white sharks and tiger sharks seek out larger prey, such as seals and sea lions. But adult sharks have few predators other than humans. For that reason, some are top predators within their ecosystem.

Some sharks eat the same kinds of fish that people do. But when it comes to selecting which individual to catch, sharks and people have different approaches. Sport fishers aim for the biggest, heaviest fish, and commercial fishers often capture fish at random. But scientists believe that sharks tend to catch sick, injured, older, or less agile animals—in other words, those individuals that are less capable of escaping an attack. In this way, sharks may help ensure that the fittest animals survive to reproduce, boosting the overall health of ocean populations.

Scientists are concerned about the effects that shark depletion could have on marine biodiversity—the overall species diversity of the sea. In addition to weeding out less healthy individuals, sharks take advantage of big population booms in their prey populations. In so doing, they keep any one species from becoming dominant and overwhelming other species that share their home.

And, of course, sharks themselves are part of the overall diversity of the ocean. If they decline, the richness and variety of the ocean will be diminished too.

BIOFACT
Shark’s teeth, which are actually modified scales, grow in rows, and sharks can sometimes have as many as five rows of teeth at a time! Rather than growing along with the shark, sets of teeth are replaced with other sets of teeth as the animal matures.
Name That Shark!

Few people know that there are nearly 500 species of sharks around the world. Check out these pictures to get a glimpse of the incredible diversity of shark species.

- Bluntnose Sixgill Shark
- Prickly Shark
- Gulper Shark
- Mandarin Dogfish Shark
- Sawback Angelshark
- Zebra Bullhead Shark
Name That Shark! (Cont’d.)

- Northern Wobbegong Shark
- Zebra Shark
- Thresher Shark
- Barbeled Catshark
- Hooktooth Shark
- Sandbar Shark
Laws for Jaws

The U.S. government and some state governments have taken a number of steps to try to protect sharks from overfishing. In 1976, the United States declared exclusive control over fishing within 200 miles of its coastline. The federal government has now made it illegal to kill sharks in the Atlantic and Pacific Oceans just for their fins. It also established shark catch quotas, which set specific annual limits on shark takes in the Atlantic. Concern about shark depletion has led to even greater restrictions on shark fishing since 1997, when the government reduced the quota on some sharks in the Atlantic by 50 percent. In addition to these fishing controls, the establishment of marine protected areas in certain parts of the world is helping to protect shark nurseries and habitat.

All of these laws are good for sharks, but problems remain. After all, the United States is only one of 125 countries actively involved in trading shark products. Not all shark populations enter into international waters, so the United States can protect some species of sharks, but if other countries don't set limits on shark takes, laws that exist in only a few countries will not be enough to keep all shark populations healthy.

Also, shark quotas don’t address the number of sharks killed as bycatch and thrown back into the sea. As it is now, the bycatch numbers are very large, and many marine conservationists think they need to be better controlled. (For more about marine legislation, see pages 341-344.)

Changing Views of Sharks

People’s attitudes toward sharks vary widely from place to place and from culture to culture. For example, traditional Hawaiian cultures treat all sharks with respect in their religion, mythology, and daily life. By contrast, some Western cultures tend to view sharks as frightening creatures of the deep, that can pose a serious threat to human life. This attitude has done a great deal to fuel shark hunting, while making it very difficult for shark conservation to gain public support.

But there are signs that things are changing. Peter Benchley, the author of Jaws, now writes articles and essays explaining his new understanding of the creatures he once portrayed as ruthless man-eaters. He believes people need to respect and protect sharks. And perhaps they are beginning to do just that: New laws for shark conservation suggest that people are coming to recognize the importance of these fascinating fish. Perhaps as we learn more about sharks, we can get past some of our fears. We may still get spooked when we take a swim at an ocean beach, but that doesn’t mean we can’t recognize the vital role sharks play in the ocean environment and take action to ensure that they survive into the future.

Scientists believe that ancestors of sharks swam through Earth’s seas more than 400 million years ago—about 200 million years before dinosaurs.
“What I definitely have become—to the best of my ability—is a shark protector, a shark advocate, a shark appreciator, and above all, a shark respecter. Sharks have an extremely important place in the natural order . . . and we’re just beginning to learn how complex and wonderful they are. I know so much more about sharks than I did when I wrote *Jaws* that I couldn’t possibly write the same story today.”

—Peter Benchley, author
What Do You Think About Sharks?

AT A GLANCE
Explore your knowledge of and attitudes toward sharks by reading a short story.

OBJECTIVES
Identify statements that are facts versus those that are attitudes. Explore personal attitudes toward and knowledge of sharks. Describe some of the ways that knowledge and attitudes are related. Name several ways that attitudes about sharks can influence our actions toward them.

SUBJECTS
language arts, social studies, science

SKILLS
interpreting (inferring, identifying cause and effect, reasoning, elaborating), evaluating (critiquing, identifying bias)

FRAMEWORK LINKS
37, 40, 59, 60

VOCABULARY
attitude, fact

TIME
one session

MATERIALS
copies of “A Short Shark Story” (page 211), “Shark Survey” (page 212), and “Shark Meters” (page 213)

CONNECTIONS
For other values-clarification activities, try “Sizing Up Shrimp” (pages 160–165), as well as “The Spice of Life” in Biodiversity Basics and “Perspectives” in Wildlife for Sale.

Man-eater. Predator. Monster of the deep. Read a popular account of sharks, and you’ll likely come across these or similar phrases. In contemporary Western culture, sensational articles and spine-tingling movies such as Jaws, The Deep, and Deep Blue Sea have largely shaped our views of sharks. As a result, most people view sharks with fear and animosity.

But these views of sharks are not universal. Cultures that have long-standing ties to the ocean often view sharks with respect, if not reverence. New research is also helping people to see that sharks are not the indomitable people-killers we make them out to be. In fact, they are much more vulnerable to the actions of humans than we are to them.

In this activity, your students will get a chance to gauge their own knowledge of and attitudes toward sharks. And they’ll review their classmates’ results to see if there are any connections between what we know about sharks and what we think about them.
1. Give each student a copy of “A Short Shark Story.”
   Have the students read the story to themselves or ask for volunteers to read different paragraphs aloud.

2. Identify statements of fact and statements that are personal feelings or attitudes.
   Have the students review the statements made by the characters in the story. Then have them:
   (1) Underline at least three statements that reflect the personal feelings or attitudes of the speakers, and (2) put a circle around at least three statements of fact.
   If there is any confusion, ask one of the students to explain the difference between a personal feeling or attitude and a fact. Then have the students share some of the fact statements and attitude statements they selected.
   Afterward, ask the students if a person can have wrong feelings or attitudes toward sharks. (*No, because a feeling or attitude is just a personal belief or view.*) Are statements of fact ever wrong? (*Yes, because people may be making something up, incorrectly quoting an information source, or quoting a source that is unreliable.*) You might mention that not all the statements of “fact” in this story are accurate. For example, the story states that there is nothing you can do to prevent shark attacks, but see “Be Shark Smart” on page 210 for some ideas.

3. Hand out the “Shark Survey.”
   Have the students complete the “Shark Survey.” In the first part of the survey, students will record their attitudes toward sharks. You might remind them that there are no wrong answers in this section. The second part of the survey poses questions of fact. There are correct answers to these questions (see page 214), but students should simply answer according to their knowledge and best guesses.

   Now tell the students that they’re going to tabulate the results of their “Shark Surveys.” They should follow the instructions on the handout, filling in as many circles on each of the two sharks as is appropriate. The top shark measures attitudes: The more circles that are filled in, the more positively that student feels about sharks. The bottom shark measures knowledge: The more circles that are filled in, the more that student knows about sharks.
5. Review and discuss results.
When students have finished calculating their attitudes and knowledge about sharks, encourage them to share their results. You might want to have the students post their "Shark Meters" in the classroom. Or, for a more active approach, have the students line up across the front of the room in five groups: those who scored a 1 or 2 in their attitude measurement, those who scored a 3 or 4, those who scored a 5 or 6, those who scored a 7 or 8, and those who scored a 9 or 10. You should end up with five groups separated just slightly in the order described. Into which category did most of the students fall?

Now ask for a show of hands from all the students: Who got 1 or 2 of the factual questions right? Who got 3 or 4 right? Who got 5 or 6? Who got 7 or 8? Did anyone get 9 or a perfect 10? As you survey the students, encourage everyone to keep an eye on where the hands are going up. Can they detect any relationship between knowledge and attitudes? For example, did people who knew the least about sharks generally have a better attitude or a worse attitude toward sharks than those who knew the most?

Ask some of the students to share examples of where they picked up their knowledge about sharks. Based on the sources mentioned, is this information likely to be reliable? Why or why not?

Finally, ask the group for a show of hands to vote for one or two possible answers to the following: If they had $100 to designate for wildlife conservation, and they could choose to give all of it to protect pandas or half of it to protect pandas and half of it to protect sharks, which would they choose? Tell them to assume that sharks are suffering major population declines (which they are). After students have voted, ask the students to again reflect on any patterns they observed. Did people's attitudes toward sharks correspond with their willingness to help protect them?

Explain to the students that, as this unit continues, they'll be learning more about sharks and the problems they face. It might be interesting to see if anyone's attitude toward sharks changes along the way.

"Well, somehow they knew we were—woo! Our dorsal fins are sticking out! I wonder how many times that's screwed things up?"
Assessment
The students are going to be the teacher! It’s time for a test, but the students are going to create their own tests. In the center of a page, have the students write some statements about sharks—either facts or personal attitudes. On both the left side and the right side of the statements there should be blank lines. The lines on the left will be marked as “Fact” or “Attitude.” The lines on the right side will be marked “Positive” or “Negative” to show how the student thinks each statement would shape a person’s attitude.

Have the students put in the answers they believe are correct in their own tests. For fun, you could use statements from different students’ assessments and do a “fun quiz” with the class. Grades won’t be necessary, but see how well the statements worked.

Unsatisfactory—Elements of the test are missing, facts and attitudes are not clearly distinguished, and positive/negative responses are not all reasonable.

Satisfactory—Five to seven statements are presented with correctly distinguished facts and attitudes as well as reasonable positive and negative answers.

Excellent—Eight or more statements are clearly written with correct factual and attitudinal responses as well as reasonable positive and negative answers.

Portfolio
In their portfolios, students should include their “Shark Meters,” as well as a few sentences explaining how people’s attitudes about sharks may be linked to their level of knowledge about sharks. They can also include the tests they wrote for their Assessments.

Writing Idea
Each student can write a short piece that informs community members about sharks and the roles sharks play in marine ecosystems. In their pieces, students should address several common shark myths and provide factual information to help readers better understand how those myths came to be popularized and in what ways the myths may affect people’s willingness to protect sharks.

Extensions
- Look for references to sharks in the media. Your students can compile a list of the representations of sharks they found and collect images of sharks in newspapers and magazines.
- Create a shark bulletin board. Have your students post their shark meters so people can compare the results. Or, have the students post any shark articles, poems, photographs, and drawings they find over the course of the unit.
- Show a short film or video about sharks. What views of sharks does this film convey? Did it affect the students’ attitudes in any way?
- Have the students do some research to come up with a list of tips for being safe in coastal areas where sharks might be active. (Share the “Be Shark Smart” tips on page 210 with your students.)
1. Always swim in a group. Sharks are more likely to attack someone who’s alone.

2. Never swim at night or at dusk or dawn. Sharks are most active at those times.

3. Swim in clear water. In murky water, a shark may mistake you for its usual prey.

4. Stay far from places where people are fishing or cleaning fish. Fish blood and guts can attract sharks and put them in a feeding mood.

5. Stay away from places where lots of small fish are leaping from the water. This could be a sign that a shark is chasing them. Also stay away from places where lots of seabirds are diving. That’s a signal that small fish are nearby, potentially accompanied by sharks that like to feed on them.

6. Don’t stay in the water if you are bleeding. Blood can attract sharks.

7. Don’t wear shiny jewelry. Jewelry can look like flashing fish scales.

8. If you see a large shark, don’t panic and start splashing around. That can make the shark think you’re injured prey—an easy target. Just warn others and calmly leave the water.

9. If a shark ever does attack you, fight back. Hit its eye or gill areas with your fists or feet.

And here’s one more tip: Don’t worry, swim smart, and have fun!

Adapted with permission from Ranger Rick, June 2002, published by the National Wildlife Federation, © 2002.
Carlos, Katie, and Katie's twin brother, Nick, stood on the beach and stared out at the blue waters of the Pacific.

“It looks so welcoming today,” Katie said.

“No it doesn’t. Look at those little waves,” Nick said. “The more you look at them, the more they look like hundreds of shark fins popping out of the water.”

Carlos shook his head. “You can’t think about yesterday, guys, or you’ll never get in the water. Do you want to learn the joys of surfing, or don’t you?”

Katie nodded, hesitantly. Nick shrugged.

The day before had been a terrifying one at this same beach. A surfer had been lying on his board, waiting to catch the next wave, when a large shark came up and grabbed onto his board. Without even thinking, the surfer whacked the shark on the nose. The shark took a large bite of board and disappeared. The frightened surfer paddled to shore, too scared to even look behind him. Now everyone in Santa Cruz was talking about sharks—surfers, swimmers, you name it. Nick thought it was a pretty lousy time to be visiting California and getting his first surfing lesson.

“Sharks freak me out,” Nick said. “I don’t know if I can do this.”

“Sure you can,” Carlos said. “Did you know that you have a better chance of being killed by lightning than by a shark?”

“That may be true,” Katie said. “But I can do stuff to avoid being struck by lightning. There’s nothing a person can do to avoid being eaten by a shark.”

“Except to stay out of the water,” Nick said quickly.

“I’ll admit it, every surfer I know has thought about sharks at one time or another,” Carlos said. “How can you not? Scientists say a surfer lying on a board looks a lot like a seal or sea lion from a shark’s perspective. And great white sharks eat lots of seals and sea lions.”

“You’re making me feel much better, Carlos,” Nick said sarcastically, taking a step back from the waves.

“OK, so there is a risk,” Carlos said. “But we take risks every day. It’s risky to drive a car on a highway. At least out here I can catch a big, high wave and ride it in, with the sun beating on my shoulders and the water sparkling like a sapphire. That’s worth a little risk!”

“It does sound pretty great,” Katie said. “Should we go for it?”

“I think I’d rather surf in a swimming pool,” Nick said.

“It’s up to you,” Carlos said. “But I can’t stand wearing a wet suit without getting wet any longer.” He waded into the water. “C’mon, Katie. Let’s teach you how to catch a wave!”

“Are you coming, Nick?” Katie asked, turning to her brother.

“I don’t think so,” he said. “But I’ll keep an eye on the two of you, just in case you get into trouble out there.”

“You might regret this for the rest of your life, Nick,” she said, wading in after Carlos.

“At least I’ll have the rest of my life!” Nick answered.
SHARK SURVEY

What Do You Think About Sharks?

What Do You Believe?

1. Sharks are scary. .................. agree/disagree
2. People who swim in oceans where sharks live are crazy. .................. agree/disagree
3. Sharks are a little frightening, but they're not bad. .................. agree/disagree
4. All sharks that swim near the shore should be killed. .................. agree/disagree
5. Some kinds of sharks don’t seem scary to me at all. .................. agree/disagree
6. Sharks are interesting. .................. agree/disagree
7. The world would be better off if there were no sharks. .................. agree/disagree
8. Sharks are mean. .................. agree/disagree
9. I worry about people killing too many sharks. .................. agree/disagree
10. The ocean is a better place with sharks in it. .................. agree/disagree

What Do You Know?

1. Sharks are a kind of fish. .................. true/false
2. Almost all sharks live near the coast where people swim, snorkel, and surf. .... true/false
3. If you see a shark while you’re in the water, it will probably attack you. .... true/false
4. If a shark bites you, you will probably die. .................. true/false
5. There are fewer than 100 species of sharks in the world. .................. true/false
6. Some of our medicines are derived from shark products. .................. true/false
7. Some adult sharks are less than a foot long. .................. true/false
8. Some people eat sharks. .................. true/false
9. Because people are taking special precautions, there are fewer shark attacks now than ever before. .................. true/false
10. Sharks have few natural predators, so their populations are stable. .... true/false
What Do You Believe?

Compare the answers below with those you gave on your survey. Then fill in a dot on the shark meter for every answer you gave that matches the numbered answers here. (For example, if you had four matching answers, fill in four dots in a row, starting at the shark’s tail.)

(1) disagree, (2) disagree, (3) agree, (4) disagree, (5) agree, (6) agree, (7) disagree, (8) disagree, (9) agree, (10) agree.

What Do You Know?

Fill in a dot in the shark for every one of the questions you answered as follows: (1) true, (2) false, (3) false, (4) false, (5) false, (6) true, (7) true, (8) true, (9) false, (10) false.
ANSWERS TO THE “SHARK SURVEY”

1. **True.** Sharks are a special kind of fish, though, because their skeletons are not made of dense bone. Instead, their skeletons are made of cartilage, like your ears or the end of your nose. So they’re called **cartilaginous** fish.

2. **False.** Sharks live in a variety of ocean settings—from coastal areas to the deep ocean.

3. **False.** Sharks rarely attack humans, and when they do it’s likely to be a case of mistaken identity: The sharks mistake the person for a sea lion, another marine mammal, or an injured fish. Sharks also may attack divers who bother them in some way.

4. **False.** Scientists think sharks often give people a bump or bite to investigate what they are (or to make them go away if they’re bothering the sharks) and will not necessarily continue to attack.

5. **False.** Scientists have identified nearly 500 species of sharks worldwide.

6. **True.** Parts of sharks have been used for everything from artificial skin for burn patients to anticoagulants for people with heart problems.

7. **True.** There are many species of small sharks. For example, adult pygmy sharks grow to be only 10 inches in length.

8. **True.** Shark is a popular dish at many restaurants, and shark-fin soup is a delicacy in some Asian countries as well as in the “Chinatown” areas of many large, U.S. cities.

9. **False.** Despite increased understanding of shark behavior, shark attacks have increased over the past several decades. Scientists believe that human population growth—simply having more people in the water than ever before—explains most of this increase.

10. **False.** While it is true that most adult sharks have few natural predators, humans now kill sharks intentionally or accidentally at extremely high rates. For that reason, scientists believe that some coastal shark populations in U.S. Atlantic waters have declined by 50 to 75 percent over the last 20 years.
“We now know that the best shark is not a dead shark; that these oft-maligned fish play critical roles in preserving balance in the marine ecosystem.”

—Mike Hayden, President/CEO, American Sportfishing Association
The vast expanses of water in the oceans seem so much alike. That's why students are often surprised to learn that the ocean has different zones of life, defined primarily by the depth of water and distance from shore, as well as by geographic distribution—from polar to temperate to tropical regions. In this activity, students will learn about some of the different zones in the ocean as they meet a range of shark species and piece together information to determine where each one lives.
1. **Discuss shark attack scenario.**
   Begin by describing this scenario to your students:
   
   "A 12-year-old girl is attacked by what witnesses call a 'big shark' in waist-deep water on the Florida coast. After her mother pulls her to safety, the girl receives 72 stitches to her leg and survives."

   Ask the students if they think it would be difficult to identify the kind of shark that attacked the girl. Are there many different kinds of sharks? Are they similar or quite different? Explain to your students that sharks vary a lot from one species to the next. In this activity, each student or pair of students will determine the habitat of an assigned shark species and assess whether their species might have been the shark that attacked the girl.

2. **Hand out copies of “Meet the Sharks” and “Clues—Where the Wild Sharks Are.”**
   Tell the students that the information on “Meet the Sharks” will introduce them to 25 species of sharks, all of which can be found in North American waters. Can someone define the term species? (A species is a group of organisms that have a unique set of characteristics [such as body shape and behavior] that distinguish them from other organisms. If they reproduce, individuals within the same species can produce fertile offspring.) You might explain to the students that there are nearly 500 shark species worldwide. Assign one species to each student. (Some may need to work in pairs or work on two sharks, depending on your class size.) Tell the students that their job is to read the information and clues to determine where their particular shark species lives. Have the students cut out the shark with its description and, if you wish, tape one end of a piece of string to the back of it. They can also color the shark if they'd like.

3. **Discuss ocean zones.**
   While the students are preparing their sharks, hang up the ocean zone diagram. When the students are ready, ask them to think about conditions in the ocean. If they walk into the water right off the beach, what is the ocean like? (Shallow, cold in winter but warmer in the summer or in the tropics.) If they were able to keep walking into deeper and deeper water, how would the ocean change? (It would get darker and colder. Fewer or no plants would be growing on the ocean floor, there would be fewer or no coral reefs, and so on.) Remind the students that, because of variations in light, temperature, and other conditions, species of fish and marine mammals are usually better suited to one part of the ocean than the other, just as some land animals are suited to different climates, different parts of a forest, and so on.

   Discuss the four oceans zones (epipelagic, mesopelagic, bathypelagic, and coastal), explaining the characteristics of each (see page 224). Point out to your students that, while most sharks spend the majority of their time in one particular zone, they do travel throughout various ocean zones especially to feed.

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**Before You Begin**

Make one copy of "Meet the Sharks" and "Clues—Where the Wild Sharks Are" for each student or pair of students. Redraw the "Ocean Zones" diagram (from page 226) on a large piece of paper. You can label the ocean zones yourself or leave them blank and have your students label them, using the clues on the handout. Do not put the numbers on your drawing. Students will be asked to place their sharks in the correct zones, but they do not have to have the exact placement as shown on page 226.
At this point, if you haven’t already labeled the ocean zone diagram, ask for volunteers to use clues from the handout to fill in the blanks.

4. **Affix sharks to chart.**
Now invite the students to come forward and place their sharks in the appropriate zones of the ocean, explaining what clues led them to this conclusion. (Mention that some students may need to wait until other sharks have been placed before they can place their own species accurately.) They can either tape the sharks directly in the zones or tape them nearby using a piece of string to connect them to the proper zone. Also, have the students say whether they think their species of shark could have been responsible for the shark attack described at the beginning of the activity. Why or why not? (See page 226 for appropriate zones.)

You may want to remind the students that, although this diagram will indicate the particular ocean zone each shark species prefers, it doesn’t reflect their geographical distribution. For example, blue sharks are found all around the world, but Atlantic angel sharks are found only in the ocean waters from Massachusetts to the Caribbean. Yet both appear in this diagram together.

5. **Discuss results.**
After students have completed their handouts, discuss the following questions.

- What are some of the reasons that different species of sharks favor particular zones of the ocean? *(Some follow preferred food sources, some are better adapted than others to cold water and dark water, some are too large for shallow water, and so on.)*

- Were you surprised that some of the larger sharks, such as great white sharks and tiger sharks, often venture into coastal areas? Why does this make sense? *(These sharks feed heavily on marine mammals, which are concentrated close to land.)*

- Biodiversity is a word that means the variety of life on Earth—including genes, species, and habitats. What aspects of biodiversity did this activity cover? *(The activity illustrated the great variety of shark species and provided examples of some of the different types of habitats where they live.)*

- Do the students notice any pattern in the distribution of sharks on this diagram? *(Although the diagram is not comprehensive, it does show more sharks in coastal areas than in other parts of the ocean.)* You might take this opportunity to explain to your students that marine biodiversity is not evenly distributed across the oceans. Certain areas—such as coral reefs and other coastal habitats—contain disproportionately more species than other areas. And these areas are often more vulnerable to harm from pollution, destructive fishing practices, and other problems caused by people.

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**BIOFACT**

Whale sharks are the largest fish in the sea, reaching lengths of over 40 feet and weights of up to 20 tons.
Assessments

Ask students to draw a cross-section (side view) of the ocean floor. They should identify some of the different zones in their diagrams and label what changes there would be between each zone. Have the students name a shark that would live in each zone.

Unsatisfactory—Only one or two zones are identified with differences clearly noted, or several zones are identified but no differences are explained.

Satisfactory—Three zones are identified with differences named. At least one shark is assigned correctly to each zone.

Excellent—Four zones are identified with differences named. At least one shark is assigned correctly to each zone.

Portfolio

If students complete one of the shark mystery challenges (page 227), have them include a short piece on their mystery species in their portfolios. Or, if students pursue research as outlined under the first Extension activity, have them include the reports in their portfolios.

Writing Idea

Have students create field guide entries for each of the species highlighted in the “Meet the Sharks” diagram. Field guide descriptions include information on the species, such as its common and scientific names, length, coloration, habitat, range, and preferred diet. Or ask students to write up their answers to the “Shark Mystery Challenges.”

Extensions

■ Have each student choose one species of shark and put together a short report on it. The report should describe its preferred food, geographic distribution, method of reproduction, and other interesting aspects of its life and behavior.

■ Give each student a copy of “Shark Mystery Challenges” on page 227. Explain to the students that our current understanding of sharks lags well behind our knowledge of many other kinds of animals. Can they guess why? (For many years, information about sharks was obtained primarily through brief glimpses of live sharks and the study of dead specimens. As diving equipment became more sophisticated, scientist began to slowly accumulate data on shark behavior. Year-round, close-up observations were first possible when people began to keep sharks in captivity. Another boost has come quite recently with the development of advanced scuba equipment, which enables divers to stay underwater for long periods of time. Now scientists are able to observe sharks in their natural environment and tag sharks for long-term monitoring.) Why might this information be helpful? (Corrects misconceptions about sharks. Guides decisions about how best to protect sharks over the long term.)

Have each of your students investigate what scientists do and do not know about sharks by researching one or more of the mysteries on page 227. Turn to page 228 for help with evaluating their answers.
1. Frilled Shark
Frilled sharks are about six feet long and have soft, eel-like bodies. This has led some people to observe that they look more like sea snakes than sharks. Frilled sharks feed on octopuses and bioluminescent squids and are sometimes caught in bottom trawls.

2. Bramble Shark
The bodies of bramble sharks are covered with thornlike spines that help them glide through the water. The large, slow-moving shark will sometimes float motionless, perhaps looking for hidden octopuses and rockfish.

3. Spined Pygmy Shark
The spined pygmy shark is one of the smallest sharks in the world, reaching lengths of only about eight to ten inches. It is blackish-brown on most of its body and has a luminescent underside.

4. Cookie-Cutter Shark
Scientists finally discovered why small, round holes covered the bodies of some tuna, porpoises, whales, and sharks when they observed how the cookie-cutter shark feeds: The shark holds its mouth against the skin of its prey, sucks in a cylinder (or plug) of flesh, tears it off with its sharp teeth, and leaves a hole. These strange sharks emit a greenish glow.

5. Atlantic Angel Shark
Also known as a sand devil, the Atlantic angel shark looks a lot like a ray. Angel sharks feed on mollusks, skates, flounders, and other creatures. They are found in the same zone as lemon sharks, but tend to burrow under the sand.

6. Horn Shark
Horn sharks have a short, blunt head with high ridges above the eyes. By day, they often hide in kelp beds, emerging at night to feed on small fish, mollusks, and other creatures.
7. **Nurse Shark**
Sluggish and generally docile, nurse sharks often lie on the ocean floor without moving. But watch out! Some divers have made the mistake of touching the quiet sharks, only to receive a sudden, severe bite in response. You can recognize nurse sharks by long fleshy appendages, called barbells that hang below their snouts. These sharks are commonly found in the vicinity of reefs.

8. **Whale Shark**
Whale sharks are gentle giants that are covered with spots and stripes. They’re the largest fish in the world, averaging about 32 feet in length. Certain individuals may reach lengths of more than 40 feet! But whale sharks are very docile, feeding on plankton and small crustaceans on the surface, usually well off shore.

9. **Sand Tiger Shark**
Sand tigers are voracious eaters, consuming a steady diet of fish and squids, and they’ve even been known to feed on sea lions and other mammals. Nonetheless, these large sharks are essentially gentle and rarely dangerous. Groups of sand tiger sharks often gather around rocky reefs.

10. **Goblin Shark**
The unusual snout of the goblin shark extends out from its head in a long, flat blade. It is one of the rarest of shark species. Little is known about the goblin shark’s feeding habits, but it is thought to spend most of its time swimming at depths of more than 3,500 feet.

11. **Megamouth Shark**
In 1976, a U.S. Navy crew stationed off Oahu, Hawaii, found an enormous shark entangled in a large sea anchor about 500 feet below the surface. Apparently the shark had tried to swallow the anchor and died. The shark, new to science, was given the name megamouth shark because of its huge, wide mouth.
12. Bigeye Thresher Shark
Bigeye thresher sharks feed primarily on squids and small tuna, and often get caught in tuna fisheries longlines. Like other thresher sharks, they have extremely long tails, which scientists think they may use to round up or even stun fish.

13. Basking Shark
Basking sharks swim with their mouths open, gulping water and plankton and then straining out the water. The second largest species of shark, basking sharks are reported to attain lengths of 40 to 45 feet. In summer, they are often seen basking near the surface of the water.

14. Great White Shark
Few animals cause as much terror as great white sharks. They are strong swimmers, and they prey on seals, sea lions, porpoises, tuna, sea turtles, and other sharks. They often congregate around seal and sea lion rookeries and are responsible for one-third to one-half of all human shark-attack fatalities each year. But that doesn’t mean that a lot of people are killed by them: The total number of fatalities internationally from great white shark attacks was only ten for the entire 1990s.

15. Shortfin Mako
The fastest of all sharks, shortfin makos prey on other sharks, swordfish, and tuna. They are among the most beautiful and powerful fish in the sea. But they’re probably best known for their fierce antics when caught on a fishhook. They can leap high in the air to try to shake out the hook and, in an attempt to escape, may even attack fishing boats and the people in them.

16. Porbeagle Shark
In the nineteenth century, porbeagle sharks were heavily fished for their liver oil, which was used to tan leather. These sharks feed on squids, and fish such as mackerel, cod, and flounder.

17. Brown Cat shark
Only about two to three feet long, the brown cat shark feeds primarily on shrimp and small fish. It has a chocolate brown body and green eyes.
18. Leopard Shark
This shark is spotted like a leopard and eats small fish, crabs, sea worms, and other organisms. Leopard sharks are sometimes seen in large schools by divers and kayakers, but they are harmless to humans.

19. Silky Shark
A fast-moving shark with unusually smooth skin, the silky shark feeds on organisms such as squids, mackerel, tuna, and pelagic crabs. Sometimes they swim in the same ocean area as blue sharks.

20. Bull Shark
Bull sharks are sizable predators—they can grow to the length of 11 feet. They have been known to attack swimmers in estuaries, rivers, and freshwater creeks that flow directly into the ocean.

21. Tiger Shark
The tiger shark is striped like a tiger and weighs as much as 2,000 pounds. Although they usually feed on marine birds and seals, a variety of items have been found in the stomachs of tiger sharks, including: squids, lobsters, smaller sharks, turtles, canned peas, lumps of coal, the leg of a sheep, and human remains.

22. Night Shark
Night sharks search for fish and shrimp with their large, green eyes. They give live birth, and their litters usually range from 12 to 18 pups.

23. Lemon Shark
Lemon sharks are active around docks and estuaries, and they feed on fish, crabs, seabirds, and more. They look somewhat like bull sharks, but they have distinctive yellowish undersides.

24. Blue Shark
One of the widest ranging sharks, blue sharks have been known to swim more than 40 miles a day! Their migrations keep them in cool waters, where they feed largely on schooling fish and squids.

25. Great Hammerhead Shark
You won’t have any trouble identifying a hammerhead: Its head is shaped like a wide rectangle with eyes at either end. It is a voracious eater, making a meal of rays, smaller sharks, and other fish. Hammerheads are very common around tropical reefs.
| 1. | The two largest sharks in the world reside in the same ocean zone. |
| 2. | Kelp beds grow just off the coast in many temperate climates. |
| 3. | Sharks with large eyes and/or green eyes tend to live in the deepest parts of the open ocean. |
| 4. | Swordfish, tuna, and squids are often found in the epipelagic zone. |
| 5. | Sharks that dwell in the bathypelagic zone often have luminescence (the ability to glow), which may allow them to communicate and capture prey in the ocean’s darkest, deepest waters. |
| 6. | An estuary is a place where freshwater creeks or rivers empty into the sea. |
| 7. | Seals and sea lions tend to congregate on islands and rocky coasts. |
| 8. | Cookie-cutter sharks and green dogfish are found in the same ocean zone. |
| 9. | Bottom trawling is a fishing method in which a large net, or trawl, is dragged along the seafloor bottom to catch shrimp and pelagic fish. |
| 10. | Many coral reefs are found in coastal zones. |
| 11. | Porbeagles and shortfin makos are found in similar habitats. |
| 12. | Leopard sharks and horn sharks live in the same zone, but they’re found in different parts of the world. |

**OCEAN ZONES**

**Coastal:** Located near the shore, and stretching from the ocean’s surface to a depth of 650 feet, this sunlit zone is home to a wide variety of marine species—from squid to sea lions.

**Epipelagic:** This zone, similar to the coastal zone, is located in the open ocean rather than near the shore. Phytoplankton flourish in the abundant natural light, providing nutrients for a wide array of marine animals.

**Mesopelagic:** Extending from about 450 feet to 3,300 feet, light penetrates the upper areas of the zone, but the lower reaches are almost completely dark.

**Bathypelagic:** No sunlight touches this region (3,300 feet to about 13,200 feet, not including the sea floor), but bioluminescent animals thrive in the dark waters, producing their own light to lure prey.

*Pelagic means “of the open ocean.”*
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Answer: Where the Wild Sharks Are

hammerhead shark
Ocean Zones

The numbers correspond to the sharks listed in "Meet the Sharks."

EPIPELAGIC ZONE:
8, 13, 15, 16, 19, 24

COASTAL ZONE:
5, 6, 7, 9, 14, 18, 20, 21, 23, 25

MESOPELAGIC ZONE:
11

BATHYPELAGIC ZONE:
1, 2, 3, 4, 10, 12, 17, 22

Where the Wild Sharks Are
Sharks Case Study

World Wildlife Fund
1. Your Uncle Hughie is the director of a large aquarium. For years, his visitors have been begging him to display a live great white shark. Now Uncle Hughie has asked you to look into the matter. Do great white sharks survive in captivity? If so, what are their basic living requirements? If not, can you recommend another shark that would be more suitable . . . and still please the public?

2. You’ve learned how to scuba dive and can’t wait to take a dive off the coast of California. But there’s one problem: You’re terrified of sharks. You’ve decided you’re willing to buy the best equipment to keep you safe. What kinds of inventions have been designed to help protect people from sharks? Which ones work? How? Is there anything else you can do to reduce your risk of attack?

3. A friend tells you, “Sharks aren’t good for anything.” You disagree, so you propose a bet. He’ll pay you $5 for every benefit sharks provide for people and the planet. How many benefits can you find? What are they? How much money does your friend owe you?

4. You’ve learned that a tour boat leader has started “chumming” the waters about three miles from your favorite beach. Chumming means spreading bait, such as animal blood and oil, to attract sharks for viewing and filming. You think this sounds bad. Can you justify your concern? Why or why not?

5. One day you’re walking through a fish market in Southeast Asia, and you come across a shark you can’t identify. You buy the shark—not to eat it, but to compare it with pictures you have of sharks in your favorite shark book. After a bit of searching, you tell your travel companions that you think you’ve found a new species of shark. They think you’re crazy. How could you justify your position? How could you find out if you really do have a new species of shark?

6. You’ve been hired to help create the set design for a new Jurassic Park movie. The producers want to have an ocean scene, but they aren’t sure which animals were around during the Jurassic period. Can you find out which sea animals existed at that time? Were sharks present? When did the first shark relatives appear on Earth?

7. Your mother tells you that she’s found a delicious-looking recipe for shark-fin soup, which she hopes to serve at her next dinner party. You think the recipe must be a joke, and you’re determined to talk her out of it. What can you find out about shark-fin soup?
**ANSWERS TO “SHARK MYSTERY CHALLENGES”**

1. There are about 100 species of sharks on display in aquariums around the world. The sand tiger shark, bull shark, sandbar shark, blacktip reef shark, and whitetip shark are some of the sharks that have adapted most easily to aquarium life. By contrast, the great white shark has never done well in captivity. In general, sharks do well if they have enough space and if scientists know enough about their feeding habits to keep them well fed.

2. One important thing you can do to lower your risk of a shark attack is to avoid diving, swimming, or snorkeling when sharks are most active—at dusk or dawn. Some wetsuits have been designed to mimic the striped coloration of pilot fish, which sharks don’t eat. But these suits don’t work: Sharks don’t avoid pilot fish because they’re striped, but because healthy and strong pilot fish are too hard to catch. More successful suits have been made with tiny interlocking stainless steel rings, which are able to protect a person from a shark’s bite. Unfortunately, these suits are very expensive. (For more tips on avoiding shark attacks, see “Be Shark Smart” on page 210.)

3. Many very large sharks, such as great white sharks and tiger sharks, feed on seals, sea lions, and other marine mammals that eat large amounts of mollusks and other small organisms. The sharks’ predation helps keep populations of those mammals from depleting their own prey populations. Smaller sharks provide food for other species. Sharks have also been useful as medicines: In the 1930s, shark liver was used widely as a source of vitamin A, but now vitamin A can be synthesized, so this use is no longer common. Shark corneas have been used successfully as transplants for human corneas. Shark cartilage yields a kind of artificial skin used for victims of burns. Anticoagulants from sharks are used for treatment of cardiac problems. And an extract from shark bile has been shown to be useful in treating acne.

4. Scientists are still investigating the effects of chumming on sharks and people, but in general people are concerned that chumming makes sharks unnecessarily dependent on people and may put nearby swimmers and divers at risk.

5. So far, scientists have identified nearly 500 species of sharks. Most scientists believe that we have not yet discovered all the shark species that exist in the world. For example, in a study conducted in 1998 and 1999, scientists discovered 14 potentially new species of sharks at a fish market in the Philippines. So finding a new species of shark at a market isn’t as crazy as it may seem. You could consult a shark field guide or an expert to see if your species has previously been recorded.

6. Sharks were beginning to dominate the sea by the Jurassic period, some 208–155 million years ago. Other animals present in the ocean at that time were turtles, clams, snails, and corals. The first primitive sharks appeared at least 400 million years ago. That means they preceded dinosaurs, trees, mammals, and flying insects!

7. There are indeed many people who believe that shark-fin soup is a delicacy. Unfortunately, the food spurred a practice called finning—catching a shark, removing its fins, and throwing it back into the water. These sharks die after being finned and, since so little of the shark has been used, the practice is both wasteful and a contributing factor in the decline of sharks worldwide. Shark finning has been banned in U.S. waters, and many shark-fin products worldwide now come from fisheries that make use of the entire fish.
“In all our lives there are milestones, important moments we remember long after. This was one of them. For the brief time of his appearance I drank in every detail of the shark—his eyes, black as night; the magnificent body; the long gills slightly flaring; the wicked white teeth; the pectoral fins like the wings of a large aeroplane; and above all the poise and balance in the water and the feeling conveyed of strength, power, and intelligence.”

—Hugh Edwards, naturalist
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 aren’t 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 shark meat, shark fins, and other shark products has made sharks a direct target of fishers who previously didn’t capture sharks, or at least didn’t keep the sharks if they were caught. (For more on shark-fishing methods, see pages 197–199.)

But these practices might not take such a dramatic toll on sharks if it weren’t for some basic aspects of sharks’ reproductive biology. Sharks are slow-growing, late-maturing animals that don’t 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.
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're 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 (optional)

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 for three volunteers to be fishers. Have the fishers stand aside while you divide the remaining members of the class as follows:

1) 3 to 4 pairs of students (with arms linked) = adult tuna
2) 3 to 4 individual students = juvenile tuna
3) 3 to 4 pairs of students (with arms linked) = adult sharks
4) 3 to 4 individual students = juvenile sharks
5) 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've 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 wouldn't be safe to throw a hook and line at their classmates, they'll "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," but if it's not an adult tuna, the fishers should “throw” the fish back into the group and toss the ball again. Have the adult tuna that are caught stand next to the fishers who caught them. 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’s unlikely that many would die.)

3. Simulation B: Gill Nets

Explain to the students that some commercial fishers use gill nets to catch fish in the open ocean. Gill nets allow a fish to fit its head and gill covers, but not its fins or other parts of its body, 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’re hauled in. Others are allowed to float through the open water. (These floating gill nets are called drift nets.) Sometimes drift nets get lost; they can float for years gathering fish and other sea creatures in them.

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’ve been assigned):
1) 1/4 of the students = adult tuna
2) 1/4 of the students = juvenile tuna
3) 1 student = sea turtle
4) 1 student = dolphin
5) 2 to 4 students = small fish
6) 1/2 of remaining students = adult sharks
7) other 1/2 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.

BIOFACT

In Hong Kong, a bowl of shark-fin soup can sell for as much as $90!
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 40 miles across the ocean. (Help your students understand this distance by comparing the distance to a place about 40 miles away from your classroom.) Tell the students that on a longline, there is a float attached to the cable every few hundred feet and a baited hook every 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’ll 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’ve been assigned):
1. 1/4 of students = adult tuna
2. 1/4 of students = juvenile tuna
3. 2 students = sea turtles
4. 1 student = dolphin
5. 1/2 of remaining students = adult sharks
6. other 1/2 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 haven’t yet decided which side of the room (front or back) the fishers will start from, so there’s 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 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**  
(See “Catch of the Day” on pages 167-169 of the Shrimp Case Study.)

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 weren’t 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 don’t 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 homework.**  
Assign “Fishing Worksheet B” for homework. Use the worksheets as a means of assessing each student’s understanding of the concepts (see Assessments). Then return the sheets to the students and set aside a class period to review and discuss the answers. (An answer sheet is provided on page 238.)

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? *(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? *(It’s 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 won’t 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.

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**BIOFACT**

The fish used in England’s famous “fish and chips” dish is sometimes from a shark—the dogfish shark.
**Assessments**
For assessment, use “Fishing Worksheet B” as a homework assignment.
- **Unsatisfactory**—Provides incomplete or insufficient answers.
- **Satisfactory**—Adequately answers each question.
- **Excellent**—Provides thoughtful responses to each question.

**Portfolio**
Students should include “Fishing Worksheets A and B” in their portfolios.

**Writing Idea**
Have students write a letter to the editor of a local newspaper from a fisher’s perspective, explaining the pros and cons of the fishing methods explored in this activity. The letter should also discuss the need for further research on new ways to catch fish that cause minimal marine habitat destruction and reduce bycatch.

**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.
Record the fishing results for each of the following methods. Circle the types of fish that were ultimately kept.

**Chart A: Hook and Line**

<table>
<thead>
<tr>
<th></th>
<th>Adult tuna</th>
<th>Juvenile tuna</th>
<th>Adult shark</th>
<th>Juvenile shark</th>
<th>Other fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round One</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round Two</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Chart B: Gill Nets**

|               | Adult tuna | Juvenile tuna | Adult shark | Juvenile shark | Sea turtle | Dolphin |
|---------------|------------|---------------|-------------|----------------|------------|
| Round One     |            |               |             |                |            |
| Round Two     |            |               |             |                |            |

**Chart C: Longlines**

|               | Adult tuna | Juvenile tuna | Adult shark | Juvenile shark | Sea turtle | Dolphin |
|---------------|------------|---------------|-------------|----------------|------------|
| Round One     |            |               |             |                |            |
| Round Two     |            |               |             |                |            |

**Chart D: Trawling**

<table>
<thead>
<tr>
<th></th>
<th>Kind of netting</th>
<th>Targeted species</th>
<th>Bycatch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round One</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round Two</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 1. Explain what you think might be the *advantages* of each of the following fishing methods.

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

### 2. What do you see as the *disadvantages* of each of the following methods?

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

### 3. Most sharks reproduce slowly, producing small numbers of young at a time and maturing quite late in life—more like elephants or humans than cockroaches or rabbits. Why might some fishing methods, such as using drift nets and longlines, present particular problems for many shark species, whether they are intentionally or accidentally caught?

### 4. In recent years, many sharks that were caught accidentally were dumped back into the sea—dead or alive. Now, because of the rising popularity of shark-fin soup, many fishers are cutting off the sharks' fins and then dumping the sharks back into the ocean. What do you think of this practice?
1. **Advantages of hook and line:** Doesn’t require extremely expensive equipment, better able to catch target species. **Advantages of gill nets, longlines, and trawls:** They catch many more fish and require less labor and precision.

2. **Disadvantages of hook and line:** Requires a lot of human labor and is time intensive. **Disadvantages of nets, longlines, and trawls:** They catch species indiscriminately so they accidentally kill many unwanted species, although the size of openings in the nets’ mesh and the types of hooks used can help make these methods more selective. In some areas, up to half of the bycatch consists of sharks. Also, gill nets and longlines can get lost at sea and will continue catching and killing fish and other marine creatures. When trawling is done along the ocean floor, it destroys ocean habitat.

3. **Because nets and longlines catch sharks of all ages,** they catch many immature females—females that have never had a chance to reproduce. For example, if a female dusky shark is caught before she’s 22 years old, she will not have had the opportunity to produce any offspring. What’s more, those sharks that do reach reproductive age do not produce many young at a time, so populations cannot easily bounce back from heavy fishing tolls.

4. **Answers will vary.** Some students may point out that cutting off the fins can give fishers some monetary reward for catching a shark and that it’s less wasteful than throwing back a dead shark without using any part of it. Others may think that it’s still wasteful to use so little of a shark and may point out that finning only increases the total number of shark deaths and encourages the market in illegal trade. Some students may point to the cruelty of throwing a mortally wounded animal back into the sea to suffer and die.
"... Or can man not only learn how to live in harmony with his fellow men, but also contrive to co-exist amicably with sharks, avoiding unnecessary conflict and recognizing that planet Earth is the home of other species, as well as Homo sapiens, and that these species have an equal claim on the resources of the world."

—Rodney Steel, science journalist
Rethinking Sharks

4

SUBJECTS
language arts, social studies, art

SKILLS
applying (creating, synthesizing, composing), presenting (writing, illustrating)

FRAMEWORK LINKS
5, 37, 41, 42, 58

VOCABULARY
attitudes, culture, nenue, Seri, Tlingit

TIME
one to two sessions, depending on projects chosen

MATERIALS
copies of “Sharks in Culture” (pages 243-246), lined and unlined paper, pencil, paints, colored paper, scissors, glue, clay, musical instruments, and other items as needed

CONNECTIONS
To further explore cultural connections with biodiversity, use “Salmon People” (on the Web) and “The Culture/Nature Connection” in Biodiversity Basics, and “A Wild Pharmacy” in Wildlife for Sale.

AT A GLANCE
Read a traditional Hawaiian story about sharks and then write a poem, make a poster, draw a comic strip, or create a piece of art that portrays your views toward sharks.

OBJECTIVES
Describe different cultural views of sharks. Articulate your attitude toward sharks.

If you could travel around the world, you’d find signs of sharks everywhere. After all, they don’t just inhabit the world’s oceans—they also are found in the culture and imaginations of people. For example, sharks play a role in many Hawaiian and Polynesian stories. Sharks decorate the bark paintings of Australian aboriginal peoples and the hats and carved poles of the Haida and Tlingit peoples of Alaska and British Columbia. Pacific Islanders and the Seri Indians of Mexico carve shark sculptures.

Take a close look at those representations and you’ll see that negative attitudes toward sharks aren’t universal. Far from being the evil villains depicted in most Hollywood movies, sharks are often portrayed in other cultures as powerful guardians, even deities, of the ocean realm.

In this activity, your students will read a Hawaiian story about sharks and look at pictures of shark art from around the world. Then they’ll make their own art to portray their perspective on sharks.
Make one copy of "Sharks in Culture" for each student. Gather whatever writing or art supplies you’d like to provide for the students’ art projects.

1. **Hand out copies of “Sharks in Culture.”**
   Have the students look over the handout. Explain that the story and artwork are examples of how sharks are portrayed by people from different cultures around the world. Read “The Shark Guardian,” pages 243-244, to the class. Afterward, spend some time discussing the story and the artwork presented. Were the students surprised that the people in the story acted as guardians of sharks? What is the tone of the shark painting? *(Emphasizes the horror of the scene, grotesqueness of the shark.)* What sense of the artists’ view of sharks comes through the other shark artwork? *(All three reflect an integration of sharks with the culture—Seri sculpture comes from direct observation of sharks in their habitat, and Australian and Tlingit pieces show spiritual connections to sharks.)* Why might people from different cultures have different attitudes toward and relationships with sharks? *(Answers will vary.)*

2. **Assign shark project.**
   Tell the students that their assignment is to create their own written or artistic representation of their views of sharks. They can model their art piece after one of the examples on their handout (for example, by writing a story about sharks, painting a shark, or carving a shark figurine). Or, they may want to try one of the following:
   - Write a poem about sharks, with the word “SHARKS” running down the left side and each line beginning with one of these letters.
   - Make a poster for an imaginary movie about sharks. Would the shark be the villain? The hero?
   - Draw a comic strip about a superhero who does or does not like sharks.
   - Make a shark puppet out of fabric.
   - Make a shark piñata.
   Whatever format the students choose, their piece should reflect their personal view of sharks.

3. **Share results.**
   Give the students an opportunity to share their art pieces informally or in a class art exhibit. They may want display their pieces in a public space and encourage other people to rethink their attitudes toward sharks.

*“If there is poetry in my book about the sea, it is not because I deliberately put it there, but because no one could write truthfully about the sea and leave out the poetry.”*
– Rachel Carson, ecologist
Assessment
Use the poem, poster, comic strip or art piece and have each student write an explanation of how their work reveals their personal attitude toward sharks. Students should also describe the reasoning behind their attitudes.

Unsatisfactory—Explains either attitude or reason (but not both) or fails to explain how the art shows the attitude and reason.

Satisfactory—Describes the attitude and reasons.

Excellent—Relates the reasons with the attitude and reveals how the work includes this.

Portfolio
Include students’ poetry and stories in their portfolios. If artwork doesn’t fit in the portfolio, have students make a sketch of it or take a photo of it.

Writing Idea
Have students interview neighbors and family members to find out about their perspectives on sharks. Based on these interviews, students should write short “Shark Stories” that explore their community’s attitudes toward sharks and highlight how those attitudes might be linked to local culture.

Extensions
■ The story you read to the students was about shark guardians. Do the students know any other shark guardians? Have them investigate careers that are devoted to protecting sharks.
■ Have the students visit Web sites of organizations working on shark conservation. Then ask them to generate a list of what ordinary citizens can do to help sharks.
THE SHARK GUARDIAN

This is a story of the days when Mary Kawena Pūku‘i was a little girl in Ka‘ū on Hawai‘i. One very rainy day she got to thinking of a certain kind of fish. “I want nenue fish,” she said.

“Hush, child,” her mother answered. “We have none.”

“But I am hungry for nenue fish!” the little girl repeated and began to cry.

“Stop your crying!” said another woman crossly. “Don’t you see we can’t go fishing today? Just look out at the pouring rain. No one can get you nenue fish. Keep still!”

The little girl went off into a corner and cried softly so that no one should hear, “I do want nenue fish! Why can’t someone get it for me?”

Her aunt came in out of the rain. It was Kawena’s merry young aunt who was always ready for adventure. “What is the matter with the child?” she was asking. “The skies are shedding tears enough, Kawena. Why do you add more?”

“I want nenue fish,” the little girl whispered.

“Then you shall have some. The rain is growing less. We will go to my uncle.”

In a moment the little girl had put on her raincoat, and the two were walking through the lessening rain. It was fun to be out with this merry aunt, fun to slip on wet rock and shake the drops from dripping bushes.

At last they reached the uncle’s cave. “Aloha!” the old man called. “What brings you two this rainy morning?”

“The grandchild is hungry for nenue fish,” Kawena’s aunt replied.

“And nenue fish she shall have,” said the old man. Net in hand, he climbed the rocks above his cave home. Kawena and her aunt watched him as he stood looking out over the bay. He stood there like a man of wood until the little girl grew tired watching. The rain had stopped and sunlight touched the silent figure. Why didn’t he do something? Why didn’t he get her fish? Why did he stand there so long—so long?

Suddenly he moved. With quick leaps he made his way to the beach and waded out. Kawena and her aunt hurried after him and saw him draw his net about some fish and lift them from the water. Just as the girl and woman reached the beach the old man held up a fish. “The first for you, old one,” he said and threw the fish into the bay. A shark rose from the water to seize it. “These for the grandchild,” the old man added. He was still speaking to the shark as he gave four fish to Kawena.

The little girl took her fish, but her wondering eyes were following the shark as he swam away.

“That is our guardian,” the uncle said. He too was watching the shark until it disappeared.

“Tell her about our guardian,” said the aunt. “Kawena ought to know that story.”

The uncle led them back to his cave. There, dry and comfortable, they sat looking down at the beach and the bay. “It was from those rocks that I first saw him.” The uncle began, his eyes on rocks below.

“One day, many years ago, I found my older brother lying on the sand. For a moment I thought that he was dead. Then he opened his eyes and saw me. ‘Bring ‘awa and bananas,’ he whispered. I stood looking at him, not understanding his strange words. After a bit he opened his eyes again and saw me still beside him. ‘Awa and bananas!’ he repeated. ‘Get them quickly.’

blue shark
“As I started away I saw him pull himself to his feet, holding onto a rock. He looked out over the bay and called, ‘Wait, O my guardian! The boy has gone for food.’ Then he sank back upon the sand. I looked out into the bay, but saw no one.

“I got ‘awa drink and ripe bananas and brought them to my brother. He pulled himself weakly to his feet once more and moved out onto those rocks, motioning me to bring the food. He called again and his voice was stronger. ‘O my guardian, come! Here is ‘awa drink! Here are bananas! Come and eat.’

“Suddenly a large shark appeared just below the rocks on which we stood. As my brother raised the wooden bowl of ‘awa, the great fish opened his mouth. Carefully my brother poured the drink into that open mouth till all was gone. Then he peeled the bananas one by one and tossed them to the shark, until the great fish was satisfied. ‘I thank you, O my guardian!’ Brother said. ‘Today you saved my life. Come here when you are hungry.’ The shark turned and swam away.

“While my brother rested on the sand he told me his adventure. His canoe had been caught in a squall and overturned. He was blinded by rain and waves and could not find the canoe. It must have drifted away. The waves broke over him and he thought the end had come.

“Then he felt himself on something firm. ‘A rock!’ he thought, and clung to it. Suddenly he felt himself moving through the waves and knew that he was riding on the back of a great shark and clinging to his fin. He was frightened, but kept his hold.

“The storm passed on, and my brother saw the beach. The shark swam into shallow water, and Brother stumbled up the sand. It was there I found him.

“He never forgot that shark. Often I have seen him standing on the rocks above this cave with ‘awa and bananas ready. Sometimes he called. Sometimes he waited quietly until the shark saw him and came. Sometimes the shark drove a small school of fish into the bay as you saw just now. My brother caught some and shared them with the shark.

“The time came when my brother was very sick. Before he died he beckoned to me. ‘My guardian,’ he whispered. ‘You must give food to the one that saved my life.’

“I have not forgotten, and the shark does not forget. I feed him ‘awa and bananas, and he sometimes drives fish into my net. Today he wanted nenue fish and put the thought of them into your mind. Always remember our guardian, Kawena.’

Kawena Pūku‘i is a woman now, but she has never forgotten the shark guardian.

Told by Mary Kawena Pūku‘i

1) “Watson and the Shark” by John Singleton Copley, 1778.

In 1749, a 14-year-old orphan was swimming in the harbor in Havana, Cuba, when he was attacked by a shark. This painting by American painter John Singleton Copley depicts the orphan’s shipmates’ desperate attempts to rescue him.

2) Seri Indian ironwood carvings of sharks.

The Seri Indians live on the coast of the Sea of Cortez in Sonora, Mexico, where they hunt and fish for much of their food. Some Seris carve these sculptures to depict the animals they see in their region.
3) Australian bark painting with shark on it.

Australia's aboriginal people have been making bark paintings for thousands of years. They grind colored rocks to make paint and use eucalyptus bark as the canvas. The scenes on the bark paintings reflect the spiritual “dream time” stories of the aboriginal peoples.

4) Tlingit carved pole.

Creatures from the natural world are depicted on most of the traditional poles of the Tlingit people of the Northwest Coast of North America. The animals on these poles are totem animals who help shape the lives of the families connected to them.

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Shark Resources

Here are additional resources to help you design and enhance your Sharks Case Study. Keep in mind that this resource list includes some of the materials we have found or used; however, there are many other resources available on sharks. For a list of general marine biodiversity resources, see the Resources section on pages 360-369.

Organizations

American Elasmobranch Society is a nonprofit science organization that conducts research on sharks, skates, rays, and chimaeras, and promotes public awareness of natural resources. www.flmnh.ufl.edu/fish

Mote Marine Laboratory's Center for Shark Research is an international center for research, scientific collaboration, consulting, education, and public information on sharks and their relatives (skates and rays). Their Web site includes shark facts and statistics. www.mote.org

Curriculum Resources, Books, and Web Sites

The Bridge—Ocean Sciences Education Teacher Resource Center is a growing collection of online marine education resources. Use the Search feature, or under “Ocean Sciences Topics,” click on “Biology,” then “Sharks.” Sea Grant Marine Advisory Services, Virginia Institute of Marine Science College of William and Mary, Gloucester Point, VA 23062. www.vims.edu/bridge

Great White Sharks (Adult) by Richard Ellis and John E. McCosker centers on one of the most feared ocean creatures. Extensively illustrated, the book is the first-published compilation of information and research about great whites. (HarperCollins, 1991). $35.95

NOVA Online: Shark Attack! is an “online adventure” resource on the biology of sharks, their distribution, and the people who interact with them. www.pbs.org/wgbh/nova/sharks

The Shark Almanac (Adult) by Thomas Allen tries to dispel myths of sharks as man-eaters and delves into the unknown world of these marine creatures. The book provides recent scientific research as well as updates on continuing shark conservation efforts. (Lyons & Burford Publishers, 1999). $35.00

Shark Research Program of the Florida Museum of Natural History provides links relating to various aspects of sharks. Viewers can visit an image gallery featuring a range of species or click on “Education” for a discussion of shark natural history. www.flmnh.ufl.edu/fish/sharks/sharks.html

Sharks (Elementary) by Niki Walker and Bobbie Kalman is a general shark resource for children. Complemented by color photographs, the book outlines various species of sharks, from tiny cookie-cutters to giant makos. (Crabtree Publishing Group, 1997). $19.96

Sharks! (Elementary) by Irene Trimble and Mike Maydak, a work of the “Know-It-All” series, is a die-cut book featuring shark species, their diet, and physical abilities. (McClanahan Book Company, 1999). $2.79

Sharks in Question: The Smithsonian Answer Book (Adult) by Victor G. Springer and Joy P. Gold addresses commonly asked questions about sharks in the first half of the book. The second half covers the biology of various shark species and the reasons behind attacks on humans. (Smithsonian Institution Press, 1989). $24.95