Jean-Michel Cousteau OCEAN ADVENTURES

PBS

Shark Encounter

Students work in teams to explore what they think to be true about sharks as they rotate through a series of four stations.

SUBJECTS
Science

GRADE LEVEL
6

TIME
1 hour

OBJECTIVES
Students will be able to
- identify facts and misconceptions about sharks.
- graph results of a shark survey.
- draw and label the parts of a shark.

MATERIALS
Station 1
For the class:
- Copy of *Sharks at Risk* episode of **Jean-Michel Cousteau Ocean Adventures**
- TV and VCR
- 1 copy of Station 1 Student Directions (optional: laminated)
- Timer

For each team of seven to eight students:
- One pencil or pen
- One Station 1 Student Sheet

Station 2
For the class:
- Shark Anticipatory Chart (see Getting Ready)
- Colored markers (various colors)
- Masking tape
- One copy of Station 2 Student Directions (optional: laminated)

BACKGROUND
Of the 368 known species of sharks, only about 20 are "man-eaters," or more correctly, "person-biters." The shark is possibly the most maligned of all animals. Literature, movies and scientific studies over the years have reinforced the notion of sharks' stupidity and savage nature. Partly because of the attention often focused on sharks following a rare "attack," their reputation for ferocity is much overplayed. In this activity, students will explore what they know—and what they think they know—about sharks.

Extensive background information for teachers is included at the end of this lesson plan.

TEACHER PREPARATION
1. Make one copy of each of the four Station Student Directions. You may want to laminate them for later reuse.

2. Make four copies of the Station 1 Student Sheet and place with the television, VCR/DVD, timer and *Sharks at Risk* video in one corner of the room for Station 1.

3. Cue up the shark video to a spot with good, dynamic footage that is 4 minutes in length.

4. Make 30 copies of the Shark Anticipatory Chart student sheet and place with a box of pens or pencils in a second corner of the room for Station 2.

For each team of seven to eight students:
- Seven (eight) copies of Shark Anticipatory Chart student sheet
- Seven (eight) pens or pencils

Station 3
For the class:
- Overhead projector
- Transparency pens
- Transparency of blank Shark Survey Bar Graph
- One copy of Station 3 Student Directions (optional: laminated)

For each team of seven to eight students:
- Seven (eight) copies of the Shark Survey
- Seven (eight) pens or pencils
- Two transparency pens, different colors
- One Shark Survey Bar Graph transparency

Station 4
For the class:
- Masking tape

For each team of seven to eight students:
- One large sheet of poster paper
- Colored markers (various colors)
- Seven (eight) pencils
- One copy of Station 4 Student Directions (optional: laminated)

STANDARDS
National Science Education Standards Grades 5-8
http://www.nap.edu/catalog/4962.html

Unifying Concepts and Processes:
Form and function

Science As Inquiry – Content Standard A:
Abilities necessary to do scientific inquiry

5. Using chart paper and colored markers, make the class poster of the Shark Anticipatory Chart, as follows:

SHARK ANTICIPATORY CHART

"What we think we know about sharks"	"What we would like to know about sharks"	"What we know to be true about sharks"

6. For Station 3, make 30 copies of the Shark Survey student sheet and place in a third corner of the room with a box of pens or pencils and four transparencies of the Shark Survey Bar Graph.

7. Make five transparencies of the Shark Survey Bar Graph.

8. Place four large sheets of chart paper and marking pens in a fourth corner of the room for Station 4.

9. Gather shark resources, including posters, books, videos and, if possible, artifacts (such as jaws).

10. Write the key concepts (see below) on chart paper with colored markers. Use large, bold letters.

Sharks are an example of evolutionary success because they have existed relatively unchanged for the past 400 million years.

Shark populations are being severely threatened by unregulated fishing practices in the United States and other countries.

Life Science –
Content Standard C:
Structure and function
Regulation and behavior
Diversity and adaptations of organisms

Ocean Literacy:
Essential Principles and Fundamental Concepts
http://coexploration.org/oceanliteracy/

Essential Principle #5:
The ocean supports a great diversity of life and ecosystems.
a. Ocean life ranges in size from the smallest virus to the largest animal that has lived on Earth, the blue whale.
d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.

Essential Principle #6:
The ocean and humans are inextricably interconnected.
e. Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out of and put into the ocean. Human development and activity leads to pollution (point source, nonpoint source and noise pollution) and physical modifications (changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

PROCEDURE

1. **Divide into groups**
   Divide the class into four teams of seven or eight students. Assign each team to one of the four Shark Stations. Tell the students they will spend approximately 8 minutes at each station, then on your cue they will rotate as a team to a new station.

   Stations can be doubled in order to reduce group sizes if necessary.

2. **Explain the approach**
   Briefly describe each of the stations (see student directions below) before having the students start the rotation. Tell them that after they have visited all the stations, the class will gather as a group to discuss their results.

3. **Visit the stations**
   Have the student groups rotate through the four stations, completing each task at each station.

4. **Discussion**
   After the tasks at all the stations have been completed, lead a class debriefing of each of the stations and record the students' ideas, on chart paper or the overhead projector, as follows:

   - For Station 1, have each team share their team's answers as described on their worksheet. Record their ideas on a transparency or chart.
   - For Station 2, post the Class Anticipatory Chart and record each team's ideas directly on the chart. If a team shares an idea another team has already offered, put a star by it to show the level of agreement in the class.
   - For Station 3, have each team in turn place their bar graph on the overhead projector on top of the previous team's so that answers can be compared. Then place a blank bar graph on the overhead and add up all the student's responses to get the results for the entire class. [Answers to Station 3: (1) No; (2) Yes; (3) Yes; (4) Yes; (5) ?; (6) No; (7) ?; (8) ?]
   - For Station 4, have each team hold up its shark drawing and describe the labeled parts.

5. Finally, ask the students the following questions:
   Which points do all the teams have in common?
   What are the differences? How do the teams' drawings differ?
   Could a list be composed of general statements about sharks that the entire class would agree to be true?

EXTENSIONS

- **Student Posters**
  Have each group select one of the following topics to discuss and represent graphically on a poster. Have each group share their poster with the rest of the class.

- Why have sharks been hunted in such great numbers around the world? Do you think these are good reasons? Why or why not? What factors caused this to happen?

- The marine mammal population, especially that of the elephant seals, has been increasing off the coast of California ever since the Marine Mammal Protection Act was passed in 1972. What effect do you think this has had on the great white shark population? How do you think surfers feel about this? What about shark researchers? What do you think we should do about the situation?

- Discuss the "bad" reputation of sharks and how people stereotype sharks. How can movies like *Jaws* and *Deep Blue Sea* affect people's attitudes?

- **Commercial Shark Fishing**
  Students research how different countries catch sharks, where the major shark fisheries are located and what parts of the shark are used. (Japan just recently outlawed the practice of capturing sharks, cutting off their fins and throwing the sharks back alive.)

- **Shark Researchers**
  Invite a shark researcher or educators from a local college, university or museum to come and make a presentation to your class. They will often bring shark artifacts to display.

FURTHER RESOURCES

Additional educator resources for ***Jean-Michel Cousteau Ocean Adventures*** can be found at **pbs.org/oceanadventures.**

- The International Shark Attack file
  http://flmnh.ufl.edu/fish/sharks/isaf/isaf.htm

- Monterey Bay Aquarium's live kelp forest cam
  (leopard sharks)
  http://www.montereybayaquarium.com

- SeaWorld/Busch Gardens Animal Bytes
  http://www.seaworld.org/animal-info/animal-bytes/index.htm

- Zoom Sharks
  http://www.enchantedlearning.com/subjects/sharks/

CREDITS

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STATION 1: STUDENT DIRECTIONS

Shark Video and Discussion Questions

1) With the sound turned down completely, watch the 4 minute video about sharks and quietly discuss with your team what you're seeing. Be sure to set the timer to go off after 4 minutes so you will have time to answer the following questions.

2) After the video, take 4 minutes to answer the following questions on your group worksheet.

   1. Our senses work well to perceive our environment. Do you think they would work just as well if we lived in the ocean?

   2. How might our senses have to change if we lived in the ocean?

   3. What are the first things that come to mind when you think about sharks?

   4. In what ways are we similar to sharks, and in what ways are we different?

   5. Think about what you've heard about sharks and what you've seen in the movies and on television. Two common statements are: "Sharks must always swim." "All sharks are bloodthirsty." What do you think of these statements? What other statements have you heard? Do you think they are true? Why or why not?

3) Be prepared to share your team's ideas with the whole class during the debriefing.

4) Cue up the video to where you started viewing it.

STATION 2: STUDENT DIRECTIONS

"Mind Meld" and Anticipatory Chart

1) Think individually about each of the first two columns ("What we think we know" and "What we would like to know") on your Shark Anticipatory Chart and write down some of your ideas.

SHARK ANTICIPATORY CHART

"What we think we know about sharks"	"What we would like to know about sharks"	"What we know to be true about sharks"

2) Pair up with another student on your team and compare/ discuss your ideas. If you like, go ahead and add to your chart lists after discussions with your partner.

3) Share the ideas the two of you came up with, with another pair of students on your team. Go ahead and add more ideas if you wish.

4) Have the entire team share their ideas and again add to your lists if you like. Be prepared to share your team's ideas with the entire class during the debriefing at the end of the station rotations.

STATION 3: STUDENT DIRECTIONS

Shark Survey

1) Individually complete your copy of the Shark Survey, then discuss your ideas with your team.

2) Plot your team's results on the Shark Survey Bar Graph transparency.

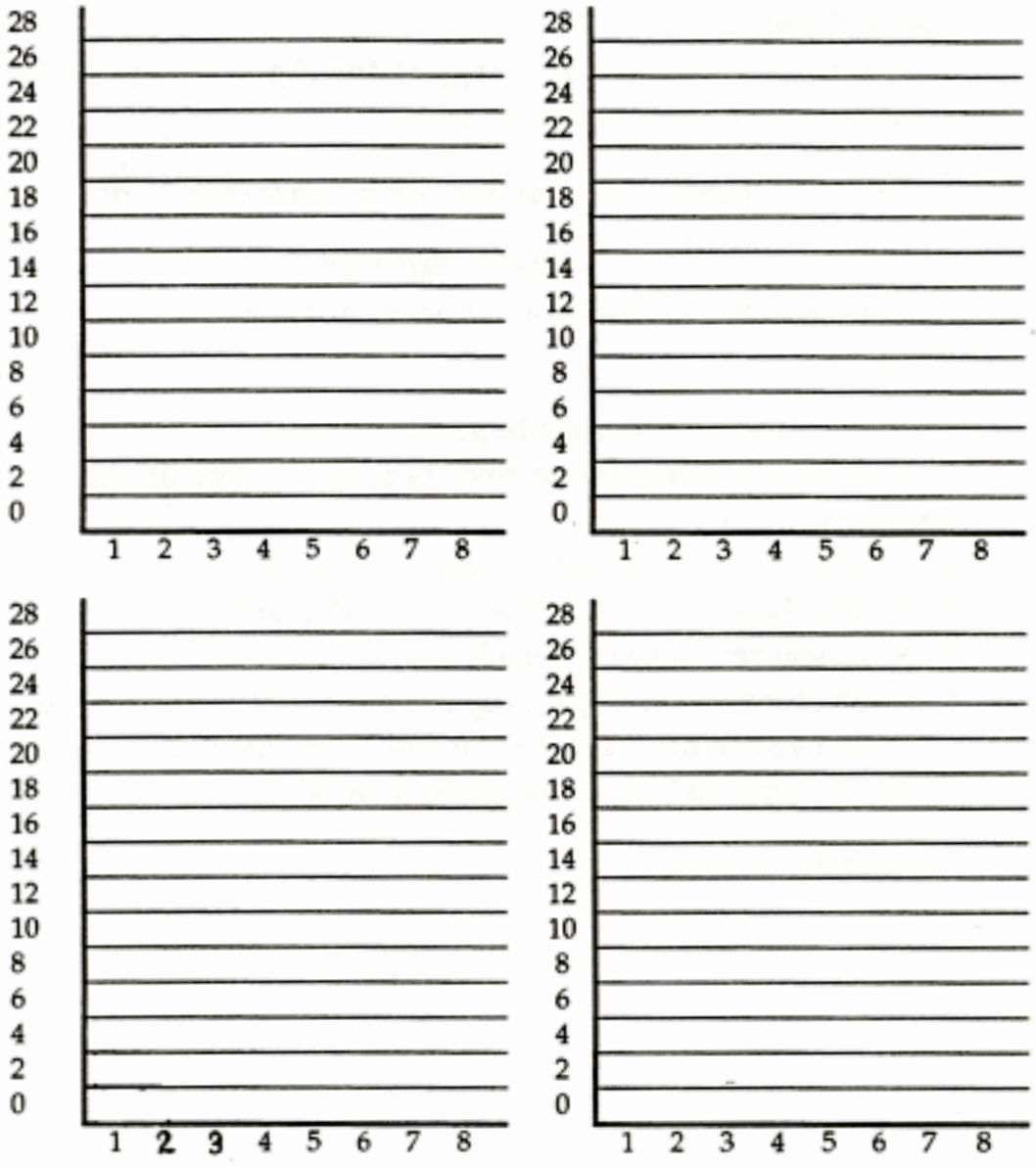
3) Place your completed bar graph near the overhead projector at the front of the room.

Shark Survey

Answer "yes", "no" or "don't know" to each statement or question below:

1. All sharks are dangerous to people.
2. Sharks have been around since before the time of the dinosaurs.
3. People are the greatest enemies of sharks.
4. Sharks have a well-developed sense of smell.
5. Have you seen a living shark?
6. Most countries have good regulations about shark fishing.
7. Would you be afraid to swim in the ocean because of sharks?
8. Do you want to learn more about sharks?

SHARK SURVEY BAR GRAPH



STATION 4: STUDENT DIRECTIONS

Sketch a Shark

1) Work with your team to create a poster of a shark, labeling any parts you already know. If you don't know the "right" word for a part, make up a word that describes what it is for or what it looks like.

2) Draw the shark BIG!

STATION 1: SHARK VIDEO AND DISCUSSION QUESTIONS

1) Our senses work well to perceive our environment. Do you think they would work just as well if we lived in the ocean?

2) How might our senses have to change if we lived in the ocean?

3) What are the first things that come to mind when you think about sharks?

4) In what ways are we similar to sharks, and in what ways are we different?

5) Think about what you've heard about sharks and what you've seen in the movies and on television. Two common statements are: "Sharks must always swim." "All sharks are bloodthirsty." What do you think of these statements? What other statements have you heard? Do you think they are true? Why or why not?

STATION 2: SHARK ANTICIPATORY CHART

"What we think we know about sharks"	"What we would like to know about sharks"	"What we know to be true about sharks"

STATION 3: SHARK SURVEY

Answer "yes," "no" or "don't know" to each statement or question below.

1) All sharks are dangerous to people.

___ **yes** ___ **no** __ **don't know**

2) Sharks have been around since before the time of the dinosaurs.

___ **yes** ___ **no** __ **don't know**

3) People are the greatest enemies of sharks.

___ **yes** ___ **no** __ **don't know**

4) Sharks have a well-developed sense of smell.

___ **yes** ___ **no** __ **don't know**

5) Have you seen a living shark?

___ **yes** ___ **no** __ **don't know**

6) Most countries have good regulations about shark fishing.

___ **yes** ___ **no** __ **don't know**

7) Would you be afraid to swim in the ocean because of sharks?

___ **yes** ___ **no** __ **don't know**

8) Do you want to learn more about sharks?

___ **yes** ___ **no** __ **don't know**

Background

Of the 368 known species of sharks, only about 20 are "man-eaters," or more correctly, "person-biters." The shark is possibly the most maligned of all animals. Literature and scientific studies over the years have reinforced the notion of sharks' stupidity and savage nature. Partly because of the attention that is often focused on sharks following a rare "attack," their reputation for ferocity is much overplayed. The vast majority of sharks are scavengers just looking for a meal and would never bother a human. Even predatory sharks have gotten a bad rap. It is now believed that many attacks by great white sharks are accidental. The great white has poor vision and apparently identifies its prey with an exploratory bite. If the item it bites does not match a known prey "feel," then the shark typically ignores the item. In any event, such feeding strategies were well in place millions of years before our earliest mammal ancestors were being accidentally squashed under the foot of a dinosaur.

Sharks first appeared in the Devonian Period, approximately 400 million years ago. By the Cretaceous Period, 135 million to 165 million years ago, all of the modern groups of sharks had been established. Today, sharks (and their close relatives, skates and rays) are known to comprise than 900 species, including the largest fish on earth, the massive whale shark, which can grow up to 60 feet in length. Incidentally, this giant filter-feeds on microscopic plankton.

Sharks, skates and rays belong to the class Chondrichthyes—the cartilaginous fish. Sharks have little true bone, present only in the base of their teeth and scales. Their entire skeleton is composed of cartilage. This cartilaginous skeleton has often been used as an indication of the "primitive" nature of sharks. In fact, cartilage is simply an excellent structural material for life underwater. It's light, flexible and resilient, and it affords rapid growth. If cartilage is an inferior and primitive material, we may need to reconsider our relationship to the cartilage in our ears and noses.

Success in the game of evolution is not measured in change, but in the longevity of a species. Having existed relatively unchanged for 400 million years, sharks are clear winners. This evolutionary success can be attributed in part to their reproductive strategies. Placental mammals (for example, humans) have viviparous birth, that is, the young gestate and receive all of their food and oxygen through a placenta connected to the mother. Most bony fish lay millions of eggs (oviparous), which have an extremely high mortality rate. Sharks, on the other hand, have internal fertilization and either retain their embryos within the uterus of the mother for extended periods of time (ovoviviparous) or they lay tough, camouflaged eggs that have large yolk sacs. The newborns are fairly large and well toothed at birth, which helps to reduce predation. The embryo of some ovoviviparous sharks, such as the sand tiger, the mako and the white, actually eat unfertilized ova when their own yolk sac is used up. Dissections of pregnant females have revealed that some unborn sharks also prey upon their siblings when yolk sacs have been depleted. The longest known

gestation period of any animal is that of the spiny dogfish shark. This shark gives birth 20 to 24 months after fertilization. And although the shark's reproductive strategies may have hallmarked its long evolutionary success, that same strategy may also prove fatal to many shark species.

In the last decade, the demand for shark products, fins in particular, has skyrocketed. The demand for shark fin soup, costing upwards of $30 a serving and considered a delicacy in numerous Asian cultures, has created an intense worldwide fishing effort centered on sharks. Pectoral, tail and dorsal fins are removed from still-living sharks and the remaining carcass is discarded. According to research generated by conservation groups such as WildAid, the only industry more profitable than shark finning is the global drug trade. This direct pressure and the overall expansion of fisheries to meet the escalating demand have taken their toll on shark populations around the world.

Despite our growing fascination with sharks, scientists still know relatively little about their biology and their ecological role in the structure and function of marine communities. What we do know is that sharks are frequently the top predators in the marine food chain. As a result, like lions and wolves, they often occur in relatively small numbers. The white shark, for example, is found in many places around the world, but it is generally rare anywhere it lives.

Even when sharks are not the target species for commercial fishing, their populations have suffered because of incidental harvesting, or by-catch, on gillnets, longlines, and seining for other commercially valuable species. Late sexual maturity, slow reproductive cycles, few offspring and the migration of populations through the fishing ranges of more than one nation has resulted in depleted populations of numerous shark species. Once they are overfished, these species may take decades to recover—or they may disappear entirely.