

ACTIVITY 8

Sharks in the Estuary

Estuary Principle

Estuaries support an abundance of life, and a diversity of habitat types. Plant and animal species that live in estuaries have specialized physical, biological, and behavioral adaptations which allow them to survive in the ever-changing estuarine environment.

Research Question

What are the basic characteristics of sharks that allow sharks to survive in the ever changing estuary environment?

Introduction

There are sharks in the estuary! This isn't something unusual or uncommon. Some sharks live in the estuaries. Other sharks come to the estuaries to feed or to reproduce. The more we study and learn about these misunderstood creatures, the more we can dispel the misgivings people have that all sharks are menacing man-eaters. In this activity, students will examine two sharks found in estuaries and identify features that make the sharks well suited to life in the estuary environment.

Table of Contents

Teacher Guide.....	2
Exercise: <i>How to Read a Shark</i>	4

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TEACHER GUIDE

Sharks in the Estuary

Research Question

What are the basic characteristics of sharks that allow sharks to survive in the ever changing estuary environment?

Content Objectives

Students will understand that:

- The elasmobranchs, or cartilaginous fish, include rays, skates, and nearly 400 species of sharks.
- The torpedo shape of the shark helps the shark swim quickly through the water.
- The shape and size of the caudal fin (tail) and dorsal (back) fins provide clues about how fast a shark might swim and whether a shark is hunting for fast prey in the open ocean or slower prey in the estuary.
- Different sharks have different teeth depending on what they eat.
- In addition to the sensory network made of the lateral line system and ampullae of Lorenzini, sharks also rely on hearing, smell, and vision.

Exercises

Exercise: How to Read a Shark

Students examine two sharks found in estuaries (the leopard shark and the sandbar or brown shark) and identify shark features that make the sharks well suited to life in the estuary environment.

Assessment Questions

Assessment questions based on content covered in *Sharks in the Estuary* can be downloaded on the web page for this activity in the Middle School Curriculum section of the Estuary Education website at estuaries.noaa.gov.

Vocabulary

Adaptation – an inherited change in a living thing that helps it survive better in its environment.

Behavior – the way an animal acts, especially in response to something in its environment.

Caudal fin – tail, provides forward mobility.

Countershading – coloration that features dark shading on the dorsal (top) side and light shading on the ventral (bottom) side, used as camouflage.

Dorsal fin – fin(s) on dorsal or back side of a fish.

Elasmobranchs – approximately 400 species of fish, including sharks and rays that have skeletons made of cartilage.

Ecosystem – the biotic community and its abiotic environment.

Estuary – a partially enclosed body of water where two different bodies of water meet and mix.

Gills – respiration organs that absorb oxygen from the water.

Habitat – the particular part of the environment where a plant or animal naturally lives.

Lateral Line – canal running along the sides of a fish that is used by the fish to sense movement and vibration in the water.

Pectoral fins – fins originating near the gills from the pectoral muscle area that stabilize and steer.

Predator – an animal that hunts, kills, and eats other animals.

Prey – an animal that is hunted, killed and eaten by other animals.

Vertebrate – animal having a backbone.

Taking It Further

Sharks are often misunderstood. Here are a few things you and your students can do to help advocate for sharks and shark awareness:

1. Start by educating yourselves about sharks. Visit NOVA's Island of the Sharks: Exploding Myths web page with your students to learn about some of the countless myths and misconceptions surrounding these creatures. Mary Cerullo's book, *The Truth About Great White Sharks*, is also a great resource.
2. Work with your students to write letter and/or emails to local, state, national, and international leaders about the need for shark conservation. Encourage your students to create posters to post around your school and community that inform the public of the need for shark conservation.
3. Start a fundraiser to raise money for shark conservation at your school. Ask your students to think creatively about items that they can sell. Research the best organization to receive your donation.

Through each of these efforts, your students will not only learn about sharks, they will also learn about the importance of civic action in affecting change.

For links to web pages referenced in this activity, visit the Middle School Curriculum section of the Estuary Education website:
<http://estuaries.noaa.gov>.

EXERCISE

How to Read a Shark

Estuary Concept

Sharks have specialized physical, biological, and behavioral adaptations.

Focus Questions

- What are the basic characteristics of elasmobranch fishes such as sharks?
- How are sharks adapted to living in their environment?
- How do the various structures of sharks relate to function?

Performance Tasks

Students will:

- Identify the key characteristics of sharks.
- Examine different shark species to compare and contrast body features and adaptations.
- Correlate different shark body features and adaptations to specific environmental needs such as ability to swim fast, feed along the bottom, detect prey from a distance, etc.

Teacher Background

There are about 400 species of sharks in the world. They live in a broad range of marine habitats, from the deep ocean to the shallow coastal waters, including estuaries. Even though sharks are considered to be primarily an ocean species, they are commonly found in the lower and middle reaches of estuaries. As with other fish, the estuary is a nursery ground for sharks. You can see this in the sizes and ages of the sharks found in the estuary (typically younger and therefore smaller).

Sharks use the shallow, protected water of estuaries to escape their potential predators and to feast on the abundant prey found there. In the estuary, sharks are considered one of the apex predators, meaning they are often at the top of the food chain. Sharks are primarily carnivores and their diets consist chiefly of fish, crabs, shrimp, squid, and other sharks — foods that are all common in the estuary.

Overview

In this exercise, students will examine two types of sharks found in estuaries (the leopard shark and the sandbar/brown shark) and compare them with at least one open-ocean shark species. Students will examine shark features and how those features and adaptations provide clues as to where and how a shark lives. This activity is adapted from How to Read a Fish by Margaret Olsen.

Time required

One and a half 45-minute class sessions

Shark Specimens

Biological supply houses sell preserved dogfish shark specimens for dissection. These sharks are typically around two feet in length and sell for around \$15 per specimen. However, in the interest of shark conservation, please consider using models, photos, or virtual resources instead of dead sharks. Some biological supply and art supply companies carry plastic or rubber shark models.

Teacher Preparation

Obtain shark specimens, models, and/or photos representing a minimum of three shark species. If you are using shark photos, enlarge and then laminate them prior to using. Be sure to include the leopard and sandbar (or brown) sharks, both of which frequent estuaries. You will find photos and other information about these two shark species on the web page for this activity on the Estuary Education website at estuaries.noaa.gov. You should then choose at least one open-ocean shark, such as the blue shark or tiger shark.

1. You may want to gather additional shark identification and shark biology resources that your students can refer to during the exercise.
2. Make copies of Student Master: *How to Read a Shark*, including the Data Table and the Background article. Students will need additional copies of the data table if you are showing them more than three shark specimens.
3. Number the shark specimens and place them around the classroom in a way that will be convenient for student viewing

Procedure

1. Distribute copies of Student Master: *How to Read a Shark*.
2. Students should read the Background article as homework the night before the activity.
3. Review the directions for the activity with your students before they begin. Show students where the shark specimen, models, photos, etc. are located and be sure to tell them how many sharks they must examine.
4. Have students move from specimen to specimen and record data in their data table.
5. Students then answer the questions on the Student Master. Possible student answers to the questions are provided below.

Questions and Possible Answers

Q1. What are the basic characteristics of elasmobranch fishes?

The elasmobranch fishes are cartilaginous. Their skeletons are made of cartilage instead of bone. Elasmobranchs also have a type of tough scales that are actually modified teeth, useful for protection and for letting the fish slide more easily through the water.

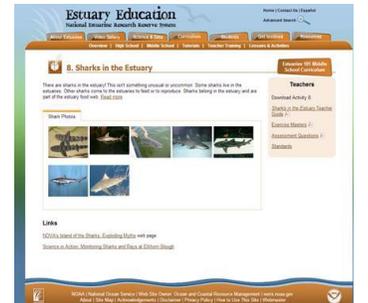
Q2. What body part does the shark use to move itself through the water?

The shark uses its caudal (tail) fin to move itself through the water.

Q3. How do sharks defend themselves?

Smaller sharks can still be the prey of larger sharks. Sharks use coloration to provide themselves with camouflage. Countershading is a special form of coloration that allows a shark that's swimming up off the bottom to blend in with the water above or below. Sharks also have special, tooth-like scales that make their skin extra tough. Sharks can also swim away quickly or bite an attacker.

You'll find multimedia and other resources on the web page for this activity in the Middle School Curriculum section of the Estuary Education website: <http://estuaries.noaa.gov>.



Materials

Per student:

- Student Master: *How to Read a Shark*

Q4. How do sharks detect their prey?

While sharks have eyes, their sense of smell is even more important. They are able to smell very tiny amounts of blood in the water and can detect the presence of nearby fish using smell alone. They also have their lateral line and their ampulae of Lorenzini to detect movement.

Q5. Leopard and sandbar sharks feed and live in estuaries. How are these sharks adapted for feeding in this particular habitat?

Leopard and sandbar sharks have unique coloration that allows them to blend in with the muddy estuary bottom. They are both bottom feeding sharks. Their mouths are on the bottom of their heads and their teeth are made for gripping and crushing invertebrates found along the bottom.

Q6. In your own words, explain how the adaptations of a shark's body (its coloration, body shape, mouth position, fin position, and swimming style), indicate where that shark lives and feeds.

Student answers will vary. Students should discuss the importance of mouth position in terms of bottom feeders versus sharks that hunt in the open ocean. Student should mention different fin types and how those affect the speed of a shark, which is an adaptation to the speed of the shark's prey. Students may also discuss coloration and the specific adaptation of countershading.

STUDENT MASTER

How to Read a Shark

Sharks are amazing, often misunderstood animals. A shark's shape and other adaptations in the shark's body provide important clues as to where that species of shark lives, how it hunts, what it eats, and the role it plays in its ecosystem. The key to "reading" a shark is to examine these features and adaptations.

Procedure

1. Read the Background article beginning on the next page before coming to class.
2. Examine each of the preserved shark specimens, models, or shark pictures provided by your teacher.
3. Use the shark diagram to identify each shark's external organs, including the gill slits, spiracles, fins, eyes, jaws, lateral line, Ampulae of Lorenzini, and claspers.
4. Record data about your observations in the data table provided. You will need enough copies of the data table to answer the questions for all shark specimens.
5. When you are finished examining the sharks, use the Background article and data in your data table to answer the questions below. Record your answers on a separate sheet of paper.

Questions

- Q1. What are the basic characteristics of elasmobranch fishes?
- Q2. What body part does the shark use to move itself through the water?
- Q3. How do sharks defend themselves?
- Q4. How do sharks detect their prey?
- Q5. Leopard and sandbar sharks feed and live in estuaries. How are these sharks adapted for feeding in this particular habitat?
- Q6. In your own words, explain how the adaptations of a shark's body (its coloration, body shape, mouth position, fin position, and swimming style), indicate where that shark lives and feeds.

Background: How to Read a Shark

Fish are members of the phylum Chordata. That means that fish, like humans, are vertebrates and have backbones. All fish have a few major characteristics in common. Fish have backbones, live in the water, breathe through gills, swim using fins, and are cold-blooded. Fish also have several features that enable them to survive in their environment. They are all covered with scales, which serve as a protective outer covering. And fish have fins that enable them to swim, turn, stop, and remain upright in the water.

There are over 20,000 species of fish worldwide. Only about 400 of those fish species are sharks. Sharks and rays are elasmobranchs or cartilaginous fish, meaning that their skeletons are made of cartilage rather than bone like other fish. Elasmobranchs also have scales that are similar to their teeth, making their scaly outer coating extra protective and helping streamline their bodies so that they cut through the water with little effort.

Fish have adapted well to the different aquatic environments in which they live. By observing a fish's body shape, its behavior, mouth position, teeth shape, fin positions, and swimming style, you can figure out where the fish probably lives, how it lives, and sometimes figure out what it eats.

The same is true for sharks. Looking at a shark's body features and exceptional adaptations provide clues as to where that shark lives, how it hunts, what it eats, and the role it plays in its ecosystem. If you try, you can "read" a lot about a shark from its features.

Shark Features

Fins: Fins give fish mobility, stability, and maneuverability. Fish use fins to swim, turn or steer, stop, and to stay in place. There are two types of fins: paired (two fins, one on either side of the body) and median (unpaired single fins, located along the middle top or bottom of the body).

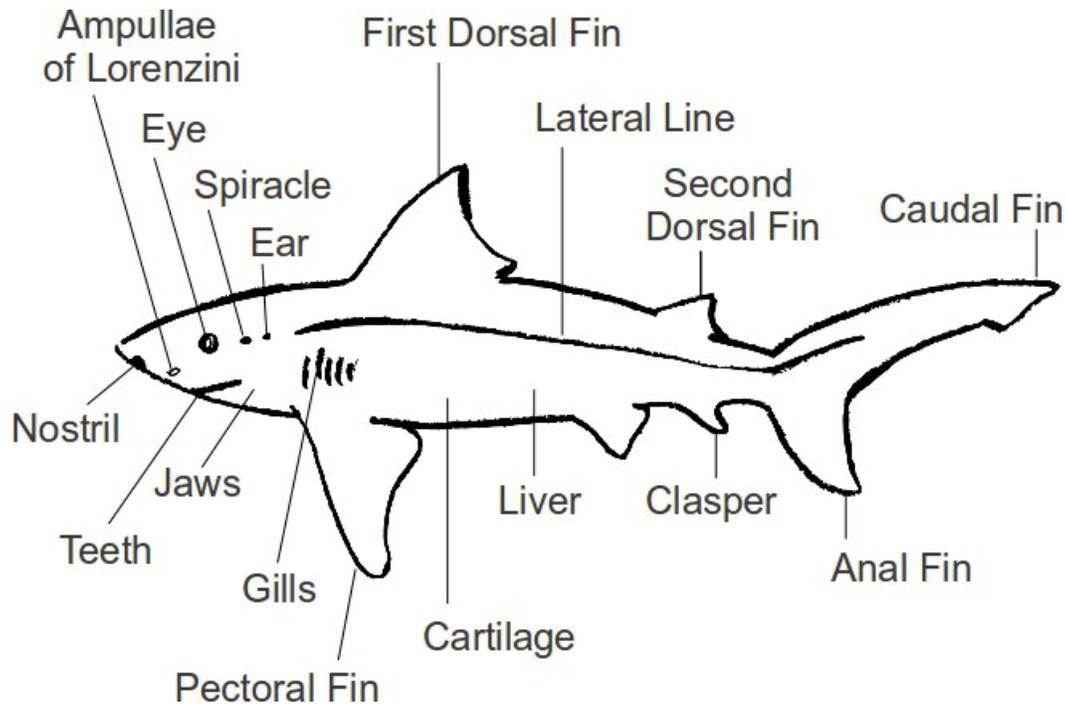
- **Dorsal fins** are median fins that act as keels and prevent the shark from spinning or rolling. Dorsal fins keep a shark upright and stabilized in the water so it can swim straight. Some sharks have large, forward dorsal fins while other, slower sharks may have two dorsal fins of nearly equal size.
- **The caudal fin** (or tail fin) is an unpaired median fin. Fish use their caudal fin to move through the water and to maneuver. The caudal fin generates swimming power and assists in turning, slowing down, and stopping. For sharks, the shape and size of the caudal fin and dorsal fins provide clues about how fast that type of shark swims and whether that shark hunts for fast prey in the open ocean or something a bit slower, such as a horseshoe crab or clams, in the estuary. Fast sharks have crescent shaped tails with one large dorsal fin and a small second dorsal fin that reduces drag and increases the shark's speed in the water. In slower sharks, the upper lobe of the caudal fin is frequently longer and more prominent.
- **The anal fin** is an unpaired median fin located near the tail. The anal fin serves as a stabilizer. Not all sharks have an anal fin.
- **The pectoral fins** are paired fins used for steering. Pectoral fins are angled in a way that helps provide lift as a shark swims.



This Lemon shark (*Negaprion brevirostris*) was caught during shark monitoring trip at Rookery Bay NERR.

Credit:Rookery Bay NERR

- **Pelvic fins** are also paired fins. Fish use pelvic fins for stabilizing and braking. Some fish have special adaptations for pelvic fins. Male sharks, rays, and skates use their modified pelvic fins for mating.



Body Shape: Fish tend to have body shapes suited for where they live and feed. Each shape has advantages for a different lifestyle. Most sharks are torpedo shaped, which is an ideal shape for fast, continual swimming. Fish with this body shape are well adapted for feeding and survival in open water because their body shape creates minimal drag as the fish swims through the water. Some sharks, such as the angel shark, have a body shape that is flattened from top to bottom. This body shape is ideal for living on the bottom.

Mouth and Teeth: Many fish have mouths on the bottom or underside of their heads instead of in front. This mouth position is useful for bottom feeding. Bottom feeding sharks, such as nurse sharks, also have barbels, small whisker like projections near the mouth, which help sense potential prey just below the sand or mud. Sharks are known for their teeth. Sharks teeth are not always the same. Different sharks have different teeth depending on what they eat. For example, some open ocean sharks that feed on large fish and turtles have teeth for cutting. Bottom feeding sharks that live closer to the shoreline may have teeth for gripping and crushing invertebrates.

Color and Pattern: The color and pattern of designs on a fish's body creates camouflage, which provides protection from predators. Some fish have stripes that run from tail to head, or color bands that run around the body. Other fish have spots or speckles. One clever use of different colors to create camouflage is called countershading. A fish with countershading is dark on top and light on the bottom. If you, or a predator, were to look down on the fish from above, the fish would seem to blend in with the darker, deeper water below. If you were below the fish and looking up, the lighter bottom of the fish might appear to blend in with the lighter water nearer the surface. Countershading is common in sharks that swim in the open ocean. In the case of sharks, countershading can make the shark a sneakier hunter.

Sensory organs: Sharks have eyes, of course. And sharks "noses" are so sensitive that they can "sniff out" as little as one part per ten billion of fish extract or blood in the water. But they also have other ways of sensing movement and vibration in the water. Like other fish, sharks have a lateral line running down their sides. The lateral line is a sensory organ. Sharks may actually be able to use their lateral lines to sense changes in magnetic fields and to sense the approach of severe storm systems. Elasmobranchs also have sensory organs called the ampullae of Lorenzini. These are very sensitive electroreceptors, able to pick up tiny electrical fields such as those given off by another organism's muscles. Clearly, these are useful adaptations to have for a shark hunting for food.

How to Read a Shark: Data Table

	Specimen #	Specimen #	Specimen #
Shark name			
1. Coloration:			
Are there signs of countershading? If so, describe it.			
Is the shark's coloration striped, banded, barred, or spotted? Describe how. If none of the above is present, describe the overall coloration.			
Explain how the shark's color is an adaptation for its habitat. In which habitat does the shark probably live?			
2. Look at the fins:			
How many dorsal fins are there?			
Describe the shape and size of the dorsal fin(s).			
Is the caudal fin forked or is the top lobe significantly longer than the lower?			
Describe the pectoral fins.			
From the fin descriptions, would you say that this shark was a fast or slow swimmer?			
3. Body Shape:			
Describe the shark's body shape.			
What is this shark's body shape probably adapted for?			

4. Mouth & Teeth:			
Are this shark's teeth shaped for cutting, grabbing, or crushing prey?			
Are there any barbels present? Is there a lateral line?			
Where does this shark probably feed?			
Predict from the above features of each shark:			
Its swimming style and speed (fast or slow).			
Its feeding style: open water or benthic (bottom).			