Shark Anatomy

Topics
Sharks, Adaptations

Grades
3-5

Site
Indoors

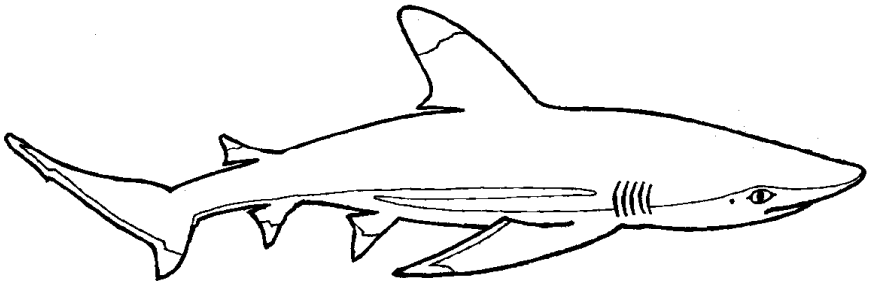
Duration
30 minutes (minimum)

Materials
- **Shark Anatomy Cards**
- **Shark Anatomy Language Frame**
- Nonfiction resources (books, magazines or websites) about sharks and rays
- Magazine or calendar pictures of sharks and rays
- Construction paper
- Drawing supplies
- Cardstock or stiff paper

Vocabulary
adaptations, cartilage, characteristic, denticles

National Science Education Standards
Life Science (K-4)
Characteristics of organisms
Organisms and environments

Life Science (5-8)
Diversity and adaptations of organisms



Overview

What makes a shark a shark? What adaptations help them survive in their habitats? Students explore shark anatomy by becoming "experts" on shark adaptations and physical characteristics. They take part in a debate justifying the importance of their adaptation or characteristic and then do research to see how specific sharks compare.

Objectives

Students should be able to:
- Identify two shark adaptations or physical characteristics and explain how each helps a shark to survive.
- Recognize that shark adaptations and physical characteristics vary with habitat and ecological role.

Background

All sharks belong to the class of fish called Chondrichthyes. Like fish, sharks have gills and fins. These physical **characteristics** help sharks and other fish to breathe and move underwater. But sharks have some specialized characteristics, or **adaptations**, that other fish don't.

Unlike bony fish, sharks lack true bones and have skeletons of cartilage, which consists of calcium phosphate and other minerals. The cartilage strengthens their body frames and makes them very flexible and lighter in weight than bony fish.

Sharks' bodies also have rough skin, which is covered with **dermal denticles,** known as placoid scales or "skin teeth." These scales are similar to human teeth, are covered with enamel and contain dentine. The scales continue to grow as the shark grows.

All sharks have five to seven pairs of gill slits for breathing. Water flows through the shark's partially opened mouth and out through the gills, where oxygen is absorbed. Some sharks, especially those that rest on the ocean floor, may have holes behind their eyes, called spiracles, that also aid in the flow of water.

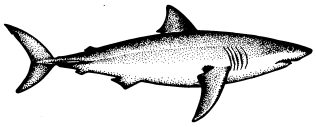
VOCABULARY

Adaptation: a body part and behavior that helps an organism survive

Cartilage: calcium phosphate and other minerals that make up a shark's skeleton; this is the same material in a human's nose and ears

Characteristic: a typical or distinguishable quality or feature

Denticles: a shark's rough skin is covered with these "skin teeth"



Sharks have rows of teeth or fused tooth plates, which are continuously replaced from inside the mouth. Many sharks prefer to eat fish, crabs or mollusks rather than mammals and have specialized teeth for surviving and eating in their habitats. None includes humans in their diet, unless it's a case of mistaken identity or opportunistic feeding.

The senses of sharks are very acute. Sharks have no external ear flaps but have two small pores on the top of their heads that connect to inner ear ducts. The inner ears of sharks consist of three fluid-filled semicircular canals and three otolith ("ear bone") organs. These organs have tiny hairs that bend when an animal moves near the shark. The hairs trigger the ear canal organs, and nerve cells send a message to the animal's brain about the prey's position and direction of movement. Like in humans, these inner ear canals are very important for balance and orientation. Sharks also have a lateral line which runs from head to tail. It is made up of small hairs within pores and helps a shark detect movements and vibrations it may not be able to hear in the surrounding environment.

Many sharks' eyes are on the side of their heads, allowing them to see forward, backward, up and down. Sharks have two eyelids that do not meet to cover the eye. Some sharks have a third eyelid, called a nictitating membrane, that covers the eyes for protection. The pupils appear as oval black patches and have the appearance of a cat's eye.

Sharks' nostrils, or nares, are located under their snout. The nostrils contain a pair of olfactory sacs that detect odors. Water flows in and through the sacs and carries smells to these organs. They also have clusters of sensory pores, called ampullae (am-PUY-lay) of Lorenzini, on their heads. These jelly-filled pores can detect very weak electrical signals given off by an animal's muscle movements.

The muscles and fins of a shark are what help it swim efficiently. The muscles are the shark's engine and helps it cruise for long distances. A shark's fins provide lift and enable it to effectively navigate. The stiff pectoral and pelvic fins help a shark move up and down and control the animal's movements. The caudal fin moves from side-to-side and propels the shark forward. Dorsal and anal fins prevent sharks from rolling from side to side when moving forward.

Unlike bony fish with gas-filled swim bladders for buoyancy, a shark's liver is filled with fatty oil, called squalene. This helps it adjust its buoyancy in the water column. Bottom-dwelling sharks have less squalene than open-ocean swimming sharks.

Despite popular perceptions of sharks as invincible, shark populations around the world are declining because of overfishing, habitat destruction and other human activities. Of the approximately 350 species of sharks, 79 are imperiled, according to the International Union for the Conservation of Nature. Buying seafood caught using fishing methods with a low occurrence of bycatch (see www.seafoodwatch.org for more information) and supporting marine protected areas in which human activities are more regulated all help protect shark populations.

Teacher Preparation

1. Gather shark and ray images and information from nonfiction resources and websites. Find an labeled image of shark anatomy (see http://www.seaworld.org/infobooks/Sharks&Rays/sharkanatomy.htm for an example).

2. Make one set of **Shark Anatomy Cards** to use with your class. Print them back-to-back with the **Shark Anatomy Images** or with the **Shark Anatomy Answer Cards** using cardstock or stiff paper. You may also choose to write your own. Each student or student pair will need one card.

3. Make copies of the **Shark Anatomy Language Frame** or project it and have students use their notebooks to write answers.

Procedure

Part One: What Makes a Shark a Shark?

1. **DISCUSS WHAT ADAPTATIONS AND PHYSICAL CHARACTERISTICS THE STUDENTS HAVE THAT HELP THEM SURVIVE.**
   Depending on prior knowledge, you may introduce the word "adaptation." Then ask students what adaptations and physical characteristics they have. *(hands to put food in their mouths, thumbs for opening cans and doors, voices for talking, lungs for breathing air, toes and feet for balance, legs for walking and running)*

2. **INVESTIGATE WHAT ADAPTATIONS AND PHYSICAL CHARACTERISTICS SHARKS HAVE FOR SURVIVING IN THE OCEAN.**
   As a class, brainstorm adaptations and physical characteristics sharks may have and list them on the board or chart paper. You may use guiding questions such as: *How do sharks eat? How do sharks swim? How can they breathe underwater?* Have individuals or student pairs randomly choose one **Shark Anatomy Card.** Then pass out one **Shark Anatomy Language Frame** per student or student pair. Have the students use research materials to gather more information on that adaptation or characteristic and complete the language frame. If short on time, you may pass out the **Shark Anatomy Answer Cards** instead of having students do their own research.

3. **DEBATE THE IMPORTANCE OF DIFFERENT SHARK ADAPTATIONS AND CHARACTERISTICS.**
   After students have become "experts" on their shark adaptation or characteristic, give them time to prepare an argument for why their adaptation or characteristic is the most important one for shark survival. In a brief presentation to the class, have students introduce their adaptation or characteristic, label it or point it out on a large shark image and share their argument. (For younger groups, you may just have them share the adaptation or characteristic and how it helps a shark.) Have the class label or draw each adaptation or characteristic on their language frame when it is presented.

4. **DISCUSS HOW ALL THE ADAPTATIONS AND CHARACTERISTICS ARE IMPORTANT FOR THE SHARKS' SURVIVAL.**
   After all the adaptations and characteristics have been presented, ask the class to vote on "Which is the most important?" There will probably be a variety of opinions. Use this to lead into a discussion of why ALL the adaptations and characteristics are important and to clear up any misconceptions of sharks as dangerous "man eaters."

ELL TIPS

Before doing this activity, practice pronouncing and defining words on the **Shark Anatomy Answer Cards** that may be difficult for struggling readers.

CONSERVATION TIPS

Estimates are that 100 million sharks are caught and killed each year.
Half of those shark are caught accidentally and discarded.
By choosing seafood that is caught sustainably you can help reduce this number. Go to seafoodwatch.org for more information.

DID YOU KNOW?

The largest known shark is the whale shark, which reaches 50 feet in length.

One of the smallest known sharks, the pygmy ribbontail catshark, may only grow to 6 inches in length!

Part Two: Shark Diversity

1. **Each student chooses a different shark to research, draw and label.**
   Have students each choose a different shark species to research and then draw. Have students write the habitat it lives in and identify and label the animals' external and internal structures and camouflage patterns. Next have them write an explanation of how their animal's anatomy and other adaptations help it survive in its habitat. (For younger students, choose one shark for the class to research, draw and explain its physical structures.)

2. **In small groups, students compare and share their sharks and adaptations.**
   Have students get in small groups to compare and contrast their sharks. *How are the sharks alike? How are they different? What are their habitats? How might the adaptations vary with habitat?* Students should notice that fin shape, body shape, camouflage techniques and so on vary depending on habitat and "lifestyle." Some sharks live in the open water and some live on the ocean floor. Some sharks eat fish, others depend on clams and other organisms on the ocean floor as a food source.

3. **As a class, discuss how shark adaptations and characteristics vary with habitat and "lifestyle."**
   Have students share how their sharks were the same and different. Discuss the advantages of the different variations.

Extensions

- Compare a shark with a ray or bony fish. Make a Venn diagram showing what is alike and what is different.
- Make a shark anatomy book with students. Use a die-cut machine, fold a piece of construction paper in half and cut out a shark image. Make one per student. (You may choose to use the cut-out pieces for a different activity.) Cut some transparency sheets in half. Pass out the die-cut construction paper and cut transparency sheet to each student. Have students select a **Shark Anatomy Card** and draw that adaptation or characteristic on the transparency sheet. Have students make shark "windows" by placing the sheet inside the die-cut construction paper and writing explanations for how the adaptations help sharks survive on the construction paper. Staple all of the "windows" together, making a book.

Resources

Website

Monterey Bay Aquarium. www.montereybayaquarium.org
Observe sharks on the live web cams and watch short shark online videos. Print shark, ray and other animal fact cards. Read about why some sharks are endangered and other shark conservation issues.

Books

The Encyclopedia of Sharks. Parker, Steve and Jane Parker. Firefly Books, 2005.
Eyewitness Books: Shark. MacQuitty, Miranda. Knopf Books for Young Readers, 1992.
A Guide to Sharks and Rays. Tricas, Timothy C., et. al. Time Life Medical, 1997.
1001 Facts about Sharks. Pope, Joyce. Dorling Kindersley, 2002.
Uncover a Shark. Gordon, David George. Silver Dolphin Books, 2004.

Standards

California Science Standards

Grade 3: 3a, b, c, d; 5a, b
Grade 4: 3b, 4b, 6a
Grade 5: 2b, c, d; 6a

California Language Arts Standards

Reading
Writing
Written and Oral English Language Conventions
Listening and Speaking

THE MISSION OF THE MONTEREY BAY AQUARIUM IS TO INSPIRE CONSERVATION OF THE OCEANS.

Shark Anatomy Language Frame

Name:

Fill in the blanks below.

A shark has _____ *(body part)*

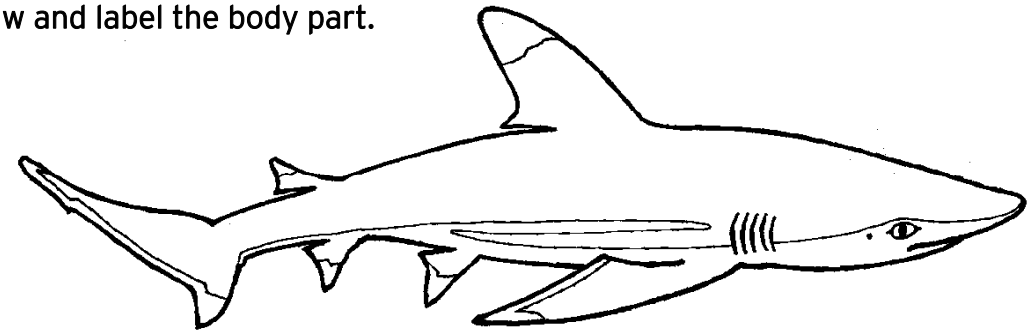
which _____*(describe).*

It helps the shark _____*(function).*

It is the most important body part for the shark's survival because

_____*(your opinion).*

Now draw and label the body part.



Shark Anatomy Language Frame

Name:

Fill in the blanks below.

A shark has _____ *(body part)*

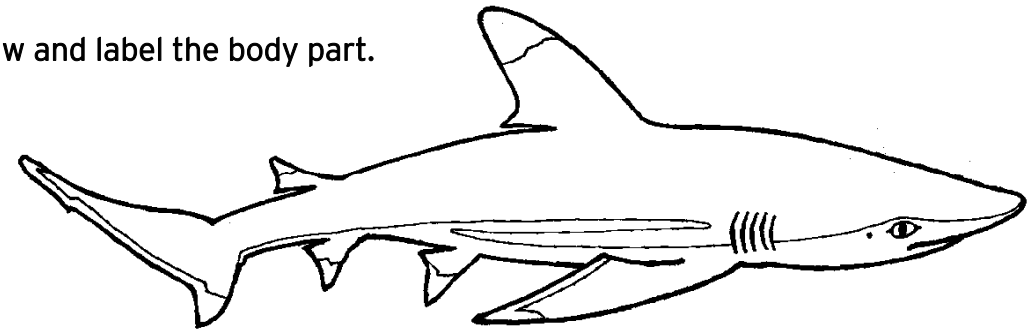
which _____*(describe).*

It helps the shark _____*(function).*

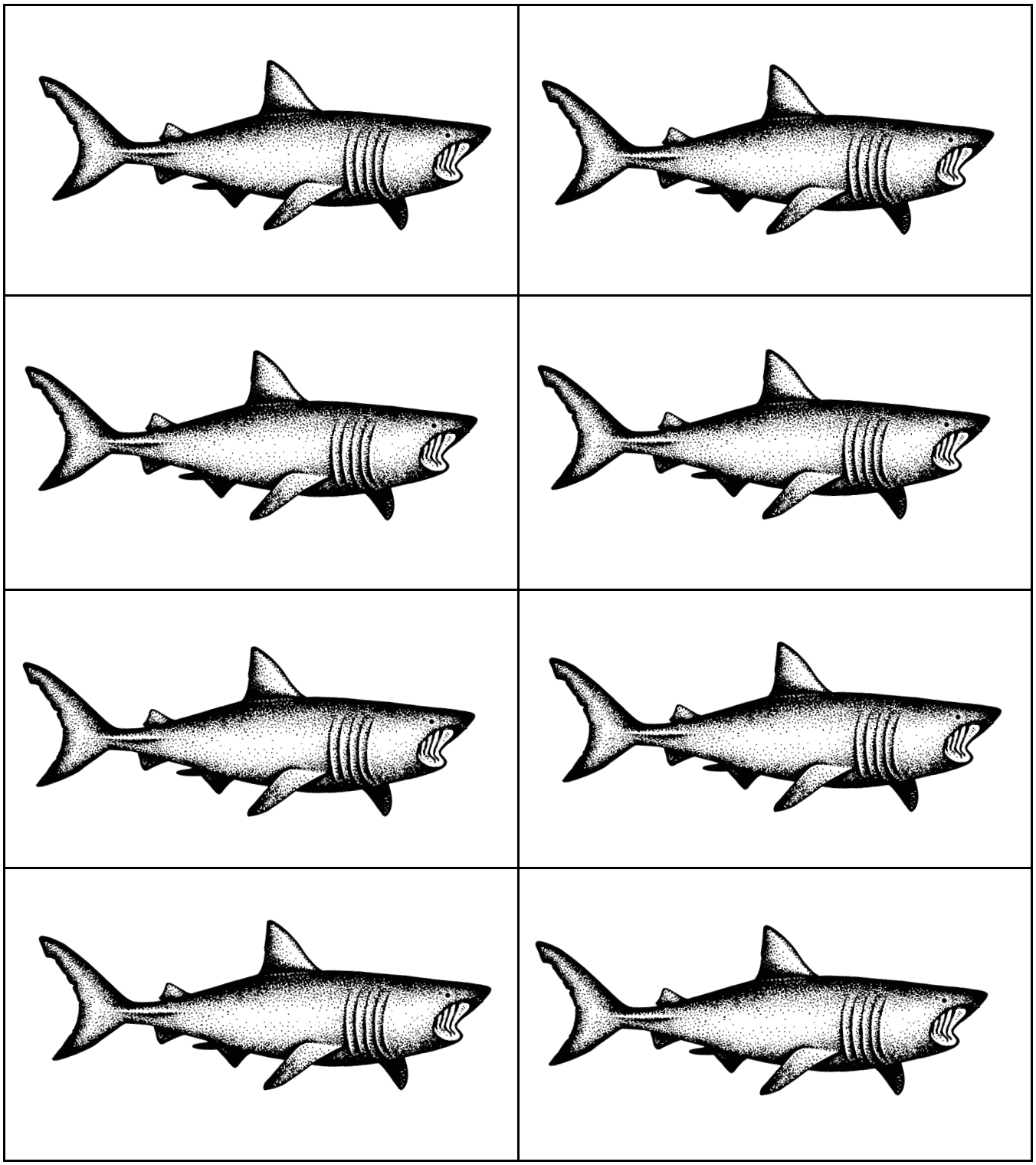
It is the most important body part for the shark's survival because

_____*(your opinion).*

Now draw and label the body part.



Shark Anatomy Images



Shark Anatomy Cards
#1

dermal denticles ("skin teeth")	cartilaginous skeleton
spiracles (holes behind the eyes)	gill slits
teeth	jaws
eyes and eyelids	inner ears

Shark Anatomy Cards
Answer Key #1

cartilaginous skeleton Sharks skeletons are made of cartilage, which is what your nose and ears are made out of. Cartilaginous skeletons are tough, weigh less and are much more flexible than bony skeletons, allowing sharks to make sharp quick turns.	**dermal denticles ("skin teeth")** These small tooth-shaped scales on the skin of a shark's body reduce drag as it swims, allowing a shark to slip quickly and quietly through the water.
gill slits Gills are the respiratory organ of sharks and other fish. Water comes in through the spiracles and passes over the gills. Dissolved oxygen moves from the water into the blood of the shark. The water then leaves the shark's body through its gill slits.	**spiracles (holes behind the eyes)** Spiracles are small openings on the head of a shark, just behind the eyes. Water enters the shark's body through the spiracles, passes over the gills and then leaves the shark's body through gill slits.
jaws In some species or kinds of sharks, like the white shark, the upper jaw is not connected to the skull. This allows the shark to take huge, powerful bites and tear its food.	**teeth** Teeth line sharks' jaws in multiple rows. As the teeth in the front row are damaged or lost, teeth from the back row move forward. Sharks lose and replace thousands of teeth throughout their life. Teeth are used in feeding for cutting, tearing, and grasping.
inner ears Sharks hear low-pitched sounds through two small holes or pores at the top of their head. Sharks' inner ears, which are very similar to the inner ears of humans, also help sharks maintain their balance in the water.	**eyes and eyelids** Sharks' eyes are well developed and very sensitive. They can see very well, even in very low light conditions. The size, shape and position of sharks' eyes vary depending on where they live as well as what and how they hunt. Some sharks have a moveable lower eyelid called a *nictating membrane* that rises to shield the eyes from possible damage during feeding.

Shark Anatomy Cards
#2

lateral line	muscles
heart	camouflage
stomach	intestine
ampullae [am-PUY-lay] of Lorenzini (sensory pores)	olfactory organs (nostrils)

Shark Anatomy Cards
Answer Key #2

muscles Muscles allow sharks to move their bodies during swimming, eating and mating. Powerful muscles in the tail help sharks move through the water and travel long distances. Muscles in the jaw allow some species of sharks to take powerful bites.	**lateral line** Made up of small hairs within pores, the lateral line senses vibrations in the water and helps sharks locate other animals in the surrounding environment. Knowing the location of other animals can assist sharks in catching prey or avoiding predators. The lateral lines are found on both sides of sharks bodies and extend from the head to near the tail.
camouflage Some species of sharks are camouflaged, which helps them avoid predators and makes it easier for them to surprise unsuspecting prey. Certain species, such as the white shark, have a special type of camouflage called counter-shading – a light belly and dark back. From above, the dark back blends in with the dark ocean below; from below, the lighter belly blends in with the surface light from above.	**heart** Sharks' hearts have two muscular chambers that pump blood throughout their bodies. The heart pumps low-oxygen blood to the gills, where it takes up oxygen. This oxygen-rich blood is pumped throughout the rest of their body.
intestine Sharks' intestines are spiral shaped. The spiral shape takes up less space inside their bodies, slows the movement of food and provides lots of area where nutrients can be absorbed.	**stomach** Most sharks swallow their food whole or bitten into relatively large pieces. Strong acids in sharks' stomachs digest the prey.
olfactory organs (nostrils or nares) Sharks have a very keen sense of smell. Some species of sharks can smell a drop of fish blood in a million drops of seawater. This characteristic allows some species of sharks to hunt injured prey. It helps other sharks find prey buried in the sand.	**ampullae [am-PUY-ley] of Lorenzini (sensory pores)** Ampullae of Lorenzini are small sensory pores filled with a jelly-like substance on the tip of sharks' heads. These pores help sharks detect bioelectricity - the weak electrical current that living things produce. By sensing bioelectrical pulses, some sharks can find hidden prey.

Shark Anatomy Cards
#3

pelvic fins (bottom fins)	pectoral fins (side fins)
dorsal fins (top fins)	caudal fin (tail fin)
liver	anal fins (bottom fins)

Shark Anatomy Cards
Answer Key #3

pectoral fins (side fins) The stiff pectoral fins, located on each side of sharks, act a lot like airplane wings, allowing sharks to steer up and down or side to side.	**pelvic fins (bottom fins)** The pelvic fins located on the underside of sharks allow them to change directions when swimming.
caudal fin (tail fin) The tail, also called the caudal fin, provides the power for sharks to swim forward.	**dorsal fins (top fins)** The dorsal fins on sharks' backs aid in stability during swimming.
anal fins (bottom fins) The bottom back anal fin assists sharks in stability and balance. However, not all sharks have an anal fin.	**liver** The liver is one of the largest organs in sharks. It filters waste from sharks' blood, stores vitamins and helps sharks turn food into energy. The large oily liver also helps sharks stay afloat.