Goals of the SeaWorld and Busch Gardens Education Departments

Based on a long-term commitment to education and conservation, SeaWorld and Busch Gardens strive to provide an enthusiastic, imaginative, and intellectually stimulating atmosphere to help students and guests develop a lifelong appreciation, understanding, and stewardship for our environment. Specifically, our goals are ...

- To instill in students and guests of all ages an appreciation for science and a respect for all living creatures and habitats.
- To conserve our valuable natural resources by increasing awareness of the interrelationships of humans and the environment.
- To increase students' and guests' basic competencies in science, math, and other disciplines.
- To be an educational resource to the world.

"For in the end we will conserve only what we love. We will love only what we understand. We will understand only what we are taught." — B. Dioum

Shark!

K–3 Teacher's Guide

PART OF THE SEAWORLD EDUCATION SERIES

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Front: sandtiger shark *(Carcharias taurus)*

Back (clockwise from left): bonnethead shark *(Sphyrna tiburo)*, swell shark *(Cephaloscyllium ventriosum)*, sandtiger shark *(Carcharias taurus)*, brown shark *(Carcharhinus plumbeus)*

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Shark!

K–3 Teacher's Guide

A SEAWORLD EDUCATION DEPARTMENT PUBLICATION

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To the Teacher

The ***Shark!*** Teacher's Guide for grades K–3 was developed at SeaWorld to help you teach your students—in an active, hands-on way—about sharks and the ecology of the ocean. Our goal was to integrate science, mathematics, art, and language. SeaWorld curriculum supports the *National Science Education Standards.*

The brief background information in this Guide was written for you, the teacher. It will help you do these activities with your students. We suggest you also refer to some of the materials listed on page 24 for more in-depth information. SeaWorld strives to provide teachers with up-to-date information and activities that motivate students to appreciate and conserve wildlife, the oceans, and the natural world.

Do you have comments or suggestions regarding the activities in this Teacher's Guide? We'd love to hear your opinion. Write the SeaWorld San Diego Education Department, email us at *SWC.Education@Anheuser-Busch.com* or call 1-800-380-3202.

Goal of the Shark! Unit

Students explore the natural history of sharks and recognize that humans are an interconnected part of sharks' ecosystems.

Objectives

After completing the SeaWorld Shark! Unit, the student will be able to...

1. Create an artistic impression of a shark and identify shark body parts.
2. Explore ways to measure the size of a shark.
3. Portray a shark's ecosystem.
4. Investigate the sense of smell.
5. Discuss ways people impact shark populations and make suggestions for how people can conserve sharks.
6. Describe what sharks eat.
7. Evaluate how schooling behavior is an adaptation for avoiding predators.
8. Share their learning experience with family and friends.

Vocabulary

anal fin — the median fin located on the underside of a fish, between the anus and the caudal fin. (Not all fishes have an anal fin.)

bony fish — any fish of the class Osteichthyes, characterized by a skeleton of bone.

bycatch — nontarget animals caught during a fishing operation.

cartilage (CAR-tih-lij) — a type of tough, flexible connective tissue. Cartilage composes the skeleton of sharks and all very young vertebrates.

caudal fin — the tail fin.

Chondrichthyes (kon-DRIK-theez) — a scientific class of fishes that have jaws, paired fins, paired nostrils, and a skeleton composed of cartilage.

conservation — taking care of our environment by wisely managing its resources.

dorsal fin — a fin on the back of a whale or fish.

ecosystem — a unit of plants, animals, and nonliving components of an environment that interact.

finning — the practice of removing only a shark's fins, which are used in sharkfin soup.

gill slits — slitlike openings through which water leaves a shark's gills.

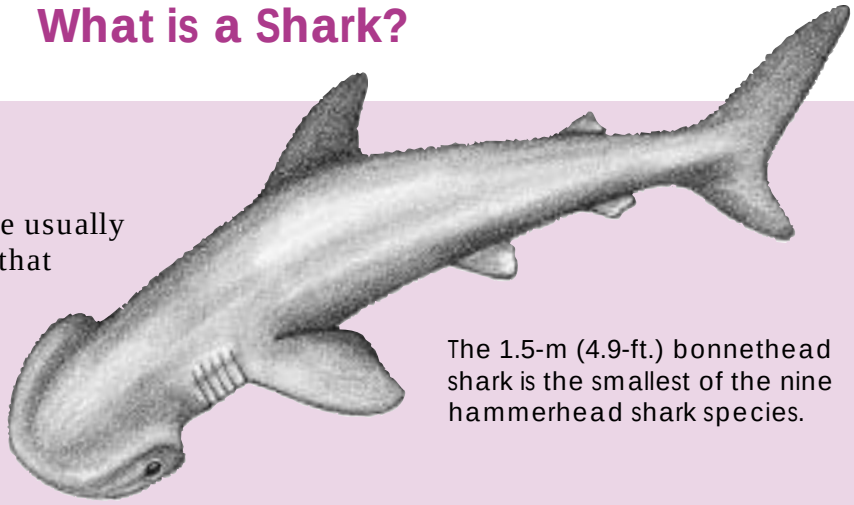
gyotaku (gyoh-TOCK-oo) - the art of fish printing, which originated in Japan or China in the early 1800s as a way for fishermen to record their catch.

pectoral fins —the pair of fins toward the front of a fish's body.

pelvic fins — the paired fins on the underside of a fish's body, behind the pectoral fins.

venomous — having venom-producing tissue and able to inflict a toxic wound.

What is a Shark?



The 1.5-m (4.9-ft.) bonnethead shark is the smallest of the nine hammerhead shark species.

What do you picture?

When we think of sharks, we usually think of sleek, large species that stalk the seas for fishes and marine mammals. Some do just that. But not all. The huge basking shark feeds on plankton. And the small horn shark crushes and eats clams lobsters, and crabs. Some sharks are giants—longer than a school bus. Some are tiny enough to hold in your hand. Some spend their entire lives in motion. And some rarely stir from the sea bottom. Yet they are all sharks.

A shark has five kinds of fins.

A shark's tail is called its *caudal fin*. The caudal fin propels the shark forward. The paired fins toward the front of a shark are its *pectoral fins*. Pectoral fins lift a shark as it swims. The fins on a shark's back are the *dorsal fins*. *Pelvic fins* are paired fins underneath the shark, and the *anal fin* is a single small fin near the tail. The dorsal, pelvic, and anal fins all stabilize the shark as it swims.

Sharks swam the seas long ago.

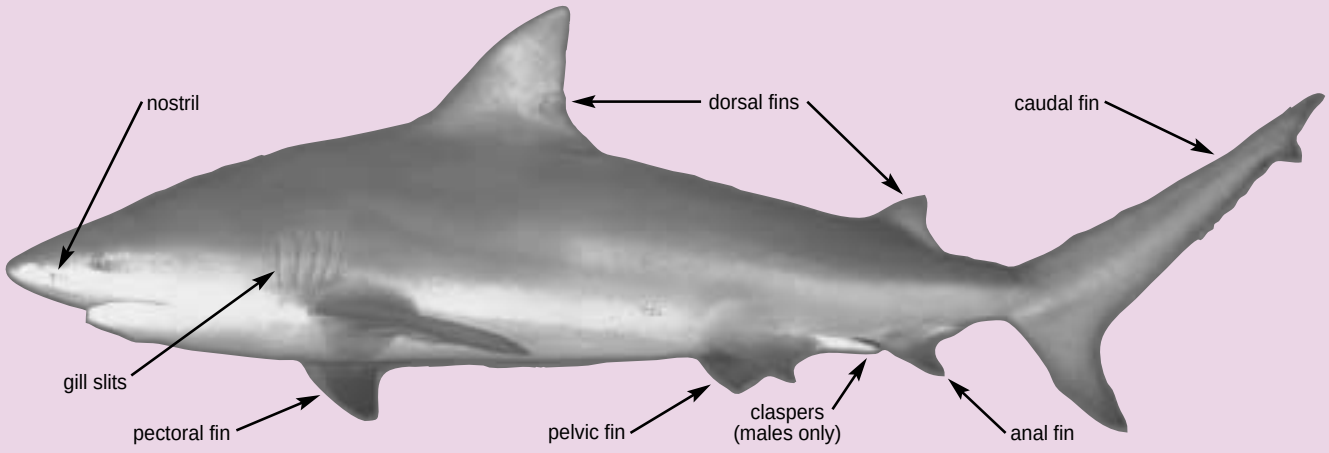
Sometimes people describe sharks as being "primitive" fishes. What does that mean? It means that most of the families of sharks alive now were swimming the seas when dinosaurs roamed the earth. Unlike other animals, sharks have changed very little since then.

You can tell males from females.

Only male sharks have claspers—a pair of organs attached to the pelvic fins. So it's easy to tell males from females.

Where do sharks live?

Sharks live all over the world, from tropical lagoons to polar seas. Some even inhabit freshwater lakes and rivers.



Fins lift, stabilize, and propel a shark as it swims.

A Shark is a Fish

Sharks have typical fish features.

Like other fishes, all sharks are cold-blooded. They have a skeleton and fins, live in the water, and breathe with gills. Most fish in the world are called *bony fishes.* Their skeletons are made of bone, as are ours. There are more than 23,500 different species of bony fishes in the world, but less than 400 different species of sharks.

So what's the difference?

One thing that makes sharks different from bony fishes is that a shark's skeleton is made of *cartilage*, not bone. Cartilage is a tough connective tissue. We have cartilage in parts of our bodies, too. Push on your nose or squeeze your ear to feel cartilage.

Another difference between sharks and bony fishes is their scales. Most bony fish scales are round, and as the fish grows, so do its scales. In fact, you can estimate how old some fish are by counting the rings in their scales, just like counting tree rings. Shark scales are different. Each one looks like a miniature tooth. And they have the same structure as a tooth: an outer layer of enamel, a layer of dentine, and a pulp cavity. Sharks' scales don't grow bigger as the shark ages. As a shark grows, it grows more scales. These toothlike scales make a shark's skin rough, like sandpaper.

Shark scales look like miniature teeth.

Sharks have lots of teeth.

A shark has several rows of teeth in its mouth. Sharks bite with the outer row of teeth, but eventually these teeth fall out. A tooth from the row behind moves up to take its place. Another difference between sharks and bony fishes is that sharks grow new teeth all the time. Some sharks may go through as many as 30,000 teeth in a lifetime.

A shark has several rows of teeth.

Think of a batoid as a flat shark.

The closest relatives of sharks are called batoids. Like sharks, they have toothlike scales and skeletons made of cartilage. What makes them different from sharks is that their bodies are flat, and the front fins are fused with the head. Some batoids, like stingrays, have one or more *venomous* spines on a whiplike tail. The sharp spine can deliver a painful sting.

A bat ray *(Myliobatis californica)* is a batoid.

Sharks are Predators

Most sharks would rather avoid you. But 32 kinds of sharks have been known to attack people.

What do sharks eat?

Some sharks are probably not very picky about what they eat. But certain kinds of sharks eat some foods more than others. Hammerhead sharks eat mostly stingrays. Smooth dogfish eat mostly crabs and lobsters. Tiger sharks eat mostly sea turtles. Blue sharks eat squids. And whale sharks eat plankton.

Many sharks prey most often on the weakest members of a population. Sharks eat weak, ill, or injured animals because they are the easiest to catch.

These predators have poor appetites.

Sharks eat far less than most people imagine. Remember that, like other fishes, sharks are cold-blooded. Cold-blooded animals have much lower metabolisms than warm-blooded animals such as mammals. So sharks don't need huge amounts of food. A shark probably eats between 1% and 10% of its body weight in a week, and many sharks probably go several weeks between meals.

Who needs silverware?

Think of a shark's lower jaw teeth as a fork, and its upper jaw teeth as a knife. As a shark's jaws extend to bite its prey, teeth of the lower jaw puncture and hold prey. The upper jaw teeth slice. A shark's short jaws make the bite powerful.

Sharks don't eat people...very often.

Only 32 (of nearly 400) kinds of sharks have ever been known to attack people. Like other wild animals, most sharks would rather avoid you. Sharks that have attacked people probably mistook them for food or may have attacked to protect their territory.

Sharks have predators, too.

As a group, sharks and batoids have several predators, including other sharks, elephant seals, and killer whales.

Shark Conservation

People are predators too.

Over the years, people have used sharks for food, medicines, vitamins, weapons, jewelry—even sandpaper. But today some species are in trouble. Why? Shark meat has become a more popular food. Also each year, thousands of sharks are caught accidentally as *bycatch,* snagged in nets set out to catch other types of fish. The number of sharks taken this way can equal or exceed the number of sharks taken intentionally. A particularly wasteful practice is shark *finning*—removing only the fins and tossing back the rest of the shark to die at sea.

Sharks can't bounce back.

Sharks grow very slowly compared to other fishes. A female shark produces at most only a few hundred pups in her lifetime, compared with millions of offspring produced by other fishes. Depleted shark populations may take years to recover.

When we understand shark populations, we can better plan for the future of sharks.

A female shark produces at most only a few hundred pups in her lifetime. Depleted shark populations may take years to recover.

Go fish—wisely.

The United States is a world consumer and trader of shark meat. The National Marine Fisheries Service has developed management plans for 39 shark species in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. While there is no federal management of sharks in Pacific waters, California and Alaska regulate shark fishing. Such plans and regulations address issues such as bycatch and include setting catch limits and closed seasons. Finning is prohibited in Alaska, California, and Atlantic waters.

What can we do to help?

Conservation begins with learning. Research into shark reproduction helps us understand shark population dynamics. And when we understand shark populations, we can better plan for the future of sharks. Keeping the ocean clean and adhering to fishing regulations are more ways we can help. *(Visit your local bait and tackle shop or contact your state's Fish and Game Department for information on fishing regulations in your state.)*

Sharks in Danger

While sharks are often feared as "man-eaters," the truth is that humans pose a far greater danger to sharks than they pose to us. Threats to shark populations include overfishing, bycatch as a result of fishing operations, and habitat degradation. The negative public image of sharks can be a challenge to conservation efforts.

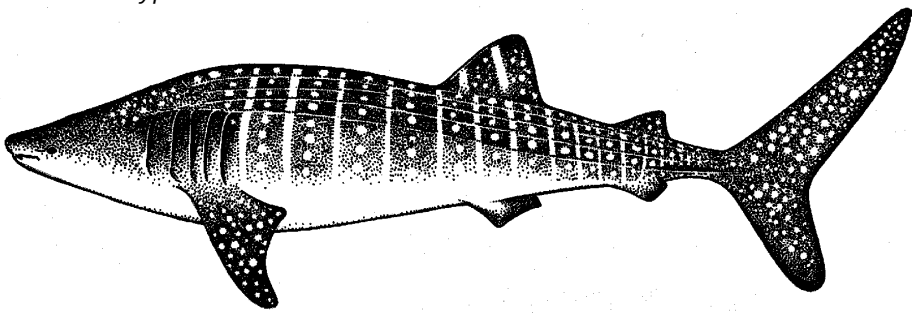
Slow-growing animals that reach maturity only after several years, sharks produce few young. When shark populations become depleted, they may take decades to recover. In fact, some species—like the rare Ganges shark *(Glyphis gangeticus)* may soon be extinct.

There are nearly 400 species of sharks. They inhabit virtually all ocean environments and range in size from about 22 centimeters (8 in.) to about 12 meters (nearly 40 ft.).

On the following pages you'll find information on seven of the shark species that are most in need of conservation.

whale shark

Rhincodon typus



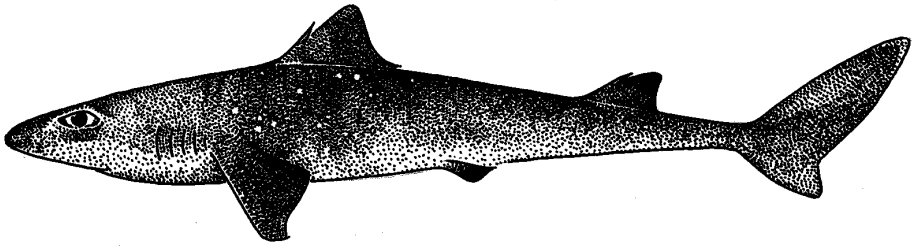
distribution: oceanic and coastal, generally close to or at the surface in tropical and temperate seas worldwide. They are often found offshore but also inshore, even in lagoons.

adult size: to about 12 m (39 ft.), the world's largest fish

conservation concerns: Whale sharks have been fished by harpoon in some areas, to the point of depletion. Protected in U.S. waters of the Atlantic, Gulf of Mexico, and Caribbean.

spiny dogfish

Squalus acanthias



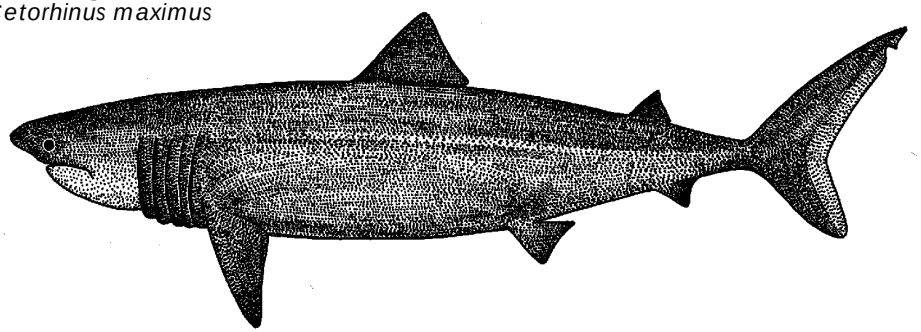
distribution: coastal and pelagic over the continental shelf in areas of temperate and subarctic waters worldwide

adult size: about 1 m (3.3 ft.)

conservation concerns: Spiny dogfish accounted for about 96% of U.S. exports of shark meat in 1995. In the 1990s, dogfish landings in the U.S. Atlantic increased six-fold, depleting the population. New legislation for the U.S. Atlantic severely reduces dogfish fishing.

basking shark

Cetorhinus maximus



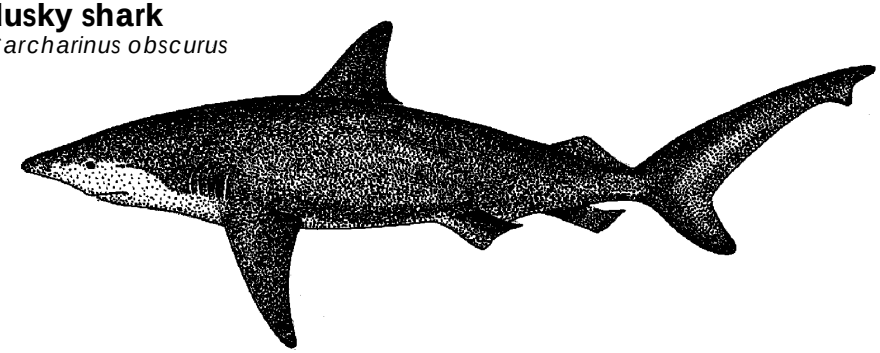
distribution: coastal and pelagic over continental shelves in temperate seas. They are found offshore as well as inshore, into the surf zone and enclosed bays.

adult size: to about 9.8 m (32 ft.)

conservation concerns: Historically basking sharks have been fished by harpoon, sometimes until local stocks were depleted. They also become entangled in gillnets and trawls. Protected in U.S. waters of the Atlantic, Gulf of Mexico, and Caribbean.

dusky shark

Carcharinus obscurus



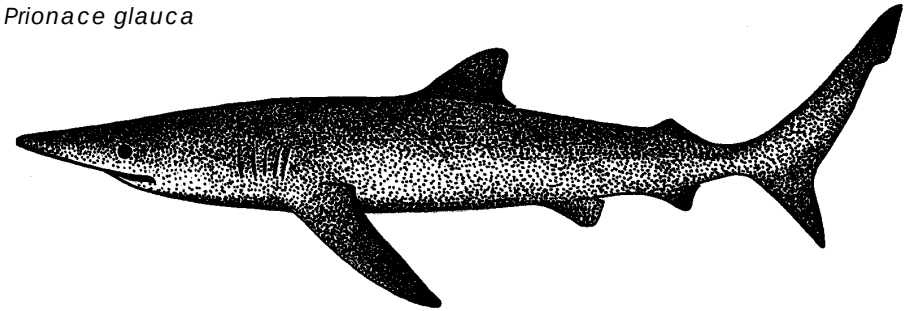
distribution: from the surf zone to well out to sea in temperate and tropical areas of the Pacific, Western Atlantic, and Western Indian Oceans

adult size: about 3.4–3.7 m (11.2–12.0 ft.)

conservation concerns: Dusky sharks were once abundant but now are in decline due to overfishing. Their fins are considered the highest quality for soup. In 1998 the American Elasmobranch Society issued a resolution urging the National Marine Fisheries Service to prohibit fishing for this species.

blue shark

Prionace glauca



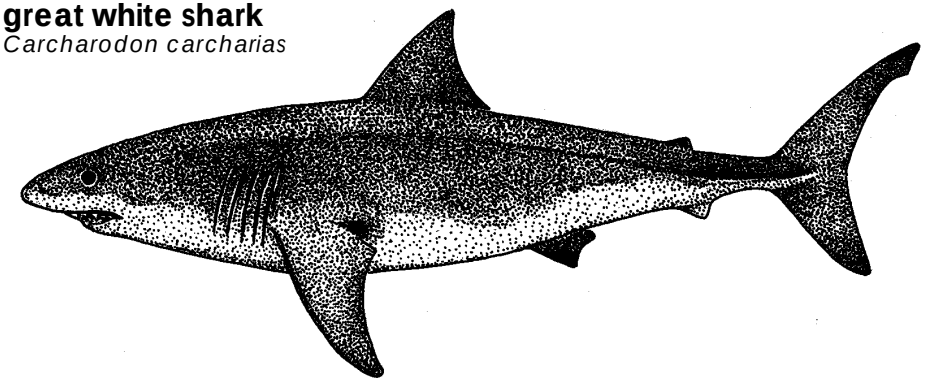
distribution: oceanic in tropical and temperate seas worldwide. They are usually found offshore but may venture inshore, especially at night.

adult size: about 1.8–3.2 cm (6.0–10.6 ft.)

conservation concerns: Blue sharks are among the predominant species fished in the U.S. Pacific. More than 60,000 are killed each year for their fins (for soup) in the Hawaiian longline fishery—one of the few fisheries left where finning is allowed. Finning is prohibited in Atlantic, Alaska, and California waters.

great white shark

Carcharodon carcharias



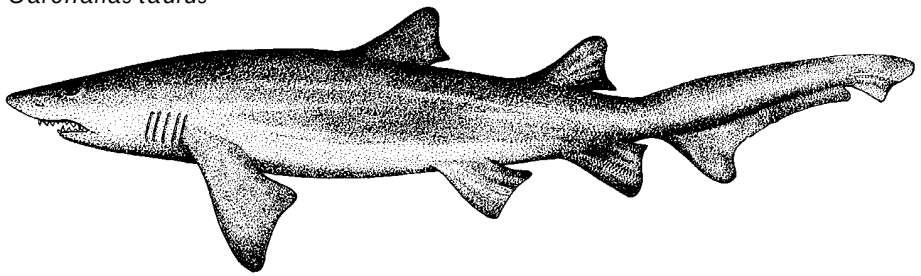
distribution: coastal and offshore over continental shelves and around continental islands in most temperate oceans of the world

adult size: about 3.7–6.0 m (12.0–19.7 ft.)

conservation concerns: Great white sharks are often a bycatch of other shark fisheries such as longlines, hook-and-line, gillnets, purse seines, and others. They are also fished for their teeth and jaws, which are used as decorations. Protected in U.S. waters of the Atlantic, Gulf of Mexico, and Caribbean.

sandtiger shark

Carcharias taurus



distribution: shallow waters of the surf zone, bays, and reefs to about 191 m (627 ft.) in areas of the temperate and tropical Atlantic, Indian, and Western Pacific Oceans

adult size: about 2.2–3.2 m (7.2–10.5 ft.)

conservation concerns: Sandtigers are fished primarily with line gear, also gillnets and trawls. Like other coastal sharks, they depend on nearshore habitats, which are vulnerable to destruction and degradation. Protected in U.S. waters of the Atlantic, Gulf of Mexico, and Caribbean.

It Makes Sense to Me

OBJECTIVE

Given various materials, students explore their sense of smell.

MATERIALS

(one of each for every pair of students)

- ❑ apple slices; orange, grapefruit, and lemon wedges; chunks of onion; cotton balls soaked in extracts such as vanilla and cinnamon oil (one of each object for each pair of students)
- ❑ blindfolds (optional)

BACKGROUND

A sense of smell is what leads many animals to their food. Sharks use their sense of smell to find prey, as do many other fishes. Sharks can detect certain substances, such as blood, in the water from hundreds of meters away from the source.

ACTION

1. Tell your students that they're going to be scientists studying a human's sense of smell. How will they do it?

   Brainstorm with your students ways that they can test which kinds of smells people are best adapted for detecting. List each of their ideas on the classroom board. *(After you do this activity you may decide to try a few of the students' ideas.)*

2. Students work in pairs. One student will wear a blindfold or close his eyes while his partner holds various objects—one at a time— a few inches in front of the first student's nose. The student with his eyes closed will try to identify the object his partner is holding. When the student thinks he knows what the object is, he makes a guess. Each student gets three guesses to identify each object.

3. Distribute objects to each pair of students. *(You may add other available objects with recognizable smells.)*

4. Students take turns closing their eyes and guessing objects by their smell. Each student gets a chance to smell every object and make guesses.

5. Discuss the results. Which objects could the students identify easiest? Which were harder to identify? Were there object that the students couldn't identify?

6. Tell students that sharks can smell certain substances from hundreds of meters away. Help students to think of substances we can smell from far away. *(Examples: tarring a roof, pine trees, coffee brewing, popcorn popping, cookies baking, a barbecue, bacon frying, a fire burning.)*

   Are there some items that we aren't adapted for smelling? For example, what does an aluminum can smell like? What does a plastic bowl smell like? A rock?

Mark the Shark

OBJECTIVES

Given an outline drawing of a shark, students will identify the fins and the gill slits. They count the number of fins they can see.

MATERIALS

- ❑ copies of the ***Mark the Shark*** funsheet on page 11
- ❑ crayons

Like other fishes, sharks have fins for swimming.

ACTION

Distribute crayons and copies of the ***Mark the Shark*** funsheet to students. Then read them the following directions, allowing time to complete each step.

1. Draw a circle around the caudal fin (tail).
2. Draw a triangle on each dorsal fin.
3. Make an arrow pointing to the pectoral fin.
4. Draw a box around the gill slits.
5. Put an X on the pelvic fin.
6. Draw some dots on the anal fin.
7. Count the number of fins you can see on your shark. Write this number on your paper.

DEEPER DEPTHS

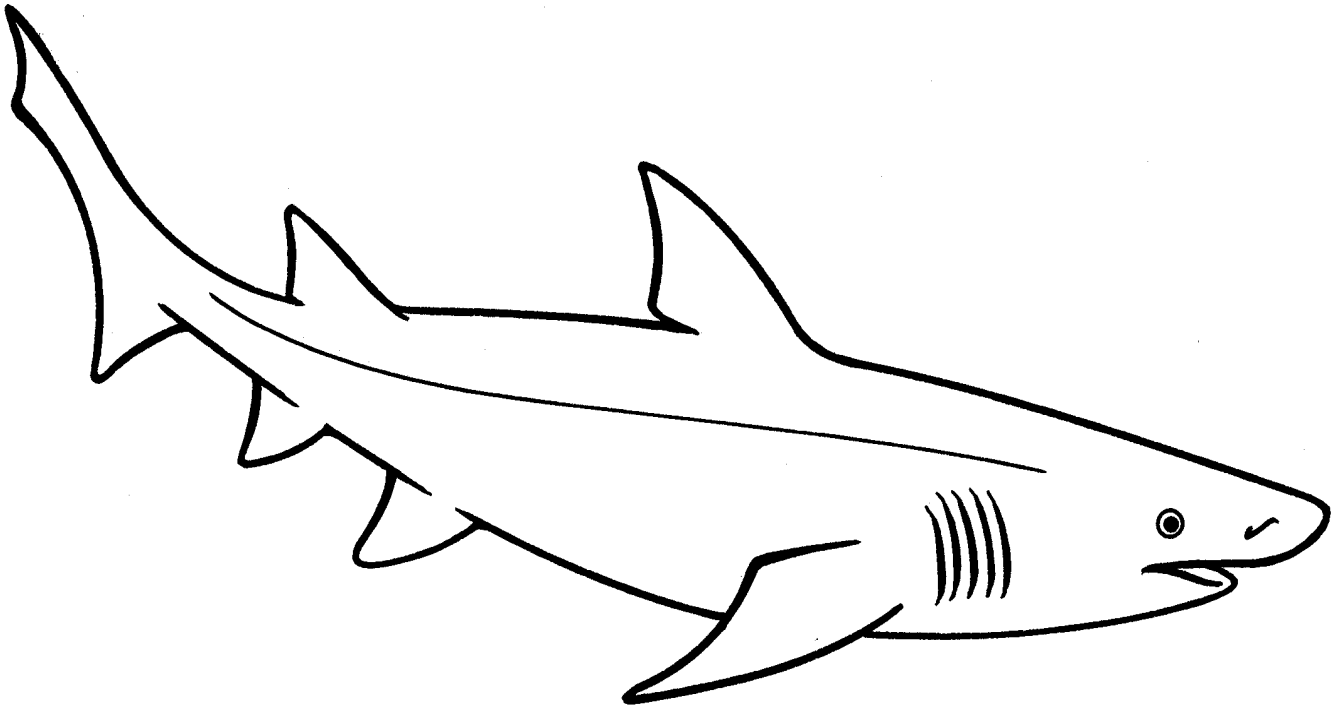
Buy a whole fish at a fish market or the supermarket seafood section. Help students (in learning groups) locate each of the fish's fins. Where is the opening to the gills? Save this fish to do ***Print a Fish*** on page 22 of this Guide.

Use the shark outline on the ***Mark the Shark*** funsheet to create a puzzle. Copy the outline. Cut apart shark body parts (fins, head, body), glue to cardboard, and laminate. Students assemble the shark puzzle and identify body parts.

Name _____

Mark the Shark

1. Draw a circle around the **caudal fin** (tail.
2. Draw a triangle on each **dorsal fin.**
3. Make an arrow pointing to the **pectoral fin.**
4. Draw a box around the **gill slits.**
5. Put an X on the **pelvic fin.**
6. Draw some dots on the **anal fin.**
7. Count the number of fins you can see on your shark.
   Write the number here:



What's For Lunch?

OBJECTIVES

Given the materials listed at right, the student will create a shark and discuss what sharks eat and one way humans may affect sharks.

MATERIALS

- ❑ copies of the ***What's for Lunch?*** pattern sheet on page 13
- ❑ 12" × 18" construction paper (one sheet per student)
- ❑ wax paper (two 5½" × 2" sheets per student)
- ❑ tissue paper (various colors)
- ❑ liquid starch and sponges
- ❑ glue
- ❑ crayons

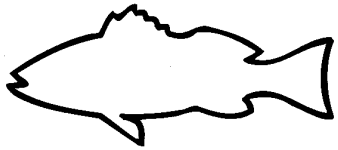
BACKGROUND

While some types of sharks are probably not very selective feeders, certain types of sharks eat some foods more than others. For example, smooth dogfish eat mostly lobsters and crabs. Blue sharks eat squids. Tiger sharks have been called "garbage cans of the sea," because they have been known to eat live animals, remains of dead animals, and even trash! Prey for sharks includes fishes, seabirds, marine mammals, sea turtles, and sea snakes. Peculiar items eaten include tin cans, boat cushions, hubcaps, and shoes.

ACTION

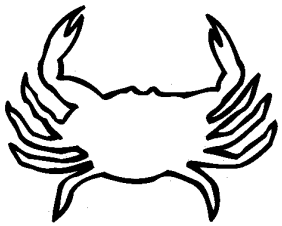
1. Prepare materials first. Trace food patterns onto tissue paper and cut them out. Enlarge the shark pattern to 18 inches long. Fold construction paper in half lengthwise so that it measures 18" × 6".
2. Students trace the shark pattern onto construction paper, placing the first dorsal fin on the fold. Help students cut out the shark. Cut an opening to represent the shark's stomach.
3. Give each student a piece of wax paper. Students use sponges to put liquid starch onto their wax paper. Then they place one of each of the food items in the starch on the wax paper. Students place a second piece of wax paper on top of the first and gently press out starch bubbles.
4. Students open their sharks. They draw a circle of glue around the center hole and place the wax paper on top of the glue. Then they glue the two shark halves together. When the glue is dry, the students draw nostrils and gill slits on their sharks.
5. Discuss why a shark might eat a tin can. What other animals eat trash? *(Sea turtles eat plastic bags that look like jellyfish; seabirds eat small plastic pieces that look like fish eggs.)* What can we do to keep trash out of the ocean?

What's For Lunch?
pattern sheet

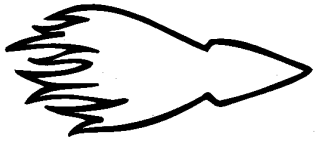


fish

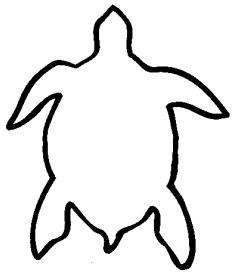
tin can



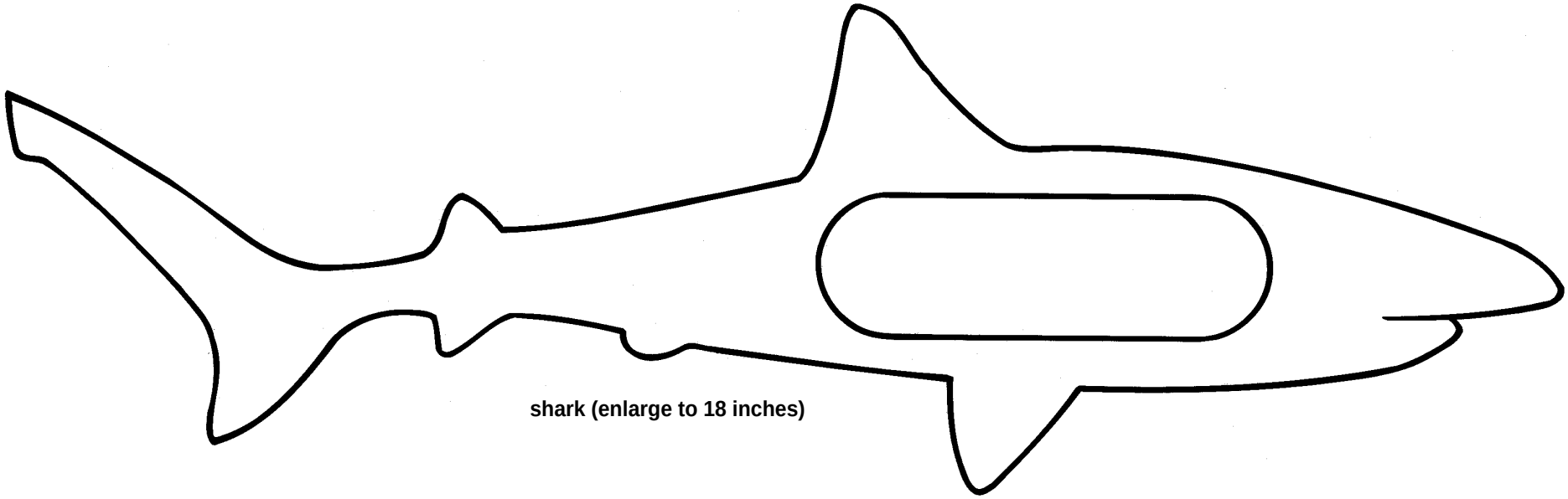
crab



squid



sea turtle



shark (enlarge to 18 inches)

Blacktip Shark Fin Fun

OBJECTIVES

Students identify and name a shark adaptation and observe the coloration of a Pacific blacktip shark's dorsal fin.

BACKGROUND

Sharks may have one or two dorsal fins. Dorsal fins give the shark stability as it swims. Pacific blacktip sharks have two dorsal fins; the first dorsal fin is larger than the second dorsal fin. These sharks have beige bodies with black tips on all fins. They average 1.5 m (4.9 ft).

MATERIALS

- ❑ photo of blacktip shark (below)
- ❑ blacktip shark fin pattern on page 15
- ❑ beige construction paper dorsal fins (precut—two per student)
- ❑ craft sticks (one per student)
- ❑ glue
- ❑ paint-sponges or paintbrushes
- ❑ white and black tempera paint
- ❑ bowls

ACTION

1. Review the fins of a shark. Show students the picture of the blacktip sharks below. Ask students to describe the coloration of a blacktip shark's dorsal fins.
2. Distribute one construction paper dorsal fin to each student. Each student writes his or her name on one side and turns the fin over. Students spread glue on the side of the dorsal fin facing them.

Pacific blacktip sharks *(Carcharhinus melanopterus)* show characteristic fin coloration.

Students create their own blacktip shark fins.

3. As students are applying glue, distribute one craft stick and a second dorsal fin to each student. Help students place craft sticks on the straight edges of their dorsal fins with half of the stick extending below the fin.
4. Students match up dorsal fins and press halves together with the stick in between. Students leave glued dorsal fins on tables to dry.
5. Distribute paint-sponges or paintbrushes to each student.
6. Review where white is found on a blacktip shark's dorsal fin and demonstrate how to sponge-paint the dorsal fin. Distribute white paint. Students paint their dorsal fins.
7. Review where black is found on a blacktip shark's dorsal fin. Students paint their dorsal fins. Hang dorsal fins on drying rack or leave on tables to dry.
8. Students role-play with dorsal fins. Role-play a school of sharks swimming around the classroom. While holding dorsal fins above their heads, students sing ***Shark Chant*** (on fin pattern below).

Shark Chant

We're rough!

We're tough!

We're rough, we're tough,

We're SH-A-A-A-R-K-S!

(WHISPER "sharks")

How Big Am I?

OBJECTIVES

Given various tools for measurement, students will be able to measure length. They will compare various units of measurement.

BACKGROUND

In all states, fishing is regulated. One way we can regulate fishing is to make sure that people don't take the smallest, youngest fish. This ensures that young fish survive to reproduce, adding diversity to fish populations. In the U.S., anglers measure fish in inches, usually from the tip of the "nose" to the fork in the tail. This measurement is called the fork length. Scientists who study fish measure them in centimeters or meters.

MATERIALS

- ❑ copies of the ***How Big Am I?*** funsheet on page 17
- ❑ butcher paper
- ❑ tape measure or yardstick
- ❑ rulers that measure in inches and rulers that measure in centimeters
- ❑ paper clips
- ❑ goldfish crackers

A Hubbs-Sea World Research Institute biologist measures a giant seabass *(Stereolepis gigas)* for a fish population study.

ACTION

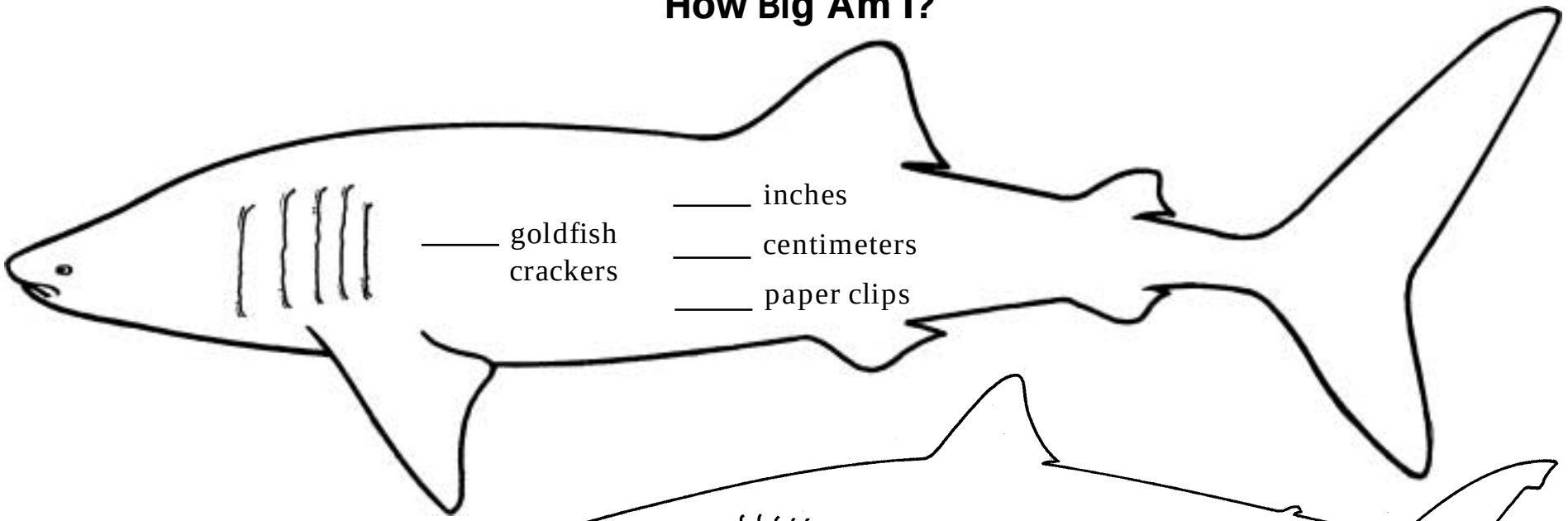
1. Discuss how people use measurements. Are the students in your class familiar with feet and inches? Meters and centimeters? Tape a strip of butcher paper on one wall and choose a student to measure. Have the student stand against the wall and mark his/her height with a thick marker. Use a yardstick or a tape measure to measure the student in inches and in centimeters. Emphasize that these different units of measurement are different ways for saying the same thing.
2. Distribute copies of the ***How Big Am I?*** funsheet. Students measure each shark using paper clips, using goldfish crackers, and using inch- and centimeter-rulers. Remind the students that these different units of measurement are all different ways for saying the same thing.

DEEPER DEPTHS

Students measure real fish. Use fresh or thawed whole fish. *(Use the same fish for the **Print a Fish** activity on page 22.)* Provide rulers, tape measures, and/or yardsticks for measuring the fish.

Name _____

How Big Am I?

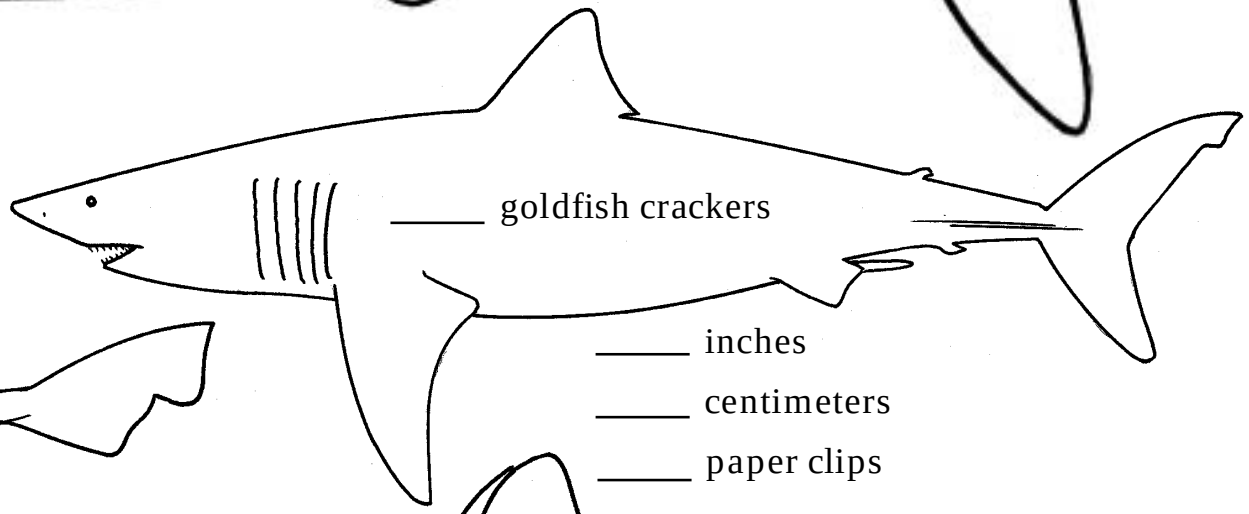


_____ goldfish crackers

_____ inches

_____ centimeters

_____ paper clips

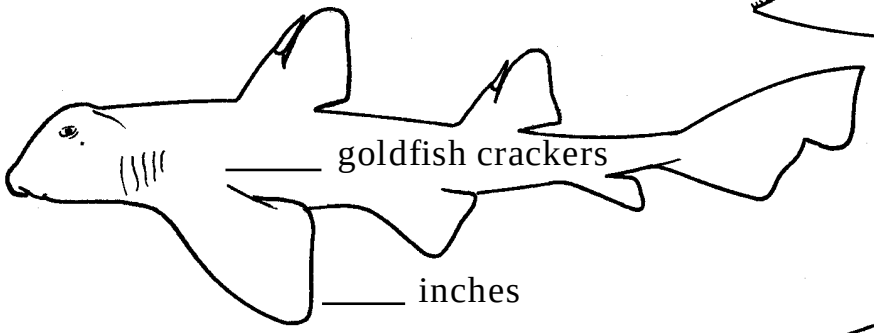


_____ goldfish crackers

_____ inches

_____ centimeters

_____ paper clips

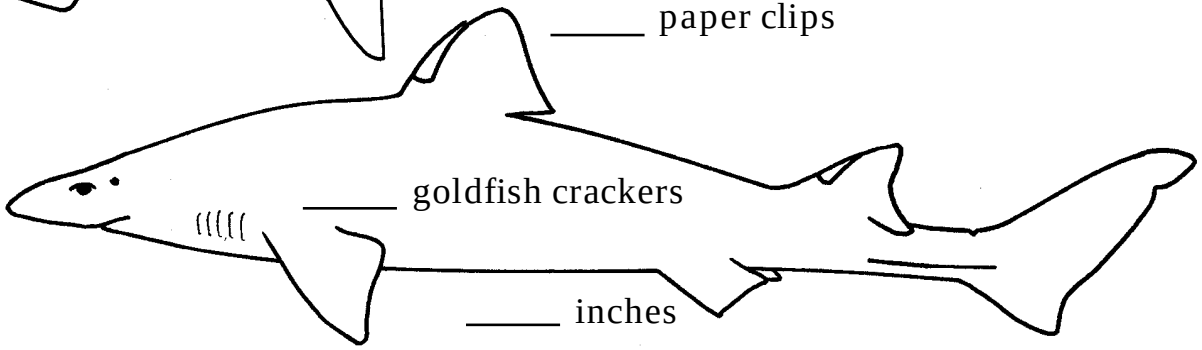


_____ goldfish crackers

_____ inches

_____ centimeters

_____ paper clips



_____ goldfish crackers

_____ inches

_____ centimeters

_____ paper clips

When Sharks Go Swimming...

OBJECTIVE

Students will creatively portray a shark's *ecosystem*.

Great white sharks inhabit cool-water oceans of the world. They can be found in offshore and inshore waters. When this great white shark goes swimming, what does it see?

MATERIALS

- ❑ construction paper
- ❑ writing / drawing paper
- ❑ hole punch
- ❑ crayons, pencils
- ❑ fasteners (yarn, brads, or clasp-rings)

BACKGROUND

As a group, sharks are adapted for a wide range of aquatic habitats and eat almost anything. Various types of sharks live in shallow waters, in deep waters, on the ocean floor, and in the open ocean. Depending on the type of shark, food items include other sharks and batoids; bony fishes; marine mammals; seabirds; crabs, lobsters, and other invertebrates; sea snakes; and sea turtles.

ACTION

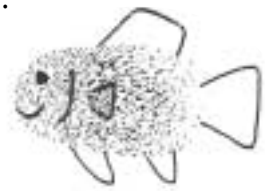
1. With your students, discuss what sharks eat and what a shark might see in the ocean.
2. As a class, make a shark book. Use construction paper for the covers. Title your book, "*When Sharks Go Swimming....*"
3. At the top of a piece of paper, write the phrase: "*This shark sees*_____." Copy and distribute one sheet to each student.
4. For younger students, read the phrase to them, and write their word(s) in the blank line space. Older students can complete the phrase on their own.

   Each student draws a picture of their shark's environment in the empty space on the page.
5. Punch holes along the left side or the top of each page and put the book together with rings, brads, or yarn.
6. Place the finished book in your classroom's reading area or library.

Fingerprint Fish

OBJECTIVE

Students explore how schooling behavior is an adaptation for avoiding predators.



BACKGROUND

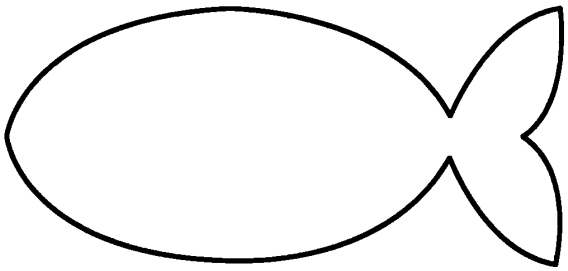
As a recommended pre-activity, read *Swimmy* by Leo Lionni. (New York: Dragonfly Books / Alfred A. Knopf, 1963.)

MATERIALS

- ❑ tagboard or cardboard
- ❑ 8½" × 11 " white construction paper (one sheet per student)
- ❑ pencils
- ❑ nontoxic red or orange stamp pads (about one for every five students)
- ❑ one nontoxic black stamp pad
- ❑ thin markers, crayons, or nontoxic tempera paint and brushes

ACTION

1. Before class, make fish templates for students to trace: Enlarge the fish outline below to about 9" long. Trace the fish shape onto tagboard and cut a fish template for every five students.



2. Students use the fish templates to lightly trace a fish outline onto a piece of white construction paper.
3. Each student presses a thumb on the black stamp pad, inking it well. They stamp a black thumb print on their paper where the fish's eye would be.
4. Students add red or orange thumbprints to fill in the fish pattern.
5. Students use thin markers to add fins, a tail, and a mouth to each of their thumbprints, turning them into little fish. (All of the little fish should be swimming in the same direction.) They can fill in the background (corals, seaweed, ocean, etc.) using crayons or tempera paint and brushes.
6. Standing at the front of the class, hold up a student's paper so everyone can see the fingerprint fish. Use these questions to lead a discussion with your class:
   - What does it look like to students in the back row? (One big fish)
   - What does it look like to students in front? (Lots of little fish)
   - How does swimming in a school protect small fishes from predators like sharks? What would a shark see? (A shark might think it's looking at a fish that's too big to eat.)

Catch as Catch Can

OBJECTIVES

Students simulate fishing techniques and explore processes that result in bycatch. They visually express their catch in the form of a graph.

Each year, thousands of sharks are caught accidentally as bycatch, snagged in nets set out to catch other types of fish.

MATERIALS

- ❑ multicolored fruit ring cereal
- ❑ large tub, bowl, or shoebox (one per each group of four or five students)
- ❑ jumbo-size paper clips (one per student)
- ❑ ladles or small (home aquarium-size) fish nets (one per each group of four or five students)
- ❑ white construction paper
- ❑ glue

BACKGROUND

Fishing nets like purse seines and driftnets make it easy to catch lots of fish. But they've also introduced new problems: the nets catch everything that can't swim through the mesh, regardless of species. When the nets are hauled in, fishers try to toss back nontarget species (the bycatch), but most of these animals die anyway. According to the Center for Marine Conservation, the number of sharks killed incidentally in fishing operations equals or exceeds those taken intentionally.

For this activity students work in cooperative learning groups of about four or five students per group.

ACTION

1. Discuss two different methods of fishing: hook-and-line and net fishing. Tell students that in this activity they will pretend to be fishermen, and they will try both fishing methods.
2. To each group, distribute a large tub, bowl, or shoebox filled with fruit ring cereal. *(Cereal should be about 3" deep.)*
3. Give each student a jumbo-size paper clip. Show them how to bend their paper clip into the shape of a hook. *(Or pre-bend hooks for younger students.)*

4. ***ROUND ONE:***

   First students will try hook-and-line fishing. Set a timer for one minute and have students hook as many "fish" (fruit rings) as they can. Students count their catch.

   Next, students try net fishing. Each student in the group takes a turn scooping a net (or ladle) through the tub of fruit rings, "catching" as many as possible. Students count their catch.

   Discuss the two methods students used to catch their fish:

   - Which method works best for fishermen?
   - Which method is better for fish populations?
   - If they were fishermen, would they choose net fishing or hook-and-line fishing?

5. ***ROUND TWO:***

   For the second round of play, choose one color of "fish" that you will be fishing for. (Any other color of fruit rings students catch incidentally are bycatch.)

   For one minute, students use their paper-clip hooks to catch as many "fish" (of the pre-decided color) as they can. Students count their catch.

   Next, students use the net (or ladle) to scoop fish. Remind them that they are trying to catch only one color of fish, but that in the course of fishing operations there is normally some bycatch. Students count their catch.

   Discuss the two methods students used to catch their fish:

   - Which method works best for fishermen?
   - Which method is better for fish populations?
   - If they were fishermen, would they choose net fishing or hook-and-line fishing?

6. Students create a bar graph to show how many fish of different species (colors) they caught in the net. On a piece of white construction paper, students line up their fruit rings by color, and glue them to the paper.

7. Discuss what happens to fish that are bycatch. (Some are tossed back to sea and survive; others die.) Explain that sharks are common bycatch fish, and they usually don't survive. As a result, some shark populations have been severely depleted. Encourage a discussion of how people can manage ocean resources.

Students document their catch by creating bar graphs. They glue rows of fruit ring cereal to a piece of paper.

Print a Fish (You Can Gyotaku, Too!)

OBJECTIVES

Student will be able to identify fish body parts and create an impression of a fish.

BACKGROUND

Sometime in the early 1800s fish printing, or *gyotaku*, originated in Japan or China. Fishermen in Japan used fish printing to keep records of their catches. Fish printing has been practiced as an art in the U.S. for about 40 years. *(Use these same directions to make prints of shells, plants, or other objects.)*

MATERIALS

- ❑ one or more fresh or thawed fish *(Use a fish with large, visible scales.)*
- ❑ nontoxic tempera paint
- ❑ small and medium fairly stiff brushes
- ❑ modeling clay
- ❑ newspaper
- ❑ prewashed fabric (a light muslin or other cotton works well), newsprint, or rice paper

ACTION

1. Wash the fish carefully and thoroughly with soap and water to remove the mucus. Pat dry the fish taking care not to rub off the scales. Clip any sharp spines with pliers.
2. Place the fish on several layers of newspaper. Plug the fish's anus *(the opening just in front of the anal fin)* with a small wad of newspaper.
3. Adjust the fish so that it lies the way you want it to look in the fish prints. Spread the fins into a lifelike position and support them with modeling clay to hold them in place.
4. Avoiding the fish's eye and the modeling clay, apply a thin coat of paint to the fish. Brush from head to tail. After the fish is covered with paint, brush from tail to head.
5. Students place paper or fabric carefully over the fish. With their fingers, they press it firmly over the painted fish, head to tail. Warn them not to wrinkle the paper or move it around too much once they've set it in place.
6. Students carefully remove the printed paper or fabric, head to tail. They may print their fish a second time right away (without repainting it) on clean paper or fabric for a better print.
7. On their prints, students paint in the eye with a small brush or marker.

Students create artistic impressions of a fish.

Rough Rubbin' Sharks

OBJECTIVES

Students gain an understanding of sharks' rough, textured skin through artwork. They demonstrate knowledge of a shark's ecosystem.

BACKGROUND

Sharks have placoid scales, also called *dermal denticles* (dermal = skin, denticles = teeth). Each one looks like a miniature tooth. (See photo on page 4). Shark scales have the same structure as a tooth: an outer layer of enamel, a layer of dentine, and a pulp cavity. Scales don't grow bigger as a shark ages. As sharks grow, they grow more scales. These toothlike scales make a shark's skin rough, like sandpaper. European cabinetmakers used the rough shark skin as sandpaper, called shagreen.

MATERIALS

- ❑ shark illustrations on page 17, or the cards on pages 7–8
- ❑ tagboard—one 8½" × 11" piece for each shark shape
- ❑ heavy-grade sandpaper
- ❑ tracing pencils
- ❑ white glue
- ❑ scissors
- ❑ butcher paper or newsprint
- ❑ assorted crayons
- ❑ colored pencils, markers, or watercolors (optional)

ACTION

1. ***CRAFT PREPARATION:***

   Using shark drawings on page 17, trace sharks onto the smooth side of sandpaper. These sharks are (from top to bottom) whale shark, white shark, horn shark, spiny dogfish. *(Or enlarge sharks from the cards on pages 7–8.)*

   Cut out sandpaper shark shapes.

   Glue the smooth side of each sandpaper shark to a piece of tagboard. Using glue, draw in eyes and gill slits. Let glue dry for 24 hours. These are your "shark masters."

2. Give each student a piece of butcher paper or newsprint. Students place paper over the shark masters. They use crayons to lightly rub over the shark masters. *(Hint: use the side of a fat crayon with the paper removed.)* The outline of the shark, as well as the rough texture, will appear on the butcher paper.
3. Students use crayons, colored pencils, markers, or watercolors to create ecosystems for their sharks.

DEEPER DEPTHS

Have students sort sharks: put the sharks in order from smallest to largest. Review names of sharks from smallest to largest.

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Shark! 1999; *Predator Alert,* 1999; *Myth, Monster or Misunderstood?* 1999.

SeaWorld Posters*

Inside Sharks, 1989; *Sharks and Other Cartilaginous Creatures,* 1994; *Great White Shark,* 1999.

Web Sites

Marine life information from SeaWorld. <*www.seaworld.org*>

American Elasmobranch Society. <*www.elasmo.org*>

Center For Marine Conservation, Shark Fact Sheet. <*www.cmc-ocean.org/2_bp/sharkfact.html*>

*Available through SeaWorld San Diego. Call for prices.

Shark! Pre/Post Assessment

Use this assessment to discover how much your students already know about sharks before you begin this unit, and later as a conclusion to your study.

- Describe two different kinds of sharks. How are they different? How are they the same?
- How can you tell different kinds of sharks apart?
- Use a dichotomous key to identify a shark species.
- Create a picture or model of a shark. Show its adaptations for surviving in the sea.
- Describe "a day in the life of a shark."
- Use a map or globe to show where various kinds of sharks can be found.
- Use math skills to calculate how much food a 350-lb. shark might eat in one week.
- Why are some shark populations in danger?
- How can people help conserve sharks?

National Science Education Standards Connections in this Guide

Connections to National Science Education ***Life Sciences*** *Standards include:*

- Characteristics of organisms
- Life cycles of organisms
- Organisms and environments

Connections to National Science Education ***Personal and Social Perspectives*** *Standards include:*

- Types of resources
- Changes in environments
- Science and technology in local challenges

Connections to National Science Education ***History and Nature of Science*** *Standards include:*

- Science as a human endeavor

Connections to National Science Education ***Science as Inquiry*** *Standards include:*

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Unifying Concepts and Processes to help students understand the natural world include:

- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement
- Evolution and equilibrium
- Form and function

National Research Council. *National Science Education Standards.* Washington, D.C.: National Academy Press, 1996.

Want more information?

If you have a question about aquatic animals, call **1-800-23-SHAMU** (1-800-237-4268). TDD users call **1-800-TD-SHAMU** (1-800-837-4268). These toll-free phone numbers are answered by the SeaWorld Education Department.

The SeaWorld Education Department has information booklets, teacher's guides, posters, and videos available on a variety of marine animals and topics. Call or write to request an Education Department Publications brochure.

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