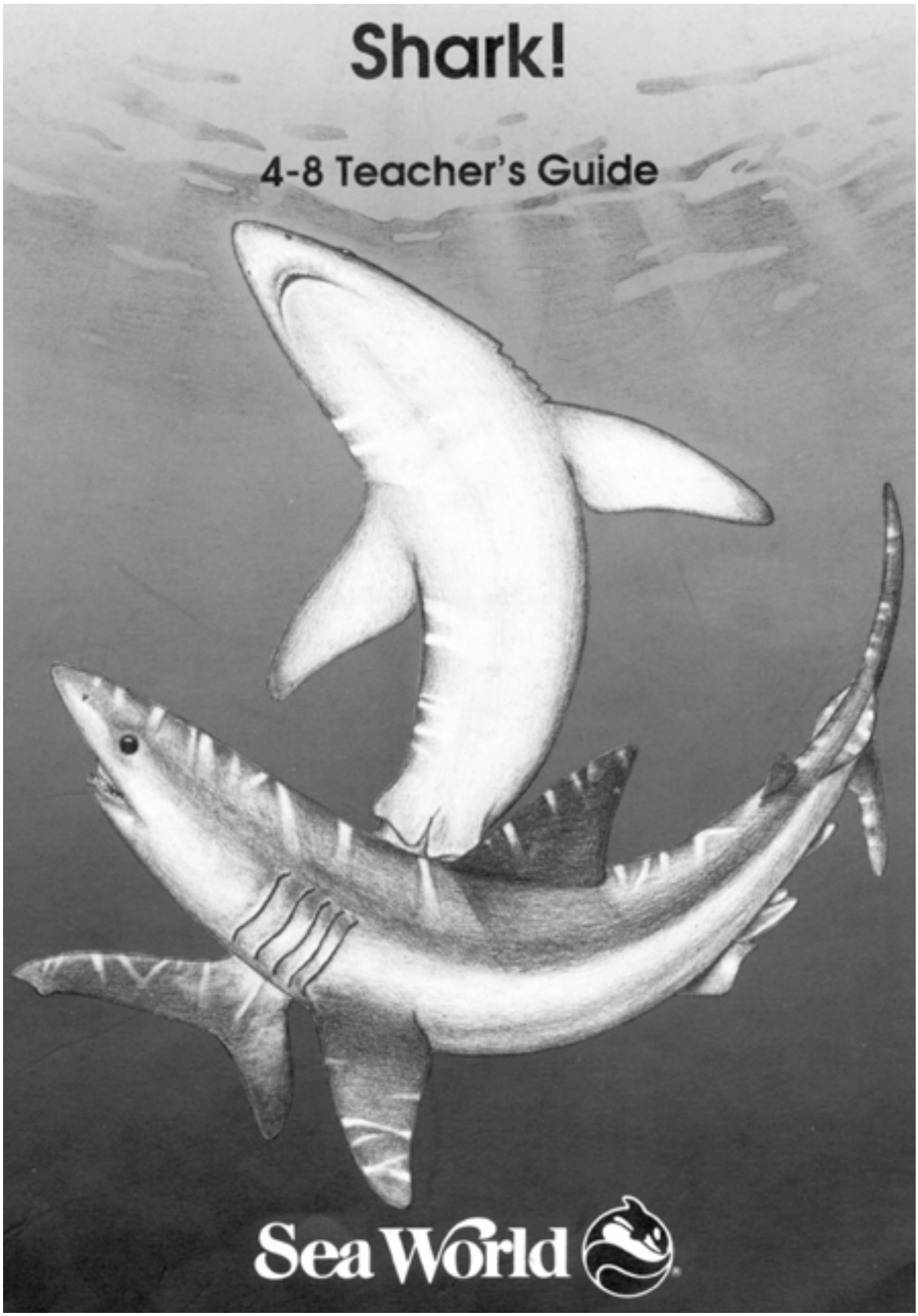


Goals of the Sea World Education Department

Based on a long-term commitment to education, Sea World strives to provide an enthusiastic, imaginative, and intellectually stimulating atmosphere to help students reach their academic potential. Specifically, our goals are ...

- To instill in students of all ages an appreciation for science and a respect for all living creatures and natural environments.
- To conserve our valuable natural resources by increasing awareness of the interrelationships of humans and the marine environment.
- To increase students' basic competencies in science and other disciplines.
- To provide an educational resource for the entire community.

"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!
4-8 Teacher's Guide

CONTENTS

*denotes classroom activities

To the Teacher

The *Shark!* Teacher's Guide for grades 4-8 was developed at Sea World to help you teach your students about sharks and the ecology of the ocean in an active, hands-on way. Our goal was to integrate science, mathematics, art, and language.

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 15 for more in-depth information.

Goals of the *Shark!* Unit

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

Objectives

After completing the Sea World Shark! unit, the student will be able to ...

1. Use a dichotomous key to identify shark families.
2. Identify and describe various shark adaptations.
3. Compare and contrast sharks and bony fishes.
4. Discuss what sharks eat.
5. Demonstrate the steps in the writing process.
6. Create an artistic impression of a fish.
7. Discuss why sharks need conservation and how they can help conserve sharks.

Vocabulary

ANAL FIN — a single fin behind a fish's anus, which lends stability. Not all sharks have an anal fin.

BATOID — flat fish that are related to sharks and have a skeleton made of cartilage, expanded pectoral fins fused to the head, and five pairs of ventral gill slits. Batoids include stingrays, electric rays, skates, guitarfish, and sawfish.

BONY FISH — the large group of fishes that have skeletons made of bone.

CARTILAGE — the tough connective tissue that composes the skeletons of sharks and batoids. Cartilage also composes the skeletons of all very young vertebrates.

CAUDAL FIN — the tail fin, which propels a shark.

CHONDRICHTHYES — the class of fishes that have jaws, paired fins, paired nostrils, and a skeleton made of cartilage. Sharks and batoids are members of the Class Chondrichthyes.

CONSERVATION — using habitats, resources, animals, and plants wisely, so as to save them for future generations.

DORSAL FIN — a fin on the top of a fish. A shark's dorsal fins give the shark stability as it swims.

FINNING — the practice of removing only a shark's fins, which are used in sharkfin soup. The shark is usually left to die.

GILL SLITS — the slitlike openings through which water leaves a shark's or batoid's gills.

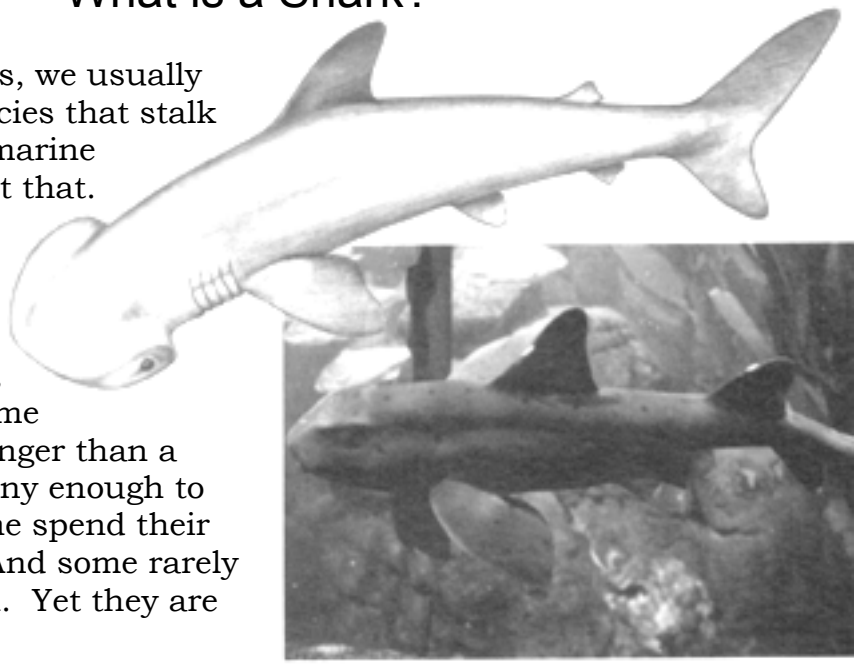
GYOTAKU — the art of fish printing, which originated in Japan or China in the early 1800s as a way for fishermen to record their catch.

PECTORAL FINS — the paired fins toward the front of a fish's body. Pectoral fins lift a shark as it swims.

PELVIC FINS — the hindmost paired fins of a fish. Pelvic fins provide stability.

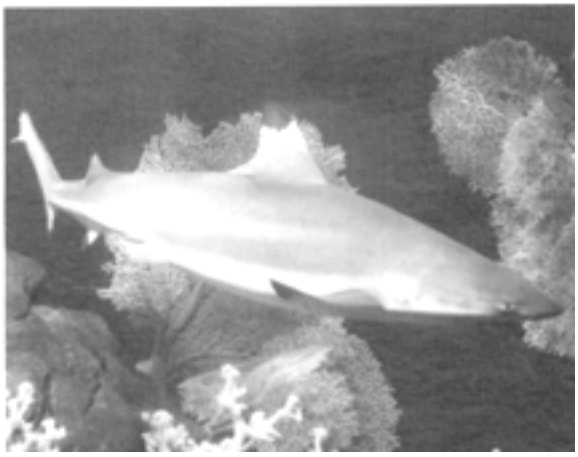
What is a Shark?

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.



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. (See page 4 for more information about fins.) So it's easy to tell males from females.



Sharks come in lots of different shapes and sizes. From top: bonnethead shark (*Sphyrna tiburo*), horn shark (*Heterodontus francisci*), and Pacific blacktip shark (*Carcharhinus melanopterus*).

Find Out for Yourself

OBJECTIVE: Given resource materials about sharks, students will be able to work in groups and research information about sharks.

MATERIALS: Reference materials on sharks such as those listed on page 15 (also various periodicals and videos that you may find).

ACTION: Divide your class into four "research committees" to study great white sharks, cookie cutter sharks, basking sharks, and manta rays. Each group uses resource materials to find information on their species, including diet, distribution, habitat, and interactions with humans. Student groups report their discoveries to the class.

A Shark is a Fish

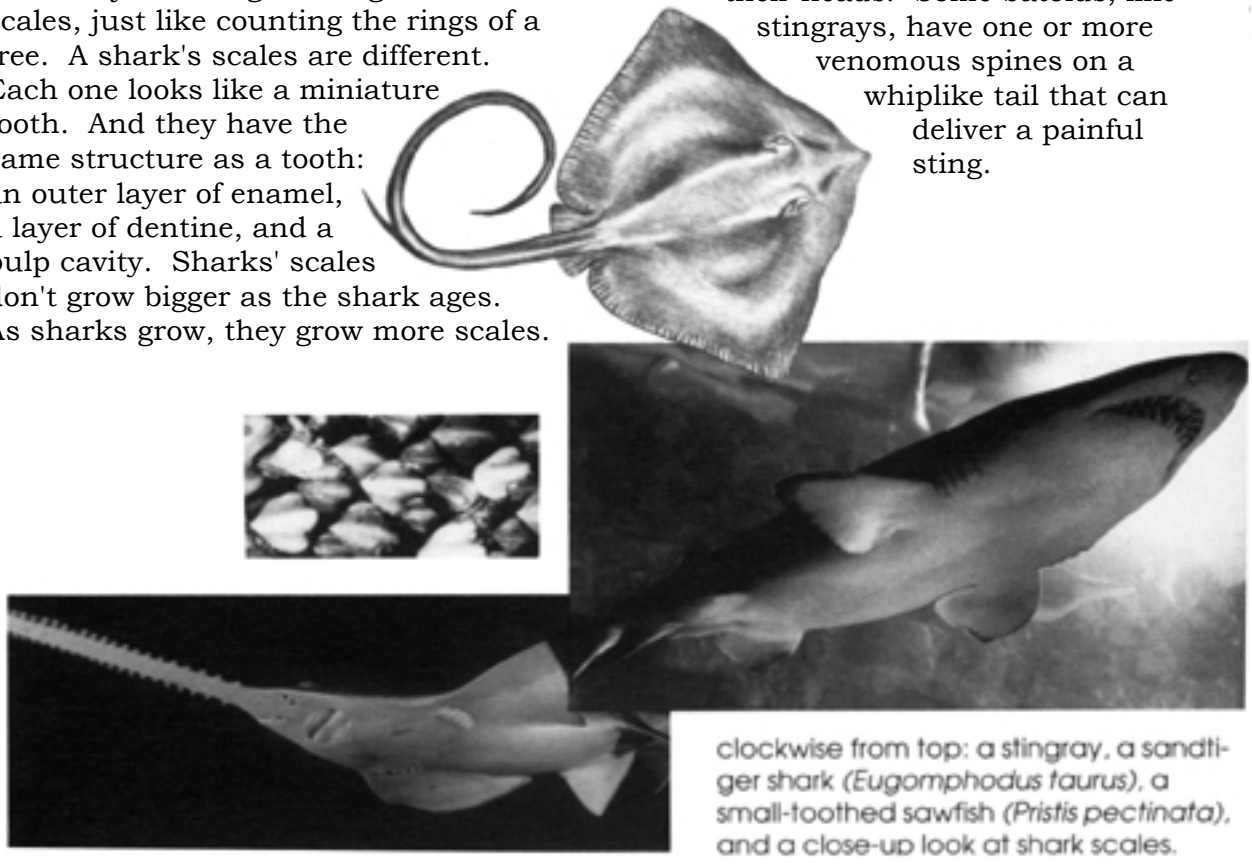
Like other fishes, all sharks are cold-blooded. They have a skeleton and fins, live in the water, and respire with gills. Most fish in the world are called bony fishes. Their skeletons are made of bone, as ours are. There are more than 22,000 different species of bony fishes in the world, but only about 350 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. The scales of most bony fishes are round, and as a bony fish grows, so do its scales. In fact, you can estimate how old some fishare by counting the rings in their scales, just like counting the rings of a tree. A shark's 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 sharks grow, they grow more scales. These teethlike scales make a shark's skin rough, like sandpaper.skin rough, like sandpaper.

Sharks have lots of teeth.
Sharks have several rows of teeth. (See photo 4 on page 8.) Sharks bite with the outer row of teeth, but eventually these teeth fall out. Another difference between sharks and bony fishes is that sharks grow new teeth all the time! So a tooth from the row behind just moves up. Some sharks may go through as many as 30,000 teeth in a
lifetime.

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

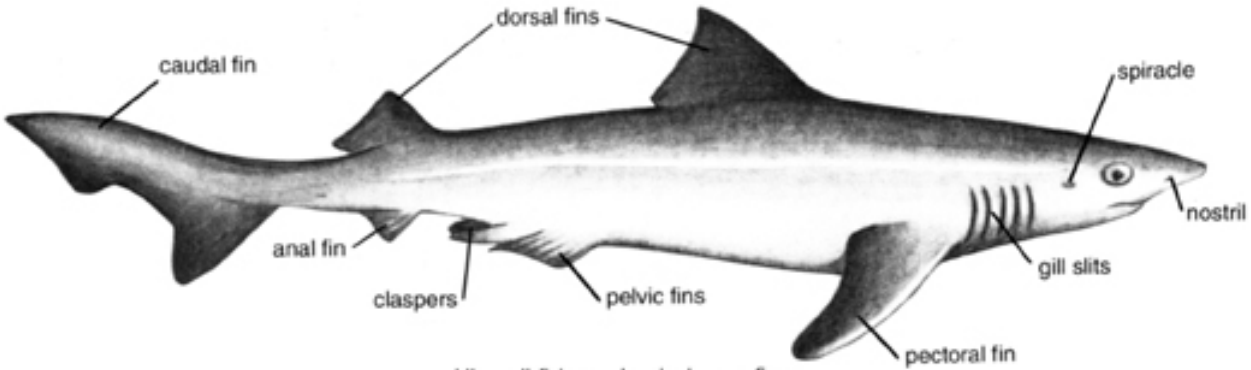


clockwise from top: a stingray, a sandtiger shark *(Eugomphodus taurus)*, a small-toothed sawfish *(Pristis pectinata)*, and a close-up look at shark scales.

All in the Family

All sharks and batoids belong to the group of fishes called the Chondrichthyes. To help learn about them, scientists divide them into groups called families. All the sharks in one family will usually look more like each other than sharks in other families.

To find out which family a shark is in, you would examine the shark carefully. You would count the gill slits on the sides of the shark's head. You would look at the shark's paired pectoral fins and paired pelvic fins, its one or two dorsal fins, and its anal fin (if it has one — not all sharks do). And you would look at the shark's tail, called a caudal fin.



Like all fishes, sharks have fins.

Name that Fish

OBJECTIVE: The student will be able to use a dichotomous key to identify shark and batoid families. (A dichotomous key leads students to the correct answer by presenting them with a sequence of choices.)

MATERIALS: copies of the Key to Families (page 6 in this Guide), Name that Fish funsheet (page 5 in this Guide), pens or pencils.

ACTION: Distribute copies of the Name that Fish funsheet and Key to Families to the students. Assign students to work in groups.

Instruct students to begin at number one on the Key to Families for each shark on the Name that Fish Funsheet. They read sentences 1A and 1B of the key. They study Shark 1 for the characteristics referred to in 1A and 1B. They answer each item with either A or B and then follow the directions given in that letter. They write the family name on the line below each animal. Lead them through one or two examples.

ANSWER KEY

1. Rajidae
2. Scyliorhinidae
3. Lamnidae
4. Squalidae
5. Heterodontidae
6. Hexanchidae
7. Alopiidae
8. Pristiophoridae
9. Carcharhinidae
10. Rhiniodontidae
11. Dasyatidae
12. Pseudotriakidae
13. Sphyrnidae
14. Mobulidae