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# IT TAKES ALL KINDS!

## FOR THE TEACHER

### **Discipline**

Biology

### **Theme**

Scale and Structure

### **Key Concept**

Fish come in a great array of forms, colors and shapes which can be used to predict the habitat and lifestyle to which they are adapted.

### **Synopsis**

Students observe color and shape adaptations in diverse fish and use this information to predict fish habitat and lifestyle.

### **Science Process Skills**

observing, communicating, comparing, categorizing, relating, inferring

### **Social Skills**

cooperation, checking for understanding

### **Vocabulary**

adaptation, camouflage, evolution, fins: (anal, caudal or tail, dorsal, pectoral, pelvic), gill rakers, predator, prey

## **MATERIALS**

### **Into The Activities**

- small pictures of a variety of fish (cutout from magazines or calendars)
- flip chart, butcher paper, blackboard or overhead projector
- videotape of fish (use visual images of various colorful fish to show the tremendous variety in their size, shape, color and habitat)
- drawing paper for each student

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### Through The Activities

- One fresh fish for each small group of 5-6 students.

***It works best if there is a diversity of fish, with each group concentrating on a different one. Asian markets are a wonderful source for many different local and exotic fish. Make sure that the fish are not scaled or gutted and that they are fresh! The following fish make good examples:***

mackerel or bonita, salmon, eels, herring, rockfish, flatfish (such as halibut, sanddabs, flounder), pompano or other exotic fish

- copies of Fish Feature Worksheet for each group
- paper plates, trays or newspaper for each fish
- pictures, books, slides, videotape and/or posters of various fish
- Fish Adaptation Charts (4) for Body Shape, Tail Shape, Mouth/Teeth/Gill Rakers and Coloration Patterns. See sample charts in THROUGH activity.

Optional:

- reference books on fish
- 8 1/2" x 11" sheet blank paper for Mini-Book
- paper quilt square (one per student), glue, book-binding tape (2 colors),
- construction paper (various colors)

### INTRODUCTION

Fish are one of the most successful of the groups of animals with backbones—the vertebrates—and consist of over 50% of all the living vertebrate species. In addition to being one of the most numerous groups, they are also among the most diverse. The incredible variety of forms and behavioral adaptations for survival seen in fish are a reflection of the complex and diverse habitats available to them in their ocean home.

The tremendous diversity in fish is the result of numerous adaptations since fish first evolved over 500 million years ago. The interplay of these adaptations has shaped fish in countless ways, but each form or shape has evolved to allow fish to successfully feed, swim, escape predators, and reproduce in their habitat. These adaptations can be grouped into categories of size, shape of body and tail, coloration patterns, location of mouth and size of teeth, and gill rakers. Close observation of these fish adaptations can lead to predictions about their behavior and choice of habitat within the ocean environment.

The shape and the position of fish fins are related to their body shape and the location of the center of buoyancy of the fish. The differences between fish in their fin shape and location are adaptations for their habitat and lifestyle and are reflected in their locomotion and maneuvering abilities. For example, the lower part of the tail fin in bottom dwellers such as rays is usually reduced, but it is enlarged in the flying fish which may use it to help them jump out of the water. Other examples of adaptations include the dorsal fin of remoras, which

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is modified as a sucker to allow it to hitchhike on sharks, and the dorsal fin of anglerfishes, which attracts prey to its large mouth.

Fish usually have the streamlined—or fusiform—shape, which is very efficient in the water, but they do show a great range of departures from this typical shape. Each of these departures is an adaptation to a specific way of life which puts a premium on something other than fast swimming.

## **INTO THE ACTIVITIES**

### **Partner Parade**

1. Share your favorite memory about fish.
2. What different kinds of fishes can you think of?
3. Describe a fish and tell how it swims.
4. Tell all the things a fish needs to obtain in order to survive.
5. Tell as many ways as you can that people interact with fishes.
6. What kinds of places do fish live in?
7. Tell a tall fish tale.

Have each student sit with a partner and list and/or draw as many things as they can remember from the Partner Parade. ***Alternatively, you can have each student do their own recording to use for individual assessment.*** Lead a class discussion about the group's ideas.

### **Anticipatory Chart**

1. Have students sit in small groups where they can quietly discuss the video they are about to watch. Have one student in each group act as the recorder and count the number of people in their group who answer yes, no or maybe to each of the questions below **before they watch the video**. Encourage the students to discuss the questions with each other as the recorder counts their answers. Have them even make up their own sentence or question.

***The questions should reflect what is actually being shown on your particular videotape.***

Anticipatory Chart  
What do you think?:

YES  
NO  
MAYBE

1. Fish all seem to have the same tail shape.
2. Fish with squared tails swim the fastest.
3. Some fish hide by lying flat on the bottom.
4. The body shape of fish tells us about where it might live.

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5. Long, skinny fish usually can be found swimming out in the open.
  6. Slow moving fish don't have any protection against being eaten.

2. Turn on the video—but leave the sound off. Again encourage the students to discuss the video and questions in their small groups as the video is playing.
3. Have students fill in this Extended Anticipatory Chart after watching the video. Tell them they can change their answers.

Extended Anticipatory Chart  
Now what do you think?

If you decided to change your answer, explain what you saw in the video to make you change your mind.

YES  
NO  
MAYBE

- 1.
- 2.
- 3.

Ask if there are questions for which we still don't have an answer? What other questions do we now want to answer? Make a list of these questions where everyone can see them. Refer to this list throughout the activity.

### **Sketch a Fish**

Place posters/pictures/books of various fish around the room. Have students draw a picture of a fish. It could be their favorite fish or one they just find interesting. Tell them they can use the pictures and posters around the room for ideas.

### **Silent Mingle**

Have students walk around the room silently, holding their drawings or another picture of a fish they have chosen from their table. Have students discuss the following questions with the closest student when you say “Pair-up.”

1. Show your fish picture to your partner. Why is this your favorite (or most interesting) fish? Describe to your partner what it looks like and why it is interesting to you.
2. How do you think this fish captures its food? What do you think it eats?
3. Look at the mouths of the fish around you. How are they different from one another? How many different mouths can you see?
4. Describe the body shape of your fish. How many fish with that body shape do you see on the posters/pictures/books near you?

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5. Describe the fins that you see. How many fins come in pairs? Look at the different tail fins—how many different shapes can you find?

**Think, Pair, Share**

1. Have students Think about the following two questions, jotting down some ideas in words or pictures:

- What are some adaptations that all fish seem to have in common?
- In what ways do fish seem to differ and do you think these differences have something to do with where they live in the ocean? Why or why not?

2. Now have each student Pair up with another and compare/discuss their ideas. They can add to their notes after discussion with their partner if they like.

3. Finally, have each pair Share their ideas with another pair of students.

4. Lead a class discussion and record the group's responses on a class chart.

**Assessment**

Teacher observation of participation in Tea Party and Silent Mingle

At least 5 items recorded from Tea Party

Participation in Group Anticipatory and Extended Anticipatory Chart

Fish Sketch

Individual recording of “Think” in Think, Pair, Share

**THROUGH**

**THE ACTIVITIES**

**Fish Adaptation Charts**

Use the four fish adaptation charts you made (*see below for example charts, be sure to add a sketch for each listed word*) to describe the body and tail shapes, coloration patterns and mouth shape, size and location including the teeth and gill rakers. Describe how these adaptations can be used to determine their food and habitat. As you introduce each color or shape on the fish charts, have cooperative groups of 5–6 students find those features on the posters/pictures/books at their table. Have groups share their findings with the class.

**(See attached for examples of fish adaptation sketches and representative fish to use when making your charts).**

**FISH ADAPTATION CHARTS**  
**BODY SHAPE**  
**TAIL SHAPE**  
**COLOR PATTERNS**  
**MOUTH, TEETH, GILL RAKERS**

Fusiform

Lunate

Camouflage

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Location  
Depressed  
Forked  
Disruptive  
Size & Shape  
Sphere  
Squared  
Countershading  
Teeth (Size & Shape)  
Ribbon  
Rounded  
Advertising  
Gill Rakers  
Compressed  
Tapered  
Deceiving Size & Shape

### **Group Brainstorm**

Pick out a few representative fish from the posters and have students help you use the new vocabulary from the fish charts to describe their features. Have groups hypothesize about the fishes habitat and what it might eat. Have groups share their speculations with the class. As an example you might want to complete the Fish Feature Worksheet for one of these fish or with a fresh fish if you have enough.

### **Fish Feature Worksheet and Mystery Fish**

1. Distribute a Fish Feature Worksheet and one fresh fish to each group and have them make drawings of the adaptations they see, including those listed on the Worksheet and two other features of this fish that they find interesting (such as size of scales, fleshy appendages, spines, size of eye). Remind them to use the new vocabulary to label their drawings. Everyone in the group must agree on the label chosen to describe the adaptations.
2. Based on these adaptations, have the groups discuss and complete the worksheet for their fish, including where they think it lives and what it eats.
3. Have the groups share their findings, drawings and hypotheses about the adaptations, diet and lifestyle of their fish with the entire class. (Optional): use a reference book to help students find a description of their fish and lead a discussion of the similarities and differences between their hypotheses and how the fish was described in the literature.

### **Mini-Book on Fish Diversity and Adaptations**

1. Have individual students create a mini-book that includes words and graphic information about what they learned. Have students fold an 8 1/2" x 11" sheet of plain paper side to side and then into thirds. Open it up all the

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way and cut along two of the folds halfway across the page so a book is formed with three pages that open vertically. (Please see the pattern at the end of this activity.)

2. With the book folded shut and only the cover showing, have students write a name for their book on the cover. Open the cover and on the first page (title page) write the author's name. Open the title page and label each of the sections: Adaptations, Habitat, and Lifestyle. Now flip up each section and draw a picture in one subsection and write text in the other. The drawings can represent the fresh fish or those seen on posters or in books. The written descriptions can be about something they learned from this activity about adaptations, habitat, and/or lifestyles pertaining to the drawing on that subsection.

### **Quilt Story**

Have each student contribute a quilt square to a class paper quilt representing the vast array of fish diversity and adaptations.

1. Distribute a blank paper quilt square, colored construction paper, and glue to each student and instruct them to make a fish in its habitat. The attributes of the fish should reflect its adaptations to its habitat. They should also name their fish. Be sure to have them leave a 1" border around the outside.

2. Once the blocks are completed, have each student work with a partner to learn about their partner's fish including habitat, adaptations, lifestyle, and name. Have them introduce each other's fish and how it lives to the class.

3. Once all the fish have been described, have the class designate some "master quilters" to piece them together using different colors of book binding tape to form the lattice strips and the border.

### **Assessment**

Teacher observation of participation in each activity

Teacher observation of Checking for Understanding and Cooperation

Group Fish Feature Worksheet and Drawing and Labeling of Mystery Fish

Individual Mini-Book and Quilt

Verbal Description of Partner's Quilt Square

## **BEYOND THE ACTIVITIES**

### **Create a Fish**

a. Have students pick adaptations from each of the following categories and use these attributes to design their own unique fish.

Color, body and tail shape, mouth size and position, size of teeth and gill rakers, unique structures (such as lures, bioluminescence, fleshy appendages, suckers), size, speed, behavior, etc.

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b. Have students draw the fish and its habitat and then describe its adaptations and lifestyle. Also have them label and name their fish. Students could then make their fish in 3-D using miscellaneous craft supplies and/or vegetables.

c. Have students form partners and make predictions of lifestyle, diet, and name of their partner's creation. The "predictor" and "creator" then make presentations to the class, switching roles as their creation is introduced.

**Gyotaku** (fish printing).

Use the finished prints to show different species adaptations for speed, defense, and food capture. Label the print with the species name.

**Charting Fish Behavior and Movement**

If possible, set up a classroom aquarium so students can observe and keep daily logs of behaviors, patterns of movement, individual variations in feeding, growth and breathing patterns. (See Mapping Fish Habitats, GEMS, Lawrence Hall of Science, UC Berkeley).

**Field Trips**

Visit an aquarium, aquarium store, or fish market to observe the great diversity of fish. Take a fishing trip to a local pier. Note the various kinds of fishing techniques and bait used by different fisherpersons.

**Dissection**

Dissect the fish used in this activity to compare their internal anatomy. Try to make correlations between the internal anatomy and their lifestyle, e.g. tuna have mostly red muscle, reflecting their ability at long distance swimming, and flatfish have no gas bladder, thereby allowing them to lie motionless on the bottom.

**Student Posters**

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

Topics:

1. What sort of adaptations do people have that help us to be successful land dwellers? How are people adapted to be good predators of fish? What have people invented to help us capture fish?
2. If you were an ichthyologist (someone who studies fish), how would you determine the lifestyle and habitat of a fish brought to you by a fisherperson who wanted to know all about it? What sort of questions would you ask the fisherperson? What would you do next to find out all you could about the fish?
3. If you could turn yourself into a fish, how would you have to change? What kind of fish would you be? What special adaptations would you have? Where would you live? How would you escape from fisherpersons and other predators?



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4. What do the expert fisherpersons need to know about fish in order to capture them in great enough numbers to be successful? What should they keep in mind so that they can continue to capture fish year after year? What might affect the number of fish they capture from year to year?
5. Compare fish and whales. How are they similar? What adaptations do they have in common? In what ways are they different? Many species of both groups have been hunted in great numbers. Some whales have become extinct and some are endangered. Do you think fish have this same problem? Why/Why not?

### **Consequence Charts**

Have students work in cooperative groups to complete charts in which they describe consequences over time given the following scenario:

**What would be the immediate, short term, medium term, and long-term consequences on fish, invertebrate, and plant diversity in the kelp forest if hunters killed off the sea otters which eat the sea urchins which munch on the giant kelp?**

**What would be the immediate, short term, medium term, and long term consequences on fish populations if their habitat became polluted with a toxic spill?**

### **Debriefing**

Have students debrief their favorite/least favorite part of the activity. What did they learn the most from? What was a waste of time? How would they change the activity if they were the teacher?

## **EXAMPLES OF FISH ADAPTATIONS**

### **BODY SHAPE**

#### DESCRIPTION EXAMPLE

#### FUSIFORM

streamlined and cylindrical; very fast and can swim continuously for long distances

bonita, mackerel, anchovy

#### DEPRESSED

flattened from back to belly like a pancake; ambush prey with short bursts of speed; burrows into sand

skates, rays, goosefish

#### SPHERE

rounded, globe-like; slow swimmers; may attract prey to them with light and lures

porcupine fish, puffer fish, anglerfish



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## RIBBON

snake-like; slow swimmers but easily move through crevices; hide under rocks or in cracks, and ambush prey that comes too near their hideout  
wolf eels, monkeyface eel

## COMPRESSED

flattened side to side; sharp, quick turns and very maneuverable; viewed head-on they almost seem to disappear  
surf perch, opaleye, halibut, flounder

## TAIL SHAPE

### DESCRIPTION EXAMPLE

#### LUNATE

(fastest)

fastest swimmers, maximum speed with minimum effort over long distances  
marlin, mackerel, dolphinfish, swordfish

#### FORKED

moderately fast, continuous swimmers  
anchovy, herring

#### SQUARED

very maneuverable, capable of bursts of speed for short distances  
rockfish

#### ROUNDED

very maneuverable, capable of bursts of speed for short distances  
senorita, goby, flatfish

#### TAPERED

(slowest)

slow swimmers, use body undulations to swim  
moray eel

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**MOUTH, TEETH,  
GILL RAKERS**

DESCRIPTION  
EXAMPLE

MOUTH ORIENTATION

1. oriented upwards denotes surface feeder or feeds on prey above it;
  2. downwards suggests bottom-grubber
1. stargazer, stonefish
  2. sturgeon

MOUTH SIZE & SHAPE

1. large jaws engulf prey;
  2. jaws which can protrude suck in prey;
  3. elongate jaws reach into crevices;
  4. elongate lower jaw feeds on prey seen above
1. lingcod
  2. rockfish
  3. butterflyfish
  4. halfbeak

TEETH SIZE & SHAPE

1. fish eaters have pointed, knife-like;
  2. snails and clam eaters have plate-like grinders and crushers;
  3. choppers on plants and corals have fused, beak-like
1. barracuda
  2. bat ray
  3. parrotfish

GILL RAKERS SIZE & SHAPE

1. comb-like gill rakers filter food;
  2. large, coarse gill rakers protect gills when they eat from large prey items
1. anchovy
  2. lingcod

**COLOR PATTERNS**

DESCRIPTION  
EXAMPLE

CAMOUFLAGE

match surroundings to blend in and hide  
halibut, cabezon

DISRUPTIVE COLORATION

spots, stripes, and patches of color breakup and diffuse the actual outline  
kelpfish, sergeant-major

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### COUNTER- SHADING

dark back and lighter belly hides fish from predators as sunlight penetrates from above

anchovy

### ADVERTISING

1. warning to stay away from poisons or spines;

2. attract mates, defend territories

3. clean other fish

1. lionfish

2. California Sheephead

3. senorita

### DECEIVING

1. false eyespots confuse predators into attacking the wrong end or miscalculating size/shape of fish;

2. fish resembles objects of no interest to enemies;

3. fish mimics something: a. helpful like a cleaner or b. dangerous like a poisonous seasnake

1. Big Skate, butterfly fish

2. stonefish, sargassum fish

3. a. blenny,  
b. snake-eel

The following table compares the adaptations of four diverse fish:

### FISH FEATURE CHART

MACKEREL

ROCKFISH

FLATFISH

ANCHOVY

#### BODY SHAPE

FUSIFORM

COMPROMISE- CHUNKY HEAD, SLENDER BODY  
COMPRESSED

FUSIFORM

#### TAIL SHAPE

CRESCENT

SQUARISH OR ROUNDED

ROUNDED

FORKED

#### MOUTH, TEETH, GILL RAKERS

LARGE MOUTH, SHARP TEETH, NOT FINE GILL RAKERS

FAIRLY LARGE MOUTH & SHARP TEETH, NOT FINE GILL RAKERS

SMALL MOUTH, SHARP TEETH, NOT FINE GILL RAKERS

EXTREMELY LARGE MOUTH, TINY TEETH, FINE GILL RAKERS

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## COLORATION PATTERNS

COUNTER-SHADING

DISRUPTIVE & CAMOUFLAGE

CAMOUFLAGE

COUNTER- SHADING

Based on the above table, the fish can be predicted to have the following lifestyles:

### food

fish

fish & crabs

fish, shrimp & clam siphons

microscopic plankton

### habitat

open ocean

kelp forest, rocks

bottom, sand covered

open ocean

The **mackerel** appears to be an open water fish based on its countershade coloration. Its streamlined body and crescent shaped tail denotes it to be an active, fast swimmer. Its sharp teeth indicate it to be a fish eater.

The **rockfish** is camouflaged to match kelp growing on rocks. The chunky body and squared tail shows it can achieve only short spurts of speed to capture prey that comes too near its hiding place and large mouth.

The **flatfish** is extremely well camouflaged while lying on a sandy bottom. These fish are flattened side-to-side (compressed) with both eyes on one side of their head. It uses quick bursts of speed achieved with its rounded tail and strong tail muscles to capture small fish and shrimp that swim too near.

The **anchovy** is a fast swimming, open water fish based on its countershade coloration, streamlined body, and forked tail. The extremely large mouth, tiny teeth and very fine gill rakers allow it to filter-feed on microscopic plankton.

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## FISH FEATURE CHART

Fish #1      Fish #2      Fish #3      Fish #4

**BODY SHAPE**

**TAIL SHAPE**

**MOUTH, TEETH, GILL RAKERS**

**COLORATION PATTERNS**

**PREDICT:**

**FOOD:**

**HABITAT:**

**TWO OTHER INTERESTING FEATURES**

**NAME OF FISH**  
**(Look it up!)**