RED FISH ROUNDUP

FOR THE TEACHER

Discipline
Physical Science

Themes
Systems and Interactions; Scale and Structure

Key Concept
Some fish hide from predators at depth by using camouflage color.

Synopsis
Students refract light through water, and experiment with color, light, and rainbows. They search for camouflaged fish during a “scuba diving” experience while wearing blue cellophane goggles to simulate the underwater light conditions.

Science Process Skills
observing, communicating, comparing, predicting

Social Skills
cooperation, checking for understanding

Vocabulary
camouflage, photic zone, refract, spectrum, wavelength

MATERIALS
Through the Activities
Wavelengths Activity
(for class)
- one Slinky
- two ropes or jump ropes, one blue and one red
- large piece of butcher paper

(for small groups)
- drawing paper and colored pens

Making Rainbows Activity
(for each small group or for teacher demonstration)
- glass baking dish or plastic shoe box
- mirror (must fit in baking dish and extend several inches out of the water)
- water to almost fill dish

(for each small group)
- drawing paper and colored pens

Color Spinners Activity
(for each student)
- white cardstock or cardboard large enough to make 8 cm circle
- scissors
- ruler
- seven different primary colors of paint or felt tip markers
- golf pencils (or pencil stubs)
- drawing paper and colored pens

Color Filters Activity
(for small groups or as teacher demonstration)
- flashlight
- drawing paper and colored pens

Preparation for the Underwater Dive
(for the class)
- goggle pattern (see attached)
- clear tape
- blue cellophane (2 rolls)
- string or yarn for ties
- masking tape
- stapler

fish posters (optional)

(for each student)
- red construction paper 4” by 8”
- fish pattern (optional)

Kelp Forest Slide Show
- slide show

BEYOND THE ACTIVITIES
- green cellophane
- green construction paper

INTRODUCTION

The white light that comes from the Sun is actually a mixture of the seven different colors seen in a rainbow. A rainbow is formed as white light passes through water droplets in the sky or through a glass prism. Each color travels at a slightly different speed, which bends, or refracts, it by a slightly different amount, thereby spreading out the colors into the rainbow pattern. Wavelengths of light are measured just as waves are measured in water, from the crest (top) of one wave to the crest of the next. Red has the longest wavelength and is bent the least and violet has the shortest and is bent the most. The rainbow of colors always appears in the same order: red, orange, yellow, green, blue, indigo, violet.

The colors people see are called the visible light spectrum. The larger spectrum, of which the visible spectrum is a part, is called the electromagnetic spectrum. There are two very important, but invisible, parts at either end of the visible spectrum. Just beyond the red we can see is the infrared (IR), which gives us the heat from the sun, and just beyond the violet is the ultraviolet (UV), which gives us a suntan.

Paints and all colored things contain pigments. When we say something is red, it is because the pigments are absorbing all the colors in the light that is hitting the object except the red, which is reflected. A blue object has pigments that absorb all the colors in white light except for the blue, which is reflected. Plants look green because a pigment called chlorophyll, which is used in photosynthesis inside the leaves and stems, mainly absorbs red light and reflects mostly green light.

The light from a flashlight shone through your palm in a darkened room appears rosy because your flesh and skin act as filters. A filter is any material that absorbs some of the colors in light and allows others to pass through. Red filters absorb all colors except red which passes through. Your skin takes on a rosy color because the red blood under the skin works as a red filter. Red light passes through and other colors are stopped.

The ocean acts as a filter and allows only certain colors to pass through to the deep, while it absorbs other colors in the top few meters. Violet and the orange-red wavelengths are the first to be absorbed. Blue and green wavelengths travel the deepest. In very clear tropical waters, while all the red light is absorbed in the upper 10 meters, a small amount of blue light can actually make it all the way down as far as 100 meters. Many deep sea animals are red because there is no red light at these depths to be reflected to a predator's eye, and so the potential prey is essentially camouflaged.

The region of the ocean that is lit by sufficient sunlight to support photosynthesis is called the photic zone and rarely extends deeper than about 100 meters. The depth of this sunlit zone is dependent on how murky the water is. This murkiness can be caused by sediments, such as mud running off the land, or large amounts of plankton in the water. These particles in the water may scatter the light or absorb it so that even green light may not be able to penetrate past 30 meters.

INTO THE ACTIVITIES

Tape Recorders

See the Teaching Strategies section for how to present this activity.

Use the following two prompts:
1) Tell your tape recorder anything you know about rainbows.

Partners switch roles.

2) Tell your tape recorder anything you know about colors and camouflage in the ocean.

THROUGH THE ACTIVITIES

Wavelengths

Do this activity as a class demonstration.
Have two students each hold an end of a Slinky and stretch it out to about four times its length. Direct one of the students to slowly shake their end up and down several times. Have the other students watch carefully and then sketch how the Slinky moves. The up and down wave motions seen are like water waves in that they have high and low parts called crests and troughs. Have students label the distance between wave crests as the wavelength. Now have the student holding the Slinky shake the end more rapidly. What happens to the wavelength now? Have the students sketch these results and then compare the two sketches.

Now use two ropes, one red and one blue, to represent those two colors of light. Assign students to hold each end of the red rope and lay it with some slack in it on a large piece of butcher paper spread out on the floor. Have other students line up on either side of the butcher paper. Have one student shake the end of the rope back and forth slowly, while the other students mark on the butcher paper the highest and lowest points reached by the rope. Have them join these points together by drawing smooth curves to form the crests and troughs of a wave pattern.

Now have the blue rope students place their rope on the same butcher paper and shake one end of the rope rapidly. Again have the other students record the high and low points and sketch the wave pattern. This demonstration compares the speed of vibration (wavelength) and the amount of energy in the two colors of light. Blue light has a shorter wavelength and possesses greater energy than does red light. (It takes more energy to shake the rope rapidly than to shake it slowly.) Have the groups sketch the motion of the two ropes and compare the wavelengths.

Making Rainbows
Pick a bright sunny day to make a rainbow spectrum on the wall. This activity can be done as a demonstration or in small groups. Have students put a glass baking dish or plastic shoe box on a table top near a window that gets sunlight. Pour water into the dish until it is nearly full. Have the students put a mirror into the water so that the sunlight is reflected off it onto a white wall or ceiling. They can juggle the position of the dish and the slant of the mirror until they get a rainbow on the wall. *Tell the students not to look directly at the mirror reflecting the sunlight, but look instead at the wall or ceiling on which the rainbow is focused. The wedge of water between the surface and the mirror acts as a prism to bend each different wavelength by a slightly different amount so that they strike the screen at different places.*

Have one student in each group wiggle their fingers in the water to see how the colors mix to make the white light. The colors will blur and become white. Have students sketch the experimental set-up and color the results of their experiment.

Color Spinners
Have students work in small groups for this activity.
Have each student cut out a circle about 8 cm across from card, white stock, or cardboard. Color the discs with paints or felt-tipped pens, dividing each disc into seven equal areas and coloring each area with a different color of the spectrum. Have each student within the group use a different combination of the same seven colors so they can compare results. Now have them push a pencil stub, point downwards, through the center of each spinner disc (short pencil stubs are easier to spin) and then set the discs spinning. *Because the disc spins so quickly your eyes cannot make out the separate colors, they merge together so that the disc looks gray-white. Don't worry if it looks a bit dirty.—you can never get a perfect white because the card and paints are not pure colors.*

Color Filters
This activity can be done in small groups or as a class demonstration. Darken the room and have groups of students take turns holding a flashlight under their hand with their fingers held straight and pressed tightly together. Have them move the light around behind their fingers and palm and observe the color of any light that passes through. Have them sketch the results and hypothesize why. *Parts of their hand will appear rosy in color.*

Preparation for the Underwater Dive
Goggles to See as the Fish See
Trace and cut out construction paper goggles for each student using the pattern provided. Alternatively, have each student make their own. Fold or cut six layers of blue cellophane and tape over the eye holes. Staple string or yarn for ties to hold the goggles on.

Schooling Red Fish
Have each student make a fish out of red construction paper using the pattern provided or a design of their own. Review fish shapes and fins (see the tables in the It Takes All Kinds activity) and have the students include on their fish the dorsal, anal, pectoral, pelvic, and caudal fins.

Use the time students are out of the room at recess to tape all their red fish to the walls, bulletin boards, posters, curtains, etc., using a variety of light and dark backgrounds. Tape the fish around the periphery of the room so that when the students enter the room you can have them all circle the room in the same direction. Turn off the lights, close the curtains, and put on a pair of goggles to test the light levels and effectiveness of the camouflage. If the room is too dark, students will not be able to see anything and if too light, the red fish will be very obvious. The red fish should just disappear against a dark background (black, red or blue) and although their outline will be apparent against a light background, the red color should not be seen.

Searching for the Fish
Meet the students outside the classroom and have them form buddy pairs to go "scuba diving." Remind them that when they enter the room they will be diving in the kelp forest and can only use hand signals to communicate with their buddy. Have them put on their "wetsuits" and "flippers," place their "tank" on their back and the "regulator" in their mouth for their oxygen source and then distribute the goggles. Don't allow the students to wear the goggles outside for any length of time and warn them not look at the sun. Tell them that when they enter the room, the whole class will circle in one direction and each buddy pair will silently count all the red fish they can find.

After the entire class has toured the room once, increase the light levels slightly (open the curtains a little or turn on a few lights) and tell them they are now starting to surface through the kelp so the amount of light has increased.

Have them tour the classroom again and count how many red fish they can find this time. Finally, repeat the search with the lights on and the goggles off to compare the number of fish they can now see or the time it takes to find all the fish.

Review with the students that blue wavelengths are the primary colors that penetrate the furthest into the water and the blue goggles work as a filter and only let blue light reach their eyes.

Kelp Forest Slide Show
Show the *MARE* Kelp Forest Slide Show or other slides (e.g. Monterey Bay Aquarium Kelp Forest or Rocky Seashore slides from the Seashore Charades activity) and have students put their goggles on and off to observe the filtering affect of the water at depth.

Wavelength Worksheet
Pass out the Wavelength Worksheet and have the students use their colored markers to show which colors of light penetrate the furthest underwater and which "disappear" near the surface.

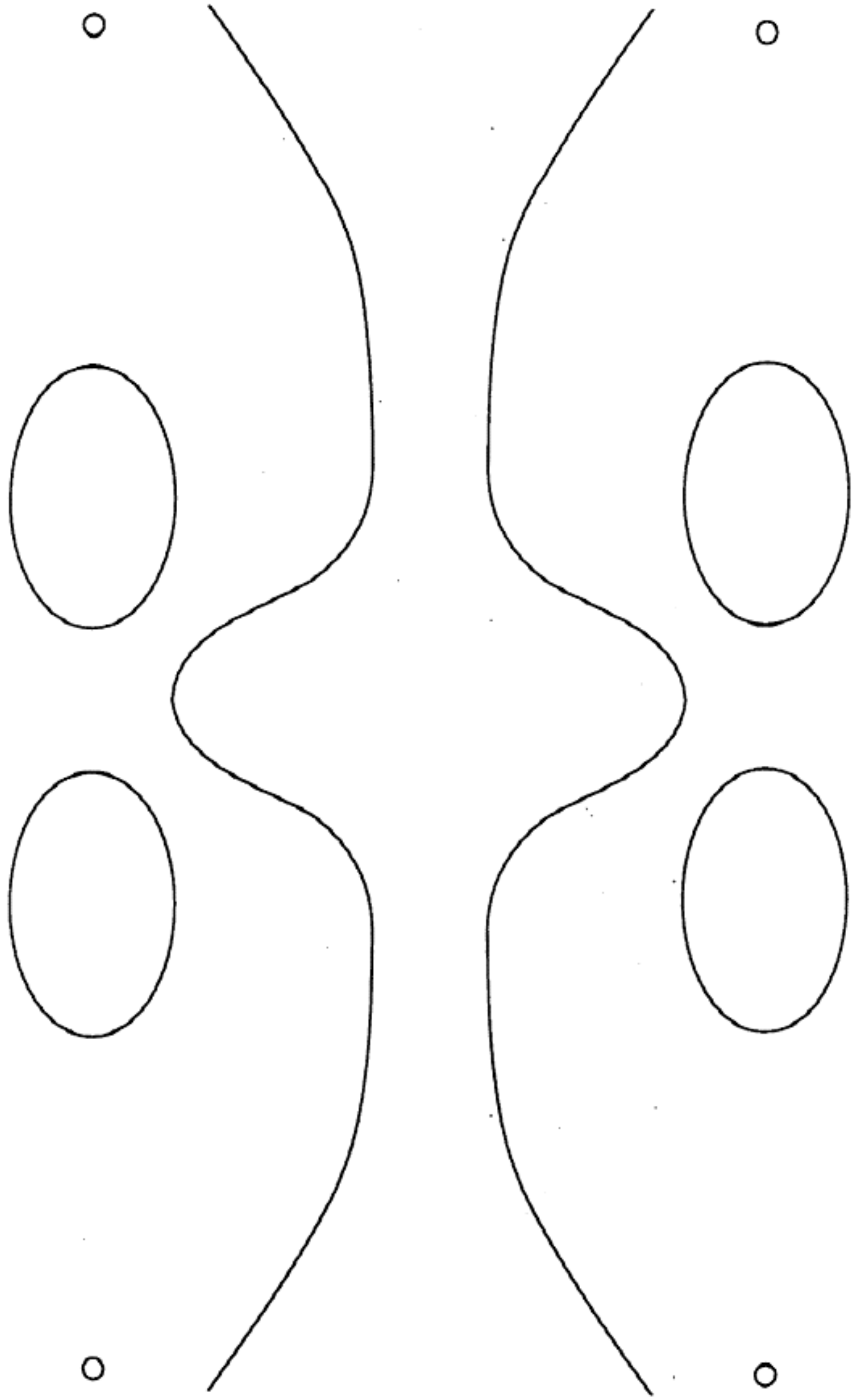
BEYOND THE ACTIVITIES

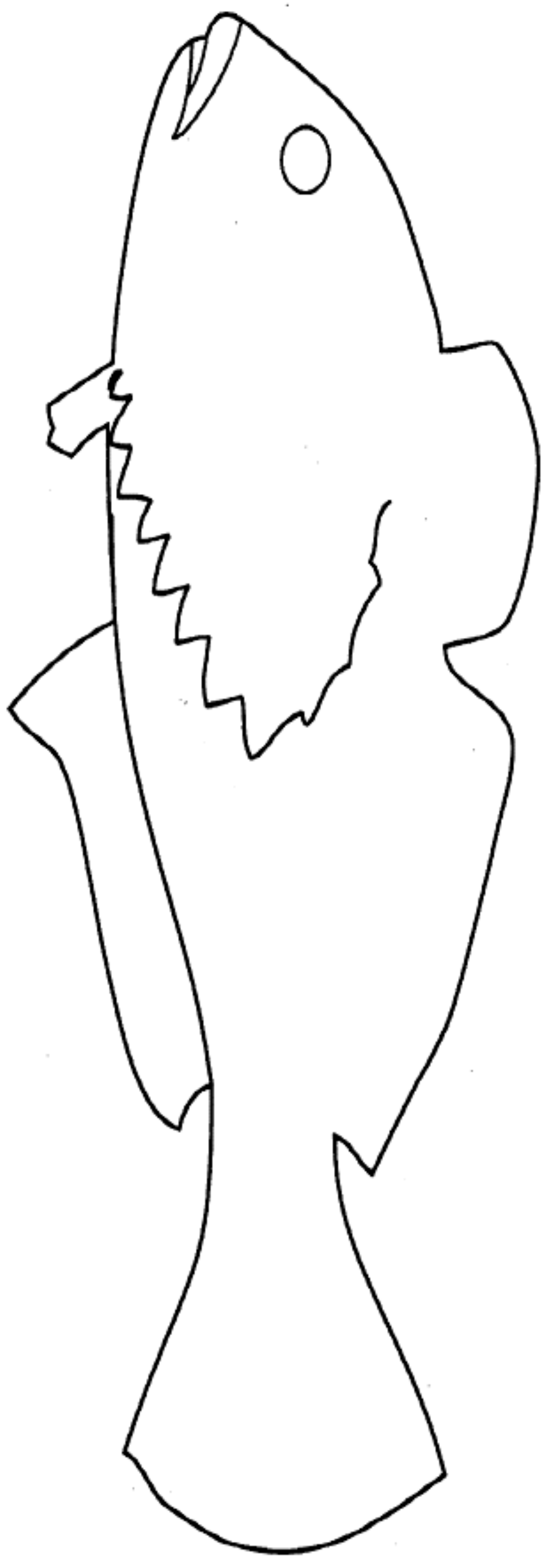
Further Experiments
Repeat the experiment with green cellophane and some green fish. Have the students make predictions before actually doing the experiment.
What would happen if red goggles were used? *(you'd see all the red fish.)*

What if?
Have students write and illustrate stories based on "What if the ocean were red instead of blue?"

Library Research
The first two topics listed below will be review for the students if they have already done the activity It Takes All Kinds. Have groups of students discuss the following topics, do some research if necessary and then make posters about their discoveries. Have the students make presentations to the class.

- What adaptations do predators have to find prey underwater in dim light? *(good eyesight, large eyes, barbels or "feelers," lateral lines and echolocation)*
- All the fish below 10 meters aren't colored red. What other ways do fish hide from predators?
- Research all the red fish that live in the kelp forest.





Wavelength Worksheet