RED FISH ROUNDUP

Overview

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.

In Session 1, students do the Tape Recorders activity to access their prior knowledge and then participate in hands-on activities as they refract light through water, and experiment with color, light, and rainbows. In Session 2, they search for camouflaged fish during a "scuba diving" experience while wearing blue cellophane goggles to simulate the underwater light conditions. Students discover that some fish hide from predators at depth by using camouflage color.

What You Need

Wavelengths Activity
For the class:
- one cotton rope (a climbing or cotton jump rope works great)
- large drawing of a rainbow

For small groups:
- drawing paper and colored pens

Making Rainbows Activity
For each small group:
- 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

Preparation for the Underwater Dive
For the class:
- goggle pattern (see attached)
- blue cellophane (2 rolls)
- string or yarn for ties
- masking tape
- stapler
- fish posters (optional)
- wavelenth worksheet copied onto chart paper

For each student:
- red construction paper 4" by 8"
- fish pattern (optional)
- wavelength worksheet (attached)
- colored markers

Getting Ready

Decide if you will do Making Rainbows, Color Spinners, and Searching for the Red Fish as a whole class or as station rotations. Stations require less materials, but more adults.

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
1. Have each student make a fish out of red construction paper using the pattern provided or a design of their own.

2. 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.

3. 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.

Wavelengths

1. Draw a picture of a rainbow on chart paper.

2. Copy the wavelength worksheet onto chart paper and color in the wavelengths of light using the colors of the rainbow.

Key Concept

Write out the key concept using colored markers on a large sheet of chart paper.

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

(Into The Activity)

Session 1: What Do You Know?

Tape Recorders

This is a good technique to access student's prior knowledge and naïve conceptions about a subject in an unthreatening and fun way.

1. Have the students pair up; one of the pair will be #1 and the other #2. Tell them that the #1's will act as the tape recorder first and like all tape recorders, are not allowed to say anything until the playback button is pushed. Their job is to listen to everything #2 says and to try to remember as much as possible. The #2's will have about 2 minutes to describe their thoughts about a question posed by the teacher (see prompts below.)

2. After the #2's finish describing their ideas, the #1's will have about 1 minute to repeat back to their partner everything the #2's said. Tell the students that they will have a chance to switch roles before the second question.

3. Ask the #2's the following question and remind the #1's that they may only listen.

Tell your tape recorder anything you know about rainbows.

4. After two minutes, call time, have the tape recorders push their "rewind button" and repeat back to their partner as much as they can remember. Then lead a class debrief, with volunteers describing what their speaker said.

5. Now have the partners switch roles and ask the new speaker the following question.

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

6. Again lead a class debrief about their ideas.

(Through The Activity)

Wavelengths – A Demonstration

1. Do this activity as a class demonstration. Have two students hold opposite ends of a rope and stretch it out so it is off the ground for its entire length. Direct one of the students to slowly shake their end up and down several times.

2. Have the other students watch carefully and then sketch how the rope 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.

3. Now have one of the students holding the rope shake the end more rapidly. What happens to the wavelength now? *(it gets smaller)* Have the students sketch these results and then compare the two sketches.

4. This demonstration compares the speed of vibration (wavelength) and the amount of energy in two colors of light. The first demonstration with the rope moving slowly, resulting in long wavelengths, represented red light. The second demonstration with greater energy going into shaking the rope more vigorously, represented blue 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.)

5. Show a drawing of a Rainbow and discuss how the spectrum always appears in the same order. One way to memorize the order is by using the mnemonic device: ROY G BIV (for red, orange, yellow, green, blue, indigo, violet.)

Some teachers like to do the following three activities in a rotation setting, with students spending approximately 15 minutes at each station. While stations are great, they do require more adults to provide supervision and check for understanding.

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.

1. 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.*

2. Ask the students why they think they see a rainbow. *(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.)*

3. Have one student in each group wiggle their fingers in the water to see how the colors get mixed up, blur together and again form white light.

4. 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.

1. Have each student cut out a circle about 8 cm across from a card, white stock, or cardboard. Plastic cottage cheese

lids work great as a pattern. Next have them divide each disc into seven equal areas.

2. Have them color the different areas of the disc with paints or felt-tipped pens, coloring each of the seven areas with a different color of the spectrum. Students within the same group can use different combinations of the same seven colors so they can compare results.

3. After coloring, 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.*

Session 2: The Dive

Searching for the Fish

1. 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.

2. 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.

3. 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.

4. 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.

5. 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.

6. Show the students the Wavelength Chart and review with them that blue wavelengths are the primary colors that penetrate the furthest into the water. Red is one of the first colors to be filtered out and so any brightly colored red fish will actually look gray at depth. The blue goggles represent the blue water and work as a filter to only let blue light reach their eyes.

7. Tell the students that those beautiful pictures of fish on calendar pages were only possible to see because the photographer took a flash down to depth and shot the picture with a blast of white light. The diver was bringing red light down to a depth that it could not penetrate on its own.

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.

Key Concept
Hold up the key concept and have one of the students read it aloud. Post it near the large chart of light wavelengths.

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

(Beyond The Activity)
Going Further

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.

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.)*

Color Filters
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.*

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.

Red Fish Roundup Home Activities

INTERNET RESEARCH
Search the internet for sites using the key words: light filtration in seawater. Bring in any additional information you find and web addresses to share with your classmates.

VIRTUAL FAMILY VACATION
Check out the internet to find aquariums (such as Monterey Bay Aquarium) with displays showing fish at different light levels–simulating what the fish would look like at different depths. Check out if they have a virtual tour or web activities about this exhibit.

DIORAMA
Cut out brightly –colored underwater pictures (from magazines or old calendars) and make a shoebox diorama of a bright underwater scene. Now, draw a picture of that same scene, but this time how it would look at about 30 meters underwater. Take your family on a "tour" of your diorama and use it to explain to them what happens to red light as it travels through the water.

A SWIM THROUGH YOUR HOUSE OR YARD
Take your family on a "swim" through your house or yard pretending that you are wearing the blue goggles. What furniture, pictures, flowers, leaves and other items would disappear from view if you looked at the world through blue-colored glasses. Ask your parents what it means to see the world through "rose-colored" glasses. Imagine what the world would look like if you could see the world from the perspective of some insects – they can even see ultraviolet!

Background

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.

