Light in the Deep Sea
Teacher Materials

Key Concepts

There is a relationship between the color of light and its ability to penetrate seawater. Animals living in the ocean take advantage of this property of light to help them hide from predators.

Algae can only grow in the top 100 meters of ocean waters, where there is light. They need light for photosynthesis.

Summary of the Activity

LOOK: Students examine a chart of the electromagnetic spectrum which lists the various colors of visible light and their wavelength ranges. Using colored pencils, they color in the spectrum and the graph indicating the depth to which the various color lights can penetrate seawater.

GUESS: Students guess which colors would be easier to see at various depths in the ocean. Which color would provide the best protection against being noticed and eaten by a predator?

TEST: Students color six fish, one in each color of the rainbow: red, orange, yellow, green, blue, violet. Then they look at the drawings through a blue filter which simulates looking at the fish low in the ocean's photic zone.

TELL: Students compare and explain their results to one another.

LOOK AGAIN: Notice the strategic coloring used by five different fish species. Color the fish diagrams so they show the appropriate color patterns.

Materials List

for each group: colored pencils, color photographs of fish and invertebrates, blue plastic film (blue plastic report folders work, but gels for stage lights obtained from a theater supply company are the best.)

Background Information

Visible light represents a narrow band of electromagnetic radiation that appears white when all colors are present. The colors of the spectrum (red, orange, yellow, green, blue, indigo and violet) can be remembered using the mnemonic device: ROY G. BIV which uses the first letter of each color.

The ocean appears blue because the colors of shorter wavelength (blues) penetrate seawater to a greater depth than do the reds of longer wavelength. This property influences the coloration patterns of marine organisms and therefore their distribution.

A colored filter allows only one color of light to pass through the filter, all other colors are blocked from the eyes of the viewer. In the case of the blue plastic filter, the only color that can pass through is blue light. This is used to represent the fact that blue light is the only light that penetrates to deeper water.

Algae can only grow in the top 100 meters of ocean waters where there is light. They need light for photosynthesis, their method of feeding themselves. Tiny, floating algae, or phytoplankton, convert sunlight energy into the food and form the basis for the entire marine food web. Larger algae, like kke provide habitat for many fish and invertebrates. Some of these photosynthesizers eventually sink toward the deep sea. On the way to the bottom, the complex molecules are recycled by bacteria and small animals, eventually feeding the midwater and benthic communities of the deep sea.

Discussion Questions

1. If you see a red fish, can you guess anything about its lifestyle? Is it more likely predator or prey?
2. Is a red fish safer from predators near the top of the water column or near the bottom? Why?
3. In addition to protective coloration, what are six other strategies fish use to avoid predators.
4. Why don't fishes' techniques for escaping predation work when it comes to human predators?

Extensions

1. Explore the increasingly effective methods of fishing that have arrived in this century and analyze what these methods have done to fish populations and human lives. What could be done about the problems that overfishing has created? How can we help ocean ecosystems to become balanced again? How can we help people who used to rely on fishing find other ways of supporting their families? Is it a good idea to eat swordfish, red snapper, salmon, shrimp and other fish and sealife whose numbers are declining drastically?
2. Try using different colored filters, such as red and green. What colors are easy to see? Which colors do not pass through the filter?
3. Some marine animals have the ability to change their colors using chromatophores. How do chromatophores work? Which animals have these structures? How do they use them?

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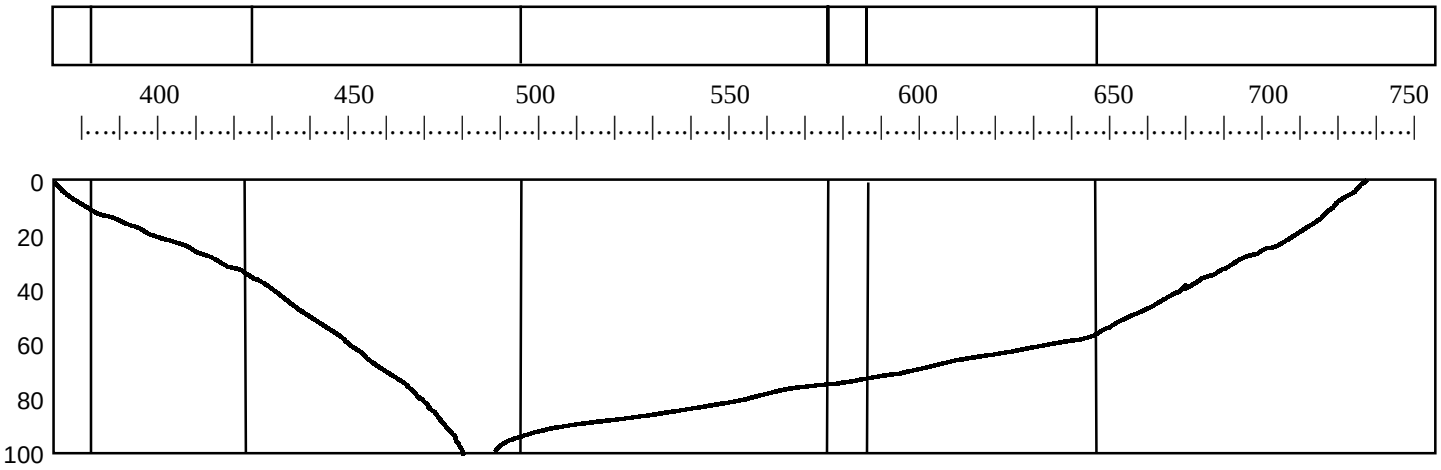
Student Materials

LOOK: 1. Look at the table of radiation types and wavelengths. Notice that the same information can be shown by a diagram of the color spectrum.

Type of radiation	**Wavelength in nanometers**
gamma rays	less than .1
x rays	0.1-100
ultraviolet radiation	100-380
violet	380-424
blue	424-491
green	491-575
yellow	575-585
orange	585-647
red	647-750
infrared radiation	750-10
radio waves	10-

2. Using your colored pencils, fill in the correct colors, corresponding to the different wavelength ranges marked.



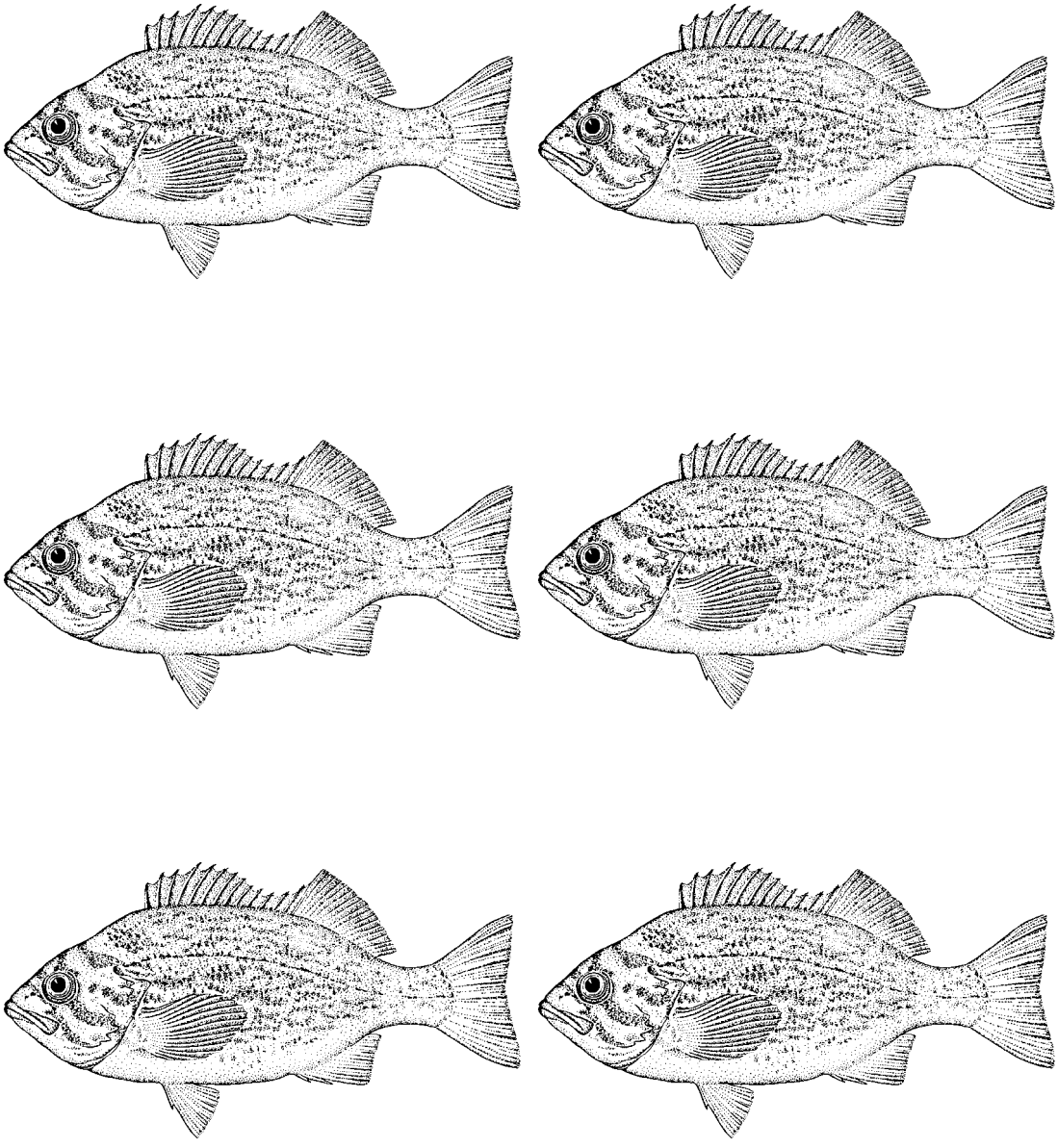
3. The graph below the spectrum represents the depth in feet to which various colored lights can penetrate seawater. Color the spaces with the corresponding colors of the spectrum.

GUESS:

1. Which colors would be easier to see, deep in the ocean?
2. Which color would provide the best protection against being noticed and eaten by a predator?

TEST:

1. Color each of the 6 identical fish you see in a different color of the rainbow (Red, Orange, Yellow, Green, Blue, Indigo, Violet) Which fish would you expect to be most visible in the water?
2. Look through the blue plastic filter at the six fish.
3. Note any differences in how easy or difficult it is to see the differently colored fish, now.



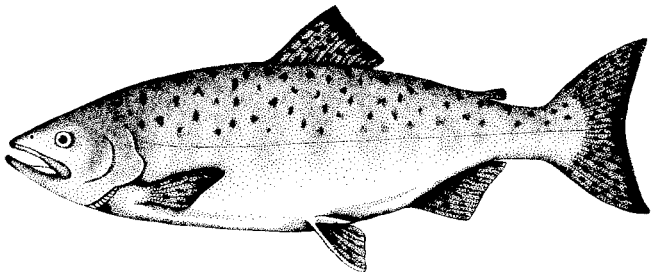
TELL: Share your observations with your classmates. Discuss which color a fish should be if it wants to escape predators' notice. Also discuss why a fish of a certain color (which color?) can't be seen if there is only blue light around them (or if they are seen through a blue filter).

LOOK AGAIN: Read about and examine the diagrams of the five different fish (salmon, anemone fish, flatfish, California sheephead, butterflyfish) to learn about more coloration strategies that fish species use to protect themselves.

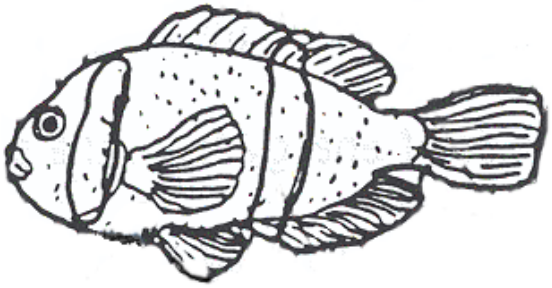
Draw and color a fish that would blend in perfectly with a deep sea environment. Compare your drawings with photographs of fish and invertebrates using the blue filter.

There are many strategies for survival among marine fishes. Some of the common coloration patterns are described below, and an example of a fish that uses it is provided. Use your colored pencils to complete each diagram below

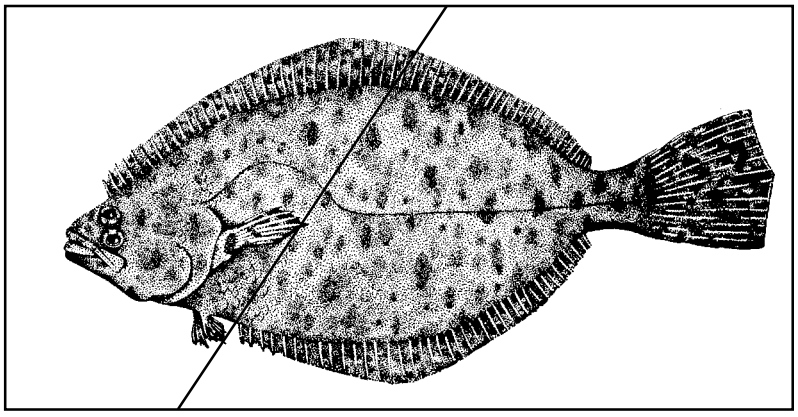
a. The salmon is a fish that employs "countershading" to blend into its environment. Its dorsal surface is dark and when viewed from above it blends in with the ocean bottom while its ventral surface is light and when viewed from below, it looks like the sky. (Color the top half of the fish dark blue and leave the bottom white.)



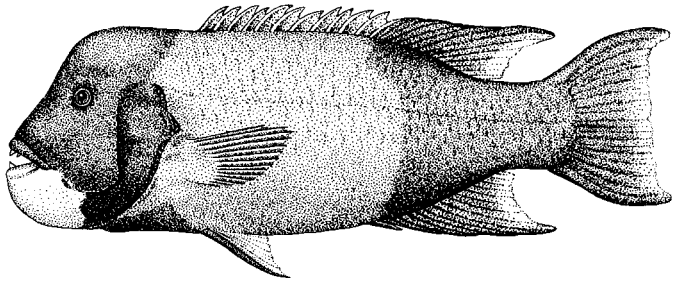
b. The anemonefish is bright orange except for the two white stripes on its side that allow it to blend in with the lightly colored sea anemones on the bottom. The red appears black at these depths while the stripes represent disruptive coloration. (Color the fish orange while leaving its vertical stripes white.)k



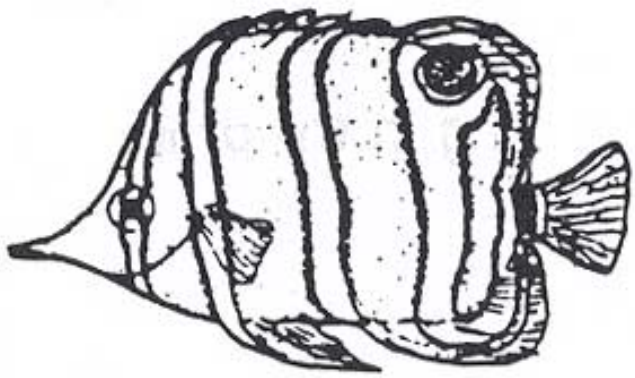
c. Many flatfish have chromatophores that allow them to change color to match their surroundings. They have the ability to contract and expand the pigments on their skin in order to accomplish this. (Simply color the left side of this diagram with a lighter shade than the right.)



d. All sheephead fish are born as females but some mature into males due to environmental cues. The females are a dull orange while the males have black heads and tail regions broken up by an orange midsection for easy recognition. (Color the shaded ends of the fish black and its midsection orange.)



e. The butterlyfish uses a dark spot as a false advertising to fool predators. The spot looks like tan eye of a bigger fish and the vertical stripes allow it to blend in. (Color the spot on its back and shaded stripes black and the light stripes orange.)



f. Your fish: