ALL THAT GLITTERS

This lesson plan developed by:

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Overview:

Some deep sea creatures use the properties of light to camouflage themselves in order to hunt for food or avoid becoming a meal. Sunlight contains all the colors of our visible spectrum. Certain colors of light can penetrate better into the water than others. In this activity, students will learn what happens to light and colors as one descends deeper into the ocean, and how some deep-sea organisms use this process to their advantage.

Materials:

Per group of students:

- Flashlight or glowstick
- Scissors
- Colored felt, foam or paper (red, orange, yellow, green, blue, dark brown and black)
- 1 black sheet of paper

Per student (materials to make Deep Sea Dive Goggles):

- Blue plastic sheets (report covers or index separators)
- Rubber band
- Paper and binder clip
- Small container

Set-up Prior to Activity:

1. Create deep sea dive goggles: Cut blue plastic into strips approximately 8.5 inches long by 3 inches wide. Punch a hole in the middle of one end of every strip of plastic. Thread 4-8 sheets of plastic through the regular paper clip. Tie one end of a cut rubber and to this paper clip. Tie the other end of the rubber band to one of the silver ends of the binder clip.
2. Cut colored felt, foam or paper into squares and separate by colors so that black, brown, red, orange, yellow, green and blue are together.

All that Glitters (cont.)

Duration:
2 hours

Physical Activity:
Moderate

Background:
This activity allows students to explore the nature of light, ask what happens to light as it passes through the ocean and speculate on how deep-sea animals deal with living in the dark. Many animals that swim in open water (pelagic) in the mesopelagic or twilight zone have large eyes relative to their body size. Large eyes capture what little light is available. As depth increases below the mesopelagic, eye size in many organisms decreases. For example, two species of bristlemouths, *Gonostoma denudatum*, a mid-water fish, and *Gonostoma bathyphilum*, a deeper water fish, have different eye sizes. The mid-water species has much larger eyes. The deep-water species has much smaller eyes—the result you would expect if eyes had no value in the total absence of light. However, an enigma exists. **Many animals living on the deep-sea floor sea have huge eyes!** One possible value of vision where there is no ambient light is that some deep-sea organisms make their own light—they are bioluminescent.

Activity:
Part 1: Introduction to Colors in the Deep Sea

1. Challenge the students to observe what the underwater world looks like by using Deep Sea Diving Goggles. Pass out the black paper, Deep Sea Diving Goggles, and colored squares to each group of students.
2. Explain that the black piece of paper represents the darkness of the deep sea. Spread the different colored squares on the black paper.
3. Use only one layer of the Goggles to observe the colors of the squares. Add another layer and observe. Continue adding layers, simulating what it looks like to go deeper into the ocean. What happened with each color? The blue plastic enables students to see how colors appear in deeper water. The blue plastic filters out other colors just as water absorbs them. Students should observe that the color black disappears first, followed by red, then orange, then yellow. Distribute the Color in the Sea Student Handout chart to each student group if you would like them to quantify their observations.
4. If they were fish wishing to hide in the mesopelagic twilight zone, what colors would be the best camouflage? Black and then red. The vampire squid, flapjack octopus and red sea fan are all organisms that use this type of camouflage (red color) to disappear in the deep sea.
5. Introduce bioluminescence using the glowstick or flash light. Demonstrate turning it on. Ask the students for their experiences with bioluminescence: fireflies are a good example. Observe the flashlight with the goggles on. How might deep-sea species use the light they make? Discuss counter-illumination, finding a mate, finding prey, attracting prey and startling predators by blinding them. What color would be the most effective for bioluminescence —blue as it penetrates water most easily.

All that Glitters (cont.)

Part 2: Dark Ocean Game

1. Select the first set of students. Give them flashlights, a container and Deep Sea Diving Goggles
2. Spread felt, foam or paper squares thinly on the black paper on the tabletop and tell them this is their food. They must find it in the dark, wearing the Goggles. They are fish living in deep water where there is very little light. They may use the flashlight, their bioluminescent organ, to look for food, but whenever it is on, you may tag them because they are visible to a predator—you. When you tag them, a gulper eel has eaten them. They may only use one hand to collect food using their thumbs and forefingers to pick up one item at a time and place it in their container. Students not playing will watch to make sure the rules are followed. Anyone being rowdy loses.
3. With Goggles in place, dim the lights and let the students begin feeding. If they can see the prey, they may feed without the light, but the light will illuminate almost invisible items. Play until you have tagged about half of the students. Repeat with another group. The students may keep their containers when tagged. They just have to stop eating.
4. Have the students evaluate the contents of their bags for colors selected. Add up all the felt, foam or paper squares eaten by color versus those left on the table by color.

Discussion:

As a group, discuss the following questions:

1. Were certain students less visible to predators than others? Was there something about their clothing that may have helped them stay invisible? What is your evidence for this?
2. How well were you able to see the prey with your flashlight off? On? Did the colors make a different in your ability to see a prey item?
3. When you used the flashlight, did you develop a strategy that decreased your chances of being eaten by the gulper eel? What did you do to avoid becoming prey?
4. Did you benefit from another's flash of light? How?
5. Did the colors influence those items eaten? If so, in what way?

The vampire squid has red coloring which it uses to camouflage (or disappear) in the deep sea.

All that Glitters (cont.)

Additional Resources:

To learn more about the activity, check out our All that Glitters "how to" video.

Ocean Literacy Principles:

Ocean literacy is an understanding of the ocean's influence on us, and our impact on the ocean. There are seven Ocean Literacy Essential Principles that all people of our blue planet should have an opportunity to learn and understand. This activity touches upon the following Essential Principles:

5. The ocean supports a great diversity of life and ecosystems
7. The ocean is largely unexplored

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Student Handout

Color In The Sea

You are hunting for bits of food in the “twilight zone.” Randomly arrange your colored squares on the black background. Put on your blue goggles to simulate light conditions in the “twilight zone,” using 2 or 3 layers (depending on the ambient light in the room. Quickly pick up the first ten pieces of :food: you see. Record your results. Repeat with another partner, record results. Analyze your overall findings.

Partner	Red	Orange	Yellow	Green	Blue	Black
1						
2						
3						
4						
Total:						