

Teacher directions for "Light up the deep-sea"...

Getting prepared for the class:

Copy one of the following pages for each class. Cut the pieces up to give one piece to each group. Remember to keep the number of groups unequal! (if you have less than 9 groups, you will not use one or more of the pairs. The last cut-out is the odd one.

Class directions:

Divide the class into small groups of two to four students each. Make sure there is an odd number of groups in the room, and ask groups to spread out around the room. Explain that each group represents an animal that lives in the deep ocean and that there are two of each kind of animal in the classroom. Their goal will be to figure out where the other animal of their type is.

Give each group a flashlight and a card with a light pattern. Explain that a dot means they'll put the flashlight on for just a split second, while a dash means they'll hold it on for about one to two seconds. You might want to demonstrate this concept to the class with your own flashlight first.

Because it is going to be a lot of lights going on and off with such large classes, I suggest you tell them to emit their light directly on the ceiling above their group. One person of the team will emit the light pattern. The other one or two people will be watching for the same pattern they have to be emitted from another group. (don't tell them there are unequal groups!)

When all groups are ready, turn off the lights and ask them to begin emitting their patterns with their flashlights. While one student in each group beams the light, the others in the group should look carefully around the room for the same signal. When a group thinks they have found a match, have one player go over to the other group and check out their pattern. If they are right, stay together and stop flashing their light. If incorrect, go back and keep trying.

Once every group has found its "match," (all but the lone group), stop the simulation and have students return to their own seats and answer the lab questions.

Answers to Postlab questions:

1. What did the light your group was emitting represent? (Break down the word, what does it mean?)

Bioluminescence (bio = life luminescence = light)

2. Describe how an organism would use light for the following:
 - a. Communication-pg 354 send a signal to the other members of the same species to attract a mate
 - b. Attracting prey- pg 353 use of lures and barbells to attract food close to their mouth.
 - c. Counterillumination-pg 350 photophores found on their undersides produce light to break up their silhouette and blend in with the background light coming from the surface
 - d. Escaping from predators-pg 351 some produce secretions such as bioluminescent ink that allows them to squirt, dazzle the predator, and escape
3. Why was the use of several colors of lights used in the experiment? How does this relate to bioluminescent light in the deep sea? What depth zone is the colored light used?

Pg350 **midwater** bioluminescence is **blue-green** (the intensity of the light can be controlled, depending on the brightness of the light coming down from above)

Pg351 photophores under the eyes of a few **midwater** species emit **red** light. Red light is invisible to most other midwater species, yet the fish that have red light can see red light.

4. What is a photophore? Pg 345 a light producing organ
5. What sensory organs have deep-sea organisms developed to utilize the use of bioluminescence?

Pg 349 box many midwater animals have evolved **large, light-sensitive eyes** that provide good vision in dim light. Some developed **tubular eyes** that provide good upward vision. One squid even has developed one eye larger than the other, where the large eye is pointed upward and the smaller towards the depths!

6. What adaptation has the deep-sea anglerfish developed that uses bioluminescence to lure prey?

Pg 353 The anglerfish uses a lure with a light on the end to attract its prey.

7. What did the fact that one group did not find a mate represent?

Mates are hard to come by in the dark.

"Light up the deep-sea"...

Following the teacher's instructions, you will be divided into groups. Each group represents an animal that lives in the deep ocean. There are two of each kind of animal in the classroom. Your goal will be to figure out where the other animal of your type is.

Your group will be given a flashlight and a card with a light pattern. A dot means turn the flashlight on for just a split second, while a dash means turn the flashlight on for about one to two seconds.

(· · — means short, short, long)

Because it is going to be a lot of lights going on and off, emit your light directly on the ceiling above your group. One person of the team will emit the light pattern. The other one or two people will be watching for the same pattern they have to be emitted from another group.

When the teacher gives the *GO* signal, begin! When your group thinks they have found a match, have one player go over to the other group and check out their pattern. If they are right, stay together and stop flashing your light. If incorrect, go back and keep trying.

Once every group has found its "match," the teacher will stop the simulation and you will return to your own seats and answer the lab questions below...

Postlab questions:

1. What did the light your group was emitting represent? (Break down the word, what does it mean?)
2. Describe how an organism would use light for the following:
 - a. Communication-
 - b. Attracting prey-
 - c. Counterillumination-
 - d. Escaping from predators-
3. Why was the use of several colors of lights used in the experiment? How does this relate to bioluminescent light in the deep sea? What depth zone is the colored light used?
4. What is a photophore?
5. What sensory organs have deep-sea organisms developed to utilize the use of bioluminescence?
6. What adaptation has the deep-sea anglerfish developed that uses bioluminescence to lure prey?
7. What did the fact that one group did not find a mate represent?

Topic: Bioluminescence

Instructional Objectives:

Students will:

1. Learn about the function of bioluminescence among some marine animals.
2. Conduct an experiment to test the function of bioluminescence as camouflage.

Background Information:

Bioluminescence, light given off by living organisms, is common among creatures of the sea. In the deep sea, where little or no sunlight penetrates, a variety of fishes live out their lives dependent upon bioluminescence. Among these fishes, light organs have evolved to serve a number of purposes.

The hatchetfish, for example, is decorated with a dazzling array of photophores-specialized light organs. These are believed to act as camouflage in mid-water depths where some sunlight penetrates and it is necessary for survival to blend an otherwise black silhouette into the background of scattered light.

Activity: Surviving the Darkness of the Depths

Time Needed For Activity: one 45-minute period

Target Grade Level: High School

Materials:

- shoe box
- black spray paint
- flexible desk lamp
- large pin
- black construction paper
- scissors

Procedures:

1. Spray paint the inside of a shoe box black.
2. Use a large-gauge pin to poke plenty of holes in one end of the box. Cut round peephole in the opposite end.
3. Fold a sheet of black construction paper in half and cut out two identical fish-shaped silhouettes a few inches in length.
4. Using the same pin, poke lots of holes in one of the silhouettes.
5. Suspend the fish silhouette without holes inside of the box so that it hangs perpendicular to the line of sight through the peephole. Use a strip of black paper to suspend it, taped to the inside surface of the box. Close the lid, hold the punctured end of the box up to the light, and peep through the hole at the other end. Record observations.
6. Next, suspend the fish silhouette with holes inside of the box in the same way and repeat the observations. Record results.

Evaluation:

When viewed against a background of scattered light, such as that reproduced in the shoe box, a fish without photophores is likely to appear as a solid black silhouette, interrupting the background of light. Such a fish is likely to be noticed by predators in the darkness and quickly gobbled up.

Photophores, on the other hand, can act to blend the fish into the background just as the holes in your silhouette will allow light to pass through them as light passes through the box. It is this principle that helps some deep-sea fish use bioluminescence as camouflage.

Extension for Lower Grades:

Think of other kinds of animals that use camouflage to help them survive. Look through magazines for photographs of examples. Cut out pictures of predators, prey and their habitats. Don't limit yourself to the marine environment. Consider other examples such as: lions, zebras and grasslands; tigers, deer and tropical woodlands; sharks, sardines and the open ocean. How does a habitat help determine a camouflage? How does the predator take advantage of its camouflage? How does the prey survive using its camouflage? When is it better to be seen than unseen? Can you find examples? Hint: many highly venomous animals, both marine and terrestrial, have highly colorful markings. Why?