Oceanography

Great Glowing Sea Creatures

Students will learn about what bioluminescence is and how deep-sea creatures use it. Students will then witness luminescence for themselves through hands-on activities!

Materials

- Dark room
- Self-sealing envelope
- Duct tape
- Scissors
- Paper plate
- Sugar cubes
- Loose white sugar

Safety Considerations

- Be careful when crushing sugar cubes with a glass, especially in a dark room. Adult supervision highly recommended.

Background Information

What is **triboluminescence**?

- Light that is produced by crushing, tearing, or rubbing together certain materials.
- Tearing, crushing, or rubbing a material requires energy. For some material, part of this energy can be converted into a pale blue light.
- Everything around us has positive and negative charges in it. Scientists believe that when materials are crushed, torn, or rubbed, the positive and negative charges briefly separate. Because opposite charges attract, it takes a fair amount of energy to separate them! Scientists also believe that when the charges move back together, some of the energy that was initially used to separate them is turned into light.

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Background Information

What is **bioluminescence**?

- Bioluminescence is what we call an organism's ability to produce light
- Scientists have found deep sea creatures that are bioluminescent, meaning they are able to emit light.
- The light is caused by chemical reactions that take place inside the body of the organism, or chemicals that are ejected by the organism.
- Some species of fish, such as flashlight fish, have symbiotic bacteria living in an organ below their eyes. This bacteria produces light that the fish can use.
    - A **symbiotic** relationship means that both the fish and the bacteria "help each other out" and benefit from each other.
- The energy from the chemical reaction is turned into light.
- Some examples of bioluminescent organisms are some species of sharks (left picture), jellyfish (middle picture) and fish (right picture)
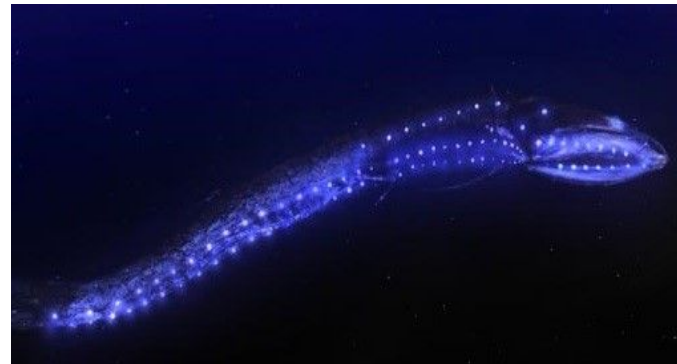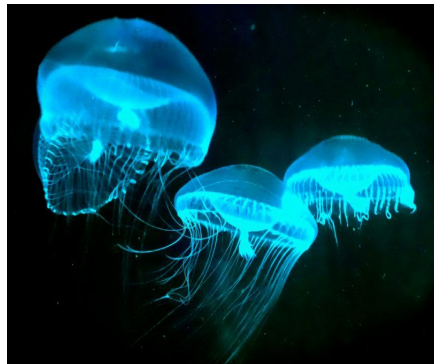
Why do some deep sea creatures have bioluminescence?

- Scientists aren't completely sure why some sea creatures are bioluminescent. They do have some hypotheses about its purpose, listed below:
    - Use it as a "flashlight", since the deep ocean is very dark
    - Attract prey
    - Communicate with other animals
    - Deter predators
    - Attract mates
    - Camouflage themselves
    - Detect toxicity - if the fish uses symbiotic bacteria to produce light, and the light goes out, that means the bacteria were likely killed by a dangerous substance nearby - sort of like a warning system for the fish.

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Activity 1

Steps:
1) Seal the envelope, leaving one corner unsealed so that you can pull it open later.
2) Turn out the lights and make sure you're in a dark room. Wait a minute or two for your eyes to adjust.
3) Make sure you're looking at the envelope, and then quickly tear the seal open. You should see some faint "sparkles" of light! This might take a few tries to get the hang of, so don't worry if you don't see light on the first try.
4) What colour was the light? Does the amount or intensity of light change depending on whether you rip open the envelope faster, slower, or at a different angle? Why do you think this might happen?

Activity 2

Steps:
1) Tear off a long strip from a roll of duct tape.
2) Fold the strip in half, with the sticky sides facing each other. Leave enough of the tape edge unstuck so that you can pull the two pieces apart.
3) Turn out the lights and make sure you're in a dark room. Wait a minute or two for your eyes to adjust.
4) Make sure you're looking at the duct tape, and then rip apart the tape. You should see a faint blue line of light when the strips tear apart! This is a bit tricky to recreate, so you may have to try a few times to get it!
5) Why do you think the light was produced? Because you used energy to tear apart the glue on the tape, triboluminescence occurred and some of that initial energy was converted to light.
6) Try the experiment again, but try using different lengths of duct tape or ripping it apart at different speeds. Does this change the amount of light that is emitted? Why do you think this happens?
   a) The harder you pull on the tape, the more energy you use. Recall that triboluminescence is caused when energy is converted into light. So, if there is more energy being used, there should be more noticeable light produced! It might also depend on the angle the duct tape is torn at. The same goes for the envelope seal in Activity 1.

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Activity 3

Steps:

1) Place a few sugar cubes on a plate.
   a) If you have loose sugar but no sugar cubes, you can make sugar cubes by mixing loose sugar with a tiny bit of water. Pack the sugar as tightly as possible into an ice cube tray or other small mold and wait for it to dry and harden - for best results, let it sit overnight. Gently pop the sugar out of the mold when you'd like to use it.
2) Sprinkle some loose sugar on top of the sugar cubes.
3) Grab a glass cup and practice crushing the sugar cubes until you feel confident doing so.
4) Clear off the plate and place a few more sugar cubes on it. Sprinkle some more loose sugar overtop.
5) Turn out the lights and make sure you're in a dark room. Wait a minute or two for your eyes to adjust.
6) Make sure you're looking at the sugar. Now put that practice to use and crush the sugar with the glass cup! Be very careful using the glass to crush the sugar, especially in the dark! You should see flashes of blue light.
7) Does crushing the sugar more quickly make the light brighter? Dimmer? What about crushing the sugar slowly? Are there any other objects that produce more light when they crush the sugar? Remember to be careful when crushing anything - it's easy to lose grip on your object.
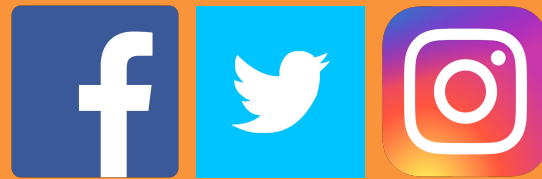
Debrief

- Which activity caused the brightest glow?
- Did you notice anything different about the colour or pattern of light between each activity?

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Have a question?

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