Maritime Slime

with Science, Art, Math, and Language Arts Extensions

Objective

Students will learn about the effects of UV light on stony coral and will discover natural adaptations to promote and prevent these effects.

Overview

This interdisciplinary activity encourages students to think about the dependence and detriment in the relationship between the sun and coral reefs, as well as the purpose of coral mucus. This activity has the ability to have a long-term impact on both corals and ocean stewardship at large, giving the students understanding of how their choices, even in sunscreen, effect the reefs. This activity can be adapted to a single day or longer, with the inclusion of art, math, and language art extensions.

Background Information

Coral releases mucus for multiple reasons. First, is to prevent desiccation. Since corals need shallow warm waters to allow their zooxanthellae to grow, they are often exposed to low tides, and being partially or completely out of water for periods of time. Mucus is produced during this time to protect them from drying out. Coral can also create mucus as a stress indicator to remove bacteria, pollutants, or other irritants. Finally, coral can use mucus to help catch prey and use ciliary movement to move the food to their mouths.

Materials

- Mixing Bowl (1/team)
- Sprinkles
- Paper plates
- Corn Starch
- Flour
- Molasses
- Other kitchen products to make Slime
- UV Beads
- Black Light
- Syringes (no needles)

Vocabulary

- Mucus
- Irritant
- Secrete
- Ultraviolet
- Cilia
- Zooxanthellae
- Oxybenzone

Standards

SC.K.L.14	SC.2.L.16	SC.4.L.16	SC.6.L.14	SC.912.L.14
SC.1.L.14	SC.2.L.17	SC.4.L.17	SC.6.L.15	SC.912.L.15
SC.1.L.16	SC.3.L.14	SC.5.L.14	SC.7.L.15	SC.912.L.16
SC.1.L.17	SC.3.L.15	SC.5.L.15	SC.7.L.16	SC.912.L.17
SC.2.L.14	SC.3.L.17	SC.5.L.17	SC.7.L.17	

Preliminary Phase

Find out what the students already know.

Teacher talk:

- *Why do we sneeze?*

Teacher allows a respectful discussion on the subject. If students begin using words such as "boogers" or "snot", Teacher will correct them with the proper term "**mucus**". Mucus is a non-water-soluble substance create from mucous membranes and glands. A list of ideas can be added to the board.

Teacher talk:

- *There are many reasons why we sneeze. When we are sick with a cold or the flu, the body sneezes to get rid of bacteria. When we have allergies, we sneeze to get rid of* ***irritants*** *(something that is irritating our body, such as dust or pollen). Some people even sneeze when they look at the sun. One-third of humans have the solar sneeze reflex in which the bright light of the sun is enough of a stimulate to cause people to sneeze.*

Focus Phase

The students explore examples of the concept.

Teacher talk:

- *Not only humans* ***secrete*** *(produce and discharge) mucus. Snails slide on mucus to get around. Frogs cover themselves in mucus to keep moist and allow oxygen to diffuse from their skin. Hagfish create mucus to protect from predators. Velvet worms will secrete mucus at a high rate of speed to catch their prey. Parrot fish will create a mucus cocoon sleeping bag to protect them from parasites as they sleep. Even coral secretes mucus for multiple reasons.*

Instead of simply talking about each of the above, Teacher can use **Extension Activity 3: Mysterious Mucus**.

Exploration Phase

The students exchange, debate, and test ideas.

Teacher talk:

- *Why would coral make mucus?*

Teacher makes a list of Coral Mucus Use on the board. Ideas are taken from the class to make a list to be used in the application section. Depending on the age and understanding

of coral, Teacher may want to move to the **Appetizing Acropora** activity pack, which gives a basic understanding or coral anatomy.

Application Phase

The students apply their rules to new situations.

Teacher talk:

- *Coral secretes mucus for many reasons, some very similar to why humans do*
- *Corals don't sneeze the same way that we do! But just like us, they create a mucus which has the same result as our sneeze. When we're sick we use mucus to help get rid of bacteria, corals use their slime when they're stressed out to help make sure they stay healthy! This slime can also help get rid of irritants or pollutants, similar to allergies, and they even produce mucus when there's too much sun!*
- *Coral mucus can contain 100 times more bacteria than the surrounding sea water! These microbial communities help prevent transmission of bacterial disease by either secreting antibodies or taking up space on the coral colony. Then there's no room for the harmful microbes!*
- *When we have allergies, our mucus is sticky so that all the irritants will attach to it. This way when we sneeze we have all the harmful particles attached together so we can expel those irritants from the body. Coral mucus acts in a similar way. Corals produce mucus to act as a sort of second skin between them and the harmful particles**.** If pathogens or pollutants or sedimentation (for example sand) start to cover the coral**,** the coral loses its access to sunlight which it needs for photosynthetic purposes, it can be buried and smothered and it could also mean the coral is using lots of energy to try to clean itself. Luckily, one of the functions of coral slime is to help get rid of these harmful particles. Just like our mucus, the coral mucus will act as a substance for all these different particles to stick to (the pathogens, the sedimentation, the pollutants) and then the coral can slough off its skin (kind of like how a snake can shed its skin) and get rid of these problems. Once its discarded its mucus, it can produce a new layer.*
- *When environmental conditions are unfavorable, corals produce mucus to help retain moisture. For example, if its low tide and the coral is exposed to the air, then they can release mucus to help retain some of that moisture and keep from drying out. This method also works if the water temperature raises or there is strong sunlight. The mucus also has the added benefit of protecting the corals against **ultravoilet radiation**. They produce their own sunscreen. It contains mycosporine like amino acids which absorb UV light.*
- *As we know the mucus is sticky! We've seen that this stickiness can help get rid of unwanted particles for the coral, but it can also help the coral get food like bacteria and*

*zooplankton! The food will stick to the mucus and then the coral can use **cilia** (hair-like organelles) movements to transport the food to their mouth!*

- *If you remember from earlier, we talked about how coral has a symbiotic relationship with **zooxanthellae** (algae that lives in the coral bodies). The algae gives corals food/photosynthesis and in return the algae gets shelter from the coral. Half of the photosynthetic products (organic matter) gets released into mucus, while the other half is used for growth and respiration. The mucus is made up of sugar protein (mucin), polysaccharides and lipids. The discarded mucus can dissolve into seawater and is used by tiny plankton or it floats away undissolved and joins other particles to make nutrient rich pellets for fish or other organisms to eat. Alternatively, it can go to the sediment where it is degraded by benthic fauna and bacteria. So, the mucus is beneficial to the whole ecosystem.*

Challenge Phase

The students take their application to a real-world situation

Teacher passes out a bowl to each group of students.

Teacher talk:

- *Today, we are going to attempt to make our own coral slime out of household ingredients. The challenge is as a team, make a slime that can be secreted, protect against irritants, catch food and block UV radiation.*

Teacher puts out all the kitchen products for the students to experiment with. Teacher gives them no further directions then the ones above. Once each team has mixed up their own slime, begin the experiments. Depending on the group, teacher can make a score card and give points for each experiment, as in first place, second place, and third place.

Teacher talk:

- *The first test will be if it can be secreted. Place a little of your slime into the syringe, and see if it can be squeezed back into your bowl. If it is too thick, it won't secrete.*
- *The second test is to see if your slime can get rid of irritants. Put some sprinkles on your plate, and see if your slime can pick it up!*
- *The third test is to see if your slime can catch food. To be able to do that, your slime must be super stretchy to reach out to the food and allow the cilia to bring it to the mouth. Let's see how far your slime can stretch!*

Teacher demos how the UV beads work. Teacher places some beads under a black light, and shows how they change color.

Teacher talk:

- *The final test will be if your slime can protect against UV radiation. Each of you take a couple of UV beads, and cover them in your slime, then I will come by with the black light and see if they change color.*

Synthesis Phase

The students take their overall understanding to the next level.

Teacher talk:

- *It's pretty amazing how coral is able to use it mucus in so many ways!* Acropora in the great barrier reef produces 1.2 gallons of mucus for every 3.2 square feet of reef

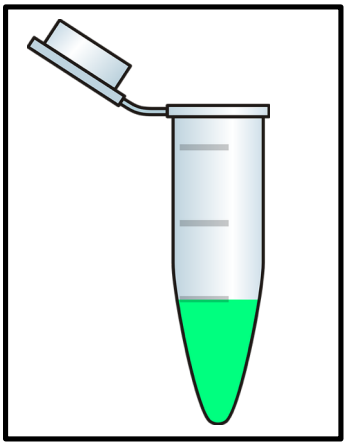
- *One way I wish we could use mucus is to protect against UV rays. Unfortunately, we need to use sunscreen to do that. Did you know that some sunscreen that we use can actually hurt corals? There is an ingredient in certain sunscreens called oxybenzone.*

- ***Oxybenzone*** *is also known as benzophenone-3. It's a white solid that has the interesting ability to absorb ultraviolet light. Oxybenzone is a broad-spectrum sunscreen that absorbs both UVA and UVB light rays. It's produced synthetically by a chemical reaction. A recent study focused on the effects of oxybenzone on a coral named Stylophora pistillata. The results were published in 2015. The research team looked at the effect of oxybenzone on coral larvae and adults. They made the following discoveries, which were published in the Environmental Contamination and Toxicology journal. Under lab conditions, oxybenzone transformed the coral larvae, or planulae, from a motile state to a deformed and sessile state. The chemical caused the coral to make an enlarged skeleton and to become encased in it. The researchers stated that* ***oxybenzone is "a skeletal endocrine disruptor" in coral****.*

Extension 1 – Glowing Goo (SCIENCE)

The Best Coral Slime!

Materials



- Biodegradable cups with lids
- Clear Nontoxic Glue
- Liquid Starch
- Stirring Sticks
- UV Powder or Paint

Background:

Teacher One interesting aspect to coral mucus that wasn't discussed was that under a black light, coral mucus is **florescent**, which means it absorbs the UV energy and releases it back in striking colors. The following recipe is for the best florescent slime!

Instructions:

1. Put equal parts water and nontoxic glue into a cup. At this point, the cup should be around half way full.

2. Have the participant mix the glue and water together with the stirring stick

3. Add a drop of UV powder or paint to each mixture. You can allow the participant to choose their color, or else just pick one.

4. Have the participant mix the color into the mixture

5. Add a "splash" (1/8th the total mixture) of Liquid starch to the mixture, and have the participant mix until the solution solidifies. If it does not turn into slime, add another splash.

6. Give a lid to each participant, and collect the stirring sticks

7. Turn on the black light and look at the slime glow!!!!

Extension 2 – Undersea UV (SCIENCE)

The reason corals are so vulnerable to UV radiation is because of the shallow waters they live in, but how deep does UV radiation travel in the water?

Allow students to use the black light and UV beads to experiment how deep UV radiation travels. Students can also go outside to test this as well using the sun.

Extension 3 – Mysterious Mucus (LANGUAGE ARTS)

Mucus in the animal world are used in lots of interesting and mysterious ways. Give each student or group of students one of these following animals:

- Moon Snails
- Hagfish
- Parrot Fish
- African Lung Fish
- Velvet Worms
- Australian Water-Holding Frog
- Dolphin
- Pyrosomes
- Shark

Have each student, or group of students, present their findings about how mucus plays in the everyday life of these animals.

Extension 4 – Substantial Slime (MATH)

1.2 gallons of coral mucus is produced for every 3.2 square feet of the Great Barrier Reef. Give each student a different reef (either dimensions or map), and ask them, if this reef produced coral mucus at the same rate, how much mucus would be produced at each location.

Extension 5 – Radiant Reef (ART)

Materials

- UV Pens or Paint

Many animals and life, when exposed to a black light, will glow. Allow students to paint their own reef-scape using both regular and UV paint.