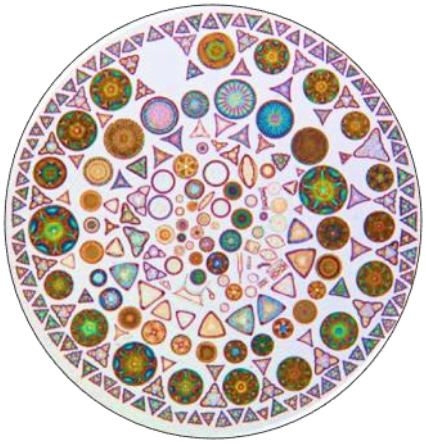
Lesson: Microorganism Discovery - Inclement Weather



Environmental Literacy Question: How have humans affected the Chesapeake Bay and its watershed?

Topic/Essential Question: How do weathering and erosion change the Earth?

Unit/Lesson Sequence: One of two lessons in the "Water's Living Things" 4th grade module based at Arlington Echo Outdoor Education Center.

Content Standards:

- **Environmental Literacy**
  4.A.1.b. Explain and demonstrate food webs for a particular environment.
  5.A.1. Analyze the effects on human activities on earth's natural processes.
  6.A.1. Identify and describe natural changes in the environment that may affect the health of human populations and individuals.
  8.F.1.b. Identify actions that can be taken as individuals and those that require the involvement of other people, organizations and government.
- **Science**
  3.4.F.1.a. Identify and describe the interactions of organisms present in a habitat.
  6.4.B.1. Recognize and describe that people in Maryland depend on, change, and are affected by the environment.
- **Common Core Standards for English Language Arts Standards - Speaking and Listening - 4th Grade**
  Comprehension and Collaboration
  - CCSS.ELA-Literacy.SL.4.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly.

Length of Lesson: 45 minutes

Student Learning Outcome: The student will discover the important role that microorganisms play in a healthy aquatic food web and will gain technical skills in operating a microscope and plankton tow.

Knowledge of the Learner:

- Prerequisite knowledge, skills, and processes: Some classroom experience using a microscope. An understanding of the idea that there are living things too small to see without the aid of a microscope.
- Student needs, interests, previous learning: These will be determined during the pre-assessment.
- Conceptual difficulties: Understanding that plankton, which are so small that we can't see them without a microscope, have an enormous impact on every aquatic ecosystem.
- Differentiated: This lesson reaches multiple types of learners. Logical/mathematical and visual learners will benefit from the food web poster activity. Kinesthetic and naturalist learners should do well with the hands-on collection of plankton and using the microscopes.

Knowledge of Content

Content knowledge for instructor is provided in the lesson and supplemental materials.

Vocabulary:

Microorganism	Phytoplankton	Zooplankton	Food web
Acid rain	Carbon	Plankton tow	

Materials:

- Plankton word cards
- Food web poster
- Copepod Plush Toy
- Sample jars (3 large, 6 small)
- Squirt bottle
- Plastic slides
- Flashlights
- 10 gallon aquarium
- 5 smaller aquariums/jars
- Stopwatch
- Plankton identification sheets
- Sheldon Plankton (from SpongeBob)
- Plankton tows
- Toothbrush
- Prism microscopes
- Pipettes
- Prepared slides
- Construction supplies: washers, paper clips, straws, popsicle sticks, pipe cleaners, etc.

Supplements:

- A: Discussion Points and Questions
- B: Background Information
- C: Microorganism Sampling Procedures
- D: Proper Use of Prism Microscopes

Lesson setup

Pick up one PFD per instructor from the boathouse. Set up the microscopes on the tables in the Resource Lab (one microscope per student). Place a blank plastic slide on each microscope. Place two prepared slides on extra microscopes. Collect sample from oyster bed using a toothbrush and squirt bottle into a sample jar.

Instructional Delivery

Engage:

Pre-Assessment Discussion

- Welcome the students to the activity and introduce yourself. Tell the students that they are going to explore the world of microscopic organisms and discover why they are important to the health of the Chesapeake Bay.
- Ask the students if they can tell you anything about microorganisms. Ask the questions found in **Supplement A**.
- Ask them what they know about plankton. At this point show them Sheldon Plankton, the plush toy from Sponge Bob.

- Use the plankton word cards as visual aids to help students guess characteristics of the two categories of plankton: phytoplankton and zooplankton. (See **Supplement A**: Discussion Points and Questions and **Supplement B**: Background Information)

Explore:

Set up a plankton tow and observe plankton under a microscope

- Using the poster, review why plankton are so important to our land and water.
- If able to go outside, have students put on PFDs.
- Bring the group to the waterfront. Demonstrate how to use the plankton tows (see **Supplement C**).
- Allow each student to take a sample of the water.
- Bring the students back up to the classroom. Demonstrate to the students how to use the pipettes to put a sample from the jar onto the slides (1-2 drops).
- Explain how to use the microscopes. Students should be on the 10x magnification (red lens) when using the RL microscopes. Ask chaperones to help students focus their microscopes (see **Supplement D**).
- Have students use the plankton identification sheets to identify different types of phytoplankton and zooplankton. If a slide doesn't appear to have any plankton, student can be given a fresh sample. Instructor can also use prepared slides to supplement. Just inform students that the samples have been colored to highlight the specimen - they are not really pink/blue. Students can also take a sample from the oyster sample.

Explain:

The importance of plankton in the Bay

- Ask the students why plankton are crucial to the health of the river and the Chesapeake Bay as a whole (See **Supplement A**).
- Ask the students what happens to the zooplankton if the phytoplankton dies. Continue doing this for all of the organisms on the poster. Go further and ask which land animals depend on the water *(humans, seagulls, eagles, bears, etc.).*

Elaborate

The Great Plankton Race (If time allows)

Follow the instructions in **Supplement E** to play the Great Plankton Race.

Evaluation: Debrief and Discussion

Ask the students the questions found in **Supplement F** to review what they have learned about plankton and to emphasize the importance of plankton in the Chesapeake Bay and other bodies of water.

Notes for Clean up

Please clean, organize and return the lesson materials to their proper locations at the end of the day. Remember to inform the Arlington Echo Staff if you need assistance or if any materials are damaged or missing.

Notes for Inclement Weather: Except for extreme conditions; this decision is made by

Arlington Echo Staff and they will direct you appropriately. Student safety is our first concern.

Arlington Echo encourages keeping our outdoor activities outdoors—even in the rain—but in the case of severe weather (thunder, extreme cold, etc.), the rain location for this activity will be in the upper Resource Lab (RL). Collect water samples whenever there is a break in the weather.

Supplement A: Pre-Assessment Discussion Points and Questions

Discussion Point/Question	Answer/Direction
What is a microorganism?	• Micro refers to something so small you need a microscope to see it. Organism refers to something that is alive, such as a plant or animal. Therefore, a microorganism is a living thing that you can't see without a microscope.
What are plankton? (Use the PLANKTON card)	• Show Sheldon Plankton (the plush toy from Spongebob Squarepants). Many students have heard the word plankton from the cartoon series. Sheldon Plankton is an antagonist that attempts to steals the recipe for Crabby Patties. • "Plankton" comes from a Greek word meaning "to drift." • Plankton are organisms that move in the water with the current, tide, or wind. • An example of a large plankter (singular form of "plankton") is a jellyfish.
There are two different categories of plankton. What category do you think phytoplankton are? (Use the PHYTOPLANKTON card)	• "Phyto" comes from a Greek word meaning light ("photo" like photosynthesis). • Most (but not all) phytoplankton are microscopic plant-like organisms that make their own food using energy from the sun.
What category do you think zooplankton are? (Use the ZOOPLANKTON card)	• "Zoo" (pronounced zō –ō) comes from a Greek word meaning animal. • Most (but not all) zooplankton are microscopic animal-like organisms that consume other plankton for their energy.

Supplement B: Background Information

- Both phytoplankton and zooplankton can only move with the currents and tides, unlike fish, which can swim from one side of the river to the other.

- Plankton and zooplankton are comparable to plants and animals on land. Just like land plants and animals, there are thousands of different kinds of phytoplankton and zooplankton. Different types of habitats have different kinds of plankton.

- Some zooplankton are simple, microscopic organisms for their whole lives. Other zooplankton are the larval (baby) stages of larger organisms like crabs and fish. Sheldon Plankton is a specific kind of zooplankton called a Copepod, and he will always be microscopic.

- Jellyfish and sea stars (common name: starfish) are zooplankton.

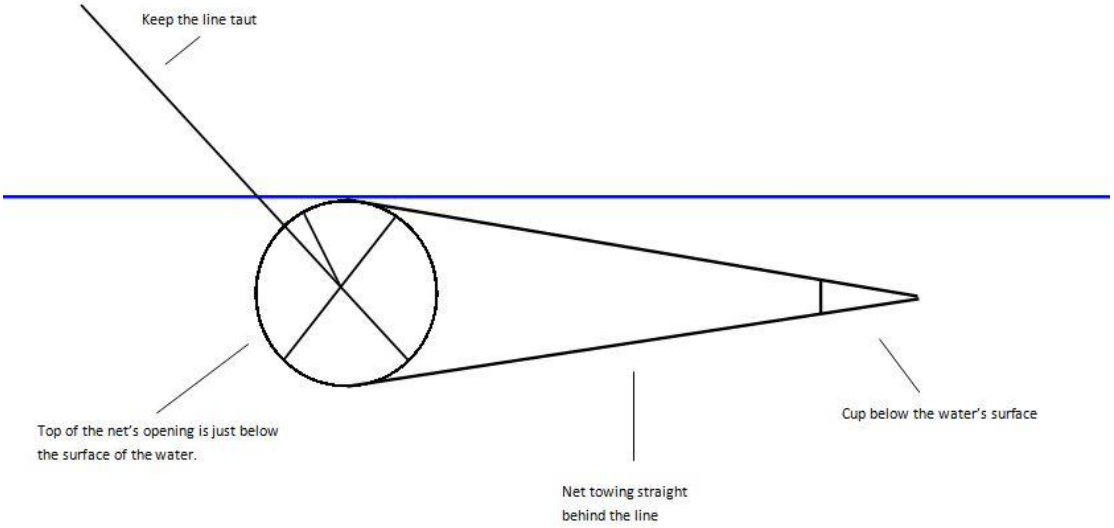
- When students are looking at organisms, most will look clear, like the pictures. Tell students that phytoplankton can't move very well at all, so if they see something moving across their slides it will be a zooplankton. If the zooplankton seems to be feeding on something, it is most likely feeding on phytoplankton.

Supplement C: Microorganism Sampling Procedures

Open Water

Materials: plankton tow, sample jar
Procedure:
1. Drop plankton net into the water along the pier or bulkhead. Keep a firm hold on the tow line.
2. Swish the plankton tow back and forth to free any excess air bubbles.
3. Slowly walk 10-15 feet along the pier or bulkhead while towing the line across the surface of the water. Pull toe back and forth ten times (20 times each with partners).
4. Ensure that the top of the net's opening stays just below the water line and the line stays taut.
5. Pull the net in quickly and ensure the tube stays upright so you don't spill the sample.
6. Place the sample jar upside down in the plankton net and push it down as far as it will go.
7. Turn the net upside down and allow water from the tube to fill the jar.

Note that sampling from sunny areas may yield better results. Adjust as needed throughout the day.



Oyster Reef Model
Materials: toothbrush, squirt bottle, sample jar
Procedure:
1. Raise the mock oyster reef from the end of the pier.
2. Pass out the toothbrush, squirt bottle, and sample jar to three students.
3. Pick out an oyster shell and hand it to student with toothbrush.
4. Student should brush the shell over the sample jar while the third student squirts the shell with water.
5. If you don't find much on the shells, you can brush the sides of the crate.

Supplement D: Proper Use of Microscopes

There are real stained slides of phytoplankton and zooplankton in with your supplies. You can use them to supplement what the students find. The instructor should be the only one to handle them because they are glass slides. Remind students that the slides are stained to show the organisms better. They are not really hot pink!

Procedure for the Use of the Zoom Microscope

Practice with Letter "e" Slide

1. Clip letter "e" slide onto stage. Make sure the letter "e" is over the hole in the stage.
2. Start with the lowest power adjustment, 4X (red). Total magnification 10X (eyepiece) X 4X (objective) = 40X.
3. Look through the eyepiece until light can be seen. (If no light can be seen, check dial under stage; rotate until largest hole is under the stage.)
4. Adjust the focus knob until letter "e" is clearly in view.
5. Turn objective to next higher (10X) power to see it bigger. Total magnification 10X (eyepiece) x 10X (objective) = 100X.

Looking at Water Samples

1. Run your finger over the slide to make sure that the concave side is up.
2. Place a small drop of the sample onto the slide with an eyedropper.
3. Clip the slide onto the stage. Make sure the specimen on the slide is over the hole in the stage.
4. Start with the lowest power adjustment (4X). Total magnification 10X (eyepiece) x 4X (objective) = 40X.
5. Look through the eyepiece until light can be seen. (If no light can be seen, check dial under stage; rotate until largest hole is under the stage.)
6. Adjust the focus knob until the specimen is clearly in view.
7. Move the slide around on the stage to locate the specimen.
8. After observing and drawing organisms, rinse slides. Repeat procedure with other water samples.
9. To observe larger specimens, use a petri dish.

Supplement E: The Great Plankton Race

Setup

Fill the 10 gallon aquarium and smaller aquariums/jars with water. Prepare enough sets for 4-5 groups of students. Each group will need a smaller aquarium/jar and a few of each of the different construction supplies.

Resources

10 gallon aquarium
5 smaller aquariums/jars
Construction supplies: washers, paper clips, straws, popsicle sticks, pipe cleaners, etc
Stopwatch

Warm Up/Motivation

1. Students have already learned that plankton float through the water at the mercy of the currents. Explain that plankton also need to adapt to stay near the surface of the water. Why? (*Phytoplankton need to be near the sun for photosynthesis. Zooplankton need to be close to the surface because that's where the phytoplankton, their food, live).*
2. Explain that zooplankton undergo a constant daily migration. During the day they stay in the lower waters, and at night they migrate to the top to consume phytoplankton.

Procedure

1. Explain to the students that they'll be working in teams to design the best plankton they can. They'll use common objects (metal washers, paper clips, popsicle sticks, etc.) to design a plankton to compete in the Great Plankton Race. The goal is to sink the slowest.
2. Break students into teams of 2-3 and allow them 10 minutes to design their plankton and test it in their individual jars.
3. Once time is up, start the competition. Use a 10-gallon aquarium for the race. Use a stopwatch to time each plankton and see how long it takes to sink to the bottom. The slowest wins the race. Repeat the race for 3 or 4 trials as time permits. Record results to figure out the overall winner

Assessment

1. Ask the students to figure out why the winner was the slowest to sink. How does this compare to the adaptations they may have seen in the plankton they viewed under the microscopes? (*plankton have various adaptations to help them float, such as flat, wide bodies, spikes protruding from their bodies, buoyant fats/oils, etc., modeled by features like paperclips sticking out from the body or materials that naturally float, such as wooden popsicle sticks).*

Supplement F: Discussion Points and Questions

Discussion Point/Question	Answer/Direction
Why are plankton crucial to the health of the river and the Chesapeake Bay as a whole?	• They serve as the base of the food web, providing energy for larger organisms. Some zooplankton can also be the larval forms of larger organisms; including those we like to eat, such as the blue crab and yellow perch. • Phytoplankton absorb carbon dioxide and produce oxygen during photosynthesis. This helps to provide better air and water quality for organisms that need oxygen to survive. • Everyone take two breaths. 1 of those breaths came from plants like phytoplankton in the water.
How does erosion affect plankton?	• Too much sediment can make the water cloudy, eventually burying oysters and other aquatic life. Fertilizers can temporarily boost phytoplankton causing an algae bloom. Pesticides and other toxins can kill off plankton.
How are climate and weather connected to plankton?	• Phytoplankton, just like plants, take in carbon. Without phytoplankton, we have too much carbon released. Having more grasses in our water can help the plankton take in carbon as well. • An increase in CO2 in the atmosphere leads to warming and an increase in acidification of the oceans and other bodies of water, which harms plankton. • Major storm events and runoff wash pollutants and sediment into water, harming plankton. For example, when fertilizer is washed into the water, the nutrients cause an algae bloom that will be broken down by bacteria that use up all of the dissolved oxygen in the water.
As they mention that pollution can kill phytoplankton, take the picture of the phytoplankton off of the poster. What happens to the zooplankton if the phytoplankton dies?	• The zooplankton does not have a food source and dies. Remove zooplankton from the poster.
What happens if the zooplankton die?	• Small fish lose a vital food source and also die. Remove small fish from the poster.
What happens to the large fish if the small fish die?	• The large fish will die from lack of resources. Remove large fish from the poster.

Now the river's food web has fallen apart. **Does the disappearance of the river organisms have an effect on the food web on land?** **How so?**	• There are many land animals that depend on the organisms in the water for food such as humans, seagulls, eagles, blue heron, bears, etc. When the rivers food web falls apart, these land animals and birds lose important resources. These animals may die or relocate to a new area where they will have to compete with organisms that already live there.