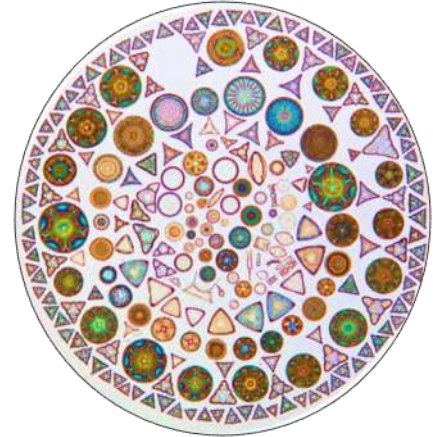


Lesson: Microorganism Discovery

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

Topic/Essential Question: What is the human impact on the interactions of organisms in Maryland's habitats?

Unit/Lesson Sequence: One of two lesson's in the "Out of Balance" 4th grade module based at Arlington Echo Outdoor Education Center.



Content Standards:

- **Environmental Literacy Quarter 1**

- 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: 35 minutes.

Student Outcome: The student will discover the important role microorganisms play in a healthy aquatic food web, and 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: The 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:

Vocabulary:

Microorganism	Phytoplankton	Zooplankton	Food web
Acid rain	Carbon	Plankton tow	

Resources:

Plankton word cards	Plankton identification sheets
Food web poster	Sheldon Plankton – from Sponge Bob
Copepod Plush Toy	Plankton tows
Sample jars (3 large, 6 small)	Toothbrush
Squirt bottle	Prism microscopes
Plastic slides	Pipettes
Flashlights	Prepared slides

Supplements:

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

Lesson setup:

Pick up one PFD per instructor from the boathouse. Gather materials from shed at the end of the pier and bring them to the picnic tables by the pier. Set up the microscopes on one picnic table. (One microscope per student and the plankton tows) 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

Module Introduction: All students and instructors will meet on the Dining Hall patio (outside the dining hall on the right side) for a water safety talk from an Arlington Echo staff member. At this time, everyone will receive PFDs they must keep on for the duration of all activities.

Pre-Assessment:

1. Welcome the students to the activity and introduce yourself.
2. Ask the students if they can tell you anything about microorganisms (see Supplement A).
3. Ask them what they know about plankton. At this point show them Sheldon Plankton, the plush toy from Sponge Bob.
4. 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)

Motivation/Warm-up

Tell the students that they are going to explore the world of microscopic organisms and discover why they are important to the food web in the Chesapeake Bay.

Procedure

1. Hang up food web poster on the line. Handout the picture cards with organisms and the cards with definitions to some of the students.
2. Have students randomly read their definition cards and place them next to the appropriate level on the food web. Students with organism pictures should add theirs. **(Supplement B).**
3. Discuss other observations they can make about the diagram.
4. Divide students into pairs. Lead students near floating dock along the shoreline and demonstrate proper plankton tow sampling technique **(Supplement C)**
5. Hand out supplies so each pair has one plankton tow. Each pair of students will collect one sample with the plankton tow (dragging the tow ten times per student) and pour it into the large sampling jar.
6. Bring the group to the end of the pier to haul up the crate which models an oyster bed. Explain that real oysters make a great habitat for zooplankton. Demonstrate how to take a sample from one or two oyster shells. **(See Supplement C)**. Add the oyster sample to a large sampling jar. (Note: This large sample jar is usually kept and added to throughout the day)
7. Instruct the students to return to their seats at the picnic tables. Use the pipettes to put a sample from the jar onto the slides (1-2 drops).
8. Explain how to use the prism microscopes. Ask chaperones to help students focus their microscopes. (See Supplement D: Proper use of Prism Microscopes)
9. 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 really are not pink/blue. Students can also take a sample from the oyster sample.

Assessment:

1. Ask students why plankton is crucial to the health of the river and the Chesapeake Bay as a whole. (See Supplement A)
2. Ask the students what causes food webs to become out of balance. **(See Supplement A).**
3. As they mention that pollution can kill phytoplankton, take the picture of phytoplankton off the poster. Ask what happens to the zooplankton if the phytoplankton dies. Take off the picture of the zooplankton. Continue doing this until the entire poster is empty - symbolizing the death of the river. Go further and ask which land animals depend on the water – humans, seagulls, eagles, bears, etc.

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.

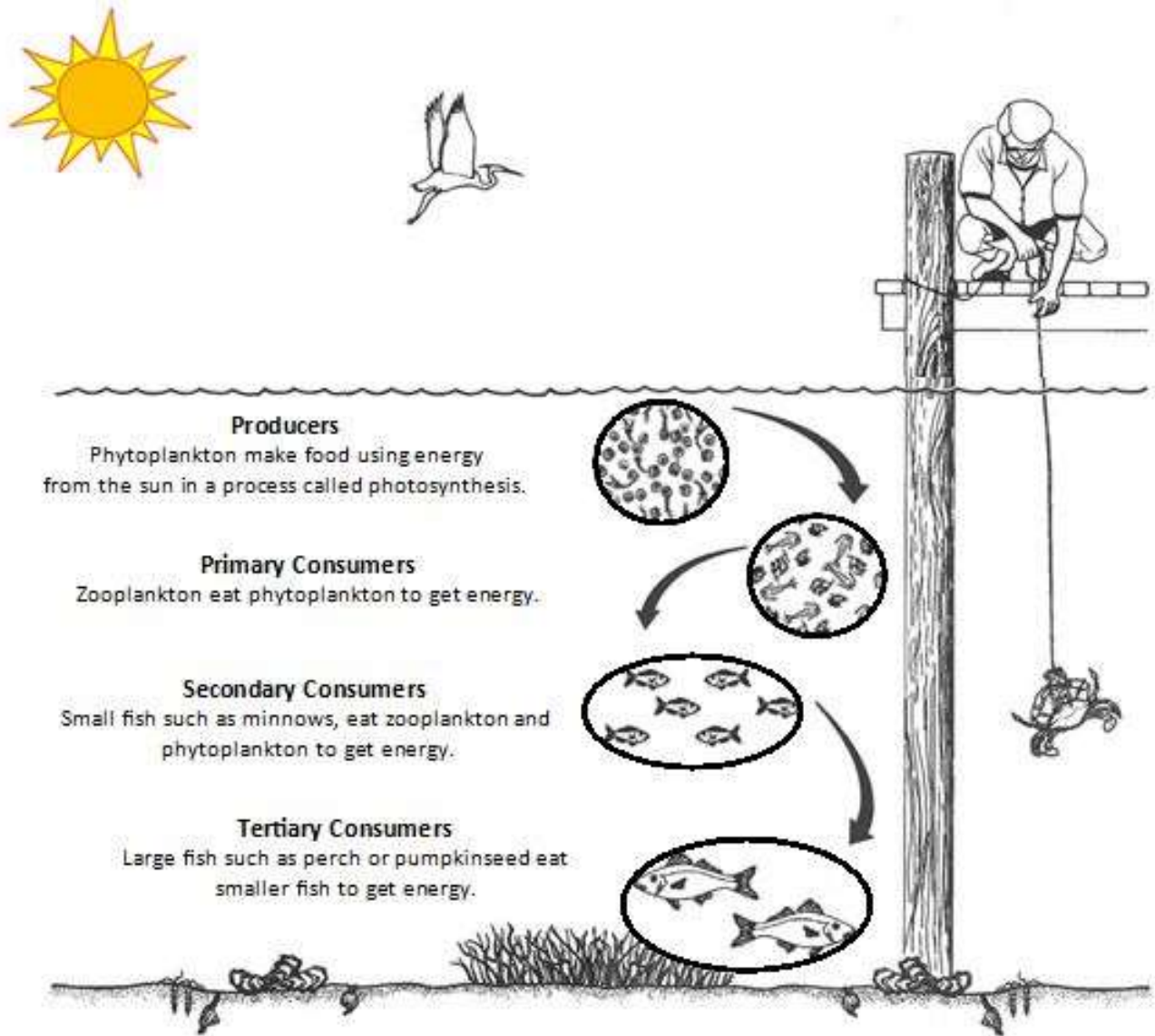
Notes for Inclement Weather: Except for extreme conditions; this decision is made by Arlington Echo Staff and they will direct you appropriately. Student safety is our first concern. Arlington Echo encourages keeping our outdoor activities outdoors—even in the rain—but in the case of severe weather (thunder, extreme cold, etc.), the rain location for this activity will be in the upper Resource Lab (RL); the microscopes there have electric lights rather than prisms. Collect water samples whenever there is a break in the weather. Students should be on the 10x magnification (red lens) when using the RL microscopes.

Supplement A: Discussion Points and Questions

Pre-Assessment Discussion

Discussion Point/Question	Answer/Direction
What is a microorganism?	<ul style="list-style-type: none"> • 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 is plankton? (Use the PLANKTON card)	<ul style="list-style-type: none"> • 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 steal 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 plankton is a jellyfish.
There are two different categories of plankton. What category of organisms do you think phytoplankton are? (Use the PHYTOPLANKTON card)	<ul style="list-style-type: none"> • "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 of organisms do you think zooplankton are? (Use the ZOOPLANKTON card)	<ul style="list-style-type: none"> • "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.

Food Chain Discussion



Action	Discussion
Place food web poster on the table. Handout the picture cards with organisms and the cards with definitions to some of the students.	
Have students randomly read their definition cards and place them next to the appropriate level on the food web.	<ul style="list-style-type: none"> • Producers: Phytoplankton make food using energy from the sun in a process called photosynthesis. • Primary Consumers: Zooplankton eat phytoplankton to get energy.

	<ul style="list-style-type: none"> • Secondary Consumers: Small fish, such as minnows, eat zooplankton and phytoplankton to get energy. • Tertiary Consumers: Large fish such as Perch and Pumpkinseed eat smaller fish to get energy.
Then students with organism pictures should add theirs.	<ul style="list-style-type: none"> • This is a food web. It shows the transfer of energy through an ecosystem, starting with the producers (phytoplankton) that make their food using the sun's energy, and moves up through various layers of consumers (zooplankton, small fish, large fish) that need to consume other organisms for energy.
Discuss other observations they can make about the diagram.	<ul style="list-style-type: none"> • The number and size of individuals at each level. <ul style="list-style-type: none"> ○ The number of organisms decreases as their size increases. As organisms grow larger, so do their energy requirements. It takes many more producers to support just a few consumers, especially at the top levels. • Why phytoplankton are important. <ul style="list-style-type: none"> ○ Many other organisms rely on them for food.

Assessment Discussion

Discussion Point/Question	Answer/Direction
Why are plankton crucial to the health of the river and the Chesapeake Bay as a whole?	<ul style="list-style-type: none"> • 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.
What can cause the food web to become out of balance?	<ul style="list-style-type: none"> • 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 the plankton?	<ul style="list-style-type: none"> • 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

	<p>take in carbon as well.</p> <ul style="list-style-type: none"> • 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.
<p>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?</p>	<ul style="list-style-type: none"> • The zooplankton does not have a food source and dies. Remove zooplankton from the poster.
<p>What happens if the zooplankton dies?</p>	<ul style="list-style-type: none"> • Small fish lose a vital food source and also die. Remove small fish from the poster.
<p>What happens to the large fish if the small fish die?</p>	<ul style="list-style-type: none"> • The large fish will die from lack of resources. Remove large fish from the poster.
<p>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?</p>	<ul style="list-style-type: none"> • 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.

Supplement B: Background Information

- Both phytoplankton and zooplankton can only move with the currents and tides, unlike a fish that 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. And different habitats have different kinds of plankton.
- Some zooplankton are simple 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.
- Jelly fish and sea stars (common name starfish) are zooplankton.
- When students are looking at organisms, most will appear to be 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 phytoplankton.

Supplement C:

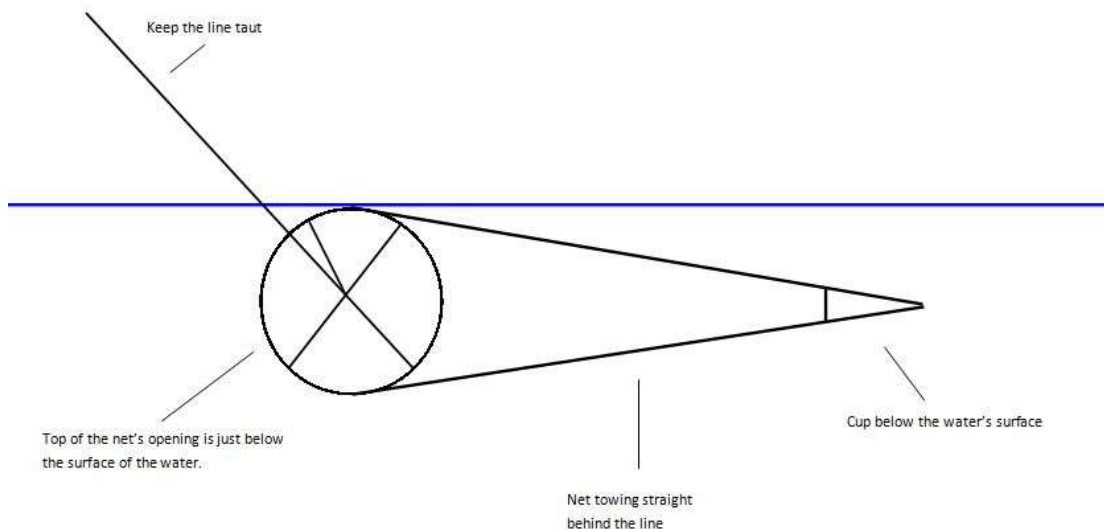
Microorganism Sampling Procedures

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 Prism Microscopes

- Prism microscopes rely on the light of the sun rather than electric light to see slides.
- If it is overcast and there is not much sunlight, you can supplement by using flashlights as the light source. Show students how to shine the light onto the prism piece.
- Instead of turning knobs to focus, slide the eyepiece up and down slowly. Once the image is in focus, move the slide around to find the plankton.
- 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!