Diatomania!

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Time: 35-45 minutes

Overview

This activity introduces participants to diatoms, their impact on river/stream ecology, and in white types on environments they will be located in on the river through use of the stream simulator.

Benchmarks Addressed

Science: Unifying Concepts and Processes

- **CCG:** Use concepts and processes of evidence models, and explanation.
    - Students will use physical models to explain such phenomena as the solar system or surface features of Earth, continents, river systems, and their neighborhood.
    - Describe examples of energy transfer.

Science: Life Science

- **CCG:** Explain the interdependence of organisms in their natural environment.

- **CS:** Diversity/Interdependence**:** Understand the relationships among living things and between living things and their environment.
    - Describe the relationship between characteristics of specific habitats and the organisms that live there.
    - Students will recognize how all animals depend upon other organisms whether or not they eat them directly.

Learning Objectives

By the end of this activity, participants will be able to:

1. Be able to identify a diatom
2. Understand the basics of how they effect aquatic environments
3. Have an idea of where their concentrations can be found

Materials Needed

- ❑ Jars for taking samples prior to lesson
- ❑ Microscopes (dissecting scopes can be used in a pinch)
- ❑ Black slides
- ❑ Prepared, professional looking diatom slides
- ❑ Litmus paper
- ❑ Stream simulator
- ❑ Pictures of diatoms, glued to cardboard squares

Background Material

Know basic Linnaean classification system. Diatoms are single-celled eukaryotes, part of the kingdom Protista. They account for about 35% of the world's primary production (as measure by carbon production), this means they are photosynthetic. A type of algae, plankton (of which they make up 75%), diatoms exist anywhere that has water

and serve as a pH buffer by facilitating diffusion of dissolved CO2 into the water (instructor should have a basic idea of pH). In fact, diatom concentrations are used as a form of water quality measurement.
Although individually clear and microscopic, without a microscope dense clumps of diatoms can be seen as a golden-brown color, due to overlap of the yellow photosynthetic plastids (their analogous organ to chlorophyll). The earliest fossil diatoms have been found in the Jurassic period, about 185 million years ago, although they most likely originated much earlier. Their chloroplasts are not derived from prokaryotes as that of all plants, indicating a later evolutionary origin than most algae. There are over 100,000 extant species of diatoms.
Diatoms can be found in open water, pond scum, and attached to submerged rocks and sticks. The smooth brown covering on sticks are large collections of diatoms. Like other algae, they have the ability to "burst and bloom" under the right conditions. For diatoms, this is in the spring and fall, when the nutrient mixture and light give them a competitive edge, allowing them to reproduce extremely fast (r-strategists). Diatoms reproduce via binary fission, as most single-celled organisms do. Under natural circumstances, this provides energy to an aquatic environment, making up the bottom of the food chain where this energy can be transferred up to fish and other larger organisms. With addition of human-made chemicals into an aquatic system however, there can be an overabundance of nutrients, causing massive blooms, resulting in bacterial decomposers removing dissolved oxygen from the water, creating an unfavorable living environment for aquatic animals.

Activity Description

Collect diatom samples off rocks, sticks, and blooms from slow moving pools, riverside soil and label each. If microscopes are available, stations are set up to look at slides of live samples. Prepared slides (non-living) should be available as a backup incase students have trouble identifying them, these are readily available from the biology department. If no microscopes are available, larger picture-plates can be used to show them close up, while live macroscopic concentrations can be viewed. Stream simulator need be set up to have the features of: slow/stagnant water, fast moving water, streamside vegetation, stream debris, and a river-mouth area simulating coastal estuaries.

Step 1. Getting Started: Introductions (1-5 minutes)

First off, a gauge of students understanding of biological classification and primary energy production (photosynthesis) need be performed (a high school biology class should be more than sufficient for understanding). Draw diagram of kingdoms, circle Protistia to give students the general idea of what diatoms are. Students should know what algae is, this is a type of algae. Discuss that 35% of the world's energy comes from diatom photosynthesis, have students say why this is important to animals. This is the base of the food chain in aquatic environment that is essential to all living things.

Step 2. List your next steps here (10-15 minutes)

- Have students look at some diatoms!!
- Under a microscope they are the clear are come shapes: circles, rectangles, cylinders. They are not mobile, so they won't run off on you. Many of the rectangular kind are linked together.
- Answer questions; take a look at what students are looking at. Make sure everyone sees them. If one particular student finds a great sample have others look at that one.
- Have students take a look at sticks and rocks from the river. That slimy/smooth substance is made up of diatoms too! Millions of them.
- Students should test the pH of these samples with litmus paper. What are the differences? Explain that diatoms are a pH buffer, helping stabilize system.
- Let students lead their own learning, making their own slide from sample water is a great idea. Don't lecture; facilitate their discovery and answer questions. This lets them learn what they want to.

Step 3. List next activity here if you have one (15 minutes)

- Use the simulator
- Ask students to point out where on the stream they would expect to find the highest concentrations. Have them create a side channel with slower moving/stagnant water. Make sure they include fallen trees, plants and rocks, as diatoms need nutrients.
- Have animals near the stream. Ask if they think an animal is a good place to find diatoms (it is! They exist in the water we drink). Certain ranges of diatom concentration are used to evaluate water quality.
- Brief focus on river mouth/estuary. Diatoms are a huge part of ocean life, constituting 50% of marine energy production, there are different kind
- Put in a mass of pond scum to simulate a massive algae bloom do to nitrogen and phosphorus into the river. This organic mater provides a huge feeding zone for decomposing bacteria. What does this do to the dissolved oxygen content in the water? (Decreases it). Who needs dissolved oxygen? (Fish, aquatic insect) – This causes them to die. Diatoms and other algae are essential, but human environmental externalities can cause them to create problems for aquatic animals.

Step 4. Gauging Understanding (5 minutes)

- Show a picture of many different looking diatoms, ask where is the diatom? (They all are, there are over 100,000 living species).
- Ask if any students see any of the ones they saw themselves.
- Ask students what the primary function of diatoms in an aquatic ecosystem is. Primary energy production via photosynthesis
- Any other functions? pH buffering. Energy transfer as they move from place to place.
- Are the existence of diatoms and other algae good or bad? Concentration is the key here. Not too much, not too little. Not having any at all would not allow other organisms to exist. An excess do to nutrient concentrations is also bad, eliminating dissolved oxygen, killing animals.

Step 5. Wrap Up (5 minutes)

Take-home message: All of the largest of plants and animals are dependent on life forms no one can see. Through photosynthesis diatoms create much of the energy later digested by aquatic animals like fish. Diatoms take the sun's energy into a river and create food for larger organisms, and energy is passed up and around the food web.

Additional Reading/Resources

Mann, D. G. (1999). The species concept in diatoms. *Phycologia* **38**, 437-495.

Round, F. E. and Crawford, R. M. (1990). *The Diatoms. Biology and Morphology of the Genera*, Cambridge University Press, UK.

Smetacek, V. S. (1985). Role of sinking in diatom life-history cycles : Ecological, evolutionary and geological significance. *Mar. Biol.* 84**,** 239-251.