Sinking Slowly

Adapted from: "Sinking Slowly" in Living in Water. The National Aquarium in Baltimore, 1997.

Grade Level: intermediate

Duration: 2 class periods OR 1 class period plus homework

Setting: Classroom/outside

Summary: Students design plankton models in a contest to see which design sinks the slowest, exploring plankton physical adaptations.

Objectives: Students learn about the adaptations plankton has developed to maintain their positions in the water column by constructing models. Students learn how zooplankton and phytoplankton differ.

Related Module Resources:
- "Micro-Odyssey" activity
- "Life at the Surface" activity
- Books: about protozoa

Vocabulary: Plankton, phytoplankton, zooplankton, protozoa

Materials (Included in Module):
- Stopwatches
- picture references of phytoplankton and zooplankton
- Video: World of Protozoa
- Microscope Slides: algae, Protozoa
- Miscellaneous junk for model construction: straws, cotton, plastic cups, Q-tips, toothpicks, wire, tape, filters, pipe cleaners, craft sticks, beads, foam pads, scour pads, paper, cardboard, packaging material, foam, etc.

Additional Materials (NOT Included in Module):
- large bucket or aquarium
- additional junk for model construction

ACADEMIC STANDARDS (ENVIRONMENT AND ECOLOGY)

7th Grade

4.1.7.C Explain the effects of water on the life of organisms in a watershed.
- Explain how the physical components of aquatic systems influence the organisms that live there in terms of size, shape and physical adaptations

4.6.7.A Explain the flows of energy and matter from organism to organism within an ecosystem.
- Describe and explain the adaptations of plants and animals to their environment

4.7.7.A Describe diversity of plants and animals in ecosystems.
- Identify adaptations in plants and animals

4.7.7.B Explain how species of living organisms adapt to their environment.

10th Grade

4.7.10.A Explain the significance of diversity in ecosystems.
- Identify a species and explain how its adaptations are related to its niche in the environment

4.7.10.B Explain how structure, function and behavior of plants and animals affect their ability to survive.
- Describe an organism's adaptations for survival in its habitat
- Compare adaptations among species

BACKGROUND:

Plankton are small marine and freshwater organisms that drift on or near the water surface. There are two types of plankton- phytoplankton and zooplankton. **Phytoplankton** generally singled celled organisms (plants). They contain chlorophyll and photosynthesize their own food and therefore are considered producers. Some species form cooperative colonies and chains or strands called filaments. Most are free-living either floating or moving around. Some move around from the wind or from the current moving the water while some can control limited movement on their own. Phytoplankton are common any water depths that have sunlight and have enough nutrients.

Zooplankton consist of protozoa, small crustaceans, jellyfish, worms, mollusks, and also the eggs and larvae of aquatic animals. **Protozoa** are one-celled organisms that lack chlorophyll, so they must catch their own food and thus are considered consumers. Zooplankton are most abundant in fertile waters where phytoplankton is abundant. Examples of zooplankton that are commonly found include- water fleas (Daphnia), Copepods, and Hydras.

Plankton form the foundation of aquatic life. Phytoplankton are the primary producers that provide the first link in the aquatic food chain. Zooplankton depend upon the phytoplankton for food, but the zooplankton are then eaten by larger organisms, such as macroinvertebrates and fish frey, these are in turn eaten by larger fish, reptiles, amphibians, and mammals that provide the upper trophic levels that we commonly see. Without the microorganisms the aquatic ecosystem would collapse.

A common misconception is that plankton float. Actually, plankton are slightly denser than water and have a tendency to sink. But both phytoplankton and zooplankton have developed adaptations that help maintain position in the water column. They often have projections that create drag and slow their descent, and additionally zooplankton actively control their position in the water by swimming.

OVERVIEW:

Students design plankton models in a contest to see which design sinks the slowest. They will make the models out of various craft supplies and junk.

PROCEDURE:

1. Have the students make observations of the shapes, projections, and behaviors of phytoplankton and zooplankton. Create a list of the student's observations and encourage them to speculate how the plankton stay up in the water. Ask them whether the plankton's projections might help or hinder their movements and why.

2. Have the class create a list of design rules for their models (such as size limits for models, material restrictions from fabric or paper, etc.) and also a list of rules on how their models should be released.

3. After considering the list of observations, the questions asked of them, and the design rules the students should design a plankton model. Emphasize that their goal is to create a model that will sink slowly, not a model that will float.

4. Provide reference materials for the students, and buckets of water or aquaria to test their designs. Use stopwatches to time the models' speed of sinking and set a time limit for this experimentation.

5. Have the contest. One at a time, release the models by holding them just under the surface of the water. Any model that floats up to the surface is disqualified. Time them with the stopwatch and record the results on the chalkboard. The slowest time wins.

6. Have the students analyze the design strategies of the slowest two models, and state why they think those designs worked the best.

   Caution: beware of models that sink because they are gradually filling with or absorbing water. To prevent this, always hold models just under the surface of the water for release.

DISCUSSION:

Have the students reflect on the thinking they used in inventing their model plankton. Did students visualize their model before they started it? How did their mental picture of the model change as they worked? What factors made them reconsider their design strategy, and why? Where did they come up with the idea for their model?

How does their model simulate or resemble real plankton? Did the model after a real plankton? How is it different than the real plankton that they modeled it after?

Why do some plankton sink slowly and want to remain stable in the water column? *Phytoplankton may remain in the water depths that receive sunlight for photosynthesis. Zooplankton may want to stay in areas that present food for them to eat. Sinking to the bottom may also open them up to additional predation – more aquatic insects and some fish are found on the bottom of waterways.*

EVALUATION:

- The strange looking shapes of phytoplankton and zooplankton have specific functions; in the case of phytoplankton these include helping them to stay in the lighted water zone so they can photosynthesize food, and in the case of the zooplankton these adaptations help them stay in areas where they can feed. Have the students analyze the design strategies of the models and explain why some designs worked and others did not. Ask them to observe the plankton again. What enables their adaptations to work so well?

EXTENSIONS AND MODIFICATIONS:

- Take the best design and have the class try to improve upon the design.
- Compare the models made with real plankton and try to see if any look similar to each other.

NOTES (TEACHERS, PLEASE WRITE ANY SUGGESTIONS YOU HAVE FOR TEACHERS USING THIS ACTIVITY IN THE FUTURE):

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