SINKING SLOWLY

SEATTLE AQUARIUM

GRADES:

9–12

DURATION:

30–45 minutes

MATERIALS:

- Buckets of water
- Aquarium with water (or deep, clear plastic bin)
- Stopwatch or watch with second hand
- Modeling clay
- Toothpicks
- Foil
- Straws
- Styrofoam
- Pipe cleaners
- Plastic water bottle lids, film canisters or other small plastic pieces

STANDARDS:

WA state:

- Application
- Life Sciences

Ocean Literacy Principles:

2. The ocean and life in the ocean shape the features of Earth.
5. The ocean supports a great diversity of life and ecosystems.
6. The ocean and humans are inextricably interconnected.

OVERVIEW:

This activity will allow the students to get creative while learning all about plankton's place in the water column and their unique physical characteristics.

GOALS AND OBJECTIVES:

Students will:

- Learn where in the water column plankton live, why they live there, and the physical characteristics that help them stay at that depth.
- Use information about plankton to make their own plankton and compete to find out whose plankton can sink the slowest.

VOCABULARY:

Plankton: Passively floating, drifting or somewhat motile organisms occurring in a body of water.

Phytoplankton: Generic term for photosynthesizing plankton (aka plant plankton).

Zooplankton: Plankton belonging to the Kingdom Animalia (aka animal plankton).

Holoplankton: Plankton that spend their entire life cycle as free-swimming organisms.

Meroplankton: Eggs and larvae of organisms that are nektonic (active swimmers) or benthic (live on the bottom) in their adult stage; temporary plankton.

Megaplankton: Planktonic organisms of about 20–200cm in length.

Macroplankton: Planktonic organisms of about 2–20cm in length.

Mesoplankton: Planktonic organisms of about 0.2–20 mm in length.

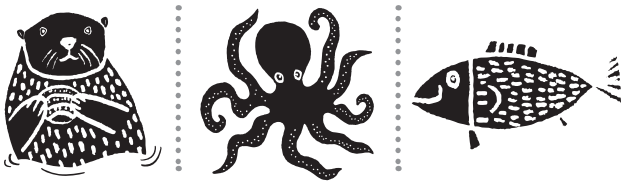
Microplankton: Planktonic organisms of about 20–200 µm in length.

Nanoplankton: Planktonic organisms of about 2–20 µm in length (too small to catch in a net).

Picoplankton: Planktonic organisms of about 0.2–2 µm in length (too small to catch in a net).

BACKGROUND:

Plankton is comprised of thousands of types of organisms including invertebrates, fish, bacteria, viruses, algaes and protozoans that are, because of their size or swimming abilities, at the mercy of ocean movement. The word plankton originated from the Greek planktos which means to wander or drift. They can't determine where they go; they drift with the currents. The ocean is full of small planktonic algaes (seaweeds) and animals which require a microscope to view properly. Surprisingly, even large animals in the ocean that ride the currents are considered plankton. Jellies (jellyfish) are examples of these. Some animals, like octopuses, spend only part of their life cycle as tiny planktonic drifters, depending on other planktonic organisms for nutrition. Plankton is not just one thing; instead, it's a lifestyle.



Plant plankton

Phytoplankton (plant plankton) consists mainly of single-celled algae known as diatoms. Diatoms provide food for many animals and are the foundation of important food chains. The other main class of phytoplankton are dinoflagellates which use a whip-like tail, or flagella, to move through the water. A famous type of dinoflagellate is Noctiluca scintillans, which causes bioluminescence (green light) in the water that you can see at night. Like plants, phytoplankton produce their own food (sugars) through photosynthesis. Phytoplankton have special adaptations to keep them floating near the surface so they can get the sunlight they need to photosynthesize. Many organisms eat phytoplankton, and it is one of the bases of the food web. It also gives Puget Sound its green color!

Photosynthesis

In photosynthesis plants, algae (which includes phytoplankton), cyanobacteria and a few other organisms capture the energy from sunlight, store it chemically and use this stored energy to combine CO_2 and H_2O to produce carbohydrates (read sugars). The carbohydrates are used as the producers' food supply. A waste product from this process is O_2.

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

At least half of the oxygen in the Earth's atmosphere is generated in the oceans. Additional nutrients are needed to build the organisms' structures and these come directly from the water.

Animal plankton

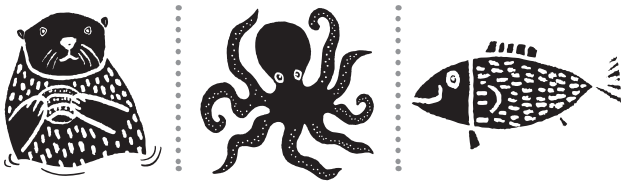
Most of the animals that you see in the tide pools in Puget Sound started out as zooplankton (animal plankton), including sea stars, sea anemones, clams, barnacles, worms, chitons, crabs, shrimp and octopuses. All of these animals spend only part of their lives drifting through the ocean and are called meroplankton. Other zooplankton, such as copepods, arrow worms and comb jellies, spend their entire lives drifting along with the ocean currents, never settling down to the bottom or swimming entirely on their own power. These are called holoplankton.

Other planktonic organisms

Lots of bacteria are also drifting throughout the ocean. In fact, there are about as many bacteria in the ocean at any one time as there are stars in the universe…times 100,000,000! Many are photosynthetic (cyanobacteria), and also produce nitrogen. Without them, we would have no oxygen to breathe, organic matter would not be degraded, and the cycling of life's essential nutrients would cease. (Look closely and you will find 500 species in your mouth.)
One study on another prolific type of ocean plankton, the viruses, showed that in a single quart of seawater there were as many as two billion viruses! Marine viruses infect and kill phytoplankton. Viruses likely have a large controlling influence on plankton diversity and population numbers.

Sizes

Plankton comes in a variety of sizes. Megaplankton, such as loose pieces of kelp or large jellies, is large enough to catch without a net. Nanoplankton and picoplankton, which include bacteria, are too small to be caught in even the finest mesh plankton net; to see them you have to look at a water sample. Other sizes of plankton can be caught in plankton nets. Using a fine mesh net versus a coarse mesh net will determine which size plankton you will catch. These "net plankton" are divided into macroplankton, mesoplankton and microplankton.



ACTIVITY:

1. Discuss with students what plankton look like and what adaptations help them stay near the surface in the ocean.
2. Students use the materials provided to design a plankton model that will remain neutrally buoyant for the longest period of time. Note: the objective here is to make a model that does not remain on the surface floating, and does not sink quickly to the bottom. Plankton that are too close to the surface of the ocean can be burned by the sun and plankton that are too deep do not get enough sunlight.
3. Give the students time to experiment with their models in buckets of water. Students should think about why the modifications they make do or do not work.
4. Students will take their best models and compete against the clock for the best time (sinking the slowest).

EVALUATION:

Upon completion of this activity students should:

- Understand where plankton lives and why it lives there.
- Be able to describe physical characteristics of various types of plankton.
- Be able to describe why their plankton did or did not "sink slowly."
- Be able to describe what changes they could make to their plankton to make it more successful.

EXTENSIONS:

Students record the total time it takes for each model plankton to sink. The rate of sinking is calculated by dividing the distance from the surface to the bottom of the test aquarium by the elapsed time. A simple bar graph of the results from each student or team of students can be made and discussed.