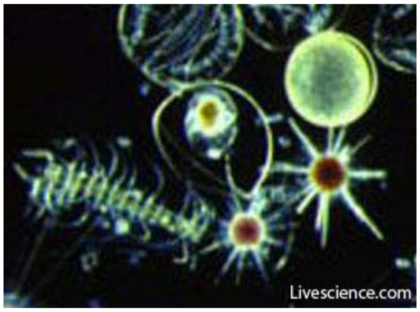
Make a Microbe

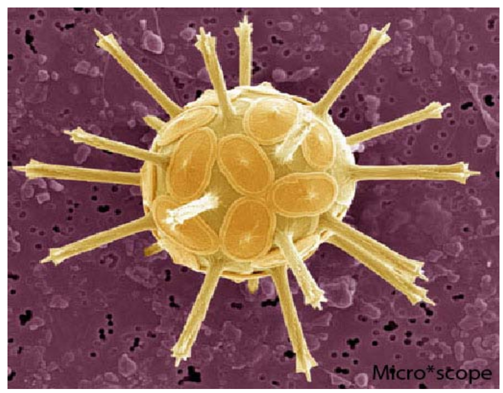
Background and Key Concepts



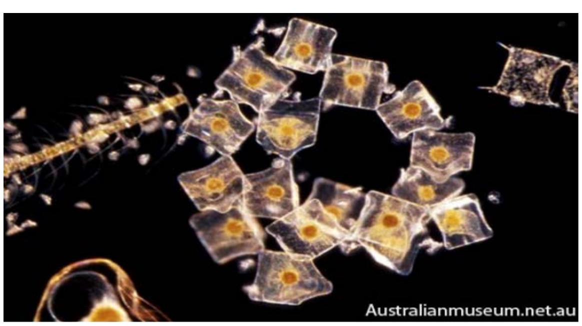
Phytoplankton, as viewed under a microscope.

Microbes are an extremely diverse group of single-celled organisms. They are found in every imaginable marine environment, including the deep sea and thermal hot springs. Some even live inside the tissues of other animals, such as corals and clams, while others live in the ice of Antarctica. Bacteria, viruses, and algae are just some of the many different types of microbes. In the ocean, plant-like microbes called phytoplankton form the base of the marine food web. They serve as food for zooplankton and small fish, which in turn are eaten by larger fish, birds, and mammals. Thus, without phytoplankton, the entire marine food web would collapse! (C-MORE, 2008)

The word phytoplankton can be loosely translated as "floating plant." Like plants, phytoplankton harness the sun's energy to convert water and carbon dioxide into carbohydrates and oxygen. This process, called photosynthesis, requires phytoplankton to stay relatively near the ocean surface: the deeper they go, the less sunlight is available. However, staying too close to the surface may expose these tiny plant-like organisms to predators, as well as to harmful damage from the sun's ultraviolet (UV) rays. Although some phytoplankton are capable of weak locomotion, they are not great swimmers and usually just float with the current. Since they are relatively immobile, how do they remain in the right depth zone to maximize photosynthesis but prevent harmful damage? Let's take a closer look at some types of phytoplankton!



Coccolithophores have hard shells and spines to protect them against predators. The spines also help with buoyancy.



Diatoms can form chains, which help with buoyancy. Each cell is encased in glass, which provides protection from predators.

Phytoplankton have a tremendous diversity of physical characteristics that serve as flotation devices and/or protection from predators. Some types of phytoplankton, such as coccolithophores (shown above), have long spines or bristles. Others, such as diatoms (left), form long chains, spirals, or circles. These adaptations allow phytoplankton to control their vertical position in the water column, allowing them to stay near their energy source – the SUN – and protected from harmful predators.

Hawai‘i Content & Performance Standards (HCPS III)
The following standards and benchmarks can be addressed using this lesson:

Science Standard 1: The Scientific Process: SCIENTIFIC INVESTIGATION: Discover, invent, and investigate using the skills necessary to engage in the scientific process.

Grade 4 Benchmarks for Science:
Benchmark SC.4.1.1 Describe a testable hypothesis and an experimental procedure

Science Standard 3: Life and Environmental Sciences: ORGANISMS AND THE ENVIRONMENT: Understand the unity, diversity, and interrelationships of organisms, including their relationship to cycles of matter and energy in the environment**.**

Grade 4 Benchmarks for Science:
Benchmark SC.4.3.1 Explain how simple food chains and food webs can be traced back to plants.

Grade 5 Benchmarks for Science:
Benchmark SC.5.3.1 Describe the cycle of energy among producers, consumers, and decomposers.

Grade 6 Benchmarks for Science:
Benchmark SC.6.3.1 Describe how matter and energy are transferred within and among living systems and their physical environment.

Science Standard 4: Life and Environmental Sciences: STRUCTURE AND FUNCTION IN ORGANISMS: Understand the structures and functions of living organisms and how organisms can be compared scientifically.

Grade 3 Benchmarks for Science:
Benchmark SC.3.4.1 Compare distinct structures of living things that help them to survive.

Materials

- Arts and craft supplies to make microbes
  - 1 weight such as a nut or washer per student (must be used)
  - 1 styrofoam or wiffle ball per student
  - Various supplies (such as pipe cleaners, rubber pencil grips, paper clips, straws, buttons, beads, toothpicks, and balloons), to vary buoyancy and protect against predation
- Safety scissors
- Transparent plastic tubs to test buoyancy (approx ~1 ft. deep, filled ¾ with water)

Procedure

1) Discuss with students what phytoplankton are, and why they need to stay relatively close to the ocean surface. (Plant-like microbes that require energy from the sun for photosynthesis)
2) Discuss with students the dangers of being right at the ocean surface (Predators, sun’s UV rays).
3) Explain that each student will soon be given arts and crafts materials to design and construct a microbe. The goal is to make a microbe that sinks very slowly through the water column. They also must protect their microbe from predators (e.g. encase it in the wiffle ball, make spines from straws, toothpicks or pipe cleaners). Every student must use the weight when constructing their microbe.

4) Before distributing materials to students, test the buoyancy of selected materials. Before placing the objects in the tub, ask the students to predict what will happen. The choices are:
    a. Object will float
    b. Object will sink quickly
    c. Object will sink slowly
5) Brainstorm on how materials could be combined and/or reshaped to vary their buoyancy.

6) Allow students to work individually to construct microbes. We recommend not making the plastic tubs available to students at this time.
7) In small groups or as a whole class, have students share their microbes, explaining (a) which adaptations they used to protect against predation, and (b) why they think their microbe will sink slowly through the water column. Have students examine each other's microbes and predict which microbes will
    a. float
    b. sink quickly
    c. sink slowly

    and have them explain their reasoning.

8) Once all hypotheses are made, have the students drop their microbes into the water-filled plastic tubs. For microbes that don't sink slowly, allow students to make appropriate adjustments and try again!

References Cited

C-MORE. 2008. Key Concepts in Microbial Oceanography. Center for Microbial Oceanography: Research and Education (C-MORE).
http://cmore.soest.hawaii.edu/downloads/MO_key_concepts_hi-res.pdf

Additional References

General phytoplankton information and photos:
http://cmore.soest.hawaii.edu/microscopy/cmore_microscopy.html