Teacher Edition

# Estimation of Biomass using Phytoplankton

**Grade:**
Grades 6-8

**Delaware State Science Standard:**
Science Standard 6 - Life Processes
Strand: Matter and Energy Transformations
Science Standard 8 - Ecology
Strand: Interactions within the Environment
Strand: Energy Flow and Material Cycles in the Environment
Strand: Human Impact

**Approximate Time Required to Complete the Project:** 7 days

**Background:** Phytoplankton are an important part of any aquatic ecosystem. These organisms form the base of the food web and so they are referred to as primary producers. All organisms require energy. Energy enters the ecosystem as sunlight and primary producers (phytoplankton) transform it into food through photosynthesis. This food is then passed through the food web, transferring energy and matter from organism to organism. When it rains, water runs off of the land into aquatic ecosystems. The "runoff" often contains extra nutrients like nitrogen from fertilizer used in farming or phosphorus from soap used to wash cars. Phytoplankton can use these nutrients to grow in number and change the stability of the ecosystem. They can go from serving as food for other organisms to forming harmful algal blooms (Fig. 1). When the phytoplankton die, they create zones of "hypoxia", where the oxygen is too low to support life.

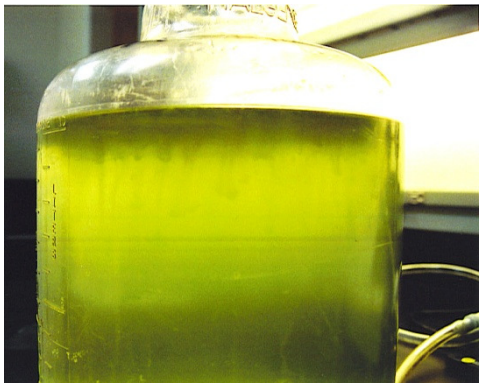

**Fig. 1 Water collected during a harmful algal bloom in Delaware's inland bays.**

One way to measure the number of phytoplankton in the environment is to estimate the biomass, which is the total mass of the phytoplankton within a given area of the environment. In this activity you will observe how phytoplankton are affected by excess nutrients and light.

***Preparation:*** *You can have the students make their own plankton net (See Activity 4: Building a Plankton Net). Filtering the water to be added to the net tow sample takes time. You may want to do this step ahead of time. Discussion topics: (i) Food webs, (ii) harmful algal blooms and (iii) photosynthesis and the transformation of energy.*

***Fun Facts:***

- *Photosynthesis by plants and algae captures about 100 terrawatts of energy per year- 6 times more than all of the power consumed by humans since the beginning of civilization.*
- *Only about 0.1% of the sun's energy that reaches earth is used for photosynthesis.*

**Materials:**

- Plankton net
- 2-liter bottle or bucket
- 4 test tubes approximately 20-50mL with caps for each group
- 1 roll of foil
- Droppers
- Miracle Grow or other plant food (approximately 2 tablespoons per 500mL)
- Filter paper or coffee filter
- Funnel
- Balance
- Graduated cylinder

**Methods:**

1. Collect samples using a plankton net.

2. Collect additional water in a bottle or bucket. Filter about 60 mL of the water through a filter into a clean bottle.

3. Label your 4 test tubes:
    A. +Nutrients and Light
    B. +Nutrients and Dark
    C. –Nutrients and Light
    D. –Nutrients and Dark

4. Place 15mL of the concentrated phytoplankton sample that you collected with the plankton net into each of the 4 test tubes.

5. Add 15mL of filtered water to each test tube.

6. Add 5 drops of Miracle Grow to the two tubes labeled +Nutrient

7. Cover the two tubes labeled dark tightly with foil so no light can get in.

8. Place tubes in a well-lit area with approximately 10-14 hours of light (but be sure they don't get too hot!).

9. At the end of one week, filter each of the tubes onto the filter paper, then dry and weigh the filters.

**Analysis:** Make a bar graph showing the weight of each filter.

**Questions:**

1. How were each of the tubes treated differently?

   *Treatment A received nutrients and light, while treatment B received nutrients but was kept in the dark. Treatment C received light, but no nutrients, and treatment D received neither light nor nutrients.*

2. Which treatment had the most biomass? Which one had the least biomass? Explain your observations

   *It is expected that students will see the most growth in treatment A and the least growth in treatment D.*

3. Was there a difference between biomass for the two light treatments? The two dark treatments?

   *If there is a difference between the weights of the two light treatments, A will likely weigh more because it received nutrients, the building blocks that it needed to grow. If there was a difference between the two dark treatments, B will likely weigh more because it received nutrients.*

4. How was **matter**, in the form of nutrients, and **energy**, in the form of sunlight, transformed into biomass in the phytoplankton?

   *Phytoplankton used sunlight as energy in the process of photosynthesis and nutrients as building blocks to grow new cells, increasing biomass.*

5. How do matter and energy "link" organisms to each other and their environments?

   *Energy, as sunlight, enters the environment. Primary producers use that energy to transform matter found in the environment as nutrients into their own biomass. Other organisms use the biomass from primary producers as food to transform plant matter into their own biomass in the food web.*

6. How do humans have an impact on the stability of ecosystems?

   *Humans can disrupt the natural balance of an ecosystem by adding extra nutrients that would not normally be found there.*

**Extra Reading:**
"Pass the Energy, Please!" by Barbara Shaw McKinney
*Online videos*
http://www.youtube.com/watch?v=6d9C6hAKF6I