# Algae and Chlorophyll a

## *What are algae?*

Algae are one celled, free floating, organisms that produce their own food by photosynthesis. Chlorophyll, the same green pigment plants contain, allows them to convert the energy from sunlight into food. Algae are among the primary producers of food and oxygen in the Bay. Some algae grow in colonies—groups of cells that grow and move together which can form filaments (threads) or large mats. Some algae are considered plants while others are classified as bacteria.

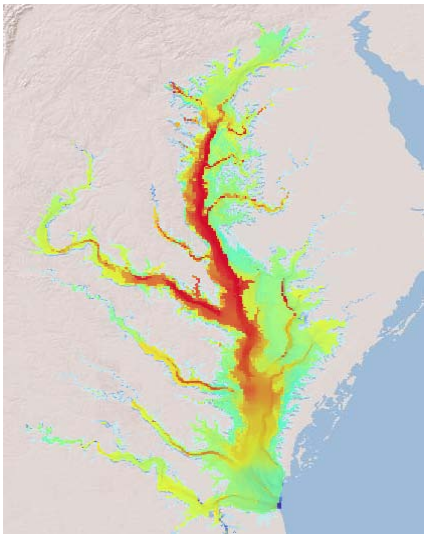
## *How do algae affect the Bay ecosystem?*

Algae are a necessary part of the Bay's ecosystem—many organisms depend on algae for food. The right level of algae means there is enough algae to fuel the food web which supports all Bay organisms including fish and shellfish.

If nutrients, especially nitrogen and phosphorus, enter the Bay in significant amounts, algae will use the extra nutrients to grow and reproduce. This sudden growth spurt, called an algal bloom, can overwhelm the ecosystem with the following consequences:

- The water becomes cloudy and sunlight cannot reach the underwater bay grasses. Bay grasses, such as eel grass and wild celery, which provide important habitat for Bay animals, might begin dying.

- Some of the algae sink to the bottom of the Bay where decomposition by bacteria occurs. Decomposition reduces the amount of oxygen in the water. This process, combined with high summer water temperatures (high temperatures also decrease the levels of oxygen) can cause large areas of the Bay to have little or no oxygen. These areas become dead zones; they can no longer support fish, crabs, and other species that need oxygen. This map shows levels of dissolved oxygen in the Chesapeake Bay in July, 2006. Areas colored in yellow, green or blue have plenty of dissolved oxygen, but areas in red have no dissolved oxygen, and areas in orange have less dissolved oxygen than many organisms need. These are the dead zones. Dead zones are an increasing problem in waters world wide.



Map from National Geographic FieldScope

- Organisms that feed on the algae and act as filters for the water (including oysters and mussels) can't keep up with the quantity of algae in the water. The algal blooms can also interfere with the feeding ability of these filter feeders making the problem even worse.

## *Nutrients, algae and the Bay*

Nitrogen and phosphorus are substances that living things need to grow and survive. Sometimes, though, there can be too much of a good thing. These two nutrients are part of the reason that the ecosystem of the Chesapeake Bay is sick.

These nutrients come from many different sources. Some of the sources are natural: soil, plants, wild animal waste and the atmosphere. But much of the nitrogen and phosphorus now entering the Bay is because of human activity. Humans have created more sources of nitrogen and phosphorus, and have destroyed much of the forest and wetland areas that used to absorb these nutrients.

The good news is that there are ways to control these sources and everyone in the watershed can help the Chesapeake Bay become healthy again.

Some of the sources of nutrients are:

- Wastewater treatment plants that remove contaminants from water. Much of the water released from these plants into streams and rivers still contains high levels of nutrients. These eventually end up in the Bay.
- Fertilizers manure, and septic systems also contain a lot of nitrogen and phosphorus. Water from storms may collect nutrients from these sources. That water enters storm sewers, or streams and rivers and will eventually enter the Bay—along with the nutrients it carries.
- Cars, trucks, factories, and lawn power tools create air pollution which adds significantly to the nitrogen in the Chesapeake Bay. The area of air pollution which affects the Bay is much larger than the Bay watershed.

## *How can algae be measured?*

A fluorometer measures chlorophyll a which indicates how much algae is in the water. It is possible to take water samples and count algal cells in order to determine the concentration of algae in the Bay. Counting algal cells, however, is very expensive and time consuming and so impractical for many situations.

## *Why would I want to measure chlorophyll a?*

Measuring the concentration of chlorophyll a is much easier than counting algal cells and provides a reasonable estimate of how much algae is in the water. Chlorophyll a is measured because it is the most common type of chlorophyll—the green pigment that is responsible for a plant's ability to convert sunlight into usable energy.

Measuring the algae in the Bay is important because the balance of the ecosystem depends on having the right amount of algae. Too much algae can cause serious problems for the other organisms in the area by blocking sunlight from reaching bottom dwelling plants and decreasing dissolved oxygen levels.

## *How to measure chlorophyll a with a fluorometer:*

There is specialized equipment necessary for measuring chlorophyll a. The simplified steps are as follows:

- A specific amount, or volume, of water is used.
- That water is filtered through a glass fiber filter—think of a really fine coffee filter made out of glass.
- The filter itself is placed in a test tube and acetone (best known as nail polish remover) is added. This test tube is then shaken to mix the filter with the acetone.
- This test tube is put in the freezer overnight.
- When removed from the freezer, the test tube is placed in a centrifuge for 10 minutes. A centrifuge spins very fast and separates substances according to their densities.
- The liquid from the test tube is then put in a culture tube.
- The culture tube is put in a fluorometer and a reading is recorded.
- Acid is added to the culture tube.
- Another reading from the fluorometer is recorded.
- The difference between those two readings is used to find the concentration of chlorophyll a.

Chlorophyll a is measured in μg/mL (micrograms per milliliter); one teaspoon of water is 5 mL. A small paper clip is about 1 gram which is 1,000,000 (that's one million!) micrograms.

In simple terms, a fluorometer works because it shines blue light on the solution. When chlorophyll a molecules are exposed to blue light, they release red fluorescence (glow). This fluorescence is measured by the fluorometer—a brighter glow means more chlorophyll and so the greater the quantity of algae in the sample.