Water Quality Factors

(Excerpted from Chesapeake Bay Program www.chesapeakebay.net/info/wquality.cfm)

Instructions

Take turns reading your assigned water quality factor section aloud within your assigned group, and use the information as a basis for further research on your factor. Use the additional information on other water quality factors as a reference when learning from the other groups.

Introduction

All living things need water. In the Chesapeake Bay region, waterways support more than 3,000 **species** of plants and animals. Healthy water contains a balanced amount of **nutrients**. It also has plenty of oxygen and little **sediment** so that underwater living resources can breathe or receive enough sunlight to grow. Monitoring the changes to the Bay's waterways is important, and the data that is collected can help scientists make determinations about water quality.

Water Quality Factors

- Nutrients are essential for plants and animals, but too much can cause harmful effects.
- Sediments can cloud the water which can interfere with the growth of **aquatic** plants.
- **Dissolved Oxygen** is essential for animals living within the Bay.
- Chemical **contaminants** can affect the growth, survival and reproducibility of **benthic** organisms.

Nutrient Pollution

(Group 1)

What are nutrients?

Nutrients, like **nitrogen** and **phosphorous**, occur naturally in water, soil, and air. Just as the nitrogen and phosphorous in **fertilizer** aids the growth of **agricultural** crops, both nutrients are vital to the growth of plants within the Bay and rivers.

How can nutrients become pollutants to the Bay and its rivers?

Although nutrients are essential to all plant life within the Bay, an excess of these same nutrients can be harmful. This is called "**nutrient pollution**."

Nutrients have always existed in the Bay, but not at present excessive concentrations. When the Bay was surrounded primarily by forests and **wetlands**, very little nitrogen and phosphorous ran off the land and into the water. Most of it was absorbed or held in place by natural vegetation. Today, much of the forests and wetlands have been replaced by farms, cities, and suburbs. As the use of the land has changed and the **watershed**'s population has grown, the amount if nutrients entering the Bay's water had increased tremendously.

Excessive amounts of phosphorous and nitrogen cause rapid growth of **algae**, creating dense populations, or **blooms**. These blooms become so dense that they reduce the amount of sunlight that can reach the **submerged aquatic vegetation** (SAV). Without sufficient light, plants cannot **photosynthesize** and produce the food

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they need to survive. The loss of sunlight can kill the grasses. Algae may also grow directly on the surface of SAV. Unconsumed algae will ultimately sink and become decomposed by bacteria in a process that uses up oxygen in the bottom waters. Like humans, most aquatic species require oxygen. When oxygen in deeper water is depleted, fish and other species will die unless they move to other areas of suitable habitat.

What are the sources of nutrients?

The main causes of the Bay's poor water quality and habitat loss are elevated levels of two nutrients, nitrogen and phosphorous. These nutrients occur naturally in soil, animal waste, plant material, and even the atmosphere. In addition to these natural sources, sewage treatment plants, industries, vehicle exhaust, acid rain, and runoff from agricultural, residential, and urban areas contribute nutrients to the Chesapeake Bay and its rivers.

Virtually all individuals and industries in the watershed, and some even beyond the watershed, contribute to the nutrients that ultimately reach the Bay. In the Bay region, excess nutrients are supplied to the system through two sources: **point** and **non-point sources**.

Sediment Pollution

(Group 2)

Background: Sediment and the Bay

'**Sediment**' refers to the loose particles of clay, **silt** and sand that suspend in a body of water and eventually settle to the bottom. It is a natural part of the Bay'se cosystem, but in excessive amounts creates harmful conditions for the Bay's plants and animals.

During periods of rain or melting snow, soil and other particles flow off the land and into waterways. Soil **erosion** caused by waves along shorelines also contributes to sediment in the Bay, and to a lesser degree, wind, ice-floes and water currents add to these loads.

- Sediment can smother **benthic** (bottom-dwelling) plants and animals, such as oysters and clams.
- Suspended sediment clouds the water, preventing light from penetrating to the leaves and stems of underwater grasses, or **submerged aquatic vegetation** (SAV).
- High concentrations of **toxic** materials also may be present in sediment, which further contaminate waterways.
- Sediment carries excess nutrients, particularly phosphorus, into Bay waters, compromising water quality.
- Accumulations of sediment can clog waterways and ports, making traffic difficult or hazardous, and requiring **dredging**.

Reducing Sediment Loads

Best management practices (BMPs) help reduce soil erosion and thus reduce sediment flowing into waterways. Farmers can help reduce sediment loads by using BMPs such as:

- Implementing soil conservation plans for their farms, such as planting **cover crops** after harvesting and **no-till farming**;
- Constructing stream bank fencing;
- Planting vegetated **buffers** at the edge of crop fields; and

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In urban areas, stormwater runoff adds to the sediment problem in waterways. Urban communities can control the amount of runoff they yield during storms, by:

- Reducing **impervious** surfaces, such as roads and parking areas (impervious surfaces prevent rainfall from being absorbed into the soil and send it instead into waterways)
- Creating **rain gardens**, which are designed to capture and filter **runoff** from impervious sites
- Planting streamside buffers, which allow plants to filter water and trap sediments
- Creating and implementing storm water management plans, which both protect natural areas that control runoff and identify areas that can be restored to further reduce runoff

Dissolved Oxygen: Supporting Life in the Bay

(Group 3)

What is Dissolved Oxygen?

Dissolved oxygen (DO) is the amount of oxygen present in the water. It is measured in terms of milligrams per liter (mg/l). Healthy Bay water has a DO level of 5.0 mg/l or greater.

Why is dissolved oxygen important?

Just like humans, most living creatures in the Chesapeake Bay need oxygen to survive – from the worms that inhabit its muddy bottom, to the fish and crabs that swim in the Bay's waters.

But, the process by which animals take in oxygen is different. Instead of lungs, the Bay's animals have gills. As the oxygen concentration of the surrounding water increases, the gills operate more efficiently. But, as oxygen concentration decreases, it is much harder for the worms, fish, crabs and other animals to take in the oxygen they need to live.

How much dissolved oxygen do the Bay's living resources need?

Bay scientists generally believe that dissolved oxygen **concentrations** of 5.0 mg/l or greater allows the Bay's aquatic creatures to thrive. However, dissolved oxygen needs vary from species to species.

As dissolved oxygen levels fall below 5.0 mg/l, living conditions for many of the Bay's inhabitants become increasingly stressful. Although some species are more tolerant than others, at times dissolved oxygen levels in the Chesapeake Bay can decrease to the point where no animals can survive.

Dissolved oxygen levels fluctuate throughout the year in the Chesapeake's waters. In fact, this fluctuation of DO levels is normal in a healthy Chesapeake Bay. However, due to human impacts, the variations in DO levels have been thrown out of balance. And, conditions in the Chesapeake can sometimes be harmful to the Bay's living resources.

What Are Bay Program Partners Doing To Reduce DO Problems?

By reducing nutrient and sediment loads, Chesapeake Bay water quality will improve, in turn providing the conditions needed for the Bay's living resources to thrive. Fewer nutrients flowing into the Bay will result in improved DO levels and abundant sunlight to fuel the growth of underwater bay grasses that provide important shelter and nursery areas for a variety of Bay species.

While reducing nutrient and sediment pollution cannot eliminate occurrences of low dissolved oxygen, they will go a long way to minimizing their size and frequency throughout the Chesapeake Bay.

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Toxics Pollution: Chemical Contaminants

(Group 4)

What is Toxics Pollution?

Toxic chemicals are chemical contaminants that harm plants, animals, fish, and humans. Many chemicals, including zinc, copper, and other metals, occur naturally in the Bay and its tributaries and do not pose a threat, but some chemicals accumulate in sediment at the bottom of the Bay, in animal tissue and in the water column and reach levels that can hurt the Bay's plants and animals.

Scientists have pointed out that any large body of water will never be completely free of chemical contaminants, but certain types and levels of chemicals found in water bodies can affect the reproduction, development, and ultimately, the survival of living resources. The toxicity of chemicals depends on many factors, including **concentration**, chemical and physical form, as well as persistence of the chemical. The chemical and physical properties of the water body, combined with the type and life stage of the living resources exposed to the chemical, also affect a contaminant's toxicity.

Sources of toxics pollution

Chemical contaminants enter the Bay and its rivers from natural processes, such as the weathering of rock, and human activities, such as manufacturing and driving. Like nutrients, chemical contaminants enter the Bay from both point and non-point sources:

- **Point sources**, such as industries and wastewater treatment plants that discharge wastewater directly into local waterways. Although these discharges are easier to manage and regulate, they are not always the biggest source of chemical contaminants to the Bay and rivers.
- **Non-point sources**, such as urban and suburban storm runoff, are significant sources of chemical contaminants because they carry residue from many outdoor products, including automobile **emissions** and pest control substances that reach local storm drains. These types of pollution are difficult to control.
- **Air pollution** is also a source of chemical contaminants in the Bay and rivers.

In order to reduce chemical releases, Bay managers are working to identify and target sources of chemical contaminants.