Eutrophication Overview… Nutrients in the water

Read the definitions below:

Eutrophication - "Eutrophication is defined as an increase in the rate of supply of organic matter in an ecosystem." - Nixon, 1995

Eutrophication - "The process by which a body of water acquires a high concentration of nutrients, especially phosphates and nitrates. These typically promote excessive growth of algae. As the algae die and decompose, high levels of organic matter and the decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish. Eutrophication is a natural, slow-aging process for a water body, but human activity greatly speeds up the process." - Art, 1993

Eutrophication - "The term 'eutrophic' means well-nourished; thus, 'eutrophication' refers to natural or artificial addition of nutrients to bodies of water and to the effects of the added nutrients….When the effects are undesirable, eutrophication may be considered a form of pollution." - National Academy of Sciences, 1969

Eutrophication – "The enrichment of bodies of fresh water by inorganic plant nutrients (e.g. nitrate, phosphate). It may occur naturally but can also be the result of human activity (cultural eutrophication from fertilizer runoff and sewage discharge) and is particularly evident in slow-moving rivers and shallow lakes … Increased sediment deposition can eventually raise the level of the lake or river bed, allowing land plants to colonize the edges, and eventually converting the area to dry land." - Lawrence and Jackson, 1998

http://toxics.usgs.gov/definitions/eutrophication.html

Using the ideas above and your own words, write an explanation of eutrophication. Explain as if you were talking to a middle school student.

Eutrophication Guided Reading- *Read and respond to the prompts:*

Eutrophication is the word used to describe the process in which nutrients, often chemical compounds like nitrate and phosphate, are introduced into bodies of water. As you probably remember, nutrients are compounds that living things need to survive. For humans, we think of nutrients, and nutrition, as good things, but for bodies of water too much of a good thing can be a problem. You are going to read about what happens when the balance of nutrients in a body of water begins to cause problems… but that comes later. For the time being, let's get back to eutrophication.

Eutrophication can be a very slow, natural process in which nutrients enter water over time and eventually transform bodies of water into wetlands or even dry land. This change happens when nutrients supply plants in the water with the resources they need to grow, and over a long time, the plant life begins to take over and change the nature of the body of water.

On the other hand, eutrophication can be greatly sped up by human activity and can disturb the natural balance of bodies of water in relatively short amounts of time, destroying both water quality and many forms of aquatic life. When humans cause unnatural eutrophication it is called "cultural eutrophication."

Stop and Jot: What are two different types of eutrophication? What are their different causes and effects?

The amount of nutrients in the water is sometimes called the nutrient load, and the process when they enter the water is also called nutrient loading. These nutrients enter the water in different ways, and their main sources are generally divided into two categories: point sources and non point sources.

Point sources are, not surprisingly, direct points of entry for the nutrients into the water. An example of a point source would be a drainage pipe from an industrial facility that leads right into a river. Non point sources are more spread out and don't have one clear physical location you can "point" to. An example of a non point source is the fertilizer that is spread over miles and miles of farm fields, some of which can end up being washed into a river or lake by a rainstorm.

Turn and Talk: What do you think is easier to control: point source or non point source pollution? Be ready to share your thinking with the class.

As mentioned above, the nutrients that end up in the water often include forms of the elements phosphorous and nitrogen. Nitrogen in water generally takes the form of nitrate (NO3), nitrite (NO2), or ammonia (NH4+ or NH3). Nitrogen from human sources often comes from sewage waste, fertilizers, animal waste, industrial pollution, and the burning of fossil fuels.

Phosphorous in water is typically in the form of phosphate (PO4-3). Phosphorous also enters the water through sewage waste, fertilizer, animal waste, and industrial pollution. Phosphorous can also come from detergents, phosphorus mining and processing, and even the treatment of drinking water.

Farms are one of the main non point sources of phosphates and nitrates in the water. Farms use these compounds in fertilizers because they are necessary resources for photosynthesis and plant growth. Sometimes, farmers apply more fertilizer than their land can absorb, and rain washes the excess fertilizer into streams, rivers, and lakes. When severe rainstorms occur, even more nutrients can get washed from farmland into the water.

Of course, it should be no surprise that nutrients like phosphates and nitrates cause plants to grow in the water if they do so on land. When nutrients like phosphates and nitrates are added into water, whether naturally or through human activity, they cause microscopic plants in the water (phytoplankton) to grow at faster rates. Algae is one example of an aquatic plant whose growth is affected in this way. When large amounts of phosphates and nitrates are introduced into bodies of water, they can cause massive blooms of algae in relatively short amounts of time.

Create a simple flow chart or illustration that shows how nutrients enter the water and then what happens to aquatic plant life when they do.

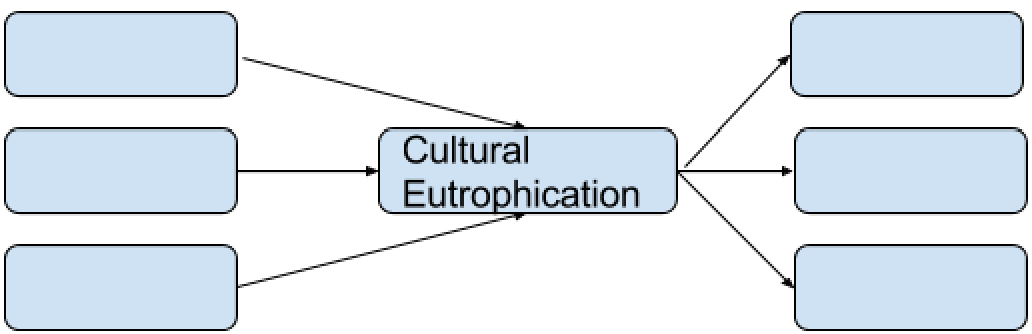
What happens when a body of water suddenly develops massive amounts of microscopic plant life? We know that plants take in carbon dioxide (CO_2) and release oxygen (O_2), so one might think that more plants in the water means more oxygen in the water, and this sometimes happens. Strangely enough, the opposite can happen as well, and conditions of hypoxia (lack of oxygen) can develop in bodies of water. Plants only take in CO_2 and put out O_2 during photosynthesis, and they only carry out photosynthesis when they have enough light. So, at nighttime, and when the water is too dark or cloudy, plants use respiration, and in respiration they take in oxygen just like we do. So if massive amounts of plants darken and cloud the water, more respiration can take place and remove oxygen from the water.

In addition, when phytoplankton like algae die, they are decomposed by bacteria, and these micro-decomposers need oxygen as fuel for their respiration while they work. So, large algal blooms can result in lots of dead algae and lots of decomposition taking place, and this can pull large amounts of oxygen from the water. When the water lacks oxygen, fish and other life forms can't survive, creating what are often referred to as "dead zones" in the water. Also, some forms of algae produce chemical toxins, so they can literally poison the water and make it unsuitable for marine life and human uses.

In recent years, Lake Erie has suffered greatly from these harmful types of algae blooms. In the summer of 2011, one sixth of the lake's surface was covered by a scum of toxic algae. The algae bloom of 2011 caused dead zones in the water, killed large amounts of fish, contaminated beaches, and damaged the local economy by making the lake unfit for recreation. Scientists and public health officials are greatly concerned about the lakes long term health.

Turn and Talk: Take turns explaining to each other how increased plant life in water can actually lead to less oxygen. Be prepared to share.

On another sheet of paper, create a cause and effect chart explaining cultural eutrophication. You can use the sample format below or create your own.



Eutrophication Guided Reading- *Read and respond to the prompt at the end:*

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