

Nitrogen and Phosphorus

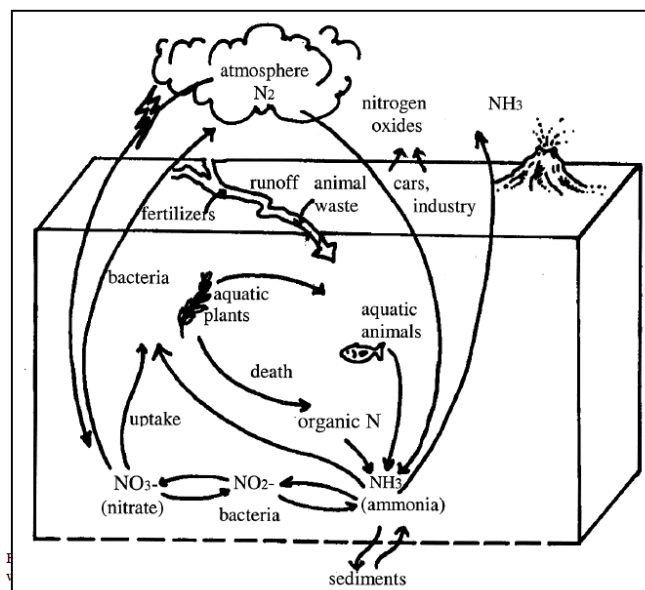
What are nutrients?

Nutrients are chemicals that are essential for plant growth. We add nutrients when we fertilize our gardens and fields. In the same way, adding nutrients to water fertilizes water-dwelling plants.

Typically, plants in water will continue to grow until something they need (sunlight, carbon dioxide, oxygen, or nutrients) runs out. In most streams and lakes, phosphorus or nitrogen limits plant growth. Adding more of the limiting nutrient, in fact, can stimulate *too much* plant growth, which starts a chain of events that may eventually deplete oxygen from the water and kill fish and other aquatic animals. For this reason, nutrients are considered a leading cause of poor water quality in Wyoming.

What is nitrogen?

Nitrogen is used in building proteins and is an essential nutrient for plant and animal growth. Nitrogen is found in a variety of forms throughout our environment and changes forms readily. The nitrogen cycle (see below) demonstrates the many different paths nitrogen may follow around our earth.



Why do we care about nitrogen?

Excessive plant growth

When we over-fertilize our waters with nitrogen, we can cause heavy plant growth. Sometimes these plants grow on stream and river bottoms. More often, the problem occurs in the lakes and reservoirs that the streams enter. Too much nitrogen can cause floating scum or “blooms” of microscopic algae in lakes and reservoirs. Over fertilization of water can cause various problems:

- Excessive plant growth can decrease the aesthetic value of water bodies by making the water cloudy or causing unsightly and smelly mats of decaying plants on the shore.
- When plants die in the water, bacteria go to work decomposing the dead material. This uses oxygen. If there is too much plant material in the water, the bacteria multiply and use up all the oxygen.
- In extremely high concentrations, some simple bacteria called blue green algae form neurotoxins that can actually kill animals drinking from the water.

Health concerns

Some forms of nitrogen are poisonous to humans or to aquatic organisms. Concentrations of nitrate in drinking water greater than 10 mg/liter can be harmful to young babies. Nitrite (a form of nitrogen) can be toxic to fish, such as rainbow trout, at concentrations of about 4 mg/liter. Ammonia (another form of nitrogen) may be toxic to fish and aquatic invertebrates at very low concentrations. Ammonia can affect fish at very low concentrations, especially when the water is somewhat basic (high pH) and at temperatures above 20 degrees C.

How do we interpret our results?

Nitrate

Usually nitrate concentrations in natural streams and rivers are less than 2 to 3 mg/liter. If the stream or river is used as a source of drinking water, Wyoming has set a standard of 10 mg/liter. When higher concentrations are found, state officials conduct additional studies to find the source.

pH effects

The common form of the ammonia molecule has one nitrogen and three hydrogen atoms (NH_3). This form is toxic to fish at very low concentrations. In somewhat acidic water, however, a fourth hydrogen atom attaches to ammonia, creating the ammonium ion (NH_4^+). Ammonium is much less toxic to fish. Therefore, we need to know the pH of water to know how toxic the ammonia concentration really is.

Temperature effects

At temperatures above room temperature (about 20 degrees C), both forms of ammonia become more toxic to fish. Most fish can handle higher concentrations of ammonia for short periods of time (hours or less) than over longer periods of days and weeks.

What is phosphorus?

Phosphorus is an important plant nutrient. Phosphorus occurs in many different forms in the environment, much like nitrogen. Unlike nitrogen, however, phosphorus cycles through the environment more slowly. Most of the phosphorus is found in rocks and minerals.

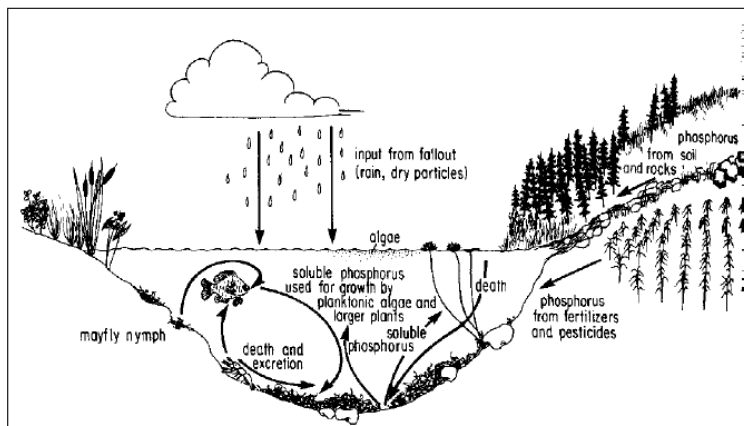


Figure IV-11. The Phosphorus Cycle—note how phosphorus enters the water from land or atmosphere and the cycles between living organisms and decayed material.

Why do we care about phosphorus?

Excessive plant growth

Phosphorus is often the nutrient that limits how much plant growth occurs in a stream, lake or reservoir. Adding a small amount of phosphorus, therefore, may cause excess plant growth. Sometimes these plants are large and grow from the lake bottoms in shallow areas. Sometimes, the plants that grow are microscopic algae. Heavy plant growth caused by over fertilization of water can cause various problems (see figure below):

- Large attached plants in shallow areas of lakes entangle boaters and swimmers. When the plants die, huge mats of decaying plants create odor and aesthetic problems.
- “Blooms” of algae make the water cloudy and unsightly.
- When the plants in lakes and reservoirs die, more oxygen may be used in the **decomposition** process than can be replaced. During winter, an entire lake may freeze and lose all its dissolved oxygen. If this happens, all the fish and other aquatic life will die.

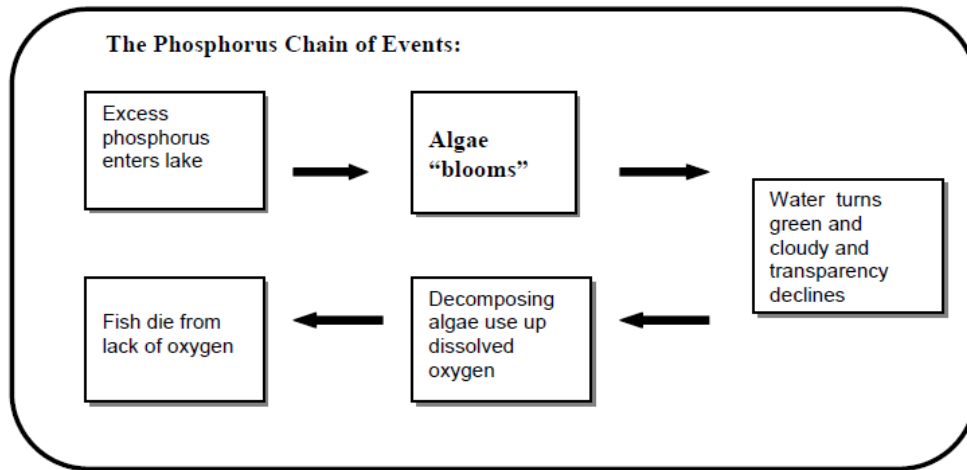


Figure IV-12. The Indirect Effect of Phosphorus on Fish. This chain of events leads from too much phosphorus in a lake to fish kills from lack of oxygen.

- Certain types of microscopic algae can be toxic if they reach very high concentrations. Animals, such as dogs or livestock, that drink from these toxic water bodies can become sick or even die.

How do we interpret our results?

The State of Wyoming considers a total phosphorus concentration of 0.05 mg/liter in a stream or river to be an indicator of pollution problems. A concentration of 0.025 mg/liter in lakes is considered a potential problem.