**Human activity affects cycling of nitrogen and its environmental consequences**

Early in the 20th century, a German scientist named Fritz Haber figured out how to short-circuit the nitrogen cycle by fixing nitrogen chemically at high temperatures and pressures, creating fertilizers that could be added directly to soil. This technology spread rapidly over the 20th century, and, along with the advent of new crop varieties, the use of synthetic nitrogen fertilizers led to an enormous boom in agricultural productivity. This agricultural productivity has helped us to feed a rapidly growing world population, but the increase in nitrogen fixation has had some negative consequences as well. While the consequences are perhaps not as obvious as an increase in global temperatures (see our Data Analysis and Interpretation module) or a hole in the ozone layer (see The Practice of Science module), they are just as serious and potentially harmful for humans and other organisms.

Not all of the nitrogen fertilizer applied to agricultural fields stays to nourish crops. Some is washed off of agricultural fields by rain or irrigation water, where it leaches into surface water or groundwater and can accumulate. In groundwater that is used as a drinking water source, excess nitrogen can lead to cancer in humans and respiratory distress in infants. The US Environmental Protection Agency has established a standard for nitrogen in drinking water of 10 mg per liter nitrate-N. Unfortunately, many systems (particularly in agricultural areas) already exceed this level. By comparison, nitrate levels in waters that have not been altered by human activity are rarely greater than 1 mg/L. In surface waters, added nitrogen can lead to nutrient over-enrichment, particularly in coastal waters receiving the inflow from polluted rivers. This nutrient over-enrichment, also called eutrophication, has been blamed for increased frequencies of coastal fish-kill events, increased frequencies of harmful algal blooms, and species shifts within coastal ecosystems.

Reactive nitrogen (like NO3- and NH4+) present in surface waters and soils, can also enter the atmosphere as the smog-component nitric oxide (NO) which is a component of smog, and also as the greenhouse gas nitrous oxide (N2O). Eventually, this atmospheric nitrogen can be blown into nitrogen-sensitive terrestrial environments, causing long-term changes. For example, nitrogen oxides comprise a significant portion of the acidity in acid rain, which has been blamed for forest death and decline in parts of Europe and the northeastern United States. Increases in atmospheric nitrogen deposition have also been blamed for more subtle shifts in dominant species and ecosystem function in some forest and grassland ecosystems. For example, on nitrogen-poor serpentine soils of northern Californian grasslands, plant communities have historically been limited to native species that can survive without a lot of nitrogen. There is now some evidence that elevated levels of atmospheric N input from nearby industrial and agricultural development have allowed invasion of these ecosystems by non-native plants. NO is also a major factor in the formation of smog, which is known to cause respiratory illnesses like asthma in both children and adults.

Eutrophication can reduce oxygen availability in the water during the nighttime because the algae and microorganisms that feed on them use up large quantities of oxygen in cellular respiration. This can cause the death of other organisms living in the affected ecosystems, such as fish and shrimp, and result in low-oxygen, species-depleted areas called dead zones. Water sources specially the island water bodies are more prone to this type of disturbance as they usually have less efficient source and sink mechanism for water and the inward movement of nutrients rich in nitrogen become one directional. In this case ultimately this type of ecosystems collapse and the natural balance is disturbed for infinite time.