# **Environmental Chemistry Discussion Guide (for use during or after reading)**

1. What are chemical reactions? How are products and byproducts related to chemical reactions? (Chemicals and Chemical Reactions, p. 7-10)
   1. Chemical reactions occur when substances split apart or combine. Anything new is considered a product. Byproducts are the extra things produced by chemical reactions. Often, byproducts are harmful and are a concern to environmental chemists.
2. What are natural cycles and why are they important? (Natural Cycles, p. 11-18)
   1. Natural cycles are the movement of chemicals through interactions with living and nonliving things. Natural cycles transport the elements of life, like carbon and nitrogen, around our planet. Living things take these elements from the environment and use them to survive. The natural cycles in place replenish those chemicals so they can be used by other living things in the future. Natural cycles are needed to sustain life.
3. Use the diagram on pages 14 and 15 to describe how nitrogen cycles around Earth. (Natural Cycles, p. 11-18)
   1. Nitrogen gas is comprised of two nitrogen atoms closely bonded together in molecules. Lightning and special kinds of bacteria can break apart nitrogen molecules into compounds we can use. Eventually, other kinds of bacteria convert the nitrogen found in wastes back into nitrogen gas, continuing the nitrogen cycle.
4. Use the diagram on pages 16 and 17 to describe how carbon cycles around Earth. (Natural Cycles, p. 11-18)
   1. Carbon dioxide is found mainly in the atmosphere as well as in the bodies of living things. Eventually, carbon dioxide from the air slowly dissolves into oceans, where it is taken up by living things or stored in sediments or even rocks. Plants take in carbon dioxide to make food through photosynthesis. Animals release carbon dioxide back into the atmosphere as a byproduct of respiration. When living things die and decay, some of their carbon is transferred to the soil. The carbon cycle is considered the most complex because there are many ways in which carbon cycles around Earth.
5. How have humans caused disruptions in the nitrogen cycle? What problems does this create? (Disrupting Natural Cycles, p. 18-25)
   1. One major way humans have disrupted the nitrogen cycle is with fertilizer meant to increase farmers’ crop yields. Humans use nitrogen and phosphorous from rocks to make plant fertilizer, which eventually runs off into lakes and rivers. The extra nutrients in these bodies of water get taken up by plantlike living things called algae that grow to cover the surface. This causes the algae under the surface to die because the surface algae blocks the sunlight needed to survive. This creates an addition problem as decaying algae absorb the oxygen from the water, killing fish and other animals along the way. This runaway process is called eutrophication and eventually leads to the death of all living things in the water.
6. How have humans caused disruptions in the carbon cycle? What problems does this create? (Disrupting Natural Cycles, p. 18-25)
   1. Humans have also caused major issues with the carbon cycle. Over the last 150 years, people have been burning fossil fuels for energy. This produces carbon dioxide as a byproduct and throws off the carbon cycle.
7. Why is it problematic that excess carbon dioxide is released into the atmosphere? (Disrupting Natural Cycles, p. 18-25)
   1. It is problematic that excess carbon dioxide is released into the atmosphere because it contributes to Earth’s rising temperatures. Because carbon dioxide is a greenhouse gas, it traps heat inside Earth’s atmosphere. This has led to warming climates across Earth and has contributed to our quickly worsening environmental health.
8. What is chemical pollution? Why are synthetic chemicals dangerous to the environment? (Pollution, p. 26-29)
   1. Chemical pollution is the release of unwanted chemicals into the environment. When we think about chemical pollution, we often think about synthetic chemicals, but it is important to note that natural chemicals can also cause pollution if used too much. Synthetic pollutants make their way into the cells of living things and stay there. Over time, living things are exposed to more and more synthetic chemicals and end up accumulating increasing levels of contamination.
9. What are bioaccumulation and biomagnification? (Pollution, p. 26-29)
   1. Bioaccumulation occurs over time as living things become increasingly contaminated by synthetic chemicals. Predators face a great danger from bioaccumulation because they tend to experience biomagnification. This is the process by which a compound, like a pollutant, increases its concentration in the tissues of organisms as it travels up the food chain.
10. What is water pollution and why is it harmful? (Water Pollution, p. 34-35)
    1. Water pollution occurs when harmful chemicals contaminate any body of water. This can happen easily because water is a solvent, a substance that can dissolve other substances, including pollutants, within it. Water pollution is harmful because it lowers oxygen levels in water, raises water temperatures, and can poison plants and animals. In addition, water pollution is dangerous because it can quickly travel from one body of water to the next, spreading the contamination.