

Chemistry Merit Badge

4a. Cut a round onion into small chunks. Separate the onion chunks into three equal portions. Leave the first portion raw. Cook the second portion of onion chunks until the pieces are translucent. Cook the third portion until the onions are caramelized, or brown in color. Taste each type of onion. Describe the taste of raw onion versus partially cooked onion versus caramelized onion. Explain what happens to molecules in the onion during the cooking process.

- The heat of cooking volatilizes the sulfur-containing compounds that give raw onions their sharp taste. Evaporating these compounds unmask the naturally sweet flavor of onions.

6a. Name two government agencies that are responsible for tracking the use of chemicals for commercial or industrial use. Pick one agency and briefly describe its responsibilities to the public and the environment.

- Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA).
- OSHA's mission is to promote the safety and health of America's working men and women by setting and enforcing standards; providing training, outreach and education; establishing partnerships; and encouraging continual process improvement in workplace safety and health.

6b. Define pollution. Explain the chemical effects of ozone, global warming, and acid rain. Pick a current environmental problem as an example. Briefly describe what people are doing to resolve this hazard and to increase understanding of the problem.

- Pollution means any contamination of air, soil, water and environment. Pollution can occur in four forms: air, water, land and noise.

Air pollution – Harmful gases and tiny particles (like carbon monoxide, nitrogen dioxide and sulfur dioxide) released from burning fuel, factories and cars.

Water pollution – Industrial waste dumping and leached chemicals from solid objects (litter).

Land pollution – Litter.

Noise pollution – Loud music, industrial equipment, planes or other noises.

- Ozone is a form of elemental oxygen. The molecules of ozone contain three oxygen atoms (O_3). Ozone is a very reactive gas, and even at low concentrations it is irritating and toxic. It occurs naturally in small amounts in the Earth's upper atmosphere, and in the air of the lower atmosphere after a lightning storm. Ozone is much more reactive than O_2 . It is a very powerful oxidizing agent. It can oxidize many organic compounds and is used commercially as a bleach in waxes, oils, and textiles, and as a deodorizing agent. Because it is a powerful germicide, it is also used to sterilize air and drinking water.

- Global warming is the increase in the average measured temperature of the Earth's near-surface air and oceans since the mid-twentieth century, and its projected continuation.
- Acid rain is rain or any other form of precipitation that is unusually acidic. It has harmful effects on the environment and on structures. Acid rain is mostly caused by emissions due to human activity of sulfur and nitrogen compounds which react in the atmosphere to produce acids.

6c. Using reasons from chemistry, describe the effect on the environment of ONE of the following:

- Used motor oil
 - Some governmental jurisdictions classify used motor oil as hazardous. It may contain additives (e.g. rust inhibitors), contaminants (e.g. heavy metals generated through engine wear, or externally introduced materials such as PCBs from old transformer oils), potentially carcinogenic, polycyclic, aromatic compounds (from the fuel combustion process), or glycol leaked from the cooling system. Because of these “impurities,” used motor oil should be handled with care and disposed of correctly to ensure the safety of the local community, environment and waterways.

6d. Briefly describe the purpose of phosphates in fertilizer and in laundry detergent. Explain how the use of phosphates in fertilizers affects the environment. Also, explain why phosphates have been removed from laundry detergents.

- Phosphates naturally bind to soil molecules. This is very good for delivering washing clothes as the phosphates will pull dirt away from clothes and take it away with the waste water. This dirt-binding mechanism is also good in fertilizers as it allows the phosphates to stay in the soil and provide nutrients to plants rather than being washed away.
- Phosphates from fertilizers affect the environment by polluting lakes and streams causing over-production of algae and water weeds. This doesn't happen when fertilizer is used properly, but can happen if an area is over-fertilized or if fertilizer is spilled onto concrete where the phosphates can't bind with soil. Grass clippings and soil erosion are other ways that the phosphates become mobile and wind up in the water system.
- Phosphates have been removed from laundry detergents to prevent the phosphates from getting into the water system. The whole point of phosphates in detergents are that they wash away with the waste water carrying dirt particles with them. As the phosphates get carried away with the waste water they move into our water system of lakes and streams. This pollutes the lakes and streams and causes over-production of algae and water weeds.