Instructor Notes

Toxicological Case Study

As residents of a highly industrialized nation, we are constantly exposed to commercial chemical processes. Some of these processes are known to have detrimental effects on human health. Therefore, citizens and other responsible groups often have to make decisions and take actions to protect the health of their families, their communities, and themselves.

In this activity, participants are given a list of health effects resulting from exposure to a chemical process. Based only on this information, participants decide what actions should be taken to address potential health hazards. At the end of the discussion, participants are informed that the chemical process is cigarette smoking.

The activity is written for workshop participants and may need modification for classroom use.

Suggested Background Reading

- An Introduction to Toxicology

National Science Education Standards for Grades 5–12

Science as Inquiry

- Abilities Necessary to Do Scientific Inquiry
  Communicate and defend a scientific argument. Students develop the abilities associated with accurate and effective communication during a class discussion assessing what actions should be taken regarding a local chemical process to protect the health of their families, their communities, and themselves. Students take different viewpoints and learn to review information, summarize data, speak clearly and logically, construct reasoned arguments, and respond appropriately to critical comments.

Science in Personal and Social Perspectives

- Personal Health
  The use of tobacco increases the risk of illness. Students learn the possible long-term detrimental effects of smoking tobacco.
- Risks and Benefits
  Important personal and social decisions are based on perceptions of benefits and risks. During a class discussion, students present different viewpoints about a chemical process to demonstrate how perceptions of benefits and risks can affect personal and social decisions.

- Personal and Community Health
  Personal choice concerning fitness and health involves multiple factors. Students learn that personal goals, peer and social pressures, and understanding biological consequences can all influence decisions about the use of substances such as tobacco.

Procedure Notes and Outcomes

Divide the class into groups, then have everyone read through the "Health Hazards of the Process" Overhead. Tell the class to assume that the process is occurring in a local workplace on a continual basis. Assign to each group a different viewpoint of someone involved in or affected by exposure to the chemical process, such as employees and their families; management or union representatives; Occupational Safety and Health officials; or officials of local, state, or federal government. (You may come up with additional viewpoints.)

After individual groups brainstorm a proposed course of action, have each one present ideas to the class. Facilitate a class discussion about how drastic some proposed measures may be compared to others.

At the end of the class discussion, tell everyone that the chemical process is actually cigarette smoking and that the health hazards resulting from exposure are real. You may wish to allow groups to offer a revised course of action once they know this. Use this opportunity to remind participants that we can all use scientific evidence to make personal choices.

Reference

Doherty, M. "A Lively and Surprising Toxicological Case Study," *Journal of Chemical Education,* 1994, *71* (10), 860.

Overhead

Toxicological Case Study

Health Hazards of the Process

- The chemical process creates an inhalable complex mixture of hundreds of substances (including radioactive heavy metals such as polonium) that concentrate in internal tissues, especially the throat and lungs.
- Other substances in the mixture include such well-known poisons as hydrogen cyanide, hydrogen sulfide, and carbon monoxide. These gases are present in concentrations too low for an acute toxic effect, although chronic exposure to low levels poses several severe health risks.
- Inhalable substances generated by the chemical process have been shown to cause cell mutations.
- Epidemiological statistics suggest that the chemical process contributes to higher levels of fatal cancers of the lung, bladder, kidneys, and pancreas; laryngeal cancer incidences rise up to twenty-fold.
- The chemical process produces stress on the body that leads to an increased risk of potentially fatal noncancerous diseases of the heart and respiratory system. For example, the carbon monoxide gas binds to hemoglobin, reducing the ability of the blood to carry oxygen to the heart.
- Studies show that the chemical process may cause a slightly higher incidence of deformities in the fetuses of exposed pregnant women; statistics show lower birth weights as well. These effects correlate to an increased risk of infant mortality. Additionally, animal studies suggest an increased risk of subsequent childhood cancers.
- Numerous recent studies have shown that people exposed to the chemical process at work often contaminate their homes and expose their families to the same risks, though at lower levels.
- Although all workers at a company or facility where the chemical process occurs are at risk, there is a higher incidence of exposure and subsequent illness among clerical or blue-collar workers. Managers, staff engineers, and scientists typically experience lower group exposure and risk. The Occupational Safety and Health Administration (OSHA) has considered regulating the process but faces an influential and well-funded lobby that opposes controls. Congress barred the U.S. Environmental Protection Agency from acting on the issue in 1976. Various government actions remain under consideration.