IONIZING RADIATION

Unit Purpose:

This unit of study consists of a series of lessons and activities designed to convey factual information relevant to radioactivity and radiation and to relate that information both to the personal lives of students and to the management and disposal of nuclear waste.

Students will experiment and determine that although radiation cannot be detected with the senses, it is possible to study radiation through indirect observation. The concept that ionizing radiation is a part of nature and our natural environment, but can result from human activity as well, will be introduced. Radioactive decay and half-life will be studied in depth to facilitate understanding of plans for permanent disposal of radioactive wastes that will continue to emit radiation for hundreds of thousands of years. This understanding will help students develop an appreciation for the necessity of planning carefully for disposal of these wastes.

Unit Concepts:

Nuclear waste emits radiation. Radiation cannot be detected directly by the senses. Nuclear waste becomes less radioactive over time.

1. Radiation cannot be detected directly by using our senses.
2. Ionizing radiation is energy in the form of electromagnetic waves (X-rays and gamma rays) or fast-moving particles (alpha and beta particles).
3. Ionizing radiation is part of our natural environment but can also result from human activities.
4. Ionizing radiation from natural sources contributes more than 80 percent of the the average exposure of an individual residing in the United States.
5. Radioactive materials become less radioactive over time through the process of radioactive decay.
6. Radioactive decay curves may be illustrated by graphing the flipping of a coin.
7. The time for radioactive materials to lose essentially all of their radioactivity can vary from seconds to thousands of years.
8. Radioactive materials with the highest activities per unit weight decay the fastest.
9. Each radioactive isotope has its own distinct half-life.

Duration of Unit:

Five 50-minute class periods

Unit Objectives:

As a result of participation in this unit of study, the learner will be able to:

1. discuss a cloud chamber demonstration;

2. define ionizing radiation;
3. name both natural and manmade sources of ionizing radiation;
4. state how many millirem of exposure to radiation the average American receives annually;
5. state what percentage of exposure of the average American to ionizing radiation is from natural sources;
6. state approximately how many millirem of exposure to ionizing radiation he/she personally received this year;
7. name the sources of his/her personal exposure;
8. collect, chart and graph data;
9. complete a chart on half-lives of significant radioisotopes;
10. differentiate which three radioisotopes have the highest and lowest specific activity; and
11. explain the significance of the information on the half-life chart as it relates to permanently disposing of radioactive wastes.

Unit Skills:

Analyzing, calculating, collecting and organizing data, critical thinking, deductive reasoning, drawing conclusions, evaluating, filling in a chart, interpreting, measuring, note-taking, observing, plotting data on a graph, reading, reading and interpreting graphs and tables, working in groups.

Unit Vocabulary:

Acute exposure, alpha particle, background radiation, beta particle, cancer, cosmic radiation, decay product, distribution of risk, electromagnetic spectrum, electron, erg, fission, frequency, gamma ray, genetic effect, half-life, ion, ionization, ionizing radiation, isotope, kilogram, millirem, nuclear fuel cycle, radiation, radioactive decay, radioisotope, radon, rem, spent fuel, terrestrial radiation, transuranic, uranium, X-ray.

Unit Materials:

Reading Lesson

Ionizing Radiation Sources and Exposures, p. SR-1

Activity Sheets

The Cloud Chamber, p. 87
Ionizing Radiation Exposure in the United States, p. 101
Calculating Your Personal Radiation Exposure, p. 103
Pennium-123, p. 105
Half-Lives, p. 107

Masters for Transparencies

DNA Molecule, p. 91
Cancer Risk Versus Radiation Exposure, p. 93
Radiation Exposure Pathways, p. 95
Electromagnetic Spectrum, p. 97