NUCLEAR WASTE: WHAT IS IT? WHERE IS IT?

Purpose:

This lesson will help students differentiate among the four categories of nuclear waste: high-level waste, low-level waste, transuranic waste, and mill tailings. The lesson defines each category and describes how each type of waste is managed to protect the public and environment from hazards associated with radiation. The lesson focuses special attention on location of spent fuel and high-level waste from defense activities.

An optional review exercise has been provided in the event that a brief explanation of the fission process would be helpful. This review of fission may be used as an explanation, a review, or not at all, depending upon the needs of students.

Concepts:

1. A national problem exists because there is an accumulation of nuclear waste.
2. There are four major classifications of nuclear waste: high-level waste, low-level waste, transuranic waste, and mill tailings — all are radioactive.
3. Classification of nuclear waste depends on its source and the types and levels of radiation it emits.
4. Each type of nuclear waste is disposed of in a way that will protect the public and environment from hazards associated with radiation.
5. High-level waste in the form of commercial spent fuel is currently stored in 35 States.

Duration of Lesson:

Two 50-minute class periods

(Allow approximately 20 additional minutes if the optional review activity on fission is taught.)

Objectives:

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

1. list and define the four categories of nuclear waste;
2. state how each type of waste is or will be disposed of;
3. write a brief statement explaining the paradoxical relationship between the total volumes and radioactivities of nuclear wastes;
4. complete an outline map of the United States showing where spent fuel or high-level nuclear waste is stored and/or will be stored by the year 2000; and
5. discuss where spent fuel and/or high-level nuclear waste is currently stored in the United States.

Skills:

Analyzing, defining, describing, discussing, drawing conclusions, evaluating, interpreting charts and tables, mapping, synthesizing, writing

Vocabulary:

Ceramic pellets, commercial, compact, cubic meter, defense high-level waste, fission, fission products, fuel assembly, fuel rods, geographic, high-level waste, low-level waste, mill tailings, neutron, nuclear chain reaction, nuclear reactor, pie chart, radioactive, radioactivity, repository, spent fuel, transuranic, volume

Materials:

Reading Lesson

Nuclear Waste: What Is It? Where Is It?, p. SR-9

Activity sheets

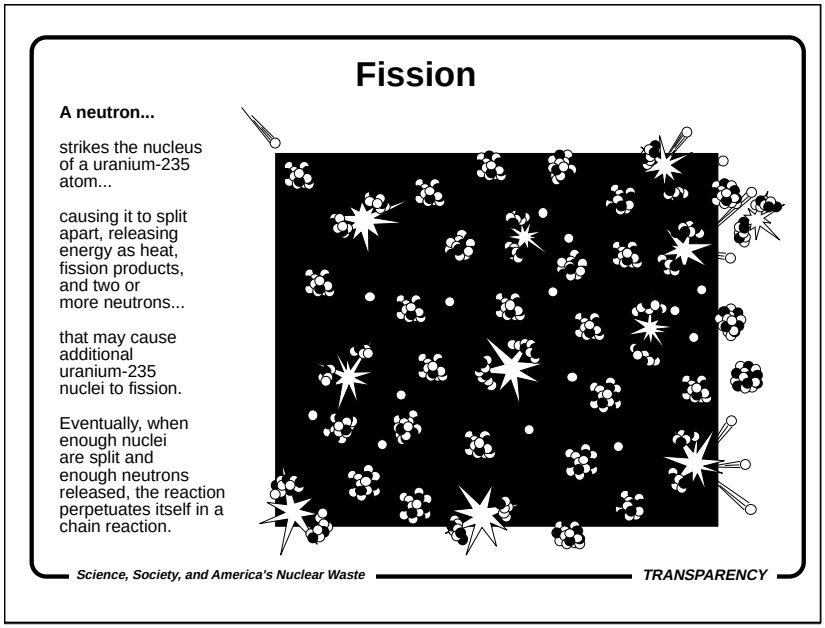
Radioactive Wastes: Volumes and Radioactivities, p. 109
Nuclear Waste: What Is It? Where Is It?, p. 111
Geographic Distribution of Commercial Spent Fuel and Commercial and Defense High-Level Nuclear Waste, p. 115
(blank U.S. map and question/answer sheet)
Geographic Distribution of Commercial Spent Fuel and Commercial and Defense High-Level Nuclear Waste, p. 117

Transparencies

Fission, p. 83
Locations of Spent Fuel and High-Level Radioactive Waste Ultimately Destined for Geologic Disposal (map and matrix), pp. 85-105

Background Notes

Types of Nuclear Waste, p. 19
Storage of Spent Fuel, p. 21
Below Regulatory Concern (BRC) Materials, p. 25



Suggested Procedure:
Part I

1. The following optional review of nuclear fission has been provided for groups who will find a brief explanation of the fission process helpful. If this review is not required, you may wish to proceed directly to #2. Concepts, objectives, vocabulary, etc. have not been prepared for this review.

Fission Review:

a. Have students read or review the reading lesson entitled *Nuclear Waste: What Is It? Where Is It?* Direct student attention to the paragraph on fission products and transuranics, in particular.

b. Discuss reading lesson.

c. Show transparency of diagram of the fission process and discuss what is being illustrated.

d. Have students define or diagram the fission process and explain the terms fission products and transuranics.

e. Ask students to describe how fission products and transuranics relate to the fission process.

2. Review the reading lesson entitled *Nuclear Waste: What Is It? Where Is It?*

3. Discuss the various types/categories of nuclear waste and what classification of waste depends on.

4. Assign the Reading Review entitled *Radioactive Wastes: Volumes and Radioactivities*. You may wish to allow students to work together.

5. Review the activity sheet in class.

6. Be sure that students understand that most radioactive waste is low-level and does not require disposal in a repository. A small percentage of the total volume of radioactive waste is high-level, transuranic, or spent fuel and requires permanent disposal in a repository. The small volume of spent fuel and defense high-level waste contains the greatest percentage of radioactivity.

7. Have students begin working on the reading review for *Nuclear Waste: What Is It? Where Is It?* for homework.

Part II

1. Discuss the *Commercial Spent Fuel Storage – 1993 and 2003* Table in the reading lesson entitled *Nuclear Waste: What Is It? Where Is It?* showing the States where spent nuclear fuel and/or defense high-level waste is stored.

2. Distribute outline map of the United States and instruct students to fill in the map showing the three separate groupings indicated by the map key. Be sure to tell students to refer to information

given in the introductory paragraph on the map activity and *Commercial Spent Fuel Storage – 1993 and 2003* Table in the reading lesson to help them make their groupings.

3. You may wish to review the map activity as a group prior to assigning the question/answer activity sheet.

4. Assign the activity sheet entitled *Geographic Distribution of Commercial Spent Fuel and Commercial and Defense High-Level Nuclear Waste*. Depending upon available time, you may wish to have students complete this as a group activity.

5. Discuss the responses when students have completed the activity sheet.

6. Have students write a short paragraph explaining the importance of this lesson.

Teacher Evaluation of Learner Performance:

Participation in class discussion, completion of reading reviews, outline map, and written assignment will indicate comprehension.

Enrichment:

Inventories of Spent Fuel, p. 43
Spent Fuel Inventories Number Line, p. 131
1993 Inventories of Spent Fuel by State, p. 133
Worldwide Nuclear Waste Management, p. 135
Low-Level Waste, p. 139
Low-Level Waste Compacts, p. 143
Low-Level Waste Number Line, p. 145
Low-Level Waste Received at Disposal Sites – 1993, p. 147