



Activity 5: Radiation Contamination and Exposure

Objectives:

Students will:

- Develop a radiation web or model to show how radiation can contaminate the environment, animals and people.
- Examine the three main exposure pathways: inhalation, ingestion and direct (external) exposure; and basic radiation protection measures.

Next Generation Science Standards

The concepts in this activity can be used to support the following science standard:

- ESS3. Earth and Human Activity.

Materials and Resources

- Uranium: Teacher Background Information.
- Vocabulary Materials.
- Art supplies for students; for example, paper or poster board, magazines, colored pencils and markers (optional for Step 4).
- Materials to create a watershed (optional for Step 4). Search for materials and directions online using keywords (build a watershed or crumpled paper watershed) or visit Build Your Own Watershed: <https://www.epa.gov/ground-water-and-drinking-water/drinking-water-activities-kids-and-teachers>.

Time

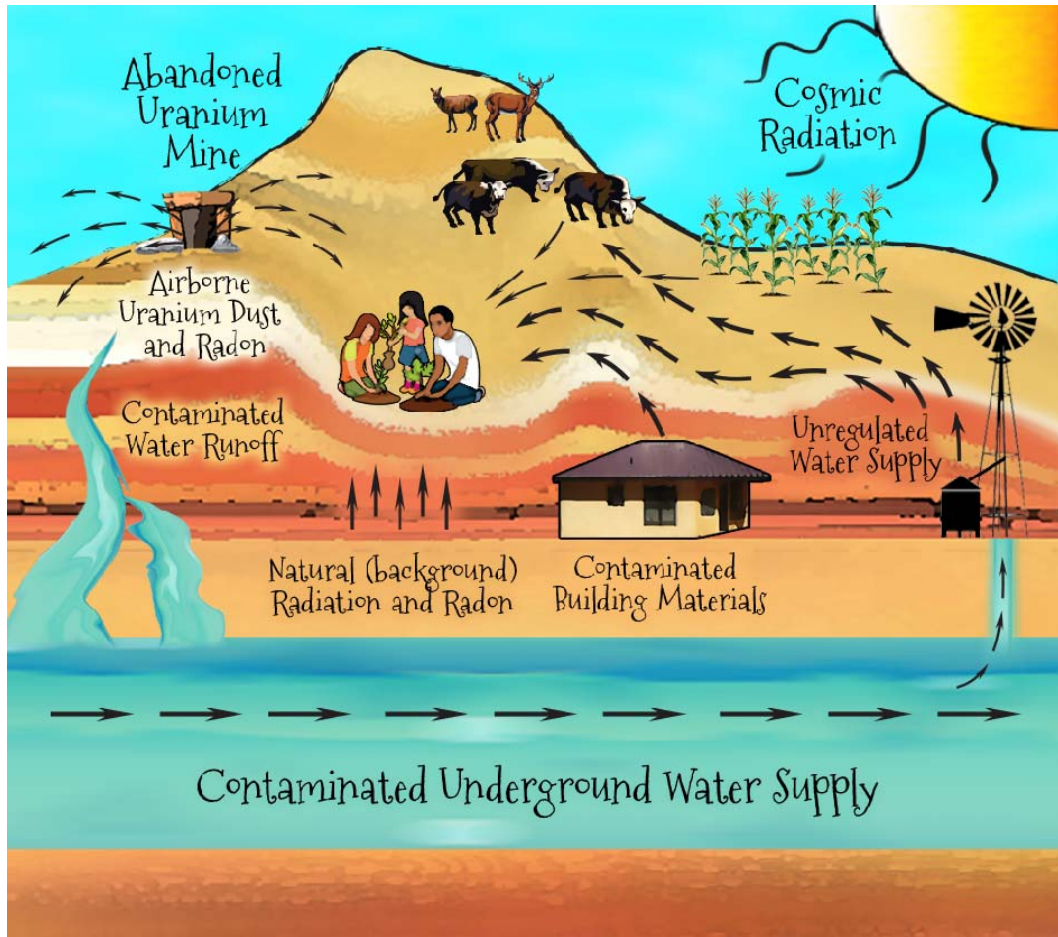
You may choose to have students complete the entire activity within one or two class periods. If time or computer access is limited, the activity can be introduced, completed outside of the class and concluded in another class period.

Vocabulary

- Direct exposure
- Exposure pathways
- Inhalation
- Ingestion
- Ionizing radiation
- Man-made radiation
- Natural (background) radiation
- Radioactive contamination
- Radon
- Uranium
- Uranium mining

Directions

1. Start with a vocabulary activity if students are not familiar with uranium and the vocabulary used in this activity.
2. Explain that natural (background) radiation is all around us and has been present since the birth of this planet. However, many Native American and Alaska Native communities have been further exposed to radiation as a result of man-made activities including uranium mining and milling and nuclear testing. In the mid-1940s, with the dawn of the nuclear age, hundreds of uranium mines and dozens of mills were established and significant nuclear testing took place. Once the uranium supply exceeded the demand in the 1970s, uranium mines and mills began to shut down. Nuclear testing continued until 1992. Some of these mining, milling and testing sites were abandoned and not properly cleaned up. As a result, some Native American and Alaska Native communities are deeply impacted by contaminated soil, air, water and materials that were left behind.
3. Ask students how we might be exposed to radiation in contaminated soil, air, water and materials. Confirm or explain that routes of radiation exposure include direct or external exposure, inhalation and ingestion. We cannot see radiation, but if we are aware of radiation sources (such as abandoned mines and equipment, mine tailings, high radon levels, and contaminated water, soil and building materials) we can apply three basic radiation protection concepts to reduce our exposure to radiation:
 - Limiting time near a radiation source.
 - Increasing the distance from a radiation source.
 - Shielding by placing material or a barrier between a person and a radiation source.
4. Direct students to list, model or draw possible routes or pathways of exposure (direct or external exposure, inhalation and/or ingestion) to radioactive materials for uranium mining, milling, nuclear testing or nuclear waste. Students can also identify radiation exposure pathways for natural radiation sources or accidents (e.g., transportation accident that releases radioactive materials into the environment or a nuclear reactor meltdown).
 - List ways in which people may be exposed to radiation according to the three main pathways: direct or external exposure, inhalation and ingestion.
 - Create a watershed model to simulate how radioactive soil can dissolve and contaminate a common body of water that can serve as drinking water for people and animals or be used for watering plant food sources. Students can use a spray bottle to represent rain. Students can also use their breath or a small fan to model how materials can be blown into the air or into water sources.
 - Diagram exposure routes or pathways in the form of radiation webs (similar to the example provided on the following page) using paper and art supplies or electronic software to create their diagrams.



Radiation Web Example

5. Conclude by asking students to respond to the following questions orally or in writing:
 - What exposure pathways had you not considered before this activity?
 - How can you prevent or reduce your exposure to radiation based on the exposure pathways (direct exposure, inhalation and ingestion)? **Possible answers: Time, distance and shielding are three basic radiation protection measures. Other actions include testing radon and radiation levels in homes or buildings, taking action if the levels are high, using water from regulated water sources, and avoiding abandoned mining areas.**
 - Did this activity change your perceptions of or fears about radiation exposure? Explain.

6. Optional activities or extensions: Have students:
 - Investigate the working conditions of uranium miners in the mid-1900s and the protection measures required in mining operations today, or examine the life of the Inupiat Eskimos living in Point Hope, Alaska and how they were impacted by Edward Teller's Project Chariot.
 - Examine the health effects and risks associated with their exposure (or potential exposure) to radiation.
 - Develop a play or skit about their experiences. Record and share the performance.



Activity 6: Radiation Cleanup and Advocacy

Objectives

Students will:

- Investigate how people and the environment have been impacted by radiation-related events.
- Examine what cleanup and advocacy efforts have been, or need to be, completed related to these events.
- Identify advocacy efforts that they or others can implement.

Next Generation Science Standards

The concepts in this activity can be used to support the following science standard:

- ESS3. Earth and Human Activity.

Materials and Resources

- Uranium: Teacher Background Information.
- Vocabulary Materials.
- Internet-accessible computer and projector or student computers with Internet access.
- Radiation Cleanup and Advocacy Worksheet (one per student, pair or group).

Time

You may choose to have students complete the entire activity within one or two class periods. If time or computer access is limited, the activity can be introduced, completed outside of the class and concluded in another class period.

Vocabulary

- Ionizing radiation
- Nuclear energy
- Radiation exposure
- Uranium
- Uranium mining
- Uranium milling

Directions

1. Start with a vocabulary activity if students are not familiar with uranium and the vocabulary used in this activity.
2. Explain that uranium was primarily mined for nuclear weapons development in the 1940s and for both nuclear weapons and energy production following World War II. Nuclear testing was also conducted and the safe disposal of radioactive waste has been a consideration with the mining, testing and use of radioactive materials.
3. Investigate one of the following topics as a class or have students research the following topics to learn about events that took place during the uranium boom, the impact it has left on the people and the environment, and advocacy efforts and/or programs that may be in place to clean up the affected areas. Events that have occurred locally can also be selected as well as national events from the Highlights in Uranium History timeline found in the Uranium: Teacher Background Information.
 - The Return of the Navajo Boy is a documentary is based on a brother being reunited with his family. The family uses the documentary to raise awareness and campaign for the cleanup of abandoned uranium mines. Students can view the documentary trailer, webisodes or information online (<http://www.navajoboy.com>).
 - The Firecracker Boys: H-Bombs, Inupiat Eskimos, and the Roots of the Environmental Movement is a book by Dan O'Neill. The book is based on Edward Teller (the father of the hydrogen bomb) and his plan to detonate nuclear bombs off the coast of Cape Thompson in Alaska. Related information can be found online by searching "Project Chariot."
 - Bikini Atoll in the Marshall Islands is where the U.S. conducted nuclear weapons testing between 1946 and 1958. Books and movies are available about the people of Bikini Atoll.
4. Provide students with the Radiation Cleanup and Advocacy Worksheet. Direct students to complete the worksheet based on the topic they researched or based on radiation-related issues that may exist within their community, state or tribal nation. If the latter, investigate potential local, regional or state issues in advance and help guide students to resources, including people (e.g., advocates, environmental and health officials or staff, and regional Environmental Protection Agency [EPA] staff) that they may use to answer the questions. Consider inviting a speaker(s) to share information about local, regional or state issues and actions. Note that the U.S. Department of Energy and EPA have programs to clean up radioactive waste. The EPA's Superfund program is part of the government's effort to clean up areas contaminated by hazardous waste.
5. Conclude by asking students to share what they or their community can do. Education and advocacy are needed to ensure the proper clean up of radioactive waste and to prevent future generations from experiencing the impacts of elevated radiation levels.
6. Optional activities or extensions:
 - Encourage students to put their ideas into action by developing an advocacy project or campaign. Advocacy ideas may include:
 - Those identified by students on the Radiation Cleanup and Advocacy Worksheet.
 - Writing letters to tribal leaders or Congress prompting action on a uranium-related issue in their community or region.
 - Creating an informational or call to advocacy video.

- Creating a social media campaign to raise awareness.
- Creating informative and educational posters that can be displayed at school and in the community.

Radiation Cleanup and Advocacy Worksheet

Name: _____

Date: _____

Research and answer the questions.

1. What problems or concerns exist related to radiation and radioactive waste?

2. What has been done to address the concerns?

3. What still needs to be done to address the concerns?

4. What can I, my community or other communities do to raise awareness and action?



Demolition and rebuilding of a contaminated home in the Navajo Nation.