



## Activity 3: Radiation Warning and Protection Equipment

### Objectives

Students will:

- Interpret the meaning of several radiation warning signs.
- Investigate how radiation protection technology and equipment are used to protect workers, the public and our environment.

### Next Generation Science Standards

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

- PS4. Waves and Electromagnetic Radiation.

### Common Core State Standards (CCSS)

The concepts in this activity align with the following CCSS English Language Arts Standards for Literacy in History/Social Studies, Science, & Technical Subjects:

- Comprehension and Collaboration: CCSS.ELA-LITERACY.SL.6-12.1
- Comprehension and Collaboration: CCSS.ELA-LITERACY.SL.6-8.2

### Materials and Resources

- *Radiation Protection: Teacher Background Information.*
- *Vocabulary Materials.*
- Computer and/or projector to display information/images and capture student comments.
- *Radiation Detection Equipment* images.
- *Radiation Symbols Worksheet* (one per student, pair or group) and teacher answer key.
- Student computers with Internet access and printers (if conducting research in class).

### Time

45-60 minutes, not including optional activities or extensions.

### Vocabulary

- Dosimeter
- Geiger counter
- Ionizing radiation
- Radiation
- Radiation exposure
- Radiation protection
- Radon

## Directions

1. Start with a vocabulary activity if students are not familiar with radiation and the terms used in this activity, or provide students with the terms and definitions.
2. Explain that radiation is energy that travels in the form of waves or high speed particles. Ask students how people might be able to detect whether radiation is present since it is not detectable with our senses.
3. Display the *Radiation Detection Equipment* images. Explain that these show a few devices that people can use to detect and monitor radiation levels. Ask students to hypothesize the purpose or uses of each piece of equipment.
  - **Ground and gamma scanners (top, left) monitor the clean up at contaminated sites such as radioactive waste sites or emergency response sites.**
  - **Radon test kits (center, left) measure radon levels in the home. At-home test kits include canisters, detectors, or devices that you can purchase in stores, by mail, phone or online. You leave them in your home for a recommended period and then send them to a laboratory for analysis. Professionals can also come to your home and measure the radon levels.**
  - **Dosimeters (bottom, left) are worn by people who work near radioactive sources or handle radioactive materials. People wear dosimeters to measure exposure to radiation so they stay within the legal exposure limits of their job. People who might wear these include astronauts, scientists, radiation protection workers, medical workers, x-ray technicians and nuclear power plant workers.**
  - **Air monitoring equipment (top, right) detects and monitors outdoor radiation levels. EPA's RadNet system monitors the nation's air, drinking water, precipitation, and pasteurized milk to determine levels of radiation in the environment.**
  - **Geiger counters (bottom, right) are hand-held devices that detect the presence of radiation. They are often used in the health physics, nuclear and geology fields.**
4. Ask students: How is the public warned about the presence of radiation? **Warning signs and radiation protection measures can alert and protect workers and the general public. Radiation warning signs may be found in workplaces, on packaging or transport vehicles, and on the sides of buildings. They often alert us to radiation sources and may direct us on how to limit or avoid exposure to radiation. We also depend on technology and protective equipment to help detect, monitor and limit our exposure to radiation.**
5. Provide students with a copy of the *Radiation Symbols Worksheet*. Direct them to answer the questions regarding the three symbols to the best of their knowledge – some students may be seeing these images for the first time.
6. Review students' responses using the *Radiation Symbols Teacher Answer Key*. You may also share the Radiation Warning Symbols information in the *Radiation Protection: Teacher Background Information* and have students confirm their responses or complete the worksheet. Students may want to share where they have seen these warning signs.

7. Ask students:
  - Based on the warning symbols or what you know about ionizing radiation, what are the three basic concepts of radiation protection? **Time, distance and shielding.**
  - How do these signs relate to the concepts of radiation protection?
    - **The international symbols of radiation prompt people to remain a safe distance from a radiation source and workers to follow the appropriate radiation protection standards (time, distance and shielding).**
    - **Hazardous materials (HAZMAT) symbols provide carriers with the necessary information they need to store radioactive materials safe distances away from people, animals and other materials and handle the materials in a safe manner. In the event of an accident, this symbol helps first responders quickly identify the materials so they can respond appropriately.**
    - **A fallout shelter indicates a location that offers shielding during a radiation emergency.**
6. Conclude by having students reflect and share one or more things they learned about radiation detection and protection.
7. Optional activities or extensions: Have students:
  - Research a radiation protection device and investigate its purpose, where and how it is used and any impacts it has on personal health and environmental protection.
  - Investigate the units of measurements calculated by the device (e.g., picocuries per liter (pCi/L) for measuring radon levels or counts per second (CPS) or counts per minute (CPM) for Geiger counter readings) and collect and graph data samples.
  - Summarize and share their findings in a verbal or online presentation (potentially including a demonstration, model or video of the device) similar to science shows and sites that describe how things work or how they are made.

# Radiation Detection Equipment



Ground and Gamma Scanners



Air Monitoring Equipment



Radon Test Kits

Source: National Institute of Environmental Health Sciences (top), Michigan Department of Environmental Quality (bottom)



Geiger Counters

Source: Oak Ridge Institute for Science and Education



Dosimeters

Source: Virginia Department of Health

# Radiation Symbols Worksheet

Name: \_\_\_\_\_

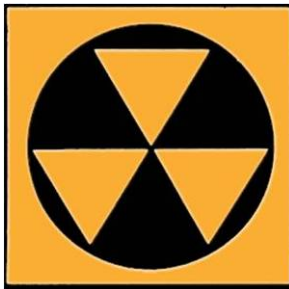
Date: \_\_\_\_\_

Answer the questions for each symbol.

1.



2.



3.

**These two symbols represent the same message.**

What do the symbols mean?

Where might you see either of them?

What actions might you or others need to take if you see either of these symbols?

What does the symbol mean?

Where might you see it?

What actions might you or others need to take if you see this symbol?

What does the symbol mean?

Where might you see it?

What actions might you or others need to take if you see this symbol?



# Radiation Symbols Teacher Answer Key

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Answer the questions for each symbol.

1.



What do the symbols mean? **Both symbols are meant to identify an ionizing radiation source and alert people of the potential dangers so they can take action to protect against radiation exposure. The first (yellow) is an international symbol of radiation. The United Nations introduced the new international radiation symbol (red) in 2007.**

Where might you see either of them? **Potentially around radioactive areas such as active or abandoned uranium mines and mills, nuclear test and radioactive waste sites, nuclear power plants, labs and medical sites.**

What actions might you or others need to take if you see either of these symbols? **Distance yourself from the area or take the appropriate precautions when entering the area such as wearing protective clothing, using shielding or limiting your time in the area.**

2.



What does the symbol mean? **There are radioactive materials present.**

Where might you see it? **On trucks or trains carrying radioactive materials or on packages containing radioactive materials.**

What actions might you or others need to take if you see this symbol? **Take precautions to package, transport and handle the materials with care.**

3.



What does the symbol mean? **It indicates the location of a fallout shelter.**

Where might you see it? **On a public building.**

What actions might you or others need to take if you see this symbol? **Going to that location in the event of a nuclear attack or large radiological disaster.**