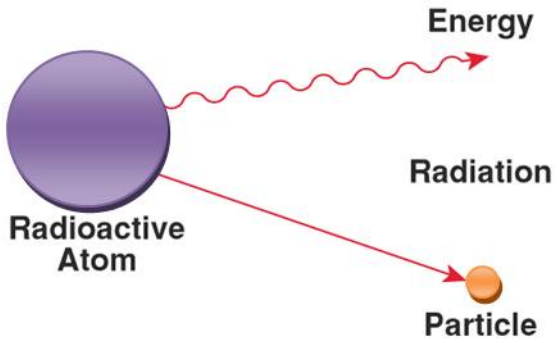
Radiation Protection: Teacher Background Information

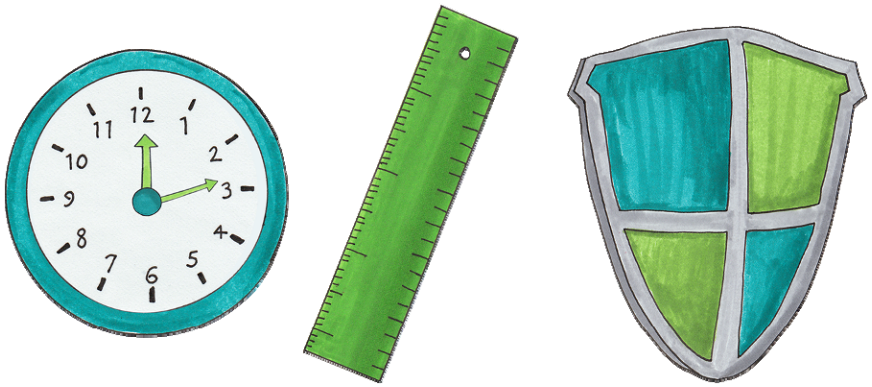
When radioactive atoms decay, they give off energy in the form of ionizing radiation (gamma rays, alpha particles or beta particles). The energy is called ionizing radiation because as this radiation moves through matter it has enough energy to knock tightly bound electrons from atoms. This causes the atom to become a charged ion. Radioactive atoms continue to decay (some for seconds or days, others for thousands of years) until they give off enough energy to become stable atoms and no longer emit ionizing radiation.



If ionizing radiation is absorbed by the body, the effects can potentially damage living cells and the DNA of these cells. Our bodies can handle some degree of exposure to ionizing radiation and still repair damaged cells. This is because humans have evolved in the presence of radiation. The effects of ionizing radiation may vary from person to person based on the total amount of energy absorbed, the time period and dose rate of the exposure, and the particular organs exposed. Dose refers to the quantity of energy absorbed by a person exposed to radiation and in the United States it is measured in millirem (mrem) or rem (Roentgen Equivalent Man). A person's risk generally increases with the amount of exposure.

Time, Distance and Shielding

People may be exposed to an increased radiation dose in certain situations (for example, when receiving a medical radiation treatment or during a radiological emergency). The concepts of time, distance and shielding are used to help limit radiation exposure. These radiation protection concepts can be applied separately or in combination. For example, people who work with radioactive materials may have time limits on how long they can be near a source which are set according to the exposure risk and shielding requirements such as wearing protective clothing or working behind a barrier.

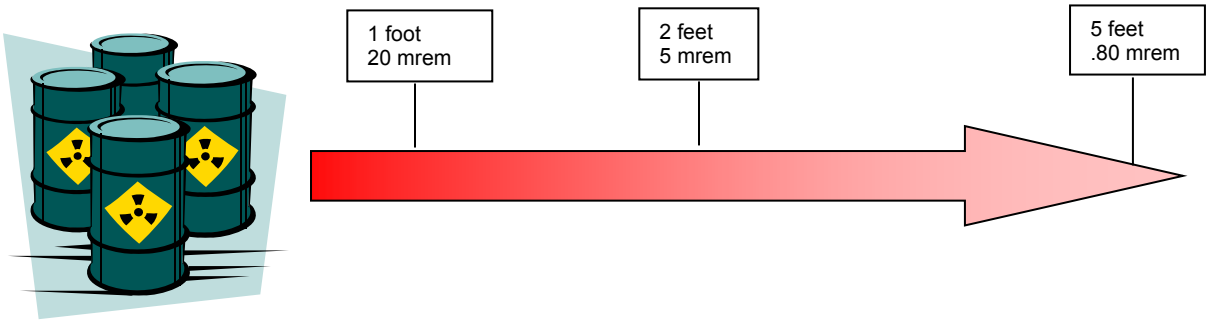


Time

The dose of radiation you receive depends on how long you are near a radiation source. Setting time limits helps keep the time spent near a source of radiation as short as possible. For example, a worker may only be allowed to work around radioactive materials for 4 to 6 hours of an 8-hour shift.

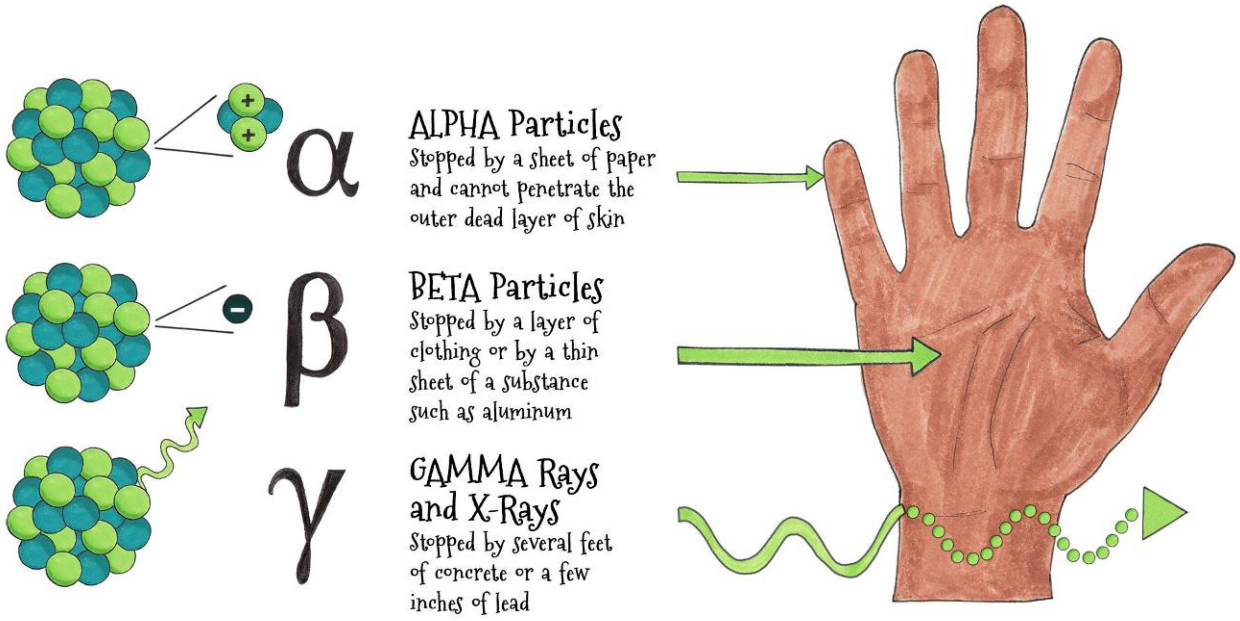
Distance

The radiation dose you receive strongly depends on how close you are to a radioactive source. For example, barrels of radioactive waste might emit or give off a dose of 20 millirem (mrem) per hour at a distance of 1 foot from the surface. At 5 feet away, the dose rate would be less than 1 mrem per hour. As you distance yourself from the radiation source, you increase the likelihood that some radiation will lose its energy. As a rule, as you double the distance from the radiation source, you reduce the exposure by a factor of four. Conversely, decreasing the distance by half increases the exposure by a factor of four.



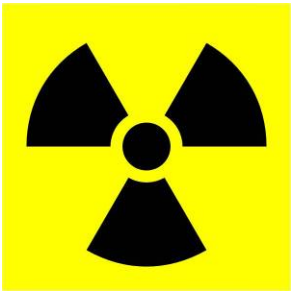
Shielding

Placing some material or a barrier, called shielding, between a person and a radiation source is another way to minimize the amount of radiation exposure. The image below shows the penetrating power of ionizing radiation (far right) and potential methods of shielding against alpha particles, beta particles, gamma rays and x-rays (center).



Radiation Warning Symbols

The international symbol of radiation, called a "tri-foil," or "trefoil," is used to identify areas restricted because of the presence of radiation. This symbol is displayed where radioactive materials are handled or where radiation-producing equipment is used. The tri-foil symbol is often displayed with a message about the nature of the radiation hazard so authorized people can take the appropriate radiation protection precautions before entering the restricted area.



International tri-foil, or trefoil, symbol of radiation

Believing the symbol was not intuitive, the United Nations introduced a new international radiation symbol in 2007. 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 new international symbol indicates to the public the importance of moving away from the source.

United Nations symbol of radiation

The hazardous materials, or HAZMAT, placard for radioactive materials must be displayed on packages, cargo units and transport vehicles when radioactive materials are transported by road, air, rail or water. Carriers are responsible for handling and storing these materials properly to prevent the release of radioactive materials. If an accident should occur during transport, the radioactive placard identifies the radiation source. First responders can use this information to assess and respond to the situation appropriately.

Hazardous materials, HAZMAT, placard

The fallout shelter sign is displayed on the outside of some buildings (e.g., schools or other public buildings) so the public can locate them in the event of an emergency. The symbol may also be displayed inside buildings to mark access routes to the shelter area.

Individuals and communities began thinking about fallout shelters in the late 1940s and early 1950s. In the early 1960s fallout shelters became part of a comprehensive Defense Civil Preparedness Agency (DCPA) program created to prepare U.S. citizens in the event of a nuclear attack.

Fallout shelter sign

In 1979, the Federal Emergency Management Agency (FEMA) took over the DCPA responsibilities. FEMA is still involved in disaster and emergency response along with state and local governments and other federal agencies, including the Environmental Protection Agency (EPA).

Additional Resources

- RadTown USA: www3.epa.gov/radtown
- Protecting Yourself from Radiation: http://www2.epa.gov/radiation/protecting-yourself-radiation
- Radiation: Facts, Risks and Realities: http://www2.epa.gov/sites/production/files/2015-05/documents/402-k-10-008.pdf