

This fact sheet answers the most frequently asked health questions (FAQs) about ionizing radiation. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this material may harm you. The effects of exposure to any hazardous material depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other radioactive materials are present.

**HIGHLIGHTS:** Ionizing radiation, like heat and light, is a form of energy. It includes particles and rays given off by radioactive material, stars, and high-voltage equipment. Most of it occurs naturally and some is produced by human activities. At very high doses, ionizing radiation can cause illness or death. Any dose could possibly cause cancer, after a several-year delay. It is not known how many of the 1,517 National Priorities List sites identified by the Environmental Protection Agency give off ionizing radiation above background levels.

## What is ionizing radiation?

(Pronounced ī'ə-nīz'īng rā'dē-ā'shən)

Ionizing radiation is any one of several types of particles and rays given off by radioactive material, high-voltage equipment, nuclear reactions, and stars. The types that are normally important to your health are alpha particles, beta particles, x rays, and gamma rays.

Alpha and beta particles are small, fast-moving bits of atoms that a radioactive atom gives off when it changes into another substance. X rays and gamma rays are types of electromagnetic radiation. These radiation particles and rays carry enough energy to knock out electrons from atoms and molecules (such as water, protein, and DNA) that they hit or pass near. This process is called ionization, which is why this radiation is called "ionizing radiation."

## What happens to ionizing radiation when it enters the environment?

Ionizing radiation, which travels as fast as the speed of light, hits atoms and molecules in its path and loses some of its energy with each hit. When all the energy is gone, there is essentially nothing left. Ionizing radiation does not make you radioactive - it just leaves some of its energy inside you or whatever else it hits.

When ionizing radiation from outer space hits the upper

atmosphere, it produces a shower of cosmic rays that constantly expose everything on earth. Some hit gases in the air and change them into radioactive material (such as tritium and carbon 14). Other radioactive materials are naturally part of the environment, such as the uranium that has been here since the earth was formed. Still other radioactive materials are made by industry for smoke detectors, medical tests, and other uses. These radioactive materials give off their ionizing radiation over time until all of the radioactive atoms have decayed.

Whenever radioactive material enters the environment, it behaves like other substances, getting into the air, water, soil, plants, and animals, while also giving off radiation.

Some ionizing radiation is made on demand, such as when doctors take x rays.

## How might I be exposed to ionizing radiation?

You are exposed to low levels of ionizing radiation from the sun, rocks, soil, natural sources in your body, fallout from past nuclear weapons tests, some consumer products, and radioactive materials released from hospitals and from nuclear and coal power plants.

You are exposed to more if you work as a pilot, flight attendant, astronaut, industrial and nuclear power plant worker, or x ray or medical personnel.

You receive additional exposure with each x ray exam and

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nuclear medicine test, and the amount depends on the type and number of tests.

### **How can ionizing radiation affect my health?**

Exposure to low levels of ionizing radiation from the environment has not been shown to affect human health. Exposure to high doses of ionizing radiation can result in skin burns, hair loss, nausea, birth defects, illness, and death. How you are affected depends on how much ionizing radiation you received and over what period of time, and personal factors such as sex, age at the time of exposure, and your health and nutritional status. Increasing the dose results in a more severe effect. Increased psychological stress has been shown in large populations exposed to small doses of radiation from nuclear accidents. Mental function has been affected in people exposed before birth to high doses of ionizing radiation.

### **How likely is ionizing radiation to cause cancer?**

Exposure to ionizing radiation may increase your chance of getting cancer. As with other health effects, how likely you are to get cancer depends on how much ionizing radiation you received, your age when exposed, and the type of cancer.

### **How can ionizing radiation affect children?**

Like adults, children are exposed to small amounts of ionizing radiation that comes from the soil where they live, the food and water they eat and drink, the air they breathe, and from sources that reach earth from space. There is no evidence that exposure to normal background levels of ionizing radiation causes health effects in children or adults.

If a pregnant woman is exposed to high levels of ionizing radiation, it is possible that her child may be born with some brain abnormalities. There is an 8-week period during early pregnancy when an unborn child is especially sensitive to the effects of higher-than-normal levels of ionizing radiation. As the levels of ionizing radiation increase, so does the chance of brain abnormalities.

### **How can families reduce the risk of exposure to ionizing radiation?**

When you or your children receive an x ray, be sure to correctly wear the protective garments that are provided. The technician will make sure that only the area that needs to be x rayed will be exposed to the x ray beam. If you or your children are treated with a chemical that has some amount of radioactive material in it to help a doctor diagnose or treat a disease, be sure to follow the doctor's directions after you have been treated.

### **Is there a medical test to show whether I've been exposed to ionizing radiation?**

There are different kinds of tests to see if you have been exposed to very high doses of ionizing radiation. One test examines changes in blood cell counts, but only exposure to high levels of ionizing radiation will produce detectable changes in blood cell counts. Another test studies your chromosomes. This test is useful for doses several times the maximum permissible dose for radiation workers.

There are many ways to see if you have radioactive material in your body. Radioactive material can be measured in your blood, feces, saliva, urine, and your entire body by specialized instruments. The instrument is chosen based on the type of radiation that is to be measured. These tests are not available at your doctor's office.

### **Has the federal government made recommendations to protect human health?**

The EPA limits the dose from radionuclides released to the air to 0.1 millirems (mrem)/year. The EPA has set a drinking water standard for radionuclides of 4 mrem/year for man-made sources of beta emitters.

The current federal and state regulations limit workers' doses to 5 rem/year; the limit for an unborn child of a female radiation worker is 0.5 rem/year; the limit for the general public is 0.1 rem/year, with provisions for a limit of 0.5 rem/year under special circumstances.

### **References**

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for ionizing radiation. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

**Where can I get more information?** For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html> ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

