Ionizing Radiation

FACT SHEET 26-010-1116

What is ionizing radiation?

Ionizing radiation is a type of energy released by radioactive atoms or produced by certain machines. The energy is in the form of electromagnetic waves (gamma or x-rays) or particles (alpha, beta, or neutrons). In general, human senses cannot detect ionizing radiation. Alpha particles are the heaviest and can be stopped by air, clothing, or the outer layer of our skin. Beta particles are much lighter than alpha particles and require more material to be stopped. Typically, neutrons, gamma, and x rays require different thicknesses of specific shielding material to be blocked.

Ionizing radiation has many beneficial applications, including uses in medicine, industry, and research. From the CT scan to look for brain injury, to the smoke detector in homes, radiation can be helpful. However, we can experience acute health effects if exposed to very high doses of ionizing radiation during a short period of time or chronic health effects if exposed to doses of ionizing radiation over the course of many years. This factsheet provides information about the sources of ionizing radiation, average radiation exposures, and potential health effects of exposure.

Where is ionizing radiation present?

Radiation is everywhere. Since the Earth was formed and life developed, all life on earth has been and is exposed to radiation. Radiation exposure comes from two sources: natural and human-made. Natural radiation comes from the soil, rocks, and the atmosphere as a result of radiation from outer space. Small amounts of radioactive material can be found in the ground, the air we breathe, the water we drink, and the food we eat. Human-made sources are those things that would not exist without people, such as some consumer products (e.g., tritium exit signs, welding rods containing thorium, smoke detectors) and medical devices like x-ray machines.

How much radiation am I exposed to?

On average in the U.S. we are exposed to 6.2 millisievert (mSv) per year (the millisievert is a unit of measure for radiation energy absorbed in humans). We receive about half of that average from natural sources, and for many of us the natural radiation dose is most of what we get in a year. Most of the natural radiation dose in the U.S. is from radon in the home. The table below shows the breakdown of the average annual radiation exposure in the U.S. It is important to keep in mind that your individual exposure will be different based on factors, such as lifestyle, geographic location, and whether you have had medical procedures that use radiation. You can get your own estimate of your radiation dose here: http://www.nrc.gov/about-nrc/radiation/around-us/calculator.html.

What are the biological effects of radiation?

We tend to think of biological effects of radiation in terms of their effect on living cells. For low levels of radiation exposure, the biological effects, if any, are so small they may not be detected. The human body is capable of repairing damage caused by radiation. There are three biological effects of radiation on living cells: cells will repair themselves with no residual damage; cells will die and be replaced by the body; or cells will incorrectly repair themselves resulting in biophysical change.

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Average Yearly Radiation Doses for the U.S. Population			
	Source	**Average Yearly Dose (mSv)**	
Natural:	Radon inhalation, other inhalation, and ingestion	2.57	Sub-total
	Terrestrial	0.21	3.11
	Cosmic	0.33	
Human-Made:	Medical	3.00	Sub-total
	Consumer products	0.13	3.14
	Occupational and others	0.008	
	Total:	6.2	
Source: NCRP Report No. 160 - Ionizing Radiation Exposure of the Population of the United States (2009)			

Chronic effects: Although radiation may cause cancer at high doses and high dose rates, currently there are no data to establish the occurrence of cancer when exposed to low doses or low dose rates (below 100 mSv). Even so, in an abundance of caution, the radiation protection community assumes that any amount of radiation exposure may pose some risk for causing cancer or a hereditary effect, and also assumes that the probability of these risks increases as exposure increases. These low doses (<100 mSv), spread out over long periods of time might not have any observable effects.

If an effect does occur, the most likely result of radiation exposure is cancer, and it will manifest 5–20 years after exposure. The relationship between cancer and radiation is complicated since radiation affects people in different ways and the cancer caused by radiation is indistinguishable from any other cancer. Associations between radiation exposure and cancer are mostly based on populations exposed to relatively high levels of ionizing radiation, such as Japanese atomic bomb survivors. High-dose exposure, 500 mSv or greater, is associated with leukemia, multiple myeloma, breast, bladder, colon, liver, lung, esophagus, ovarian, and stomach cancers.

Acute effects: High doses of radiation can kill so many cells that tissues and organs are damaged immediately. This can result in a rapid body response called Acute Radiation Syndrome, which can lead to severe illness or death. The outcome depends on many factors including the individual's health prior to the exposure and the quality and timeliness of medical care received. Unfortunately it is impossible to predict an exact radiation dose which would be considered fatal. It is believed that 50 percent of a population would die within 60 days after receiving a dose of 3500 to 5000 mSv to the whole body over a period of time ranging from a few seconds to a few hours.

How does the U.S. Army protect us from potential radiation health effects?
The profession of radiation safety / protection is called health physics. In the Army, Nuclear Medical Science Officers (72A), Health Physics Specialists (68S N4), and Army Civilian health physicists (GS 1306) perform this mission. The Army radiation protection community preserves the health and safety of people and the environment while allowing for beneficial and mission-critical uses of radiation.

Where can I get more information?
If you have any concerns about your health, you should speak with your health care provider. If indicated, your provider can refer you to a specialist for concerns related to radiation exposure. Here are more sources of information.

- RadTown USA: http://www.epa.gov/radtown/enter-radtown.html
- U.S. Nuclear Regulatory Commission,: http://www.nrc.gov/about-nrc/radiation.html
- Centers for Disease Control and Prevention,: http://www.cdc.gov/NCEH/radiation/default.htm
- Radiation Answers: http://www.radiationanswers.org