Estimate Your Personal Radiation Dose

We live in radioactive world - humans always have. Radiation is part of our natural environment. We are exposed to radiation from materials in the earth itself, from naturally occurring radon in the air, from outer space, and from inside our own bodies (as a result of the food and water we consume). This radiation is measured in units called millirems (mrems). The average dose per person from all sources is *about* 360 mrems per year. It is not, however, uncommon for any of us to receive far more than that in a given year (largely due to medical procedures we may undergo). International Standards allow exposure to as much as 5,000 mrems a year for those who work with and around radioactive material.

Factors	Common Sources of Radiation	Your Annual Dose (mrems)
Where you live	**Cosmic radiation** (from outer space) Exposure depends on your elevation (how much air is above you to block radiation). Amounts are listed in mrem (per year). At sea level.....26 mrem 4-5000 ft.....47 mrem 0 - 1000 ft.....28 5-6000 ft.....52 1-2000 ft.....31 6-7000 ft.....66 2-3000 ft.....35 7-8000 ft.....79 3-4000 ft.....41 8-9000 ft.....96 [Elevation of cities (in feet): Atlanta 1050; Chicago 595; Dallas 435; Denver 5280; Las Vegas 2000; Minneapolis 815; Pittsburgh 1200; St. Louis 455; Salt Lake City 4400; Spokane 1890.]	_____ mrem
	Terrestrial (from the ground) If you live in a state that borders the Gulf or Atlantic Coasts, add16 mrem If you live in the Colorado Plateau area (around Denver), add 63 mrem If you live anywhere else in the continental US, add 30 mrem.	_____ mrem
	House Construction If you live in a stone, adobe, brick or concrete building, add 7mrem	_____ mrem
	Power Plants If you live within 50 miles of a nuclear power plant, add 0.01 mrem If you live within 50 miles of a coal-fired power plant, add 0.03 mrem	_____ mrem
Food Water Air	**Internal Radiation***** From food (Carbon-14 and Potassium-40) & from water (radon dissolved in water) From air (radon)	40 mrem 200 mrem
How You Live	Weapons test fallout (less than 1)*.....1mrem Jet Plane Travel.....0.5 mrem per hour in the air If you have porcelain crowns or false teeth**.....0.07 mrem If you wear a luminous wristwatch.....0.06 mrem If you go through luggage inspection at airport.....0.002 mrem If you watch TV*.....1 mrem If you use video display terminal (computer screen)* .....1 mrem If you have a smoke detector.....0.008 mrem If you use a gas camping lantern.....0.2 mrem If you wear a plutonium-powered pacemaker.....100 mrem	1 mrem _____ mrem _____ mrem _____ mrem _____ mrem _____ mrem _____ mrem _____ mrem _____ mrem _____ mrem
Medical Tests	**Medical Diagnostic Tests – Number of *millirems per procedure*** X-Rays: Extremity (arm, hand, foot, or leg).....1 Dental.....1 Chest.....6 pelvis/hip .....65 Skull/neck..... 20 Barium enema.....405 Upper GI.....245 CAT Scan (head and body).....110 Nuclear Medicine (e.g., thyroid scan).....14	_____ mrem
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* The value is less than 1, but adding a value of 1 would be reasonable.

** Some of the radiation sources listed in this chart result in an exposure to only part of the body. For example, false teeth or crowns result in a radiation dose to the mouth. The annual dose numbers given here represent the "effective dose" to the whole body.

*** Average values.

Primary sources for this information are National Council on Radiation Protection and Measurements Reports. #92 Public Radiation Exposure from Nuclear Power Generation in the United States (1987), #93 Ionizing Radiation Exposure of the Population of the United States (1987); #94 Exposure of the Population in the United States and Canada from Natural Background Radiation (1987); #95 Radiation Exposure of the U.S. population from Consumer Products and Miscellaneous Sources, (1987); and #100 Exposure of the U.S Population from Diagnostic Medical Radiation (1989)

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Teacher Key

Classroom Activity
based on worksheet titled,
"Estimate Your Personal Radiation Dose"

Objectives: *Build student's ability to read and interpret information on the worksheet.*
Develop understanding of natural background radiation vs. man-made radiation.
Facilitate discussion of how we assess what is acceptable radiation exposure.

Comparing the Effects of Where you Live and How You Live

As you review answers to these questions and discuss the worksheet (Estimate Your Personal Radiation Dose), point out to students that:

- *natural background radiation exists wherever you live*
- *the amount of natural background radiation varies from place to place (see the worksheet for examples)*
- *radiation comes from man-made sources, too (TV, false teeth, smoke detectors, etc.); most exposures from these sources are smaller than what people get from natural background radiation*
- *medical diagnostic procedures are the largest single source of man-made radiation to which most people are ever exposed*

1. A family moves from a wood-frame home in Dallas to a brick home in Denver. How will this change affect each person's annual radiation dose?

   Dallas (cosmic 28, terrestrial 16, frame home 0 = 44)
   Denver (cosmic 52, terrestrial 63, brick house 7 = 122)
   Moving to Denver results in an annual radiation dose increase of 78 mrem.

2. Lucinda moves from a wood-frame home in Chicago to a wood frame home in Dallas. How does her annual radiation dose change?

   Chicago (cosmic 28, terrestrial 30 = 58)
   Dallas (cosmic 28, terrestrial 16 = 44)
   Moving to Dallas reduces his annual radiation dose by 14 mrem.

3. John likes to watch TV, play video games on his computer, and go camping (where he uses a gas lantern). After realizing that these activities expose him to radiation, he gives up all three. How much has he reduced his annual radiation dose?

   (TV +1, video display terminal +1, gas lantern +0.2 = 2.2 mrem)

   How does this compare to the average annual dose?

   (It is only a fraction of the average annual dose. Remember the average annual dose for most people in the U.S. is about 360 mrem, so this is about 2/360 = 1/180 th of the average annual dose OR ***less than*** *1% of the average.)*

4. Sam lives in a suburb of a large city. His house is 55 miles from a nuclear power plant and 20 miles from a coal-fired electrical plant. His family buys a new house in another suburb on the other side of the same city. It is 20 miles from a nuclear plant and 60 miles from a coal-fired electric plant. What is the change in his annual radiation exposure?

   First house (coal plant +0.03) Second house (nuclear plant +0.01)
   His annual exposure is REDUCED by 0.02 mrem.

   Do you think this is a significant amount?

   (Answers will vary. Remind students that the average annual dose for most people in the U.S. is about 360 mrem. The change is much less than 1 mrem, so the change is ***less than*** *1/360th of the average. It is actually, 0.02 mrem/360 mrem = 0.0056%)*

5. Mary and her mother were in a serious automobile accident that resulted in broken bones and internal injuries. Mary's mother had a neck x-ray, a CAT scan, and an x-ray of her pelvis. A week later doctors needed to conduct an x-ray of her upper GI tract. How much radiation did Mary's mother receive from medical tests, as a result of the accident?

   Neck 20, CAT scan 110, pelvis 65, upper GI 245 = 440 mrem

   How did this radiation compare to her average annual dose?

   (The radiation from medical exams accounted for more than the average annual dose, which is about 360 mrem.)

   Why is this acceptable?

   Answers may vary. Several points are worth noting: (1) the benefits obtained from the medical diagnostics may outweigh the perceived risk, (2) people who work with or around radioactive material are allowed up to 5,000 mrems per year according to accepted standards, (3) some people who have been seriously injured or ill have required many x-rays, been exposed to fairly large quantities of radiation, and still lived long lives.

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	If you wear a luminous wristwatch.....0.06 mrem	_____ mrem
	If you go through luggage inspection at airport.....0.002 mrem	_____ mrem
	If you watch TV*.....1 mrem	_____ mrem
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	If you have a smoke detector.....0.008 mrem	_____ mrem
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