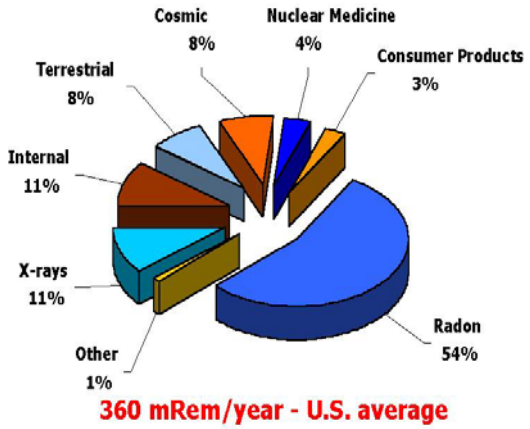
Background Radiation and Lifestyles



As we go about our daily lives, we are constantly surrounded by naturally-occurring sources of radiation. The accumulation of this radiation dosage every day throughout our lives leads to our total lifetime dosage. Depending on where we live, and our lifestyles, this lifetime dosage can make us susceptible to various forms of cancers. Generally, the lower your lifetime dose, the lower your risk for cancer.

In the following activity, you will calculate the total lifetime dosages (in Rems) for a person living in several different geographic locations with a variety of lifestyles.

1. Nancy was born in Denver where the cosmic rays (GCR) produce 120 milliRem/year and an additional 105 milliRem/year comes from the ground (Terr.). After 30 years, she moves to Baton Rouge, Louisiana where GCR = 35 milliRem/year and Terr. = 40 milliRem/year. At both locations, she buys the same kind of house and she receives 100 milliRem/year from radon gas in the basement. Assuming all other lifestyle sources contribute 50 milliRem/year during her entire life, and that she is now 65 years old, what has been her total radiation dosage to date in Rem?

2. Suppose that Nancy was also a cigarette smoker since she was 16 years old, but that she gave up smoking when she turned 52. How much additional lifetime radiation dosage in Rems did she receive from this habit during the time she lived in Denver and Baton Rouge if her one-pack-a-day habit exposed her to 15 milliRem/year?

3. Suppose that Nancy was also an airline pilot since she was 27 years old. She has been smoking since age 16. She flys 900 hours each year, with 90% of this time spent at cruising altitudes (35,000 feet) where the cosmic radiation dosage is 5 microSeiverts per hour. If 1 Seivert = 100 Rems, how much additional radiation has she received than in your answer to Question 2?

4. Suppose that after 30 years, instead of moving to Baton Rouge, Nancy moved from Denver to Kerala, India where the terrestrial radiation dosage (Terr.) is 380 milliRem/year, but gives up smoking. What will be her total dosage by age 65?

5. Instead of being an airline pilot, at age 35 she decides to become a non-smoking astronaut. From Denver, she moved to Baton Rouge for 5 years, and then finds a home in Houston near the NASA Johnson Spaceflight Center, which is the hub of manned spaceflight activities. At this location, GCR = 45 milliRem/year and Terr. = 30 milliRem/year. At age 39 she becomes the co-pilot for the Space Shuttle Atlantis on a 13-day trip, during which time her radiation dosage is 19 milliRem/day. If she takes three of these trips before age 65, what is her total dosage?

Answer Key:

1. Nancy was born in Denver where the cosmic rays (GCR) produce 120 milliRem/year and an additional 105 milliRem/year comes from the ground (Terr.). After 30 years, she moves to Baton Rouge, Louisiana where GCR = 35 milliRem/year and Terr. = 40 milliRem/year. At both locations, she buys the same kind of house and she receives 100 milliRem/year from radon gas in the basement. Assuming all other lifestyle sources contribute 50 milliRem/year during her entire life, and that she is now 65 years old, what has been her total radiation dosage to date in Rem?

Denver; (120 + 105 + 100 + 50)millirem/year x 30 years x 1 Rem/1000 milliRems = 11.25 Rem
Baton Rouge: (35 + 40 + 100 + 50) millirem/year x (65-30) years x 1 Rem/1000 milliRems = 7.88 Rem

Total = 11.25 Rems + 7.88 Rems = 19.1 Rems.

2. Suppose that Nancy was a cigarette smoker since she was 16 years old, but that she gave up smoking when she turned 52. How much additional lifetime radiation dosage in Rems did she receive from this habit during the time she lived in Denver and Baton Rouge if her one-pack-a-day habit exposed her to 15 milliRem/year?

Smoking = 15 milliRem/year x (52-16) years x 1.0 Rem / 1000 milliRems = 0.5 Rem
Geographic = 19.1 Rem
Total = 19.1 Rems + 0.5 Rems= 19.6 Rems

3. Suppose that Nancy was also an airline pilot since she was 27 years old, and retired at 45. She has been smoking since age 16. She flys 900 hours each year, with 90% of this time spent at cruising altitudes (35,000 feet) where the cosmic radiation dosage is 5 microSeiverts per hour. If 1 Seivert = 100 Rems, how much additional radiation has she received than in your answer to Question 2?

900 hours/year x (45-27) x 0.90 = 14,580 hours.
5 microSeiverts/hour x 100 Rems/1 Seivert = 500 microRems/hour
500 microRems/hour x 14,580 hours x 1 Rem/1000000microRem = 7.3 Rems
Total = 19.6 Rems + 7.3 Rems = 26.9 Rems

4. Suppose that after 30 years, instead of moving to Baron Rouge, Nancy moved from Denver to Kerala, India where the terrestrial radiation dosage (Terr.) is 380 milliRem/year, but gives up smoking. What will be her total dosage by age 65?

Denver = 11.3 Rems
Kerala = 380 milliRems/year x (65-30) years x 1.0 Rem/1000 milliRems = 13.3 Rems
Total = 11.3 Rems + 13.3 Rems = 24.6 Rems

5. Instead of being an airline pilot, at age 35 she decides to become a non-smoking astronaut. After 30 years in Denver, she moves to Baton Rouge for 5 years, then finds a home in Houston. At this location, GCR = 40 milliRem/year and Terr. = 30 milliRem/year. At age 39 she becomes the co-pilot for the Space Shuttle Atlantis on a 13-day trip, during which time her radiation dosage is 19 milliRem/day. If she takes three of these trips before age 65, what is her total dosage?

Denver: 11.3 Rems
Baton Rouge: 225 millirem/year x (35-30) years x 1 Rem/1000 milliRems = 1.1 Rem
Houston: 220 millirem/year x (65-35) years x 1 Rem/1000 milliRems = 6.6 Rem
Shuttle Flights: 3 x 13 days x 19 milliRem/day = 0.7 Rems
Total = 11.3 Rems + 1.1 Rems + 6.6 Rems + 0.7 Rems = 19.7 Rems