Biological Effects of Radiation

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Survey: How scared of radiation are you?

Living 40 yrs at Pickering boundary would result in:

- 1. No bad health effects
- 2. Small chance of bad health effect
- 3. Fairly good chance of bad effect
- 4. Almost definite bad health effect

Purpose

By the end of the lecture you will understand:

- units used to measure radiation
- natural radioactivity
- biological effects of radiation
- signifigance of radiation from various sources
- controversy about radiation

Terrestrial radioactivity

Everything is radioactive

- All rocks and soils on earth contain radioactivity
- K-40, U-238, Th-232
- Major driving force of earth
- Radioactivity enters plants and humans

Internal Radioactivity

that inner glow

- Radioactivity is inside every human
- K-40 is most important; 4500 Bq
- C-14; 3900 Bq

Cosmogenic radioactivity

Radiation from the stars

- Sun sends out solar wind
- Protons, alphas, some heavier elements, etc.
- Create H-3, Be-7, Na-22, and C-14
- C-14 is absorbed by living tissue
- Radiation increases with altitude
- Cause of northern lights

Macro conclusion:

Radiation in reasonable doses is NOT harmful

- Variations in location, altitude have not caused bad effects
- The existence of the mosquito
- Oceans have much less radioactivity

Biological Effects

The chemistry

- Radiation deposits energy in tissue
- --> ions form
- --> chemical reactions
- --> biological effects

Biological effects (continued ....)

The bottom line

- Cancer from damaging DNA
- Hereditary effects
- Damaging a cell is worse than killing it
- Rapidly dividing cells most susceptible
- Thousands of other chemicals cause same effects

Biological effects (continued ...)

Some jargon

- Dose:
- acute and chronic

- Effect
- somatic and genetic

How is radiation measured?

Units of Dose

- Becquerel = no. of disintegrations per second
- Gray = Energy (joules) absorbed per kilogram
- Sievert = Gray * Quality Factor
- Q = 1 gamma & beta
- Q = 3 to 10 neutrons
- Q = 10 to 20 alpha
- Whole body dose
- Old units

Background Radiation

Average annual dose in Canada (mSv)

• Cosmic rays	0.3	11%
• Terrestrial gamma rays	0.35	13%
• Internal sources	0.35	13%
• Radon	1.0	38%
• Medical diagnoses	0.6	23%
• All other	0.02	0.8%

Total 2.62 mSv

The bottom line

So what does it all mean?

- Low doses difficult; use epidemiology
- UNSCEAR, USNCRP, BEIR --> effects less than linear
- TMI (1985) data
- Ontario Hydro workers study
- Japanese survivors
- China (3x), India (4x), Colorado, etc.
- How anti-nuclears use linear hypothesis