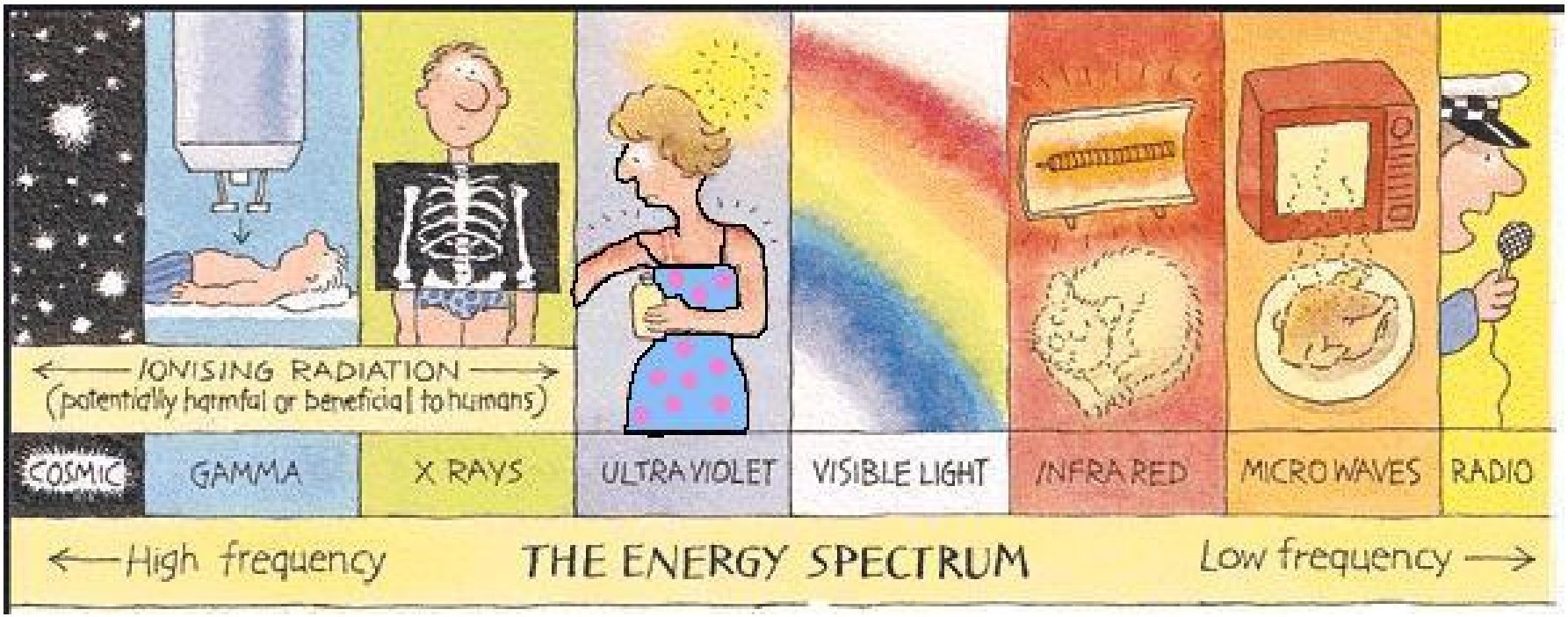
What comes to mind when one thinks about radiation?

Radiation is Energy

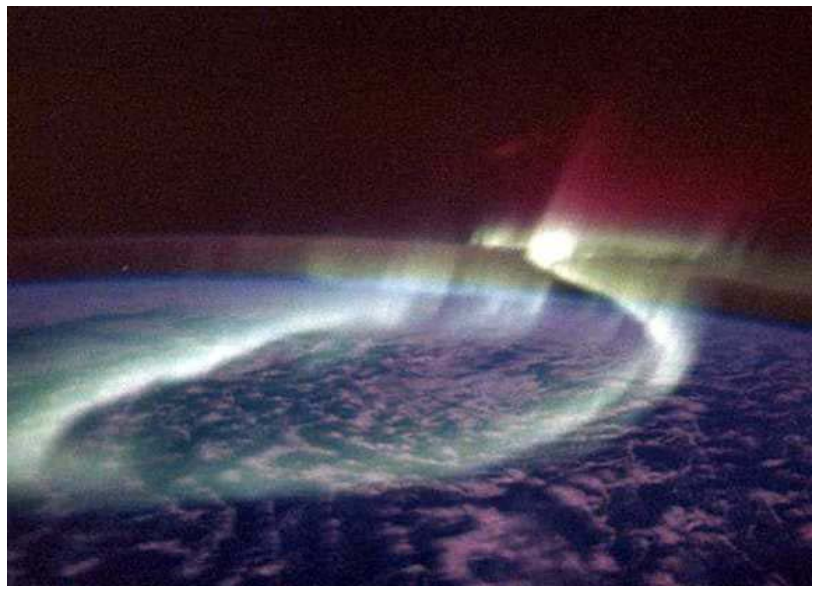
- **The energy is given off by unstable (radioactive) atoms and some machines.**



- **For this talk, we will be focusing on <u>ionizing radiation</u> and its health effects.**

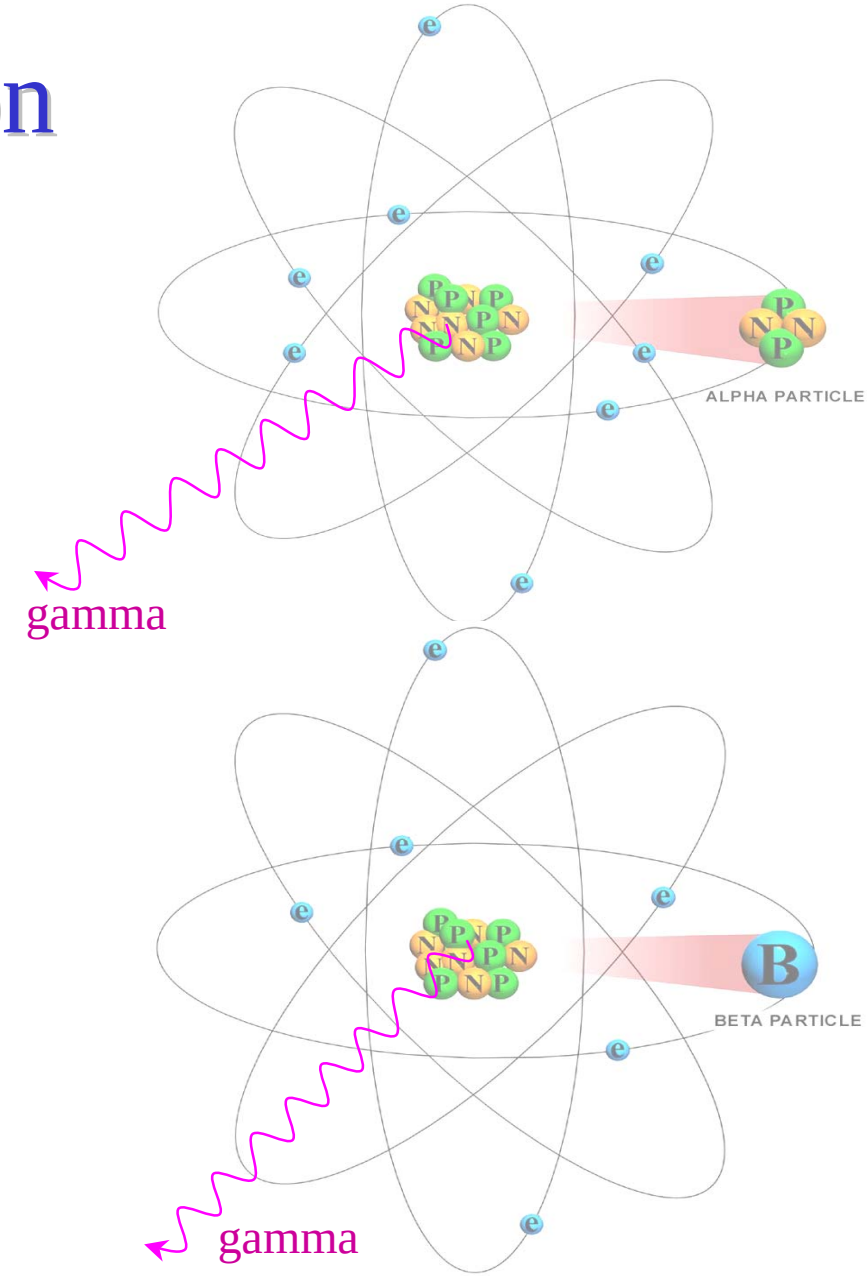
Radiation and Radioactive Material are a Natural Part of Our Lives

- We are constantly exposed to low levels of radiation from outer space, earth, and the healing arts.
- Low levels of naturally occurring radioactive material are in our environment, the food we eat, and in many consumer products.
- Some consumer products also contain small amounts of man-made radioactive material.



Forms of Radiation

- When unstable atoms transform, they often eject particles from their nucleus. The most common of these are:
  - Alpha Radiation
    High energy, but short range (travels an inch in air, not an external hazard)
  - Beta Radiation
    Longer range (10 – 20 feet in air) and can be a skin and eye hazard for high activity beta sources.
- Gamma Rays (electromagnetic radiation)
  Often accompany particle radiation. This “penetrating” radiation is an external hazard and can travel 100s of feet in air.

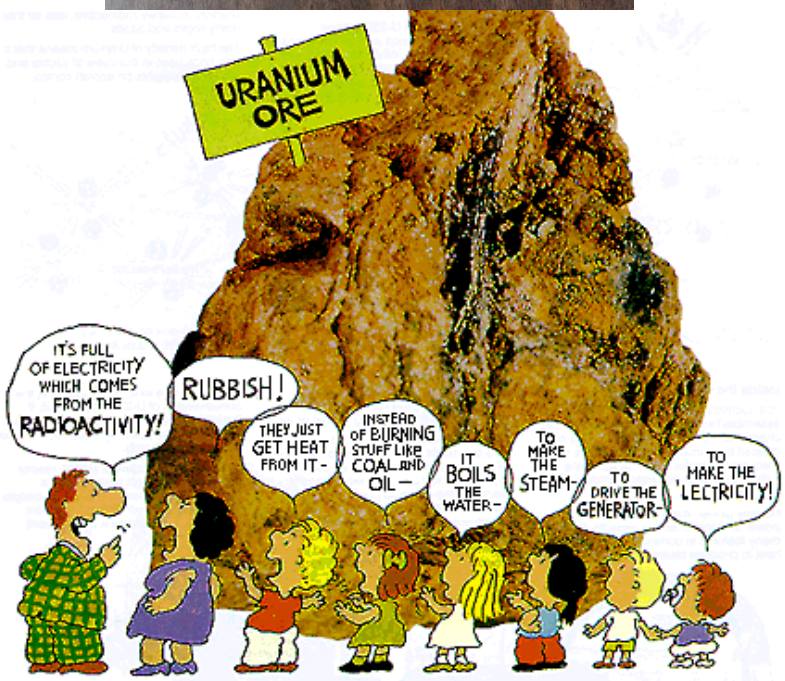


The Amount of Radioactivity is NOT Necessarily Related to Size

- Specific activity is the amount of radioactivity found in a gram of material.

- Radioactive material with long half-lives have low specific activity.

1 gram of Cobalt-60
has the same activity as
1800 tons of natural Uranium



What is a “Dose” of Radiation?

- When radiation’s energy is deposited into our body’s tissues, that is a dose of radiation.
- The more energy deposited into the body, the higher the dose.
- **Rem** is a unit of measure for radiation dose.
- Small doses expressed in **mrem = 1/1000 rem**.
- **Rad** & **R** (Roentgens) are similar units that are often equated to the Rem.

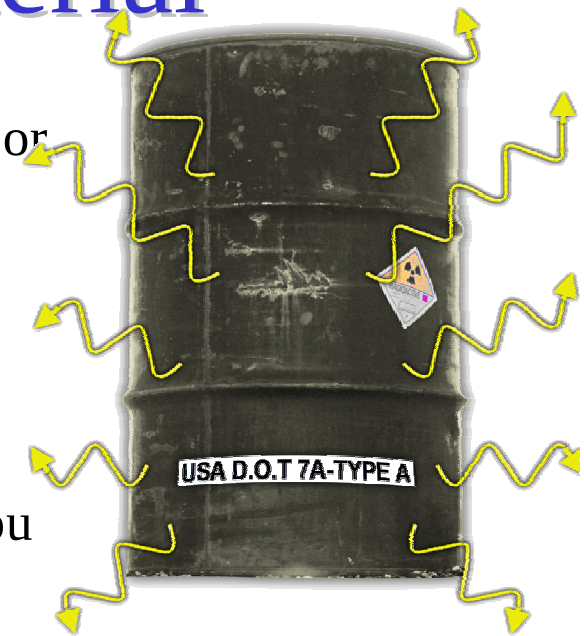
Typical Doses

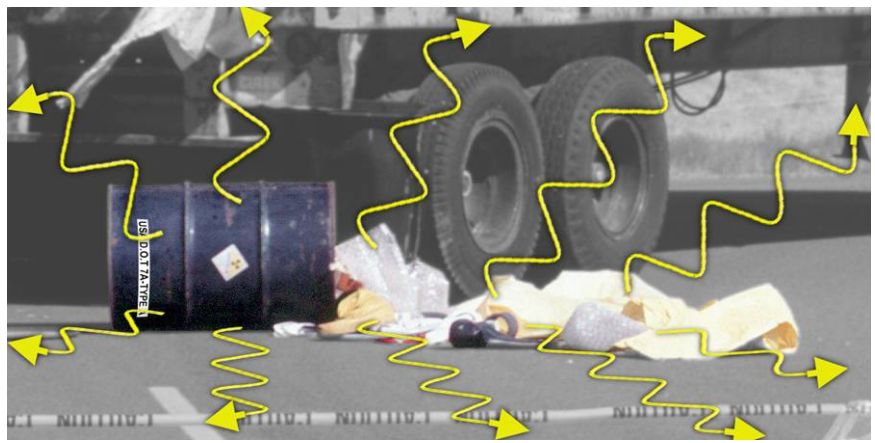
Average Dose to US Public from All sources	360 mrem/year
Average Dose to US Public From Natural Sources	300 mrem/year
Average Dose to US Public From Medical Uses	53 mrem/year
Coal Burning Power Plant	0.2 mrem/year
Average dose to US Public from Weapons Fallout	< 1 mrem/year
Average Dose to US Public From Nuclear Power	< 0.1 mrem/year
Occupational Dose Limit for Radiation Workers	5,000 mrem/yr

Coast to coast Airplane roundtrip	5 mrem
Chest X ray	8 mrem
Dental X ray	10 mrem
Head/neck X ray	20 mrem
Shoe Fitting Fluoroscope (not in use now)	170 mrem
CT (head and body)	1,100 mrem

Radiation is a type of energy; Contamination is material

- Exposure to ***Radiation*** will not contaminate you or make you radioactive.
- ***Contamination*** is Radioactive Material spilled someplace you don't want it.
- Radioactive contamination emits radiation.
- Contact with ***Contamination*** can contaminate you with the material.

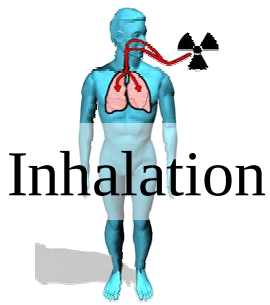




Types of Exposure & Health Effects

- **Acute Dose**
  - Large radiation dose in a short period of time
  - Large doses may result in observable health effects
    - Early: Nausea & vomiting
    - Hair loss, fatigue, & medical complications
    - Burns and wounds heal slowly
  - Examples: medical exposures and accidental exposure to sealed sources

- **Chronic Dose**
  - Radiation dose received over a long period of time
  - Body more easily repairs damage from chronic doses
  - Does not usually result in observable effects
  - Examples: Background Radiation and Internal Deposition



Dividing Cells are the Most Radiosensitive

- Rapidly dividing cells are more susceptible to radiation damage.
- Examples of radiosensitive cells are
  - Blood forming cells
  - The intestinal lining
  - Hair follicles
  - A fetus

This is why the fetus has a exposure limit (over gestation period) of 500 mrem (or 1/10th of the annual adult limit)

At HIGH Doses, We KNOW Radiation Causes Harm

- High Dose effects seen in:
  - Radium dial painters
  - Early radiologists
  - Atomic bomb survivors
  - Populations near Chernobyl
  - Medical treatments
  - Criticality Accidents

- In addition to radiation sickness, increased cancer rates were also evident from high level exposures.

At LOW Doses, We PRESUME Radiation Causes Harm

- No physical effects have been observed
- Although somewhat controversial, this increased risk of cancer is presumed to be proportional to the dose (no matter how small).

The Bad News: Radiation is a carcinogen and a mutagen

The Good News: Radiation is a **very weak** carcinogen and mutagen!

* Similar to those received by Atomic Bomb Survivors (≥10 rem)

Long-term Effects of Radiation

- **Radiation is assumed to increase one's risk of cancer**
  - The "normal" chance of dying of cancer is ~ 23% (~460 out of 2,000).
  - Each rem is assumed to increase that risk by 0.05% (~1 chance in 2,000).

The occupational radiation dose limit to the whole body is 5 rem/yr

Conclusion (1 of 2):

- Radiation is energy given off by unstable atoms and some machines.
- Radioactive Material contains unstable atoms that give off radiation when they “decay.”
- Contamination is Radioactive Material spread someplace where you don’t want it.

Conclusion (2 of 2):

- Radiation damages our cell's DNA, fortunately our body has very efficient repair mechanisms.
- Large acute doses of radiation can cause sickness or even death. The severity of the effects are proportional to the dose.
- All exposures to presumed to increase the risk of cancer. The amount of "increased risk" is proportional to exposure.

Very Small DOSE = Very Small RISK