

Understanding Radiation

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What Is Radiation?

It's energy in the form of particles or waves.

There Are Many Kinds Of Radiation

acoustic



infrared

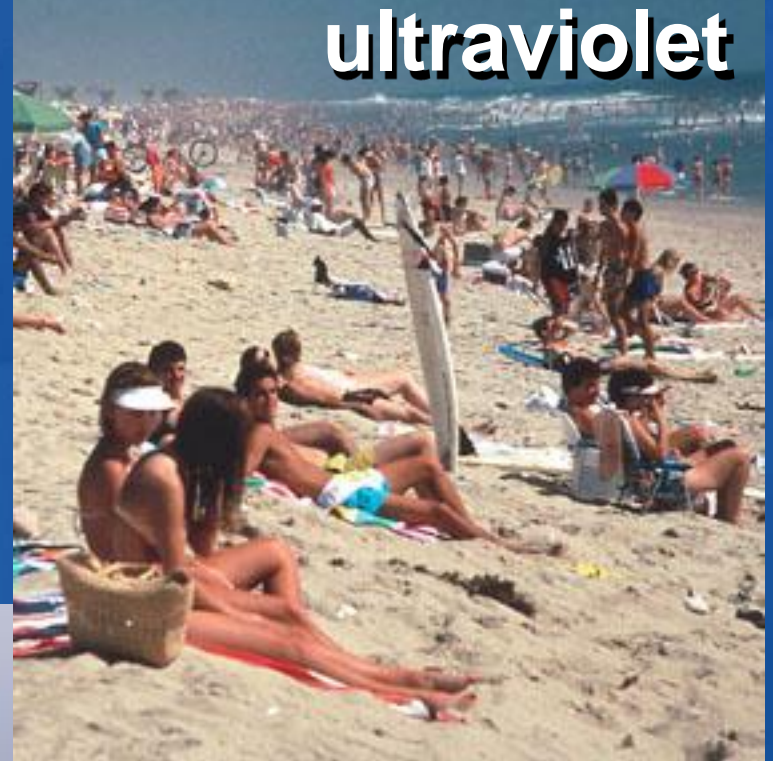


radar



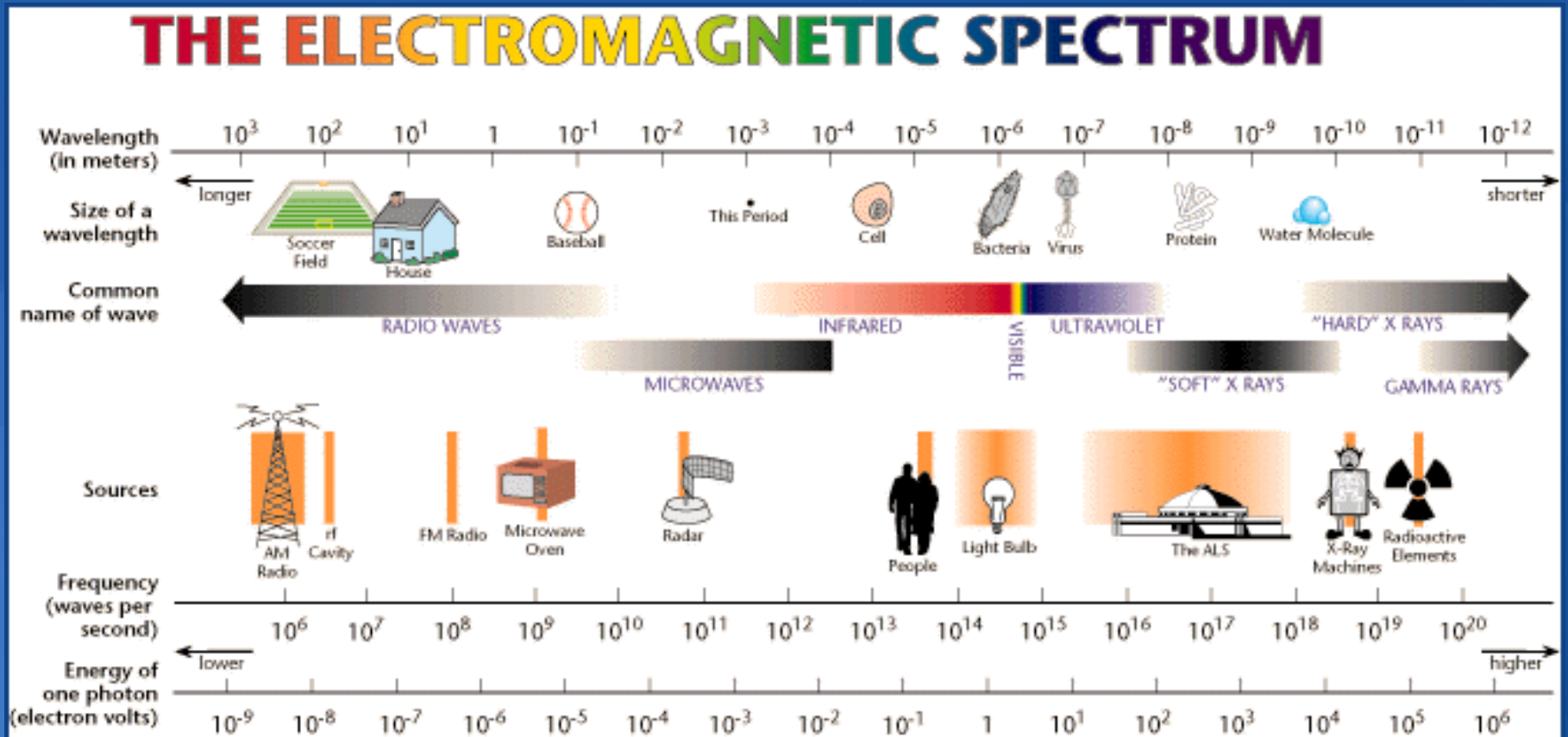
There Are Many Kinds Of Radiation

ultraviolet



It's All About Energy

(~34 electron Volts for ionization)



Ionizing Radiation Is All Around Us

From the stars and the sun



Ionizing Radiation Is All Around Us

In Earth's soil and rocks



APOLLO 16; APRIL 16, 1972

Ionizing Radiation Is All Around Us

In the air we breath, the food we eat, the water we drink, even in our own bodies



Nuclear Technology Uses Ionizing Radiation in Many Beneficial Ways

To diagnose and treat disease

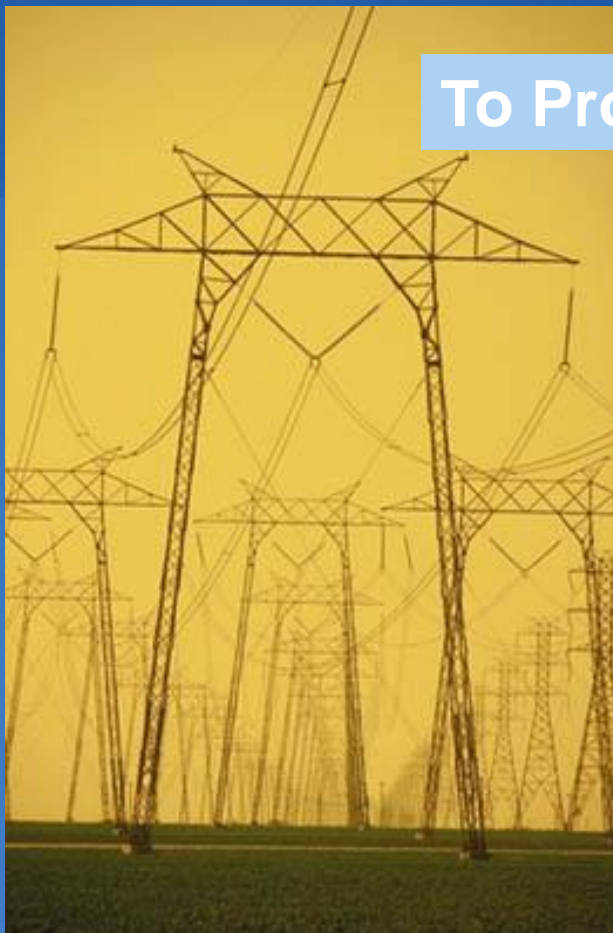
Before

After



Nuclear Technology Uses Ionizing Radiation in Many Beneficial Ways

To Produce Electricity



Nuclear Technology Uses Ionizing Radiation in Many Beneficial Ways

To Promote Livestock and Crop Health



Nuclear Technology Uses Ionizing Radiation in Many Beneficial Ways

To Make Consumer Products Safe



Nuclear Technology Uses Ionizing Radiation in Many Beneficial Ways

To Maintain the Quality of Industrial Products

←EXIT

Radiation Is Well Studied

- The world's scientists have been studying radiation for about 100 years.



Much of the scientific data used in setting radiation protection standards comes from reports produced by:

- **U.S. National Academy of Sciences' Committee on the Biological Effects of Ionizing Radiations (BEIR)**
- **United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)**

Advisory organizations use scientific data on radiation to recommend radiation protection standards:

- International Commission on Radiological Protection



- International Atomic Energy Agency



- National Council on Radiation Protection Measurements



Countries develop regulations based on these recommendations to protect public health and the environment.

In the US:

- EPA
- NRC
- DHS/FEMA
- DOE
- DOT
- FDA
- And others



Science & Radiation - I

- **Fundamentals and applications are well understood, widely-used, and highly-beneficial:**
 - what it is and where it is
 - how it interacts
 - how to make it, measure it, and control it
 - how it can be used -beneficially and otherwise

Science & Radiation - II

- **Effects of high levels of radiation on living things are highly-studied and fairly well understood:**
 - **High levels of radiation in a short period of time can cause harmful effects (death or injury).**
 - **High levels of radiation can also be used for beneficial effects (treating cancer).**

Science & Radiation - III

- **Effects of low levels of radiation are not demonstrated - even large population studies are limited because cancer is prevalent in contemporary society (>40%) and the estimated risk of health effects from low levels of radiation is relatively small**
- **Consensus scientific view is that research data does not “prove or disprove” health effects at low levels of radiation exposure**
- **But we set radiation safety standards and take actions to protect human health and the environment on the assumption that there is some risk**

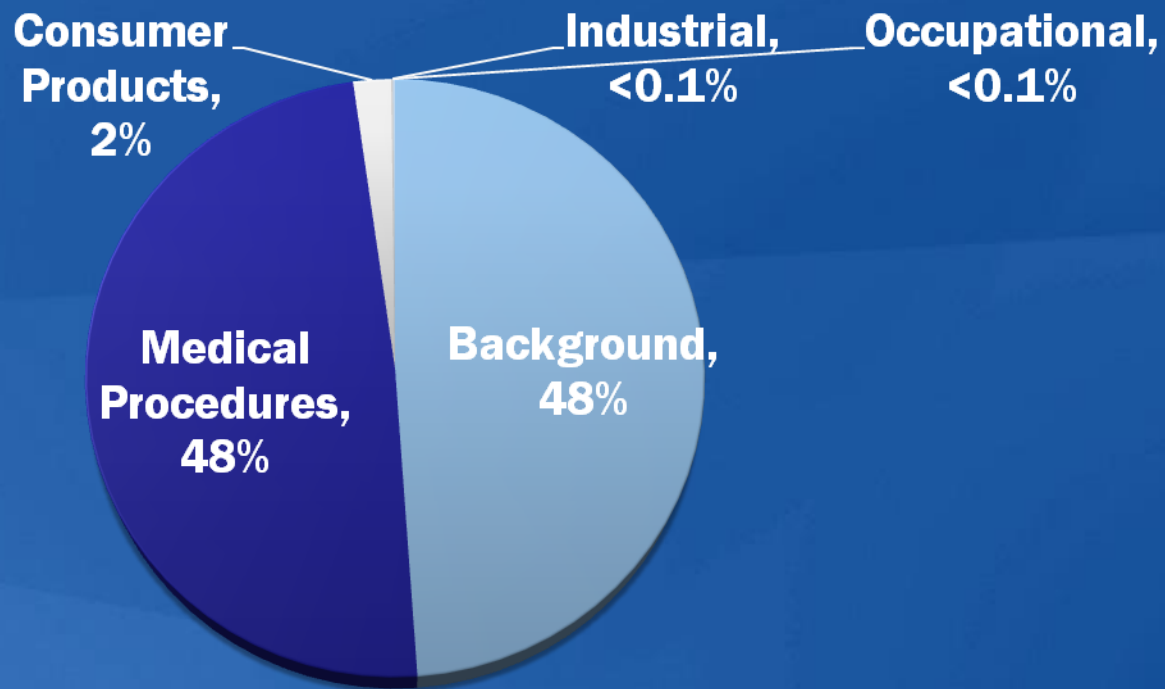
Measure of Radiation Dose

- **Radiation Dose is the amount of radiation absorbed in the body.**
- **The unit of measurement of Radiation Dose is a “millirem” (mrem).**
- **1000 mrem = 1 rem**
- **This is similar to the units used for measuring length (inch/foot) weight (ounce/pound) and temperature (degree).**

Examples of Radiation Dose

Natural Radiation	300 mrem per year
Cross-country Flight	5 mrem roundtrip
Chest X-ray	2-10 mrem
Living in brick house	7 mrem per year
Radioactivity in body	40 mrem per year
Living near a NPP	<1 mrem per year

Sources of Radiation Exposure (2006)



- Background
- Medical Procedures
- Consumer Products
- Industrial
- Occupational

Natural Background Dose (mrem)

Radiation Source	Avg Annual Dose
Cosmic	Sea Level: 26 Wash DC: 28 Colorado: 55-120
Terrestrial	East Coast: 23 Colorado: 90 Elsewhere: 46
Food & Drink	Typical: 40

Typical Medical Radiation Doses

Procedure	Dose (mrem)
Dental X-ray	2-3
Chest X-ray	2-10
Head-Neck X-ray	20
CT Scan (full body)	1,000 – 2,000
GI Series or Heart Catheterization	2,000 – 10,000

NRC Dose Limits & NPP Doses (per year)

Worker Dose Limit	5,000 mrem
Max Worker Doses (Actual)	2,500 -3,000 mrem
Average Worker Doses (Actual)	120 mrem
Public Dose Limit	100 mrem
Max Public Doses near NPP (Actual)	Less than 1 mrem
Average Public Dose near NPP (Actual)	Less than 1/100th of a mrem

Acute Health Effects

More than 1,000,000 millirem in 24 hrs	Death
100,000 to 1,000,000 millirem in 24 hrs	Death Radiation Sickness
10,000 to 100,000 Millirem in 24 hrs	Radiation Sickness Blood Chemistry Changes
Less than 10,000 millirem in 24 hrs	No observed health effects

Long Term Health Effects

Above 10,000 millirem	Increased possibility of cancer, leukemia, life- shortening (hereditary effects?) (heart disease?)
Less than 10,000 millirem	No observed health effects (but that doesn't mean there aren't any)

Radiation is...

- natural and ever-present
- well studied
- highly regulated & controlled
- safe when used properly
- beneficial to society

Sources of Information

- **Health Physics Society - www.hps.org**
- **Radiation Answers (sponsored by the Health Physics Society) – www.radiationanswers.org**
- **National Council on Radiation Protection and Measurements – www.ncrponline.org**
- **US Nuclear Regulatory Commission – www.nrc.gov/about-nrc/radiation.html**
- **US Environmental Protection Agency – www.epa.gov/radiation/**