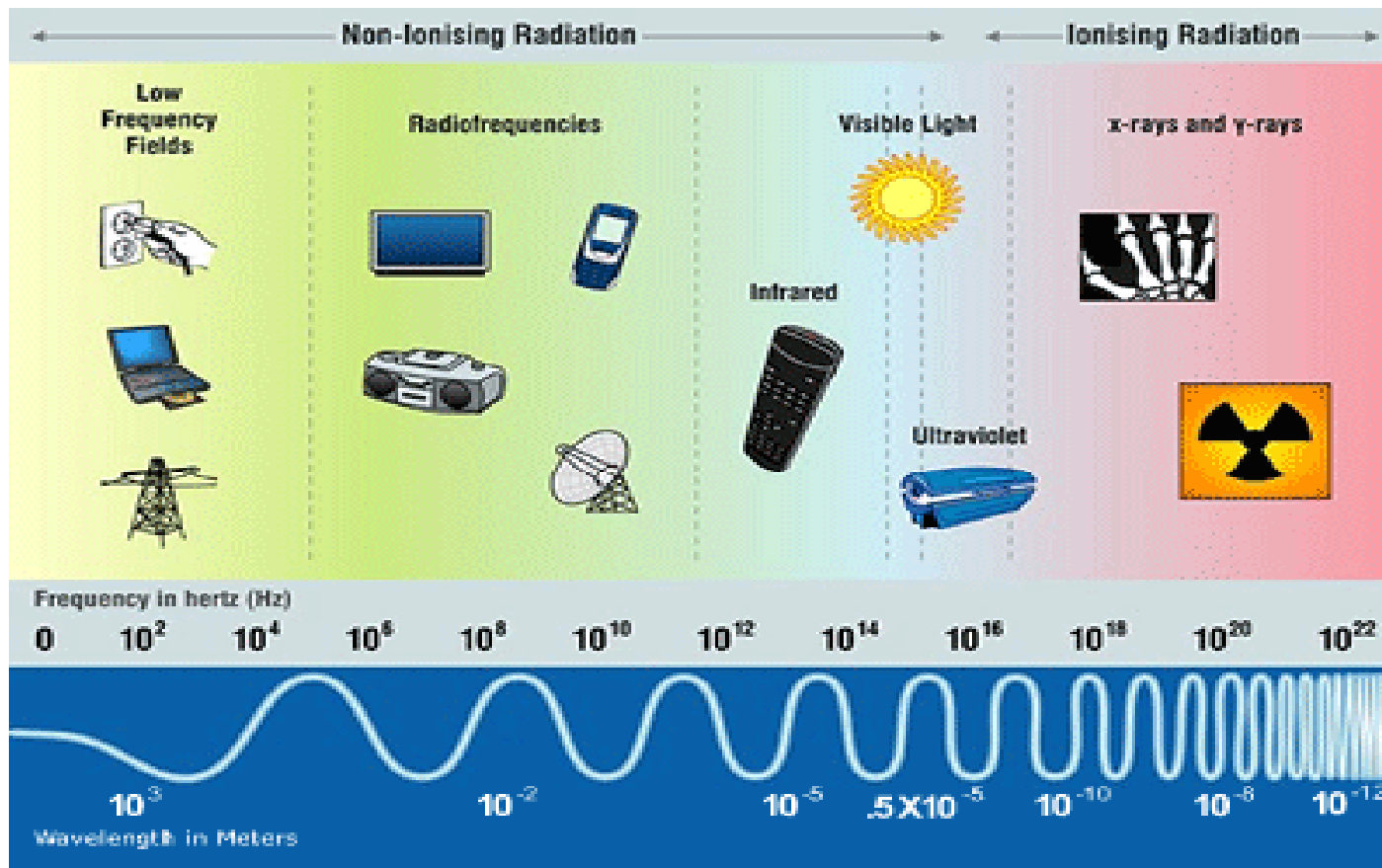
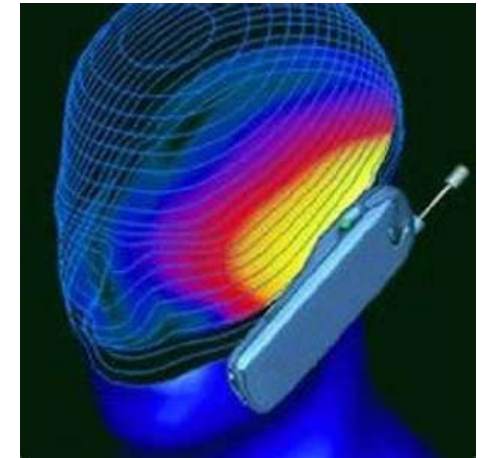


NON-IONIZING RADIATION AWARENESS TRAINING

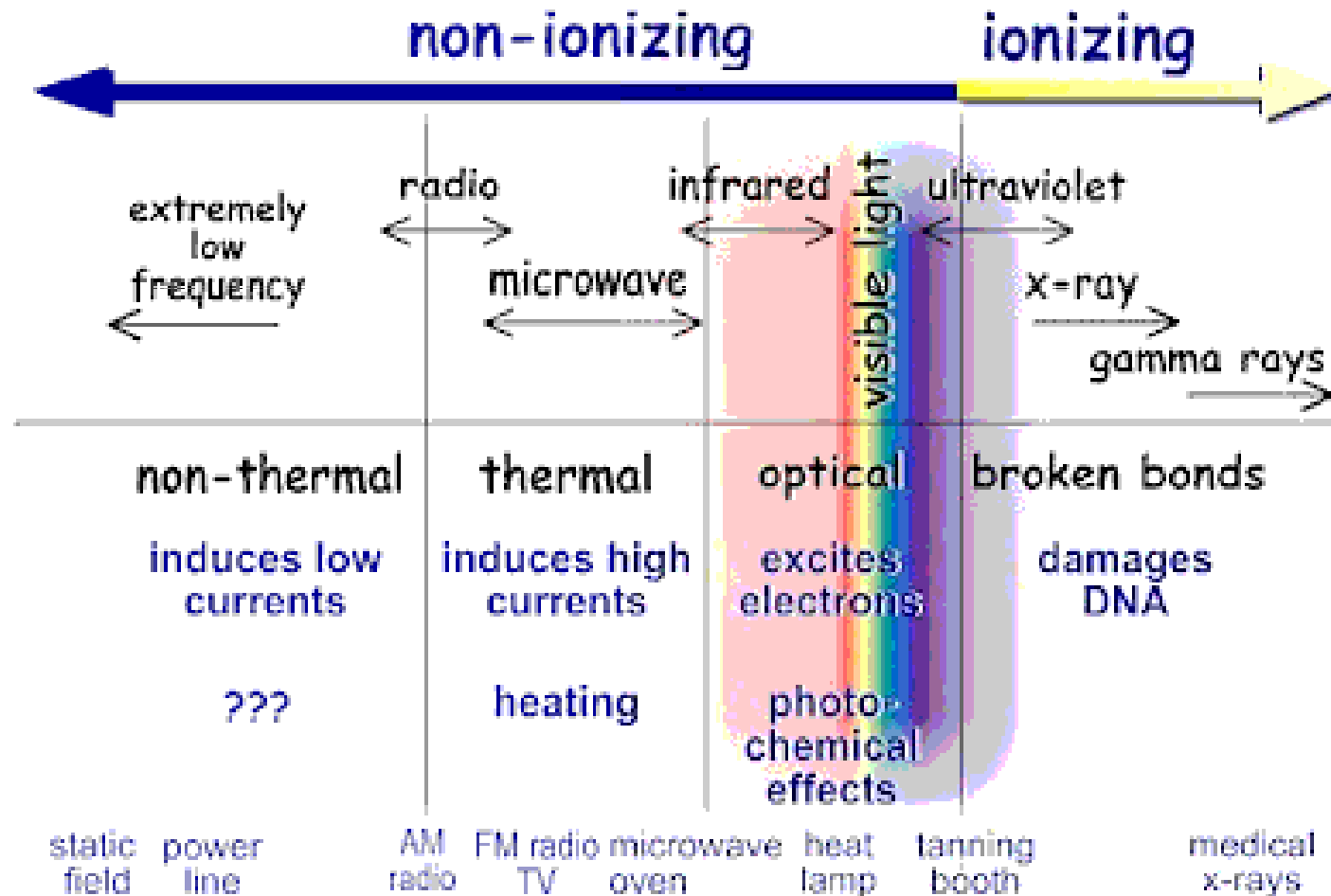


Course Outline

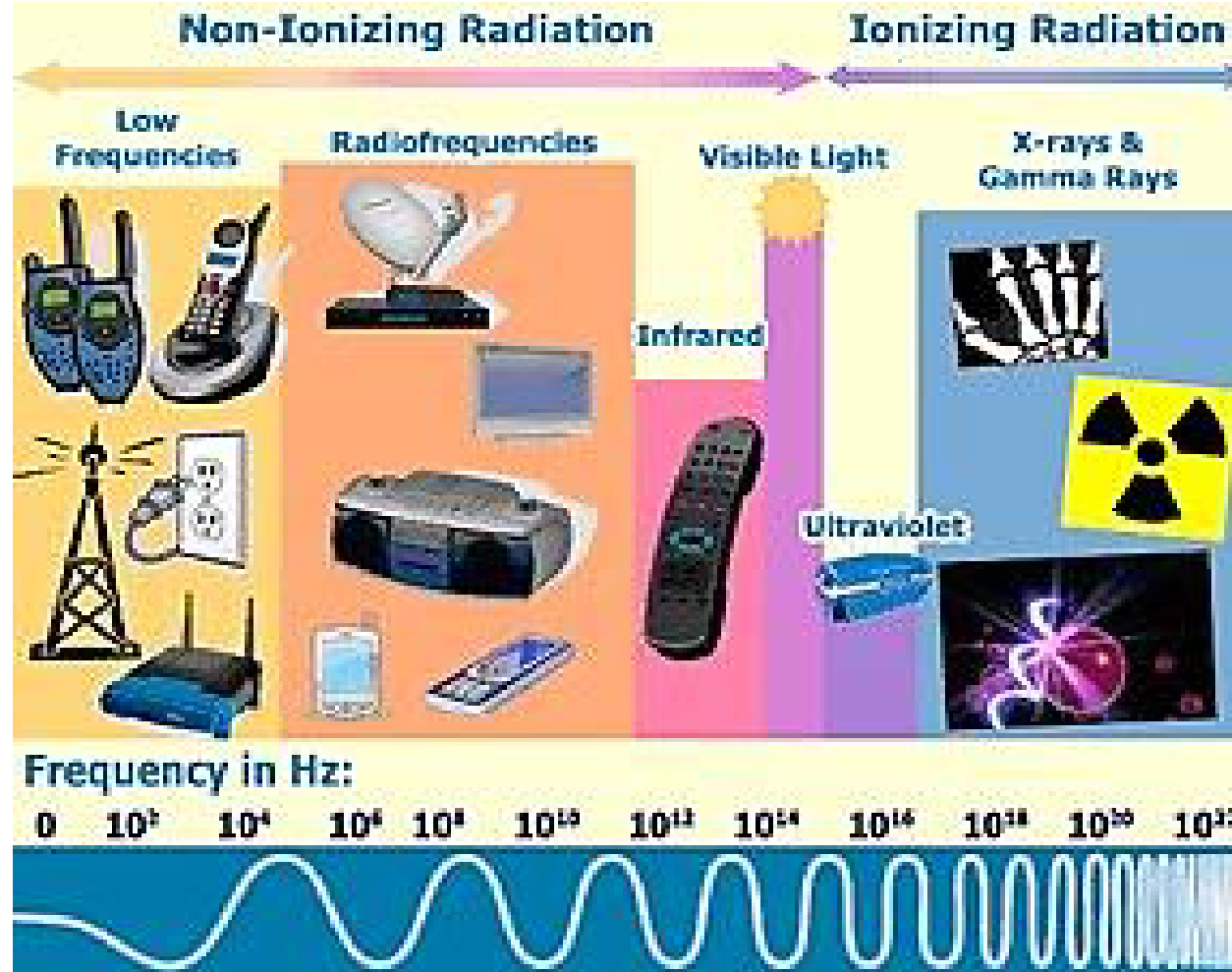
- Introduction
- Types of Radiation
- Non-Ionizing and Ionizing Radiation
- Sources of Non-Ionizing Radiation at CCWD
- Health Hazards
- Regulations
- Exposure Controls



What is Radiation?

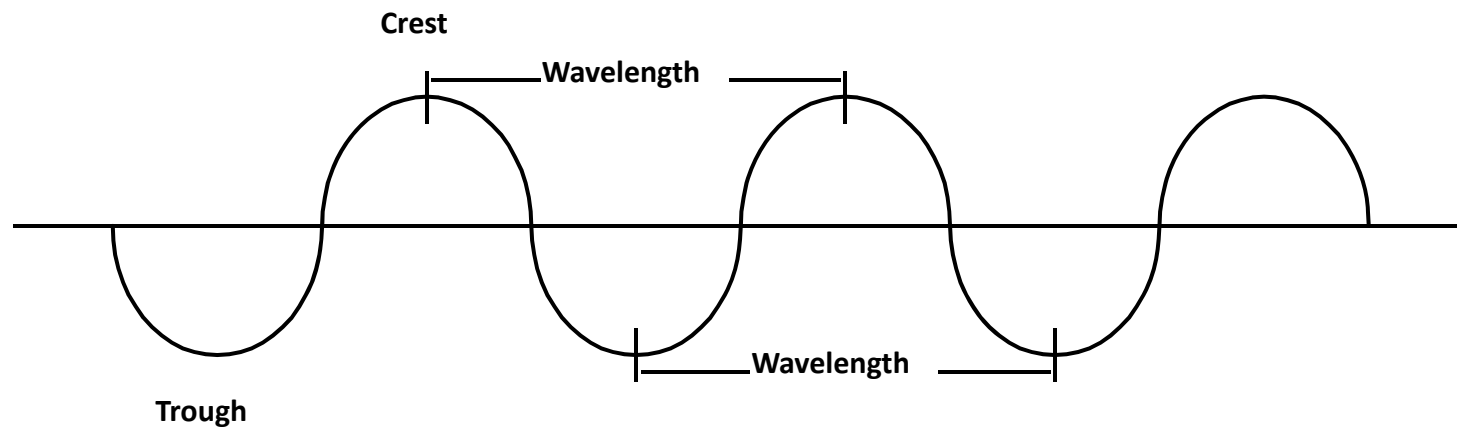


Radiation in Common Products



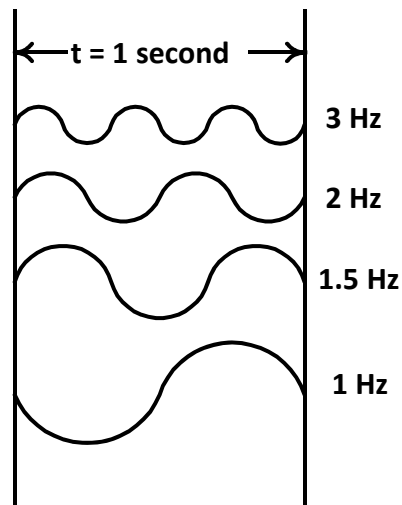
How Radiation Travels

- Radiation travels in waves at a certain frequency
 - Wavelength (λ): Distance between successive waves, measured from crest-to-crest or trough-to-trough



How Radiation Travels

-  **Frequency (Hz):** The number of complete waves passing a point in some given amount of time



Types of Electromagnetic Radiation

Non-Ionizing Radiation

- Electromagnetic energy typically with not enough energy to ionize matter
- Not shown to cause cancer

Radiofrequency (RF)

Microwaves

Infrared

Visible

Ultraviolet

Ionizing Radiation

- Electromagnetic waves and/or particulate radiation with enough energy to remove electrons from an atom's orbits and cause ionization of matter
- May cause cancer, birth defects

X-Rays

Gamma Rays

What are Electromagnetic Fields (EMF)?



- Electric and magnetic fields (EMF) are created wherever an electric current flows, such as in power lines and cables, residential wiring and electrical appliances
- Electric and Magnetic fields can be measured using instruments



Characteristics of EMF

Electric Fields

- Electric fields are present even when the equipment is switched off, as long as it remains connected to the source of electrical power
- Electric fields are shielded or weakened by materials that conduct electricity (including trees, buildings, and human skin)

Magnetic Fields

- Most electrical equipment has to be turned on, i.e., current must be flowing, for a magnetic field to be produced. Magnetic fields can pass through most materials and are therefore more difficult to shield

Both electric and magnetic field strengths decrease as the distance from the source increases.

What are "Radiofrequency" and Microwave Radiation?

- Radio waves and microwaves emitted by transmitting antennas are referred to as "radiofrequency" or "RF" energy or radiation
- The RF waves emanating from an antenna are generated by the movement of electrical charges in the antenna
 - TV and radio broadcast towers
 - Cell phone towers, cellular phones, cordless phones
 - Microwave ovens
 - Various wireless systems and devices



Health Effects

- **Thermal Effects**
 - Biological effects from heating of tissue by RF energy
 - It has been known for many years that exposure to high levels of RF radiation can be harmful due to the ability of RF energy to heat biological tissue rapidly
- **Non-thermal Effects**
 - Some studies have also examined the possibility of a link between RF and microwave exposure and cancer
 - Results to date have been inconclusive
 - Further research is underway to help resolve this question



Regulations

- **Recommendations for human exposure to RF electromagnetic fields by:**
 - California Occupational Safety and Health Administration (Cal/OSHA)
 - Federal Communication Commission (FCC)
 - American National Standards Institute ([ANSI](#))
 - Institute of Electrical and Electronics Engineers, Inc. ([IEEE](#))
 - National Council on Radiation Protection and Measurements ([NCRP](#))



Examples of Non-Ionizing Radiation at CCWD

- **Vehicle Mounted**
- **Radio Transmitter**



How Safe are Radio Antennas Used for Paging and "Two-way" Communications?

- **Transmitting power levels for vehicle-mounted land-mobile antennas are generally less than those used by base-station antennas, but higher than those used for hand-held units.**
- **Hand-held "two-way" portable radios such as walkie-talkies are low-powered devices used to transmit and receive messages over relatively short distances.**
- **Because of the low power levels used, the intermittency of these transmissions ("push-to-talk"), and due to the fact that these radios are held away from the head, they do not expose users to RF energy in excess of safe limits.**



Cell Antenna Near Midhill Reservoir



Are Cellular and PCS Towers and Antennas Safe?

- **Antennas used for cellular and PCS transmissions are typically located on towers, water tanks, rooftops and the sides of buildings.**
- **In urban and suburban areas, cellular and PCS service providers commonly use "sector" antennas for their base stations.**
 - These antennas are rectangular panels, e.g., about 1 by 4 feet in size, typically mounted on a rooftop , towers or poles.
- **Total RF power radiated by the antennas depends on the number of radio channels (transmitters) installed, the power of each transmitter, and the type of antenna.**
- **Maximum power radiated in any direction usually does not exceed 50 watts.**



Are Cellular and PCS Towers and Antennas Safe?

- **The RF emissions from cellular or PCS base station antennas are generally directed toward the horizon in a relatively narrow pattern in the vertical plane.**
- **In the case of sector (panel) antennas, the pattern is fan-shaped, like a wedge cut from a pie.**
- **The power density from the antenna decreases rapidly as one moves away from the antenna.**
- **Ground-level exposures are much less than exposures if one were at the same height and directly in front of the antenna.**



Are Cellular and PCS Towers and Antennas Safe?

- Measurements made near typical cellular and PCS installations have shown that ground-level power densities are thousands of times less than the FCC's limits for safe exposure
- Unlikely that the general public could be exposed to RF levels in excess of FCC guidelines due solely to cellular or PCS base station antennas located on towers or monopoles

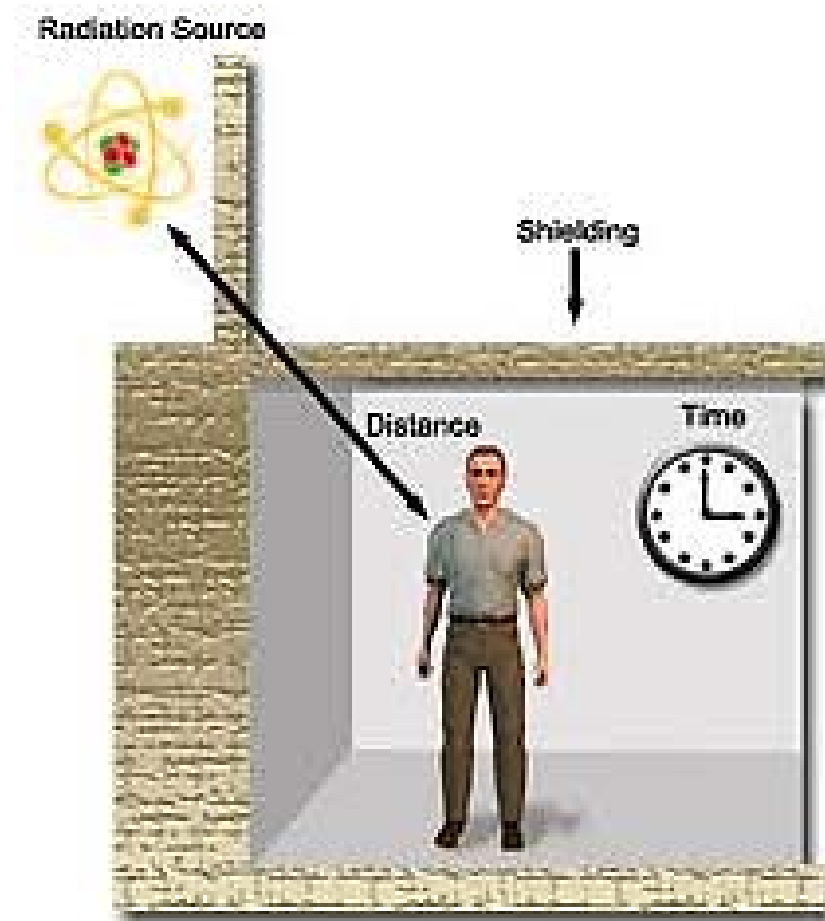


Are Cellular and PCS Towers and Antennas Safe?

- **When cellular and PCS antennas are mounted at rooftop locations it is possible that a person could encounter RF levels greater than those typically encountered on the ground.**
- **Potential exposures approaching or exceeding the safety guidelines are only likely to be encountered very close to and directly in front of the antennas.**
- **For further information on cellular services go to http://wireless.fcc.gov/services/index.htm?job=service_home&id=cellular**

Radiation Protection Methods

- Time
- Distance
- Shielding



Time

- **Two-way radios normally transmit only when the "push-to-talk" button is depressed.**
- **Significantly reduces exposure**



Distance

- **Maintain 1 to 2 feet from a vehicle-mounted antenna during transmission**
- **Obey warning signs**
- **Remain outside of fenced areas**



Shielding

- **Antenna mounted on roof to provide maximum shielding for vehicle occupants**





Thank You!

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