THE ELECTROMAGNETIC SPECTRUM

PHYSICS 112: LIGHT UNIT LEARNING TARGET 2 (LLT2)

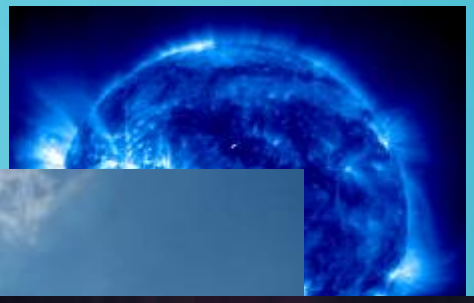
MORE THAN COLORS

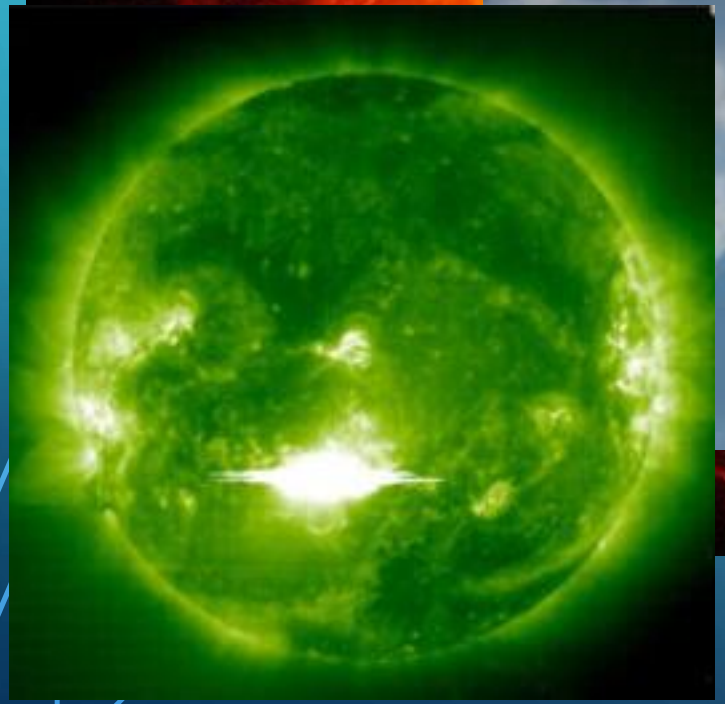
- Radio
- Micro
- Infrared
- Visible
- Ultraviolet
- X-ray
- Gamma ray

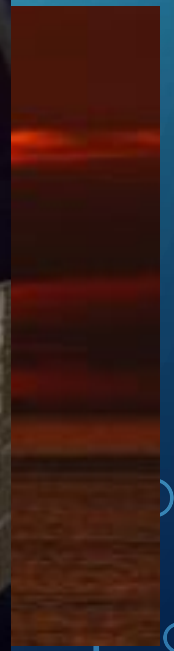
WHITE LIGHT AND COLORS

- Why is something blue?
  - That object absorbs all the colors and reflects blue.
  - Our eyes only see objects because they emit or reflect light.
- Why is something black? White?
  - Absorbs all the colors
  - Reflects all the colors

WHAT COLOR IS THE SUN?



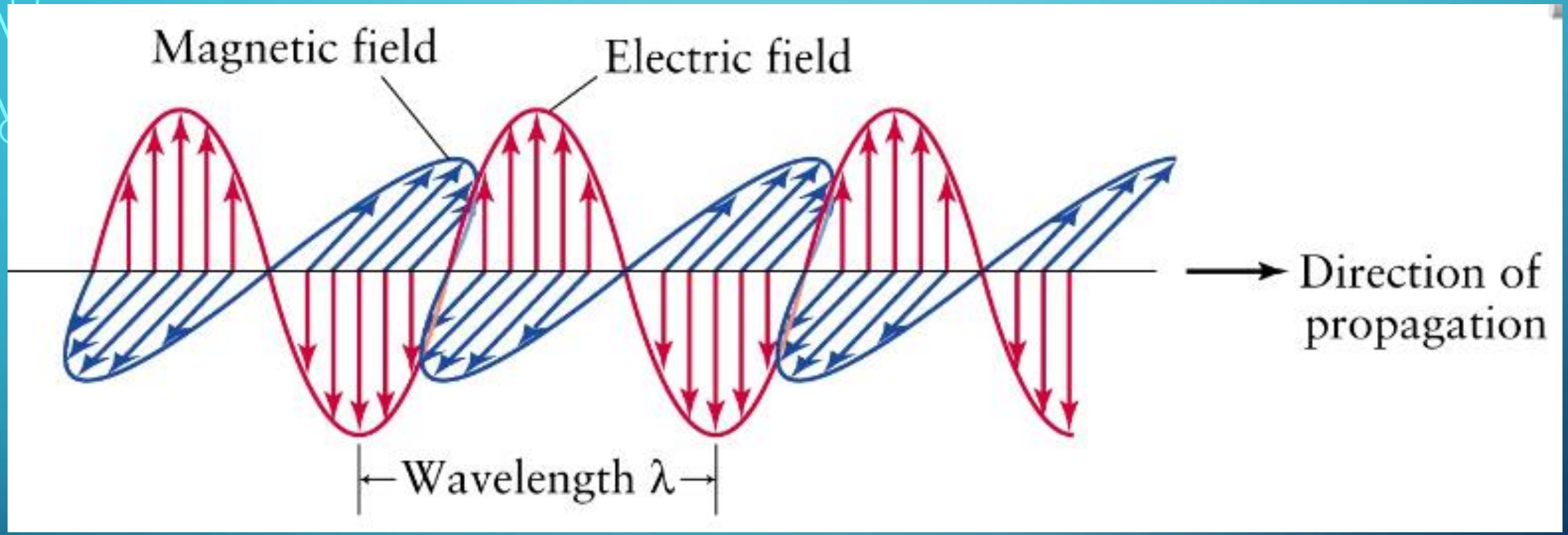


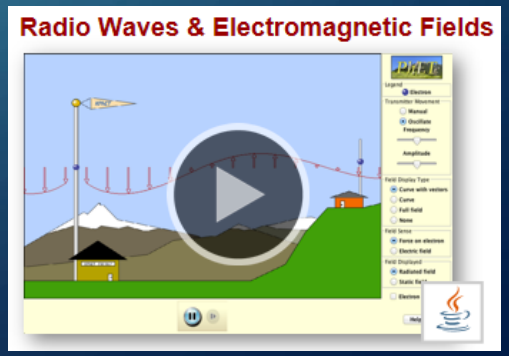


THE ELECTROMAGNETIC SPECTRUM

- They are a moving electric and magnetic field.
  - Related to moving or oscillating electrons.
  - We will use some of the properties of transverse waves to visualize EM Radiation.
- Light is a small part of the EM spectrum

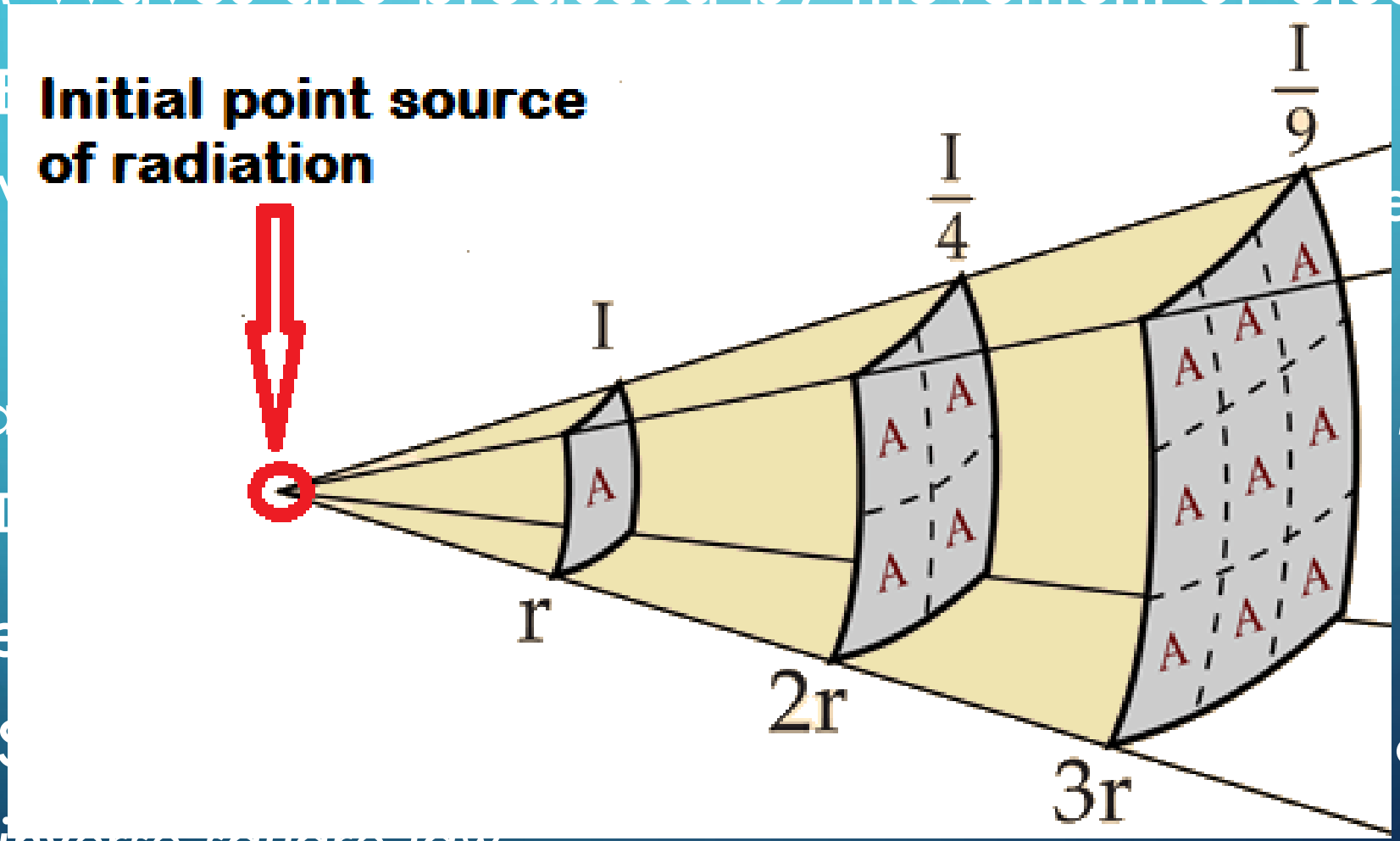
VISUALIZING EM RADIATION





DIFFERENCES FROM MECHANICAL WAVES

- EM Waves are produced by movement of electrons
  - E
  - v
- All
  - D
- Ene
  - S



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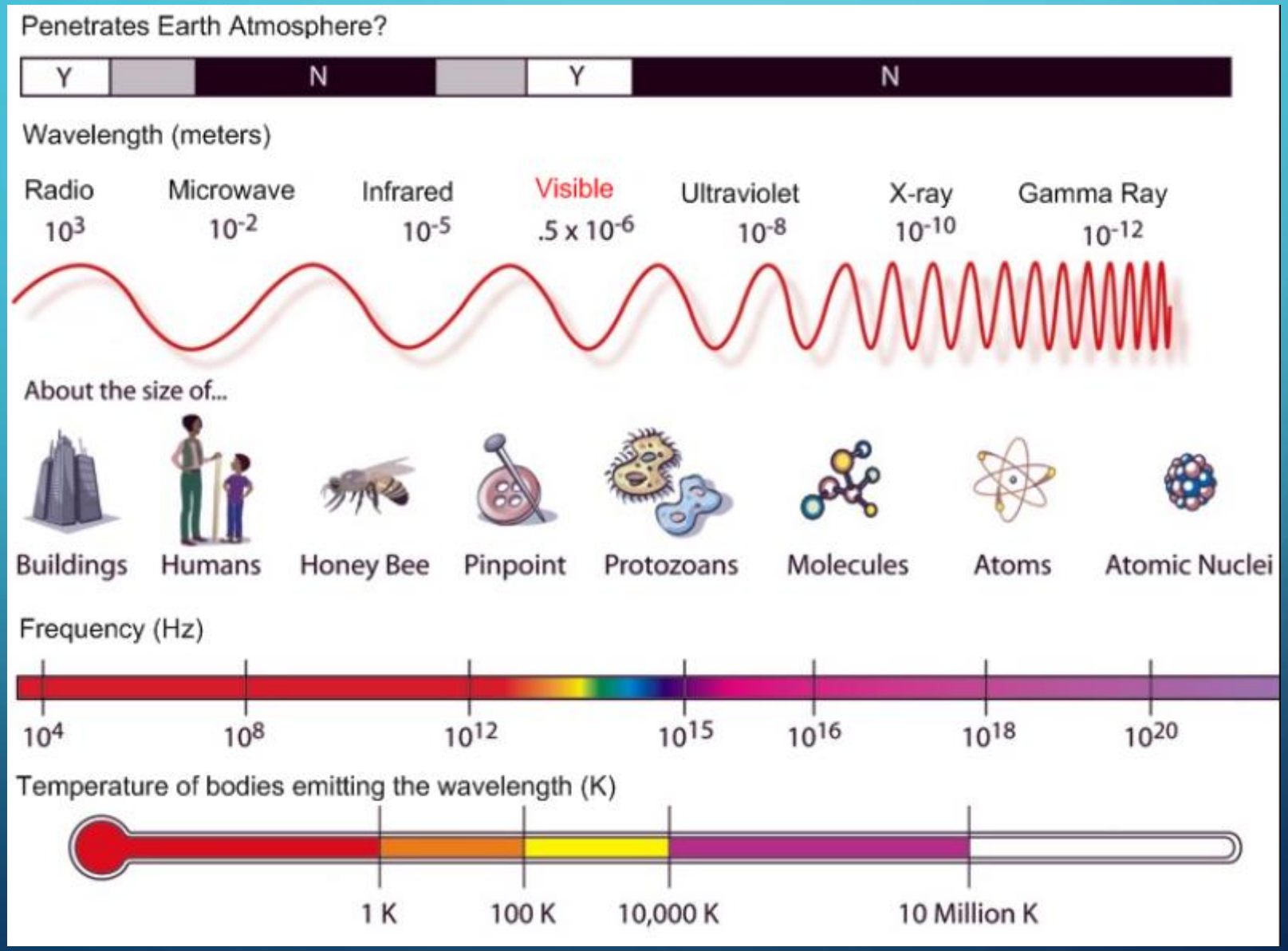
of

light

of the

inverse square law.

THE FULL ELECTROMAGNETIC SPECTRUM



ELECTROMAGNETIC SPECTRUM RANGES AND APPLICATIONS

Classification	Range	Applications
radio waves	$\lambda > 30$ cm $f < 1.0 \times 10^{9}$ Hz	AM and FM radio; television
microwaves	30 cm $> \lambda >$ 1 mm 1.0×10^{9} Hz $< f < 3.0 \times 10^{11}$ Hz	radar; atomic and molecular research; aircraft navigation; microwave ovens
infrared (IR) waves	1 mm $> \lambda >$ 700 nm 3.0×10^{11} Hz $< f < 4.3 \times 10^{14}$ Hz	molecular vibrational spectra; infrared photography; physical therapy
visible light	700 nm (red) $> \lambda >$ 400 nm (violet) 4.3×10^{14} Hz $< f < 7.5 \times 10^{14}$ Hz	visible-light photography; optical microscopy; optical astronomy
ultraviolet (UV) light	400 nm $> \lambda >$ 60 nm 7.5×10^{14} Hz $< f < 5.0 \times 10^{15}$ Hz	sterilization of medical instruments; identification of fluorescent minerals
X rays	60 nm $> \lambda > 10^{-4}$ nm 5.0×10^{15} Hz $< f < 3.0 \times 10^{21}$ Hz	medical examination of bones, teeth, and vital organs; treatment for types of cancer
gamma rays	0.1 nm $> \lambda > 10^{-5}$ nm 3.0×10^{18} Hz $< f < 3.0 \times 10^{22}$ Hz	examination of thick materials for structural flaws; treatment of types of cancer; food irradiation

RADIO WAVES

- Low Frequency, high wavelength, lowest energy EM waves.
- Radio Communication (radios, TVs, etc.)
- Radar/Sonar
- Radar Guns (to determine speed)
- Magnetic Resonance Imaging (MRI)
- Imaging the universe