The Physics of Sunburn and Electromagnetic Waves

(Teacher's Guide)

Lesson Objectives and Learning Goals:

- Students will understand the concept of electromagnetic (EM) waves based on prior knowledge of UV rays
- Students will be able to name the various iinvisible and visible types of light that make up the electromagnetic spectrum
- Students will understand the properties of EM waves, specifically frequency, wavelength, and energy

Key Concepts

- UV light, visible light, and radio waves (among other types of light) are all electromagnetic (EM) waves.
- An EM waves is comprised of oscillating electric and magnetic fields.
- EM waves travel at the speed of light (because they are light!) and can travel through space.
- Key differences between the various types of light are their wavelength, frequency, and energy
- UV light is harmful to skin because of its high energy and frequency.

Online materials included in this lesson:

 Classroom video on the physics of sunburn:

 In-classroom/at-home UV bead lab

 Graphic organizers

 Word puzzles for vocabulary practice

 Quiz and review questions

Educational Science Standards covered in this lesson:

Grade 6

3. Heat (Thermal Energy) (Physical Science) Heat moves in a predictable flow from warmer objects to cooler objects until all the objects are at the same temperature. As a basis for understanding this concept:

a. Students know energy can be carried from one place to another by heat flow or by waves, including water, light and sound waves, or by moving objects.

d. Students know heat energy is also transferred between objects by radiation (radiation can travel through space).

4. Energy in the Earth System: Many phenomena on Earth's surface are affected by the transfer of energy through radiation and convection currents. As a basis for understanding this concept:

a. Students know the sun is the major source of energy for phenomena on Earth's surface; it powers winds, ocean currents, and the water cycle.

b. Students know solar energy reaches Earth through radiation, mostly in the form of visible light.

Grade 7

6. Physical Principles in Living Systems: Physical principles underlie biological structures and functions. As a basis for understanding this concept:

a. Students know visible light is a small band within a very broad electromagnetic spectrum.

Investigation Questions:

- What causes sunburn?
- What are UV rays?
- What are electromagnetic waves?
- What are some types of electromagnetic waves?

Scientific Terms and Vocabulary:

- Waves
- Electromagnetic Waves
- Radiation
- UV Rays
- Radio Waves
- Infrared Rays
- Visible Light
- X-Rays
- Gamma Rays

- ROYGBIV
- Wavelength
- Frequency
- Light Energy
- Sine Wave

Summary of the video:

A young girl named Jade is at the beach. She sees an extremely sunburnt man and wonders what caused his sunburn. Through a series of interviews and investigation questions, she finds that UV rays are the culprit. This leads to another question, "What are UV rays?" With the help of a physics leader, Jade discovers what UV rays are. Together they explore the electromagnetic (EM) spectrum and ultimately the characteristics of UV rays that cause sunburn. As Jade's question is answered, she learns about frequency, wavelength, energy of EM waves, types of EM waves, and sun damage to the skin.

How to use this lesson:

1. Have students first answer and discuss the **investigation questions** listed above.
2. Have students fill in **graphic organizers** (look for this icon on the lesson page:) This is best done before students have had the chance to look up definitions.
3. Watch the sunburn video with students. At each decision tree in the video, discuss decision with the class. Look for this icon on the lesson page.
4. Do the UV beads lab based on the topics discussed in the video.
5. Discuss the review questions (listed below) with students.
6. Review the vocabulary with students. Look back over the graphic organizers correcting definitions of the scientific terms.
7. Have students take a quiz to test their knowledge of the EM waves material.

Review questions

- What did you learn that you didn't know before?
- What surprised you?
- What do you want to know more about?

Related Materials:

Characteristics of UV radiation - http://www.epa.gov/sunwise/doc/uvradiation.html
What is UV radiation? - http://www.sunsmart.com.au/ultraviolet_radiation/understanding_uv
EM Spectrum Overview - http://imagine.gsfc.nasa.gov/docs/science/know_l1/emspectrum.html
Electromagnetic Energy - http://missionscience.nasa.gov/ems/01_intro.html
Infrared Waves - http://missionscience.nasa.gov/ems/07_infraredwaves.html
Electromagnetic Spectrum Video - http://www.youtube.com/watch?v=cfXzwh3KadE

Science of Sunburn - http://www.livescience.com/38039-what-causes-sunburns.html
Electromagnetic spectrum and waves - http://www.youtube.com/watch?v=cjw5FJd5d0Q

Sources:

http://imagine.gsfc.nasa.gov/docs/science/know_l1/emspectrum.html
http://www.youtube.com/watch?v=cfXzwh3KadE
http://cmb.physics.wisc.edu/tutorial/light.html