Electromagnetic Spectrum

Activity 2 of 3

Grade Level: 5 – 8
Subject: Science
Prep time: <10 minutes
Activity Duration: One class period (55 minutes)
Materials category: General Classroom

National Education Standards				
Science	Mathematics	Technology		Geography
		ISTE	ITEA	
3c, 6a				

Objective: Be introduced to the Electromagnetic Spectrum and realize that there is energy beyond visible light that we cannot see.
They will also identify examples of parts of the EM Spectrum.

Materials:

- Prism
- Strong flashlight
- Crayons or markers
- Computer with Web Access (optional)

Related Links:

NASA Site Used for derivation of Lesson Plan
Electromagnetic Spectrum
http://imagers.gsfc.nasa.gov/ems/ems.html

Imagers Education Site at Goddard Space Flight Center
http://imagers.gsfc.nasa.gov/

Supporting NASAexplores Article(s):

A Room With A View
http://www.nasaexplores.com/share2_articlea.php?id=01-004

Electromagnetic Spectrum

Teacher Sheets

Pre-activity Instructions

- IMAGERS Electromagnetic Spectrum web site - Preview the electromagnetic spectrum web site the day before teaching this lesson. Find objects to represent different electro-magnetic energy, i.e. pocket radio, microwave popcorn, remote control, etc...

- Wavestown activity - You may want to review the answers to this activity prior to the lesson because some answers may surprise you.

- Optional student sheets are for those with no web access are included below.

Background Information

Ask students "what is light?" White light is all colors, like the colors of the rainbow. Explain that Isaac Newton discovered the color of light by shining white light through a prism. Demonstrate his experiment using a flashlight and a prism. Tell students that this is called the "visible light spectrum." The visible light spectrum is a part of a larger spectrum called the electromagnetic spectrum. Explain that light is energy and that there is energy beyond visible light. In this lesson, they will be studying the electromagnetic spectrum. The WORF will let waves that are outside the visible light spectrum pass through ensuring high quality photographs.

Activity Guidelines

1. Read and talk about the article.
2. Take students to computer lab.
3. Begin on the IMAGERS Student's Site (http://imagers.gsfc.nasa.gov/student.html) and select the Electromagnetic Spectrum site.
3. Read the first page titled "What are waves?" together.
4. Give each student the Wavestown picture.
5. Have students use the electromagnetic spectrum site to help them label examples of the electromagnetic spectrum found in Wavestown. Students should read the description on the site then look for examples in Wavestown.

(**NOTE:** If access to computer lab is unavailable, use the attached reading below.)

Discussion / Wrap-up

When students complete this exercise, discuss their answers as a class. Begin with radio waves. Ask students to give examples found in Wavestown. Continue with microwaves and the other wavelengths to gamma rays.

Wavestown Answer Key

Radio Waves
Ray's TV - TV reception uses radio waves
Satellite Dish on top Ray's - receives movies via radio waves from a satellite
Taxi - Car radio reception uses radio signals
Taxi - Driver receives instructions on a CB radio which uses radio waves
Radio Tower - broadcast's radio signals
Large Satellite dish in field - receives radio waves from distant stars

Microwaves
Microwave in Waves Grill - uses microwaves to cook food
Disk-like antennas on tower - send microwave communications

Infrared
Heat lamps above food in Waves Grill - use infrared waves to keep food hot
Ray's TV - Remote controls use infrared waves to communicate with the TV
Trees, bushes, grass, and farm - vegetation reflects short infrared waves
Observatory - astronomers study thermal infrared (long infrared waves) from stars

Visible Light
Rainbow - water droplets cause white light to break apart into the colors of the rainbow
Photographer's studio - portrait photographers use film sensitive to visible light
Observatory - astronomers look at visible light from planets and stars

Ultraviolet
Tanning Salon - use ultraviolet waves to tan our skin
sunglasses store - sunglasses protect our eyes from the ultraviolet waves
Suntan lotion - protects our skin from ultraviolet waves
Observatory - astronomers see some ultraviolet radiation from planets and stars

X-rays
Dr. Bob's Health Clinic - uses x-rays to study our bones
High energy x-rays are also used to treat cancer

Gamma Rays
Dr. Bob's Health Clinic - gamma radiation is used to kill sick cells through nuclear medicine.
Gamma radiation is given off by nuclear explosions that occur within stars, like our sun.
Note: Stars give off gamma rays and x-rays but we cannot see them from Earth because they cannot pass through our atmosphere

What are waves?

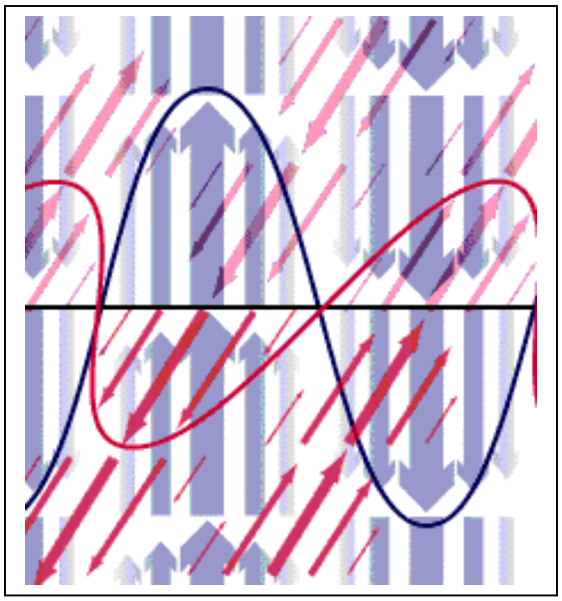
Have you ever ridden a wave in the ocean?

Ocean waves travel on the surface of the water. You can see them and you can feel them. As you swim through the water, you can even make your own waves.

Have you ever seen a flag on a windy day?

The wind creates waves in the flag. Both the waves in the flag and the ocean waves are waves that you can see. There are other kinds of waves. We cannot see these waves, but we experience them every day. These waves are called electromagnetic waves.

What are electromagnetic waves?



Electricity can be static, like what holds a balloon to the wall or makes your hair stand on end. Magnetism can also be static like a refrigerator magnet. But when they change or move together, they make waves - electromagnetic waves.

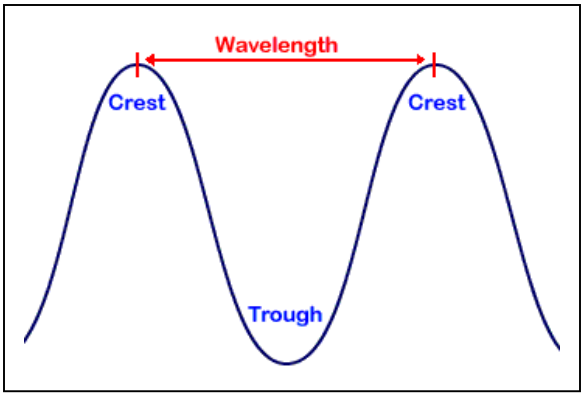
Electromagnetic waves are formed when an electric field couples with a magnetic field.

Magnetic and electric fields of an electromagnetic wave are perpendicular to each other and to the direction of the wave. James Clerk Maxwell and Heinrich Hertz are two scientists who studied how electromagnetic waves are formed and how fast they travel.

Sound also travels in waves, though we can't see them. Like ocean waves, sound waves need a medium to travel through. Sound travels through air - and can even travel through water! There is no sound in space because there is nothing there to transmit the sound waves. This is why astronauts on spacewalks use radios to communicate. Radio waves are a type of electromagnetic wave.

Electromagnetic waves do not need anything to travel through. They can travel through empty space. They can also travel through air and even through solid materials.

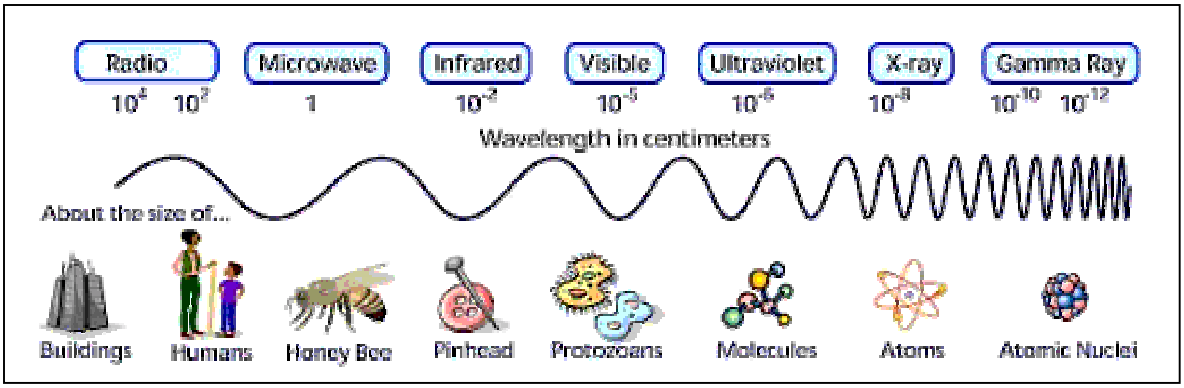
Electromagnetic Waves have different wavelengths.



When you listen to the radio, watch TV, or cook dinner in a microwave oven, you are using electromagnetic waves.

Radio waves, television waves, and microwaves are all types of electromagnetic waves. They only differ from each other in wavelength. Wavelength is the distance between one wave crest to the next.

Waves in the electromagnetic spectrum vary in size from very long radio waves the size of buildings, to very short gamma rays smaller than the size of the nucleus of an atom.



Did you know that electromagnetic waves can not only be described by their wavelength, but also by their energy and frequency? All three of these things are related to each other mathematically. This means that it is correct to talk about the energy of an X-ray or the wavelength of a microwave or the frequency of a radio wave.

Electromagnetic Spectrum

Student Sheets

Directions: Use the descriptions below to help locate examples of electromagnetic waves in the Wavestown picture.

Radio waves have the longest wavelength in the electromagnetic spectrum. These waves carry the news, ball games, and music you listen to on the radio. They also carry signals to television sets and cellular phones.

Microwaves have shorter wavelengths than radio waves, which heat the food we eat. They are also used for radar images, like the Doppler radar used in weather forecasts.

There are **infrared waves** with long wavelengths and short wavelengths. Infrared waves with long wavelengths are different from infrared waves with short wavelengths. Infrared waves with long wavelengths can be detected as heat. Your radiator or heater gives off these long infrared waves. We call these thermal infrared or far infrared waves. The sun gives off infrared waves with shorter wavelengths. Plants reflect these waves, also known as near infrared waves.

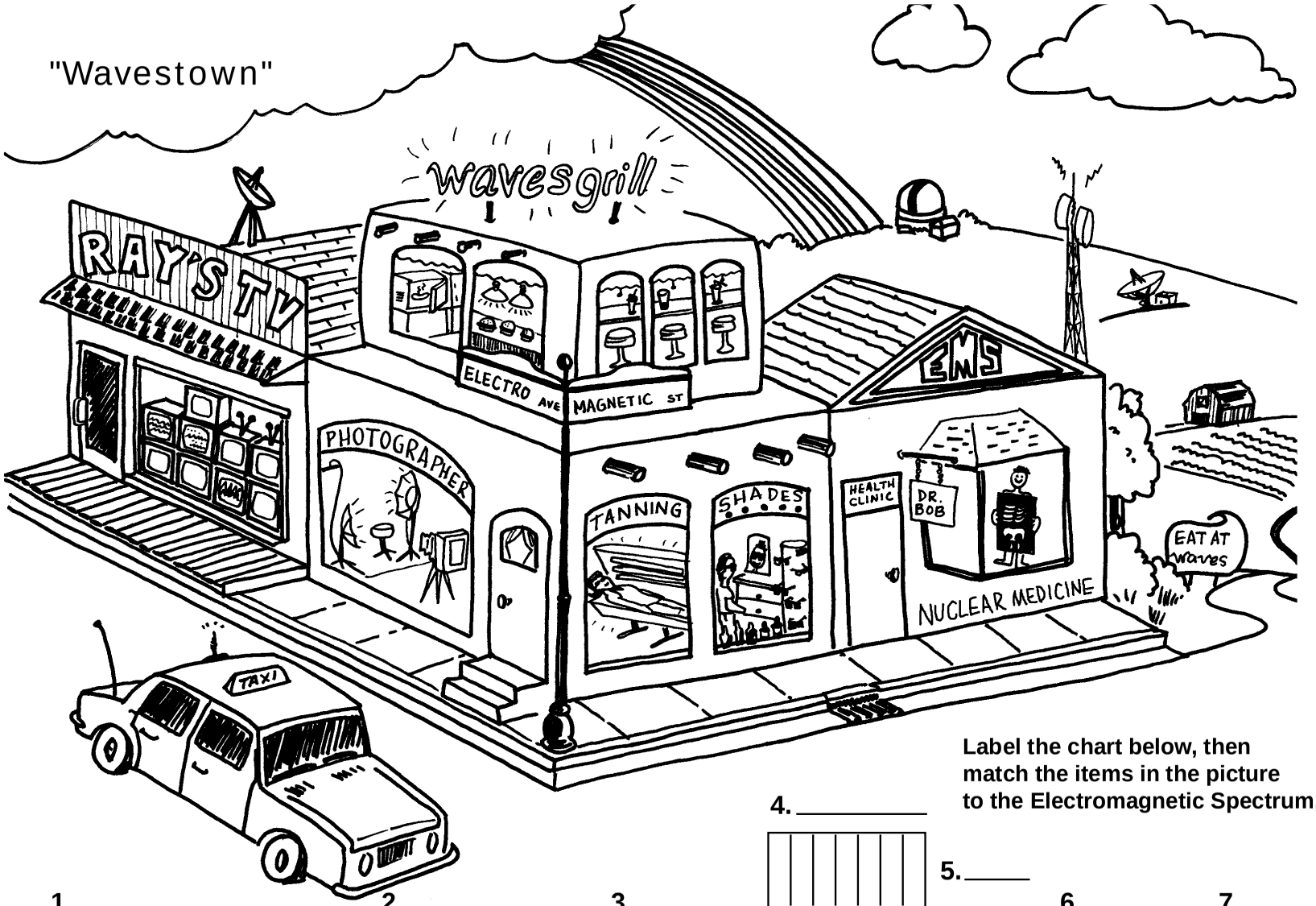
Visible light waves are the only electromagnetic waves we can see. We see these waves as the colors of the rainbow. Each color has a different wavelength. Red has the longest wavelength and violet has the shortest wavelength. These waves combine to make white light.

Ultraviolet waves have wavelengths shorter than visible light waves. These waves are invisible to the human eye, but some insects can see them. Of the sun's light, the ultraviolet waves are responsible for causing our sunburns.

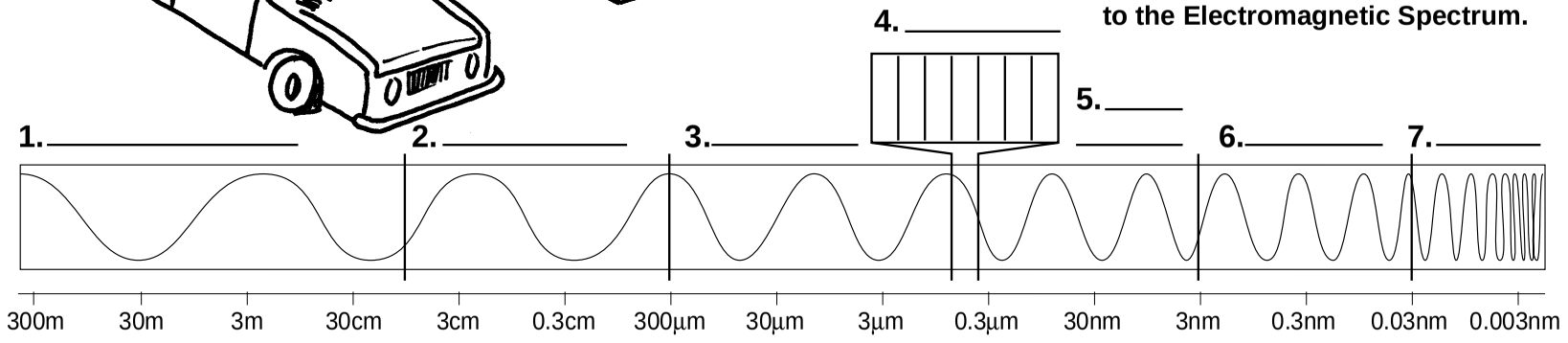
X-Rays: As wavelengths get smaller, the waves have more energy. X-Rays have smaller wavelengths and therefore more energy than the ultraviolet waves. X-Rays are so powerful that they pass easily through the skin allowing doctors to look at our bones.

Gamma Rays have the smallest wavelength and the most energy of the waves in the electromagnetic spectrum. These waves are generated by radioactive atoms and in nuclear explosions. Gamma rays can kill living cells, but doctors can use gamma rays to kill diseased cells.

"Wavestown"



Label the chart below, then match the items in the picture to the Electromagnetic Spectrum.



Name _____

Wavestown

Date _____