Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_Period\_\_\_

**Story Time**

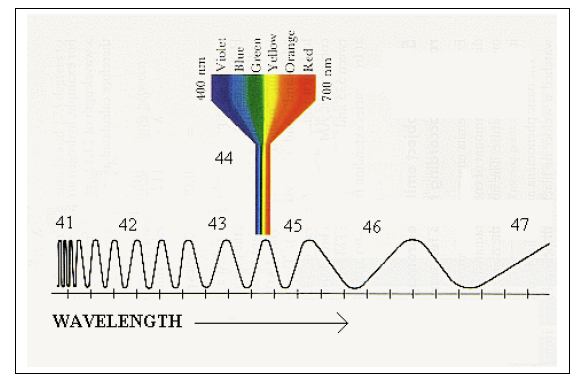
**Directions**: Listen for each wavelength in the electromagnetic spectrum, and how it is used in the story. Answer the following questions by giving the name of each wavelength.

1. What woke your teacher up early?
2. What did your teacher use to cook the oatmeal?
3. What did your teacher use to cook the bagel?
4. What amazed your teacher as she went outside?
5. Why did your teacher need sunglasses?
6. What did your teacher get at the hospital?
7. What did the smallest, green alien point at your teacher?

**Introduction to the Electromagnetic Spectrum**

URL: <http://imagine.gsfc.nasa.gov/docs/science/know_l1/emspectrum.html>

1. What is the name given to a bunch of types of radiation when scientists want to talk about them as a group?
2. Are aircraft and shipping radio band wavelengths longer or shorter than the waves you receive on your radio when you tune into 107.3 on your FM dial?
3. What can these radio waves tell you about the object that emits them?
4. Besides cooking their popcorn in 3 minutes and 20 seconds, for what do astronomers use microwaves?
5. What type of radiation is used to map the dust between stars in space?
6. What substances in the universe emit X-rays?
7. Name three things that can produce gamma rays.
8. Are gamma rays and radio waves really different things?
9. What is the mass of the particles that form the stream of electromagnetic radiation?
10. In what type of pattern do these particles travel?
11. What is the speed of these particles?
12. What is the difference between the various types of electromagnetic radiation?
13. True or false: Because microwaves can actually be used to cook your food, they contain lots of energy.
14. What are the most energetic waves of all?
15. The radio portion of the EM spectrum contains waves of what lengths? (Give a range.)
16. What is the frequency range of these radio waves?
17. Name the colors that fall between 400 and 700 nanometers in wavelength.
18. Name two types of radiation that can reach the earth from space.
19. What types of radiation can be observed from mountaintops or from telescopes in airplanes?
20. Balloons with instrumentation aboard can reach what altitudes?
21. What is the best vehicle for long-term observations of EM radiation from space?
22. Clicking on the link, “Show me a chart of the wavelength”, frequency and energy regimes of the spectrum! Label the type of radiation (i.e., radio gamma, etc.) of the electromagnetic spectrum that matches the corresponding wavelength in the diagram below.



**ELECTROMAGNETIC NOTATION**

Scientific notation is used when dealing with very large numbers such as 43,000,000 or very small numbers such as .000043. Scientific notation allows us to write these numbers and work with these numbers without the cumbersome job of dealing with so many digits. In scientific notation, forty-three million becomes 4.3 x 107 simply by moving the decimal 7 places to the left. Numbers less than one require the decimal to be moved to the right so forty-three millionths becomes 4.3 x 10-5. Notice the exponent is negative when the decimal is moved to the right while the exponent is positive when the decimal is moved to the left. Remember that with scientific notation only one digit should be in front of the decimal.

The electromagnetic spectrum is an arrangement of electromagnetic radiation according to wavelength, frequency, or energy level. The spectrum ranges from radio waves, which are low-energy, low-frequency, long waves, to gamma-rays, which are the high-energy, high-frequency, short waves. Listed in order below are the components of the electromagnetic spectrum. Beside each type of radiation you will find the length of a wave in meters which falls into that radiation type. A wavelength is the distance from one crest or trough to the next crest or trough. Convert these numbers to scientific notation by moving the decimal to the left or the right.

1. gamma-rays .0000000000001 m

2. X-rays .0000000001 m

3. ultraviolet rays .00000001 m

4. visible light .0000005 m

5. infrared rays .00001 m

6. microwaves .01 m

7. radio waves 1,000 m

The number of waves that pass a particular point in a given amount of time is the wave frequency. Each component of the electromagnetic spectrum has its own frequency range. The unit on a wave's frequency is a Hertz, or wave per second. Listed below are the components of the electromagnetic spectrum. Beside each type of radiation is a frequency value expressed in scientific notation, which falls in the range of that radiation type. Convert the scientific notation into standard form by moving the decimal the appropriate number of places to the left or the right.

8. gamma-rays 1 x 1021 Hertz

9. X-rays 1 x 1018 Hertz

10. ultraviolet rays 1 x 1016 Hertz

11. visible light 5 x 1014 Hertz

12. infrared rays 1 x 1013 Hertz

13. microwaves 1 x 1010 Hertz

14. radio waves 1 x 105 Hertz

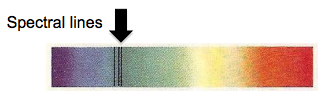
**Colors in Christmas Lights**

Colored light and white light are called visible light. Visible light travels to our eyes as waves. Our brain then interprets the waves as color. Visible light can be broken up into its colors by looking through a spectroscope. You will use light diffracting glasses to view clear, red, and blue LED lights. As you rotate around the classroom, record your answers to the questions below.

1. What colors can you see when the clear bulbs are viewed?
2. What colors can you see when the blue bulbs are viewed?
3. What colors can you see when the red bulbs are viewed?
4. Why do you think this is happening?

**Star Finger Prints**

Astronomers view stars and galaxies with a spectroscope. They use a spectroscope to record the spectral lines that are shown here as dark lines on the visible spectrum.



These spectral lines are like a fingerprint and can be used to identify the elements that are present in a star or galaxy. By looking at a star’s spectral lines, astronomers can know what elements are present in the star.

Use the spectra of Star A, Star B, and Star C to compare to the spectral lines of known elements.

1. What elements can be found in Star A?
2. What elements can be found in Star B?
3. What elements can be found in Star C?
4. What tool do scientists use to see these spectral lines?

5. Why are spectral lines like a fingerprint?