

# Electromagnetic Spectrum Web Quest

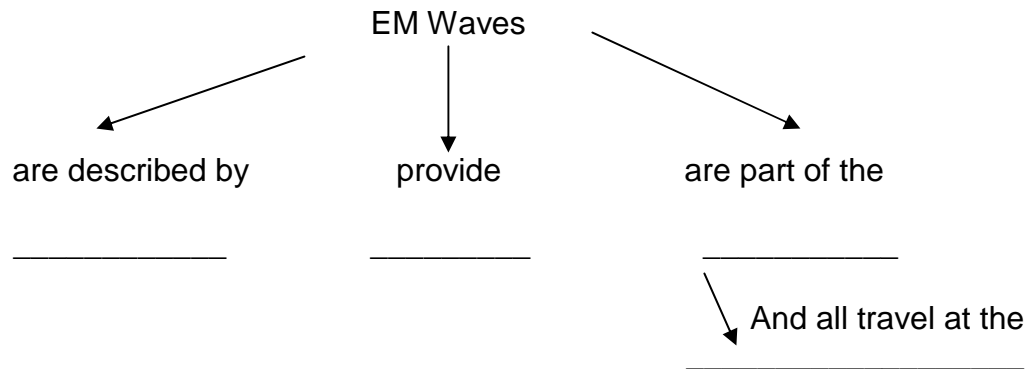
Name:  
Period:  
Due date:

Use the web sites to answer the questions below. Make sure your responses are complete.

☺🖱️ Navigate to <http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html>

1. Click on Electricity and Magnetism, and then click on EM Waves.

Complete the concept map below:



2. Observe the diagram showing the electromagnetic wave. This is a transverse wave. What are the two fields interacting in this wave?
3. At what angle do the two fields interact?
4. Click on the “Electromagnetic Spectrum”. Write the wave velocity formula below:
5. What is the speed of light? (Don’t forget to label!)
6. Using the EMS calculator, carefully enter the data, click outside the box and find the missing measurement:

EM Wave	Wavelength (m)	Frequency (Hz)	Speed (m/s) in a vacuum (Space)
Red light	$4 \times 10^{-7}$		
FM radio		100 MHz	$3 \times 10^8$
X-rays		$3 \times 10^{19}$ Hz	

7. What value remains constant in all the calculations above?
8. Scroll down to the bottom of the page. What was the comparison measurement for:

AM Radio waves are about \_\_\_\_\_ football fields long.

X-rays are about \_\_\_\_\_ of a hydrogen atom

☺👉 Navigate to: [http://www.colorado.edu/physics/2000/waves\\_particles/index.html](http://www.colorado.edu/physics/2000/waves_particles/index.html)

9. Use the mouse to adjust the wavelength on the diagram. When you adjust it to **ultraviolet** and the white baseline is flat, write the wavelength using scientific notation. Why do you think they choose sunglasses as the icon for this wavelength?
  
10. Skip ahead 3 pages to Vibrating Charges and Electromagnetic Waves. Scroll down and "Click here to learn more about the connection between wavelength, frequency and speed of light."
  - a. Change the wavelength on the wave generator to make the longest wave possible. What is the ratio of distance/time? (Don't forget to label!)
  
  - b. Change the wavelength on the wave generator to make the shortest wave possible. What is the ratio of distance/time? (Don't forget to label!)
  
  - c. Why is the ratio of distance/time the same no matter what wavelength you choose?

☺👉 Navigate to: <http://imagine.gsfc.nasa.gov/>

Click on Science (at the top of the page next to HOME). Go through each of the titles in "The Basics Section" and answer the following questions.

11. What do all types of electromagnetic radiation have in common?
  
12. What is different about the different parts of the electromagnetic spectrum?
  
13. Use the chart of the wavelength, frequency and energy regimes of the spectrum to describe what happens as you move from radio waves to gamma rays.
  - a. Does wavelength **increase, decrease** or **stay the same**?
  - b. Does frequency **increase, decrease** or **stay the same**?
  - c. Does amount of energy in the wave **increase, decrease** or **stay the same**?
  
14. Why do we have to go to space to see all of the electromagnetic spectrum?

☺👉 Navigate to: <http://science.hq.nasa.gov/kids/imagers/ems/waves3.html>

15. [radio waves] Why does a radio telescope have to be so large?

16. Why do scientists use several radio telescopes in an array?
17. What advantage do radio telescopes have over optical (light) telescopes?
- 18.[microwave] In the 1960s, a pair of scientists at Bell Laboratories detected background noise using a low noise antenna. What is the significance of this discovery?
19. [infrared] Satellite telescopes photograph infrared images in space. Why would we use infrared to study our planet?
20. [ultraviolet] Why do astronomers use ultraviolet light to study the universe?
- 21.[gamma ray] What is a gamma ray?
22. In terms of our sun's energy output, how much energy can be released in one gamma ray burst?

☺👉 Navigate to: <http://www.cfa.harvard.edu/seuforum/galSpeed/>

Read the Introduction "Frozen in Time?" Now open another page in your browser to the Virtual Spectroscope. Tile the pages so that you can see both at the same time. (Ask for help if you need it.) There are six steps in this exercise, and you need to complete them in order.

The Virtual Spectroscope page has three graphics. The first is the spectroscope, the second is the emission graph and the third is a reference spectrum. You will be using the bar in the emission graph to track various wavelengths.

23. In step 1, you can see significant decrease in intensity in the sun's infrared range. Place the bar on the lowest dip and record below the wavelength and intensity at that location. (The exact numbers are found in the upper right corner of the emission graph.)

Wavelength: \_\_\_\_\_ intensity: \_\_\_\_\_

24. In step 2, what is the relationship between the spikes (high peaks) on the emission graph and the colors that appear in the spectroscope?
25. In step 3, looking at the spectroscope and emission graph which of the two dominant wavelengths in the hydrogen spectrum should be easier to distinguish in a galaxy's spectrum?
26. In step 4, based on your observations, what do you predict you will observe if a source of waves moves towards you? (circle your choice)

The wavelength of the waves will appear **shorter**, **longer** or **the same** as when the source is stationary.

27. In step 4, based on your observations, what do you predict you will observe if a source of waves moves away from you? (circle your choice)

The wavelength of the waves will appear **shorter**, **longer** or **the same** as when the source is stationary.

28. In step 5, based on your experiments with the Doppler Effect, would you conclude that Galaxy 1 is moving away from Earth or towards earth?

29. In step 6 you will calculate the speed with which Galaxy 3 is moving away from earth. Follow the steps below.

- Record ---> Galaxy 3 red wavelength: \_\_\_\_\_
- Subtract Hydrogen's normal red wavelength (656 nm)  
Amount of shift: \_\_\_\_\_
- Divide amount of shift by hydrogen's normal red wavelength.
- Result: \_\_\_\_\_
- Your answer is the fraction of the original wavelength that corresponds to the fraction of the speed of light at which the galaxy is moving!
- Now multiply the fraction by the speed of light to calculate how fast Galaxy 3 is moving away from Earth.

Galaxy 3 is moving away at a rate of: \_\_\_\_\_

☺🔗 Navigate to: <http://theor.jinr.ru/~kuzemsky/glembio.html>

30. Who was Georges Lemaitre, and what was his contribution to our understanding of the origin of the universe?

"Georges Lemaitre was...

---

---

---

---

---

---

---

---

---

---