Spectrum Lab Worksheet

The electromagnetic spectrum and research project organizer · Logical Home Schooling

Name: _____ **Date:** _____ **Period:** _____

Purpose: Students will identify and compare characteristics of the electromagnetic spectrum, such as wavelength, frequency, use, and hazards, then research one region in depth.

Link: www.logicalhomeschooling.com/spectrum-lab.html

Objectives

- Identify wave properties and use $c = \lambda f$.
- Compare the seven regions of the EM spectrum by wavelength, frequency, energy, uses, and hazards.
- Distinguish ionizing from non-ionizing radiation.
- Calculate wavelength, frequency, and photon energy ($E = hf$).

Materials: a computer or tablet with Spectrum Lab open, a calculator, a pencil, this worksheet. Time: about 50 minutes for the lab, plus research time.

Key equations. $c = \lambda f$, $c = 3.00 \times 10^{8}$ m/s · $E = hf$, $h = 6.626 \times 10^{-34}$ J·s · 1 nm = 10^{-9} m, 1 MHz = 10^{6} Hz, 1 GHz = 10^{9} Hz. **Memory trick** (long to short wavelength): *Rich Men In Vegas Use X-ray Glasses*.

Part 1: Stage 1, Wave properties

Sketch a wave. Label a **crest**, a **trough**, the **wavelength (λ)**, and the **amplitude**.

1. Define frequency and give its unit.

   _____

2. When the wavelength got shorter, what happened to the frequency? Why?

   _____

3. What did λ × f always equal? What does that tell you about all EM waves?

   _____

Part 2: Stage 2, Compare the seven regions

Use the fact sheets. This table is your comparison data for the research project.

Region	Wavelength range	Size compared to	Everyday and industry uses	Harmful, helpful, or both?
Radio				
Microwave				
Infrared				
Visible				
Ultraviolet				
X-ray				
Gamma				

4. As you move from radio waves to gamma rays, what happens to wavelength, frequency, and energy?

Part 3: Stage 3, Helpful or harmful?

Region	Photon energy (eV)	Ionizing? (yes / no)
Radio		
Microwave		
Infrared		
Visible		
Ultraviolet		
X-ray		
Gamma		

1. What does "ionizing" mean, and why is ionizing radiation dangerous to living things?

2. A friend says Wi-Fi is as dangerous as X-rays because both are "radiation." How would you respond?

Use or effect	Region	Use or effect	Region
Microwave oven		Rainbow	
FM radio station		Sunburn	
MRI scan		Black light	
Wi-Fi router		Broken-bone image	
TV remote		Airport bag scanner	
Thermal camera		Sterilizing with cobalt-60	

Part 4: Stage 4, Calculations

Problem	Work	Answer
λ of an FM station at 98.1 MHz		
f of green light, λ = 530 nm		
λ of Wi-Fi at 2.4 GHz		
E of a green-light photon		
E of an X-ray photon, λ = 0.10 nm		
How many times more energy?		

1. A microwave oven uses 2.45 GHz. Find the wavelength in cm.

2. A red laser pointer has λ = 650 nm. Find its frequency and the energy of one photon.

Research Project Organizer

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My region of the spectrum: _____

Research item	My notes
1. Compare and contrast with the other types of radiation (use your Part 2 table)	
2. Wave properties (how it travels, speed, what produces it, how it interacts with matter)	
3. Characteristics: wavelength range, frequency range, photon energy	
4. Interesting facts, everyday uses in our personal lives, and **uses in industry**	

5. Visual representation: sketch a plan for your visual (a labeled wave, a diagram of a device, or where your region sits on the spectrum).

6. Is it harmful? Is it helpful? Ionizing or not? How do people stay safe?	

Source log (at least three reliable sources: .gov, .edu, encyclopedias, science organizations)

#	Title and author or organization	Website or book	Date used
1			
2			
3			
4			

Conclusion

Write 3 to 5 sentences: how does your region compare with the rest of the spectrum, and should people use it, avoid it, or use it with care? Use the words **wavelength**, **frequency**, **energy**, and **ionizing**.