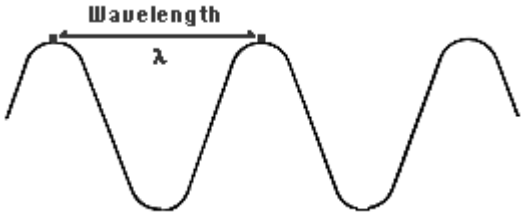
Name_____ Class Period: _____

The Relationship between Wavelength and Frequency in the Electromagnetic Spectrum

Purpose: To discover and verify the relationship between Wavelength and Frequency of the Electromagnetic Spectrum.

Background Information: **Visible light** is Electromagnetic radiation at wavelengths which the human eye can see. We perceive this radiation as colors ranging from red (longer wavelengths; ~ 700 nanometers) to violet (shorter wavelengths; ~400 nanometers.)

The visible light from the Sun is actually composed of the colors red, orange, yellow, green, blue, and violet, which can become distinguishable when sunlight passes through a prism. A good way to remember the order of the colors is to note that the first letters of the colors spell out the name ROY G. BV. We can think of light traveling in waves with properties of wavelength and frequency. **Wavelength** is the distance between identical locations on adjacent waves (see figure below).



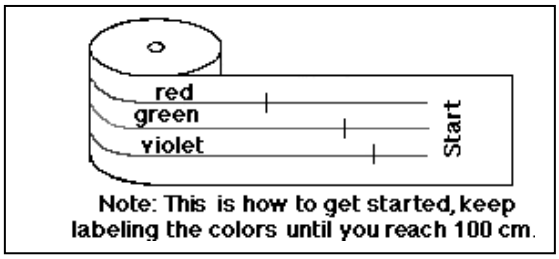
Frequency is the number of complete waves, or wavelengths, that pass a given point each second. All light travels at the same speed, but each color has a different wavelength and frequency. It is their different wavelengths that cause the different colors of light to separate and become visible when passing through a prism.

Materials:

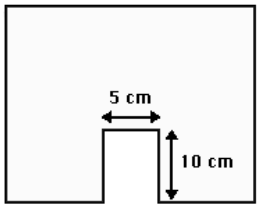
Adding machine tape	Set of red, green and violet (purple) pencils	Manila folder
Meter stick	Scissors	4 books
Timer	Masking tape	Extra pencil or dowel

Procedure:

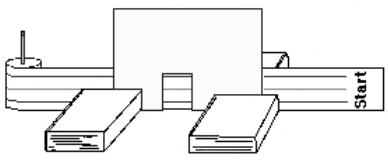
1. Draw a vertical line about 20 cm from the beginning of the adding machine tape and label it "Start" (see diagram).
2. With the metric ruler, make a point 100 cm from the starting point.
3. Draw a vertical line and label it "End".
4. Cut the tape off of the roll leaving about 20 cm space between "End" and where you cut.



5. Use the colored pencils to draw three evenly spaced horizontal lines along the tape from Start to End.
6. Make the top line red, the middle line green and the bottom line violet to represent three different colors in the spectrum of light.
7. Divide the red line every 14 cm with dark marks in red pencil. The green line should be divided every 10 cm and the violet every 8 cm. The marks that you make on the three color lines will represent the different wavelengths of the different colors of light.
8. Use masking tape to fasten the marked adding machine tape to a pencil.
9. Cut a manila folder along its crease.
10. Then cut a rectangle out of the center of one of the long sides. This rectangle should be about 10 cm high and 5 cm wide as shown below.



11. Set the manila folder cut out on the table supporting it with the four books (see below).



12. Feed the end of the adding machine tape through the narrow space between the manila folder and the two back books until "Start" appears in the middle of the opening in the manila folder.
13. Sit in front of the tape and manila folder model.

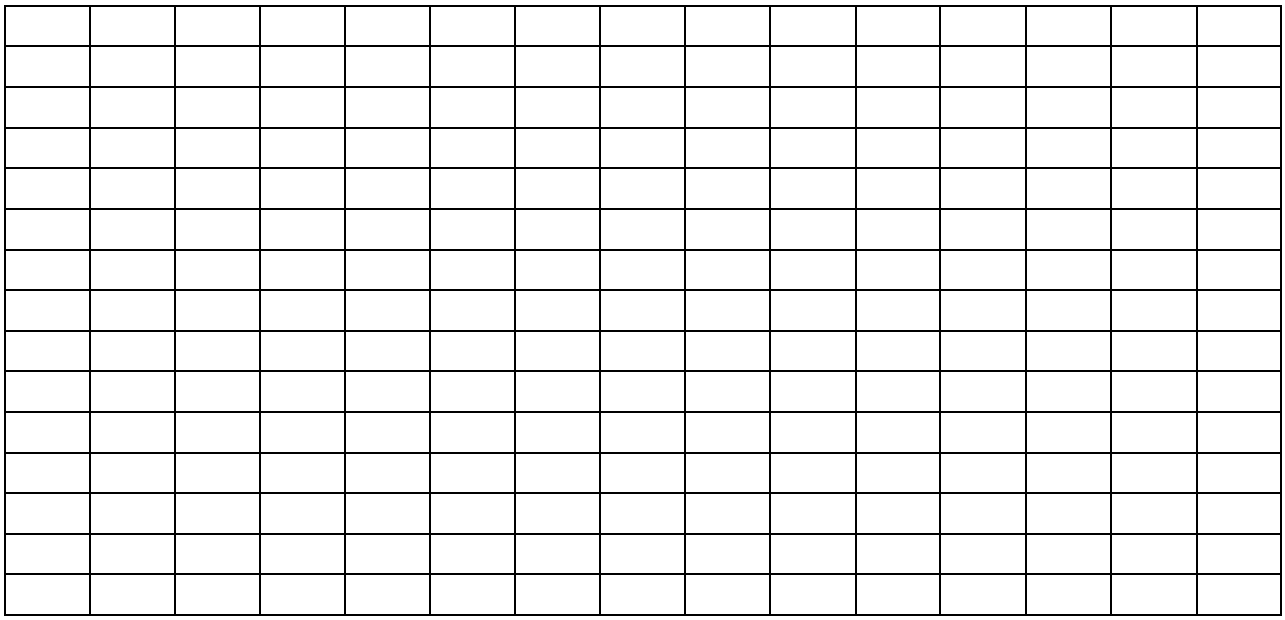
14. Time Keeper should call "start" and begin timing as he or she slowly pulls the tape along. *Try to pull the tape at about the same speed for every trial!*
15. Tally in the appropriate box on the data table every time he or she sees a wavelength mark.
16. When "End" appears, tell the Time Keeper to stop timing.
17. Make a "trial run" and then repeat the procedure in order to collect the data.
18. On the data table, determine and record the average number of wavelengths observed for each color and the average time (in seconds) from start to finish.
19. Determine and record the frequency for each of your colored light waves. *Note: frequency is defined as the number of wavelengths passing a given point per second.*

Data Table:

	Trial Run		**Trial 1**		**Trial 2**		**Trial 3**		Average (Total÷3)	**Frequency** (Average÷Time)
	Tally	**Total**	**Tally**	**Total**	**Tally**	**Total**	**Tally**	**Total**		
Red										
Green										
Violet										
Time										

Data Analysis: Make a graph to compare light color (x) to frequency found (y). Label the x, y axis and all data.

Title: _____



Conclusion Questions:

1. Look at the wavelengths and frequencies of the three waves. What patterns do you notice about the relationships between the three colors?

2. Which color had the shortest wavelength?

3. Which color had the longest wavelength?

4. Which color had the highest frequency?

5. Which color had the lowest frequency?

6. What is the relationship of the red ***wavelength*** to the green ***wavelength***?

7. What is the relationship of the red ***wavelength*** to the violet ***wavelength***?

8. What is the relationship of the red ***frequency*** to the green ***frequency***?

9. What is the relationship of the red ***frequency*** to the violet ***frequency***?

10. If waves are moving at the same speed, what is the relationship between ***wavelength*** and ***frequency***?

11. Based on the above relationship, if you were to look at a blue wave, would it have a higher or lower ***frequency*** than the green wave?

12. Based on the above relationship, if you were to look at an orange wave, would it have a longer or shorter ***wavelength*** than the green wave?