Instructor: Ghazwa Al-Doori **Date** _____
Subject: Honors Chemistry **Grade Level:** 10th grade
Model 1/Title. Arrangement of Electrons in Atoms
Day 1/Concept. The Electromagnetic Spectrum
Objectives:

1. Explain the mathematical relationship among the speed, wavelength, and the frequency of the electromagnetic radiation.
2. Discuss the dual wave-particle nature of light.

Duration/Grade Level: One 45 minutes period/ 10th grade Honors Chemistry Class.
Direct instructions:

- Describe the principles of electromagnetic radiations.
- Understand the basic theory of light as a kind of electromagnetic radiation.
- Describe how this type of energy exhibits wave-like behavior as it travels through space.
- Describe the repetitive nature of wave motion and how its characterized by measurable properties of wave length and frequency.
- Define wavelength and frequency and introduce their symbols (λ) and (ν).
- Understand the particle description of light and explain Plank's study of the emission of light by hot objects.
- Objects emit energy in small, specific packets called quanta.
- Define quantum and the relation between the quantum and frequency of radiation.
- Define the photoelectric effect phenomena and Einstein's description of the Photon.
- Describe how the energy of a particular photon depends on the frequency of the radiation.

Guide Practice:

- Model 1 will be handed out. All students are given 5-10 min. for individual reading and connecting with given instructions.
- Students are set in groups of three to work on the critical thinking questions.
- Each group will provide their answers and share them with the class.
- Discuss answers for each question within groups and with instructor.

Independent Practice: At the end of this hand out is the take home questions which is assigned to be worked on independently at home and handed in before starting the next class.
Assessment based on objectives: Home Work is graded as part of students' assessment.
Next class preparation: The second part of the HW Is to work on the W/S activity attached to Model1.

Model 1 Arrangement of Electrons in Atoms

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Day1/Concept: The Electromagnetic Spectrum
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1. Explain the mathematical relationship among the speed, wavelength, and the frequency of the electromagnetic radiation.
2. Discuss the dual wave-particle nature of light.

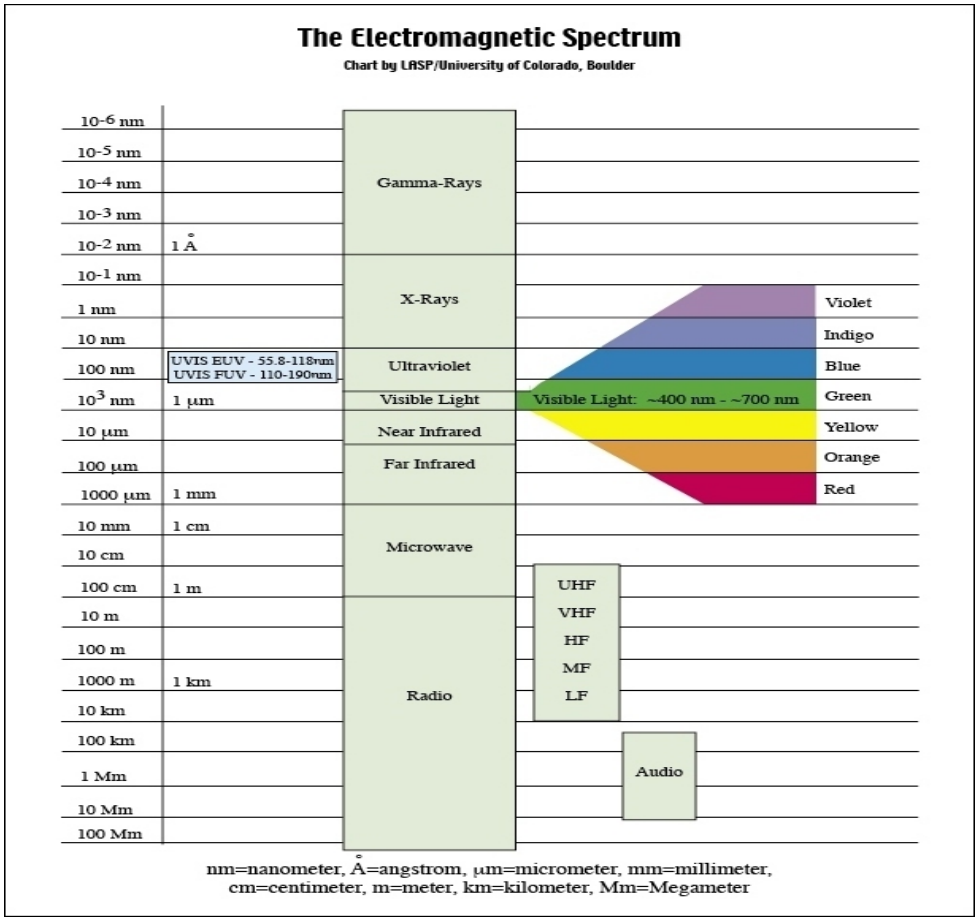
Properties of light

In the twentieth century studies revealed a relationship between light and an atom's electron. This led to the understanding of the nature of energy, matter, and atomic structure. Before 1900, scientists thought light behaved solely as a wave. Later it was discovered that light also has particle like characteristics.

The wave description of light

Visible light is a kind of electromagnetic radiation. Other kinds of electromagnetic radiation include X-ray, ultraviolet, infrared, microwaves, and radio waves. Together all the forms of electromagnetic radiation forms the electromagnetic spectrum fight.

Figure 1 the electromagnetic spectrum



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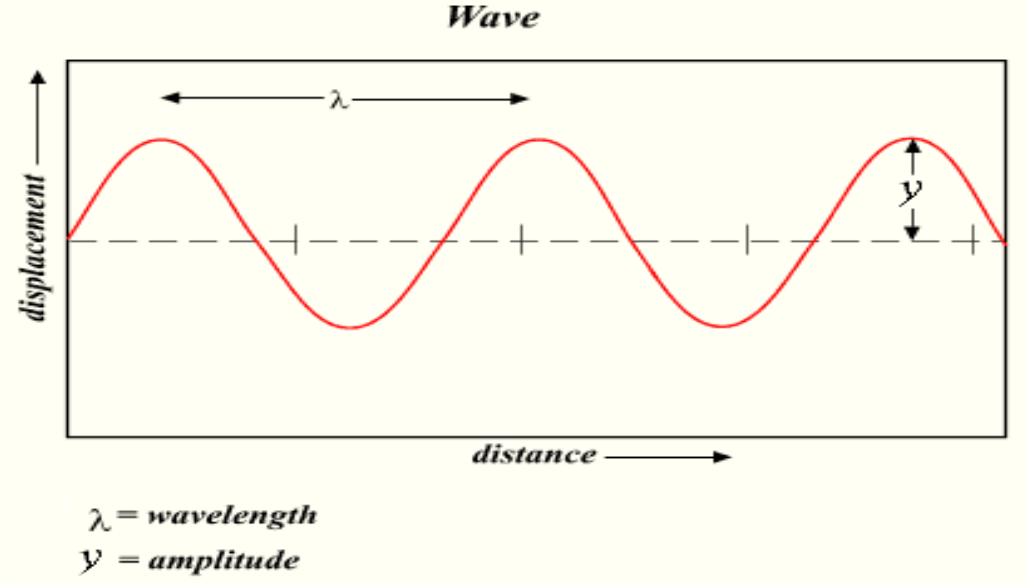
Day1The Electromagnetic Spectrum

All forms of electromagnetic radiation move at a constant speed of $3.00x10^8$ through vacuums and at slightly slower speed through matter.

All electromagnetic radiation have wave motion which repetition in nature and characterized by a measurable properties of
1. Wavelength (λ)
2. Frequency (v)

Wavelength: is the distance between corresponding points on adjacent waves and has a distance unit.
Frequency is defined as the number of waves that passes a given point in one second, and has a unit called hertz (H_2). Frequency is expressed in wave/sec.

Figure 2 wavelength and amplitude



Frequency and wavelength are mathematically related to each other as follows.

$$c=\lambda v$$

Because c is the same for all electromagnetic radiation, the product λ v is constant. Consequently λ is inversely related to v. In other words, as the wavelength of light increases, its frequency decreases.

Critical Thinking Questions

1. In what form does the electromagnetic radiation travel?

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Day1The Electromagnetic Spectrum

2. From fig. 1 what portion of the electromagnetic spectrum is visible to the human eye?

3. Arrange the visible light color from longest to shortest wavelengths?

4. Calculate the speed of light from the data for infrared radiation, using the following equation: $c=\lambda v$. How does this compare to the known value (3.00×10^8 m/s).

The particle description of light

Max plank studies the emission of light by hot objects. He suggested that the object emits energy in small, specific packets called quanta. A quantum of energy is the minimum quantity of energy that can be lost or gained by an atom. He proposed the following equation.

$$E= h v$$

E= energy in Joules
v = frequency in s^{-1}
h = $6.6_2 \times 10^{-34}$J.s

Albert Einstein expanded on planks theory and introduced the idea the electromagnetic radiation has dual waves- particle nature.
Einstein called this particle a photon.

Critical thinking Questions:

1. Define: electromagnetic spectrum, photon, quanta, wavelength, and frequency.

2. What is the energy, in joules, of a microwave photon?

3. What is meant by the dual wave- particle natured of light?

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Take Home Questions:

1. List five examples of electromagnetic radiation.

2. How are the wave length and frequency of electromagnetic radiation related?

3. How are the energy and frequency of electromagnetic radiation related?

4. How are the energy and wave length of electromagnetic radiation related?

5. Determine the energy in jewels of a photon who's frequency is 3.55×10^{17} Hz.

6. Using the two equations, $E = h\nu$ and $c = \lambda\nu$ derive an equation expressing E in terms of h, c, and λ.

7. How long would it take a radio wave who's frequency is 7.25×10^{5} Hz to travel from Mars to Earth if the distance between the two planets is approximately 8.00×10^{7} km?

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Home Work/preparation

There are ten fake addresses on the board. Copy the down to be able to work on your homework.
Use the format of street name, house/ apartment number, and Zip code. These items describe the location of student's residence.

1. How many students have the sane Zip code?

2. How many live on the same street?

3. How many have the same house number?

4. Create a unique address for each student, in the same way that no two houses have the same address. No two electrons in an atom have the same set of four quantum numbers.