

Modern Atomic Theory Rutherford's Atom and Electromagnetic Spectrum (EMS)

Atoms and Energy

- The concept of atoms helps explain why compounds always have the same composition.
 - A specific compound always contains the same types and numbers of atoms.
- It also helps explain how chemical reactions occur,
- The rearrangement of atoms.

Atoms and Energy

In an earlier unit, you learned that an atom has a <u>positively</u> charged <u>nucleus</u> composed of <u>protons</u> and <u>neutrons</u> tits center and <u>electrons</u> moving around the nucleus in a space very large compared to the size of the nucleus.

Certain elements can be grouped together because they behave similarly because of the way the electrons are arranged.

Rutherford's Atom

- An atom has a small positive core (nucleus) with negatively charged electrons moving around the nucleus in some way.
- The nuclear atom resulted from Ernest Rutherford's gold foil experiment with α particles.



Rutherford's Atom

Let's Review

Nuclear Model of the Atom

- The atom has a small dense nucleus which
 - Is positively charged
 - Contains protons (+1 charge)
 - Contains neutrons (no charge)
- The remainder of the atom
 - Is mostly empty space
 - Contains electrons (-1 charge)

Rutherford's Atom

- A question that Rutherford did not answer is, "What are the electrons doing?"
 - He suggested that they might revolve around the nucleus like the planets revolve around the sun in the solar system.

 But could not explain why the negative electrons aren't so attracted into the positive nucleus that the atoms collapse.

- Energy is transmitted from one place to another by light or electromagnetic radiation.
- Electromagnetic radiation \rightarrow radiant energy that exhibits wavelike behavior and travels through space at the speed of light in a vacuum.
- Examples include:
 - X rays, microwaves, radio waves, infrared waves, and "white" light from a light bulb

- A wave is characterized by 3 properties:
 - 1. Wavelength \rightarrow the distance between 2 consecutive peaks or troughs in a wave.
 - Symbolized by the Greek letter lambda, λ.



- A wave is characterized by 3 properties:
 - 2. Frequency \rightarrow the number of waves (cycles) per second that pass a given point in space.
 - Symbolized by the Greek letter nu, v.





- A wave is characterized by 3 properties:
 - 3. Speed of a wave indicates how fast a given peak travels.
- Like water, light (electromagnetic radiation) travels in waves.
 - Electromagnetic radiation types differ in their wavelength.





Radiation provides an important means of energy transfer.

Dual Nature of Light

Another way to think of a beam of light traveling through space is as a stream of tiny packets of energy called photons.

▶ <u>Photon</u> \rightarrow a particle of electromagnetic radiation.

Light seems to consist of both waves and a stream of particles of energy.
This is called the wave-particle nature of light.





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Light as a wave



Light as a stream of photons (packets of energy)

Energy and Light Chemistry in Your World Plants Seeing Red

Plants use proteins called phytochromes to sense light in the red (640 – 670 nm) and the far red (700 – 750 nm) ranges.

If the plant senses a lot of far red light, it thinks it has a lot of competition and therefore will grow taller and thinner to compete more successfully for sunlight.

Energy and Light Chemistry in Your World Plants Seeing Red

By using red plastic mulch, tomato plants can be fooled into "thinking" they are crowded and lead to faster seedling growth and earlier, larger fruit production.

Different wavelengths of EM radiation carry different amounts of energy.



The longer wavelength of light, the lower the energy of its photons.

The End