The Electromagnetic Spectrum

- I can explain why we see colors.
- I can describe the electromagnetic spectrum.

- Describe light.

Light

- Light has properties of both a particle and a wave.
- Light is made of packets of energy called photons.

Light

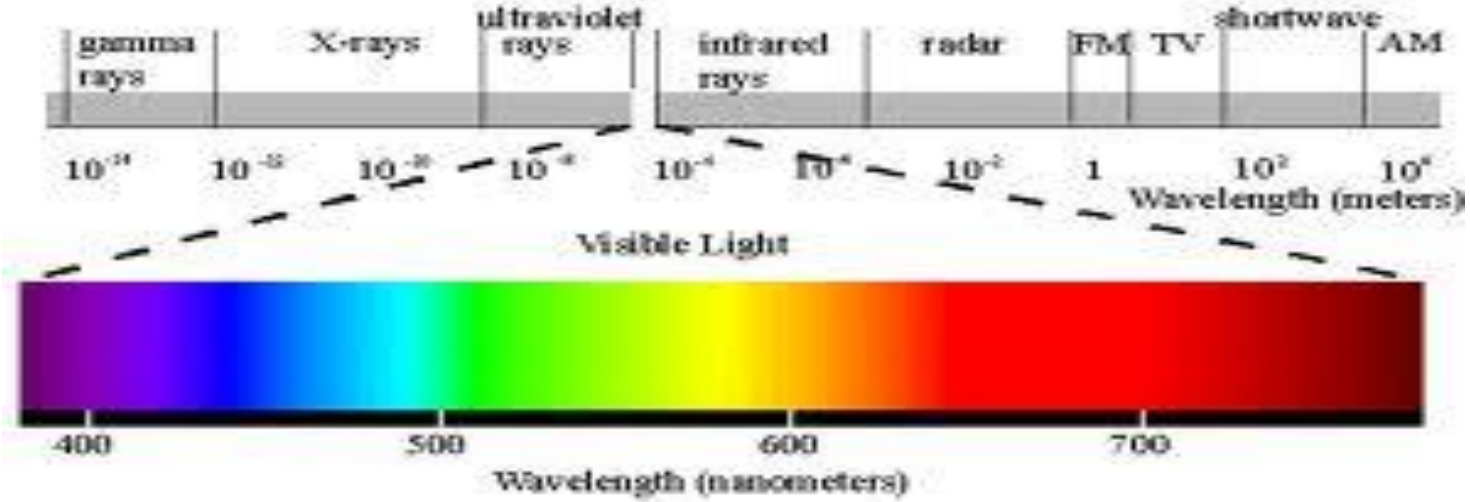
- Photons travel in waves like sound.
- Light waves are electromagnetic waves, like X-rays and radio waves.

The Spectrum

- The electromagnetic spectrum goes as follows:
  - Gamma rays → X-rays → UV light → Visible spectrum → infrared → microwaves → TV → radio
  - What colors are found in the visible spectrum?

The Spectrum

- The visible spectrum is made of the colors ROYGBIV.



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Visual Stimulus

- Which color of light has the most energy?
- Which color of light has the least energy?

Color

- Violet has the shortest wavelength and the most energy.
- Red has the longest wavelength and the least energy.

- Why do we see the color blue?

Color

- Why do you see the color red?
  - Red is reflected and all other colors are absorbed.

Color

- White light is a combination of all the colors.
- Black is the absence of color.

Planck's Theory

- Planck developed a theory that states there is a limit to the amount of energy an object can absorb or emit.
- He called these pieces of energy quanta.

Planck's Theory

- The quantization of energy is the basis for the currently accepted model of electron structure.
- In other words, there is a limit to the amount of energy an electron can absorb or emit.

Review Questions

1. Describe light.
2. What are the packets of energy light is made out of?
3. What are the colors of the visible spectrum?
4. What color of light has the longest wavelength and least energy?
5. Explain why we see colors.
6. What does Planck's Theory state about electrons and energy?

Atomic Orbitals

- I can identify the different atomic orbitals.
- I can explain how electrons are arranged around the nucleus.

- Describe how electrons move around the nucleus.
- Where would you expect electrons with the most energy to be, closer to the nucleus or farther away?

- Electrons occupy different energy levels.
- They are arranged around the nucleus from lowest to highest energy levels.

- The principal energy level is represented by the letter n.
- N is a whole number from 1-6.

- The bigger n is, the farther away the electrons are from the nucleus.
- Within the energy levels, there are sub-levels that the electrons fill called orbitals.

- N is equal to the number of sublevels available for electrons to fill.

Principle Energy Level	Number of sublevels
N=1	1
N=2	2
N=3	3
N=4	4

Orbitals

- Electrons are found in atomic orbitals around the nucleus.
- There are four types of orbitals.

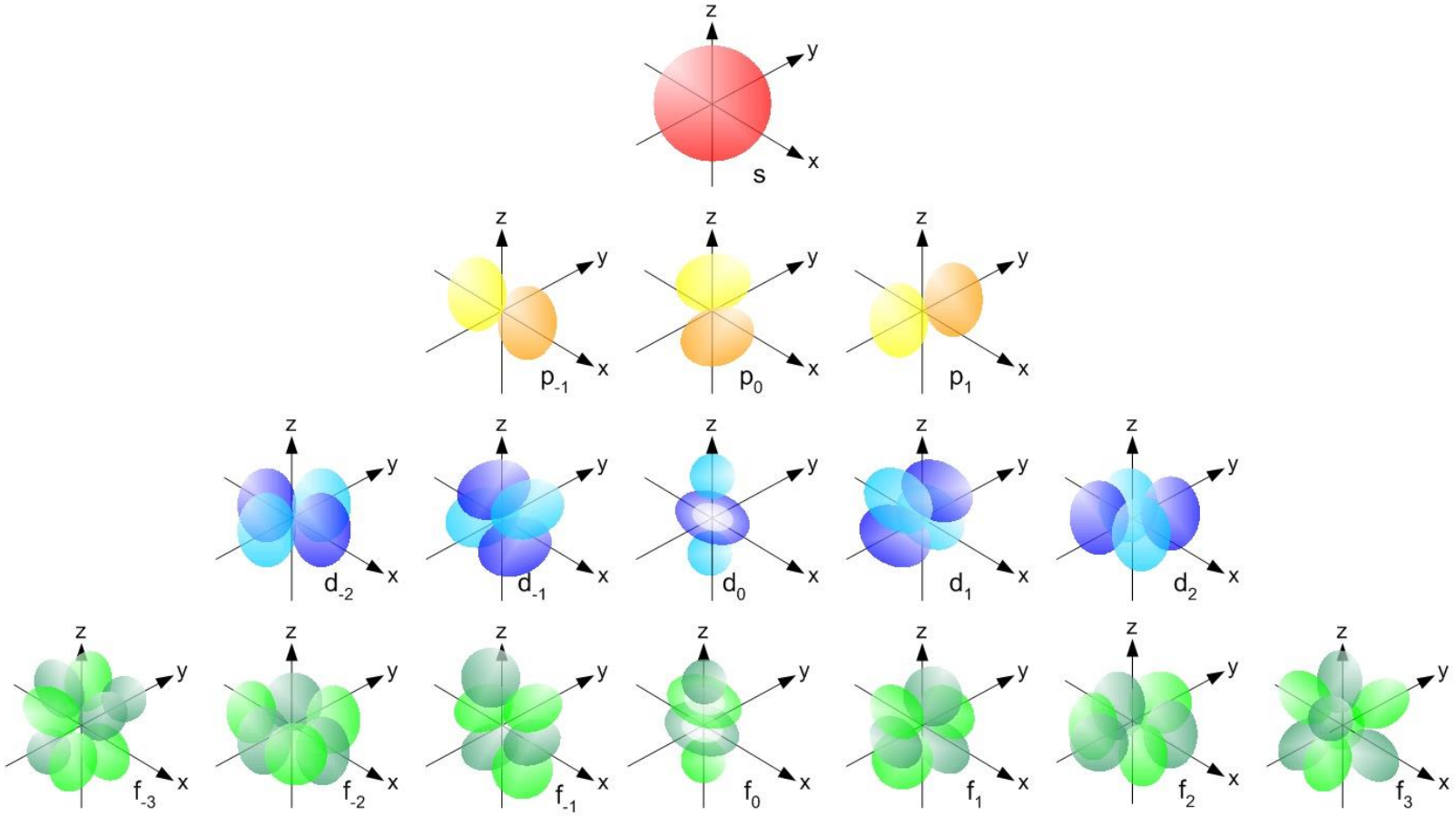
Orbitals

- Each orbital has its own shape and energy level.
- The four orbitals are represented by the letters: s, p, d, f

Orbitals

- The s orbitals can hold 2 electrons.
- The p orbitals can hold 6 electrons.
- The d orbitals can hold 10 electrons.
- The f orbitals can hold 14 electrons.

Shape of s, p, d, and f orbitals



Review Questions

- How are electrons arranged around the nucleus in terms of energy?
- What is N?
- If n is bigger, are electrons closer to or farther from the nucleus?
- What are the four orbitals and how many electrons can they hold?

Concert Rules

- The seats at the concert must be filled using these rules:

    1. Follow the seating chart.

    2. The s sections can only hold 2 people.

    3. the p sections can hold 6.

    4. The d sections can hold 10.

    5. The f sections can hold 14.

- People will fill every other seat before they pair up.
- People will be represented by arrows.

- Record the seating information if 10 people arrive.
- Record the seating information if 15 people arrive.

- What seat will the 13^{th} guest to arrive sit in?

- What seat will the 29^{th} guest to arrive sit in.

Electron Configuration Notes

- I can write the electron configuration for any element.
- I can identify the four different orbitals and how many electrons fill each.
- I can follow the rules for electron configurations.

- The way in which electrons are arranged around the nuclei of atoms is called electron configurations.
- There are three rules describing electron configurations.

- Which orbital, s, p, d, or f do you think has the lowest energy?
- Which would fill first, s, p, d, or f? Why?

Aufbau Principle

1. Electrons enter orbitals with lowest energy first.
2. The s sublevel always has the lowest energy.

- How many electrons could each section hold at the concert?
- Why did we draw up and down arrows to represent the people at the concert?

Pauli Exclusion Principle

1. An atomic orbital can only describe two electrons.
2. To occupy the same orbital, electrons must have opposite spins.
3. Spins are represented by up and down arrows.

- How did we fill in the sections at the concert? Why did we fill every other seat?
- What charge do electrons have? Will they attract or repel when they are close to one another?

Hund's Rule

1. Electrons that occupy orbitals with equal energy must fill in so that one electron enters each orbital until all the orbitals contain one electron with parallel spins.
2. In other words, every other seat must be filled before electrons start to pair up.

- Write the complete electron configuration for Bromine.

- Write the complete electron configuration for Cs.

- How many electrons can each orbital describe?
- Electrons must have _____ spins to occupy the same orbital.
- What orbital (s,p,d or f) will fill first? Why?
- Write the electron configuration for Bromine.

More on electron configurations

- Notes

- I can write the short hand electron configuration for any element.
- I can explain how to identify an element based on its atomic emission spectrum.
- I can explain why fireworks have color.

- If you could develop a shortcut for electron configurations, how would you do it?

- Electron configurations can be written shorthand by taking the noble gas in the row before the electron and putting it in brackets.
- The noble gasses are on the far right of the periodic table.

Examples

- Si
- Ga
- Er

- If I told you the last orbital in an electron configuration is $3d^4$, what element is it? How do you know?

- The last orbital will also tell you what element you have.
- To find the element you are dealing with, look at the last orbital in the electron configuration and find that spot on the periodic table.

- What element sits in the $2p^3$ spot?

- What element sits in the $5s^2$ spot?

- When electrons absorb a quantum of energy, they jump to the next highest energy level.

- When the electrons fall back to their normal energy level, they emit (release) a color of light.
- The color of light is unique to each element.

- Passing the light emitted from an element through a prism gives the atomic emission spectrum.

- The emission spectrum is unique to a specific element.
- Unknown elements can be identified using the emission spectrum.

- Fireworks and neon signs work because of the unique emission spectrums of elements.

- http://www.youtube.com/watch?v=jJvS4uc4TbU

Review Questions

- What elements are put in brackets when writing electron configurations in shorthand?
- Which part of an electron configuration identifies the element you are working with?
- Write the shorthand electron configuration for Silver.
- What element sits in the $4p^3$ spot?
- Explain what happens to electrons when they absorb energy.