

Quantum Mechanics Model Web-Quest

Write Answers on a separate sheet of paper. Questions 1-19 do not need to be in complete sentences. Make sure your computer has the latest version of JAVA installed. <http://java.com/en/download/index.jsp>

Introduction: You will remember from Physical Science and our unit on atomic structure, that the most common model of the atom is the Shell Model or more commonly known as the Bohr Model. However, this model was shown to be an inaccurate representation for all atoms on the Periodic Table of Elements. Our more modern view of the atom, according to Chemists and Physicists, is the Wave Mechanical or Quantum Mechanical Model of the atom. The essence of Quantum Mechanics and Relativity Theory states that all things are actually waves... even particles like proton, electrons, atoms, baseballs, satellites all have wave functions. We will use this web-quest to gain a better understanding of this model.

You should already know:

- Waves can be described by their speed, wavelength and frequency.
- All electromagnetic waves move at the same **speed**, the “speed of light” which is 3.0×10^8 m/s, 186,000 miles/sec, or 670,000,000 miles/hr).
- **Wavelength**, represented by (the Greek letter lambda, λ) is the distance between crests in the wave.
- **Frequency**, represented by (the Greek letter nu, ν) is the number of wave cycles that happens per unit of time. The SI unit for frequency is cycles per second called a hertz (Hz)

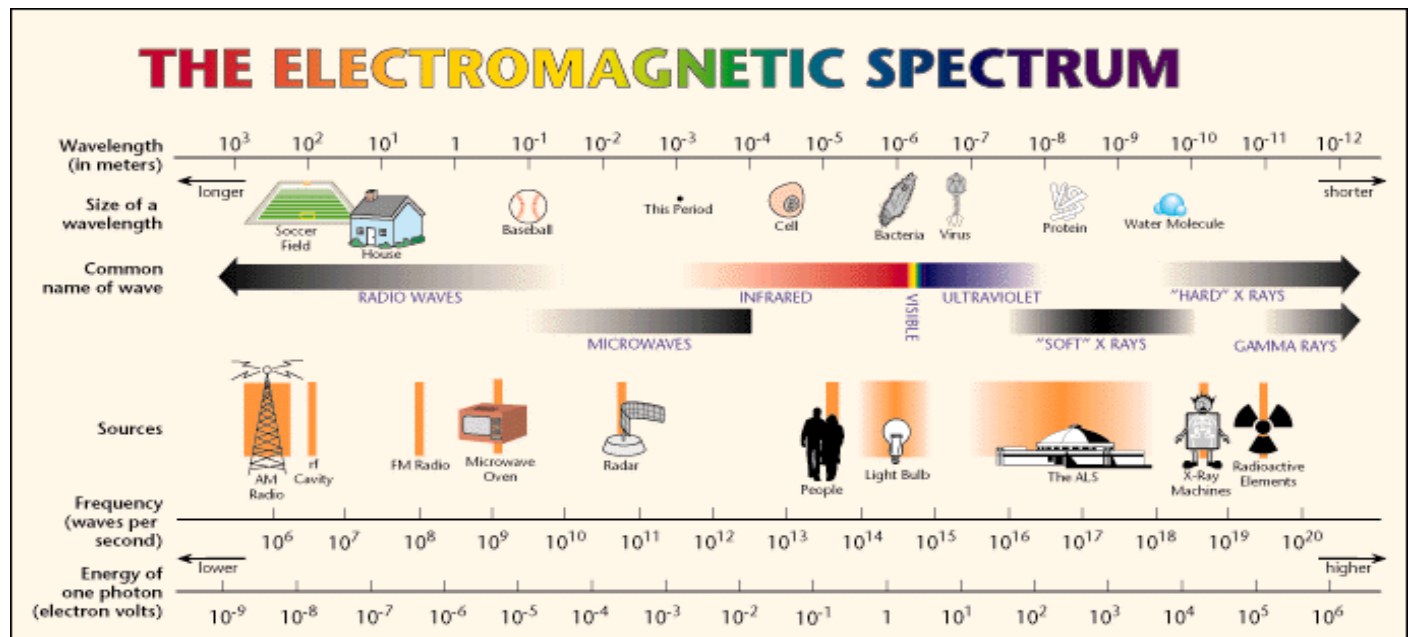
Vibrating Charges and Electromagnetic Waves = Radiation

http://www.colorado.edu/physics/2000/waves_particles/wavpart4.html

Typically when something “shakes” it makes a wave. Use your mouse to drag the negative charge up or down by different amounts, then let it go to start oscillating. Now use the slider to adjust the tension which makes for quicker repeats of a cycle, this means a higher frequency. Read the discussion below the wave animation and then answer the following question.

Q1: What happens to the wavelength as the frequency increases (having more cycles per sec)?

What happens to the wavelength as the frequency decreases?



The Electromagnetic Spectrum Momentarily use the chart above for the next questions, then revert back to the webpage.

Q2: Using the chart above, answer the following questions. List the 8 common names of electromagnetic radiation in order of longest to shortest WAVELENGTH.

Q3: Which type electromagnetic wave has a wavelength that is about 10m to 1000m long?

Q4: What are the two types of waves that have the highest energy per photon? Do you think this has a correlation to possible cell damage to humans? Explain why you'd think that.

Q5: What is the relationship between the frequencies and energy content of the waves?

Q6: Which waves are the human eyes able to detect or see? In your opinion, is this a large or small part of the entire possibility of photon types (the entire electromagnetic spectrum)?

Back to the webpage...click on the “Quantum atom” link on the bottom right of the page which connects...

Spectral Lines at <http://www.colorado.edu/physics/2000/quantumzone/index.html>

Read this entire page and answer the following questions.

Q7: Physicists know that heating things causes the atoms to “wiggle”. What is ejected from atoms when they wiggle?

Q8: Use the spectral line changer to view the visible spectral lines of at least 4 or 5 elements. Now describe what spectral lines are in your own words? And why is it they could be described as “signatures” or “fingerprints” of elements.

Click on the “Next” button which connects to...

Bohr’s atom <http://www.colorado.edu/physics/2000/quantumzone/bohr.html>

Q9: Define photons and quanta. How does this relate the “Quantum” Mechanical model of the atom as we know today based upon the discoveries of Neils Bohr.

Click on the “Next” button which connects to...

Energy Levels <http://www.colorado.edu/physics/2000/quantumzone/bohr2.html>

We modified Bohr’s ideas to say that Bigger Orbits have higher energy electrons, so we now call the rings of electrons located different distances away from the nucleus “Energy Levels”.

Q10: Describe what is required to allow an electron to jump to a high energy level?

Q11: Describe what happens when an electron returns to its lower energy level?

Click on the “Next button which connects to...

Atomic Spectra at <http://www.colorado.edu/physics/2000/quantumzone/lines2.html>

Atomic Spectra are the “signature” spectral lines released by specific atoms. Specific wavelengths are released by each atom because only specific “jumps” between that atom’s energy levels can occur. Experiment with jumping the electron in the Hydrogen atom to outer and inner orbits to see what happens with the photons absorbed or released.

Q12: If you make the electron jump downward, then return it to the outer ring what do you notice about the photon released or absorbed?

Q13: Start with the electron being highly energized in the outermost shell. Now click to allow it to drop to each of the lower energy level one at a time. What happens...why are three new spectral lines formed on the chart?

David’s Whizzy Periodic Table at <http://www.colorado.edu/physics/2000/applets/a2.html>

This interactive periodic table shows the first 4 periods (rows) of the periodic table. Notice that the atomic emission spectrum of each element is also shown for each element as you click on them in the table. The Bohr-type model on the left will also change with the pink dots representing electrons in the 1st energy level, the yellow dots representing the 2nd energy level electrons, green dots the 3rd, etc.

We will ignore the right side showing the ionization energy for now, but basically this will show that is always requires the least amount of energy (around 10 eV, electronvolts) to remove which ever is the outermost electron.

Click on 5 to 10 different elements to get an idea of what changes each time, just explore.

Q14: Now click on Li, lithium. Click on the “Nucleus View” and describe what you think is represented there?

Q15: Now click on the “Shell View” for Lithium and describe what you see in the left diagram? Be specific about what the pink and yellow dots represent.

Q16: Notice the atomic emission spectrum for Li, what color spectral lines does Li emit?

Q17: In order, click on the following elements: H, He, Li, Be, C, N, O, Cl, Ne, then Na, Mg. Describe what happens every time you proceed down the horizontal row or period. What happens when you jump down to the next row?

Check out a few more and see if your pattern continues.

Q18: In order click on He, Ne, Ar, Kr. What is similar about the number of valence electrons in each and what is different about which energy level the valence e- is/are found in?

Q19: PREDICT before looking...what will be the similarities and differences in electron locations as you click on F, Cl, Br? Now do it and see if your prediction is right.

Summary of what was learned in this webquest. *Please use complete sentences for this last one.*

Q20: Describe some reasons why our current understanding of the atom is known as the Quantum Model.