Lecture 8.

1. Energy Carried by EM radiation

Short wavelength radiation carries more energy than long wavelength radiation.

$$E = \frac{hc}{\lambda} = hf$$

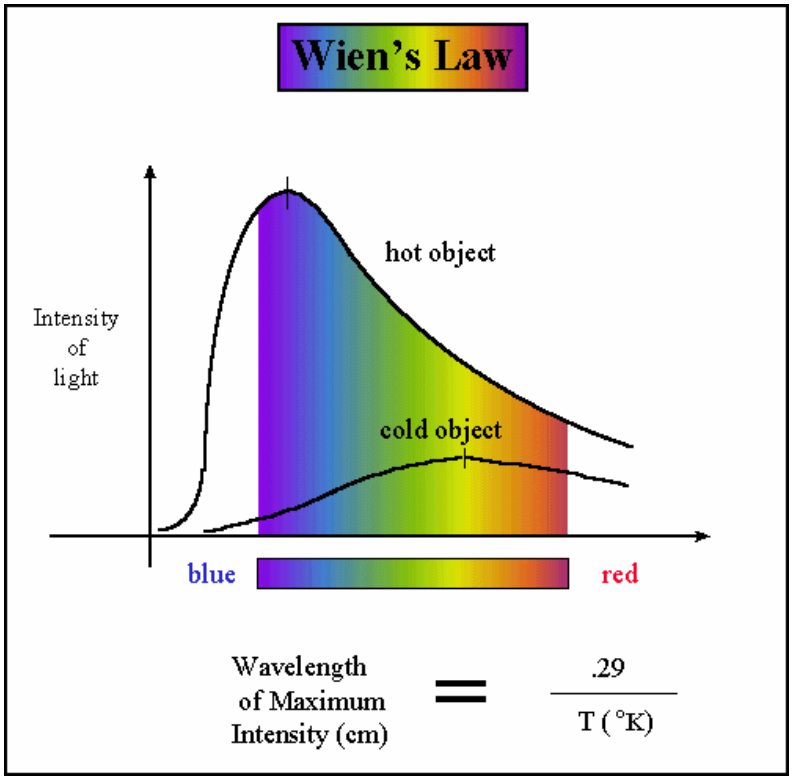
Here h is Plank's constant, and c – is speed of light.
Thus radio waves carry less energy than X-rays.

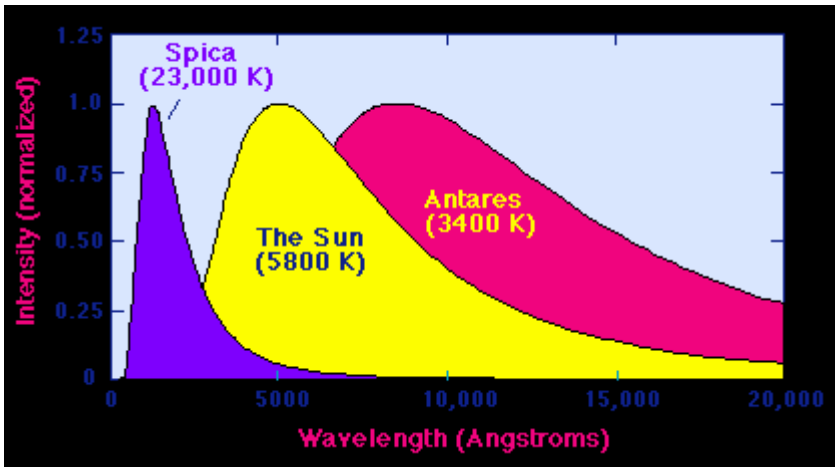
2. Radiation and Temperature

Wien's Law tells us that objects of different temperature emit spectra that peak at different wavelengths.

- Hotter objects emit most of their radiation at **shorter** wavelengths; hence they will appear to be **bluer**.
- Cooler objects emit most of their radiation at **longer** wavelengths; hence they will appear to be **redder**.

Furthermore, at any wavelength, a hotter object radiates more (is more luminous) than a cooler one.





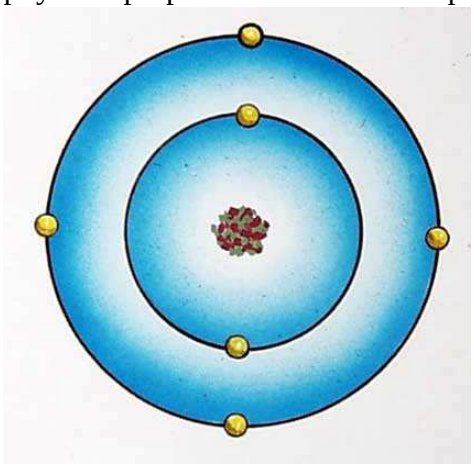
3. Structure of atoms

Atoms are composed of three type of particles: protons, neutrons, and electron. Protons and neutrons are responsible for most of the atomic mass e.g in a 150 person 149 lbs, 15 oz are protons and neutrons while only 1 oz. is electrons. The mass of an electron is very small (9.108×10^{-28} grams).

Both the protons and neutrons reside in the nucleus. Protons have a postive (+) charge, neutrons have no charge --they are neutral. Electrons reside in orbitals around the nucleus. They have a negative charge (-).

It is the number of protons that determines the atomic number, e.g., H = 1. The number of protons in an element is constant (e.g., H=1, Ur=92) but neutron number may vary, so mass number (protons + neutrons) may vary.

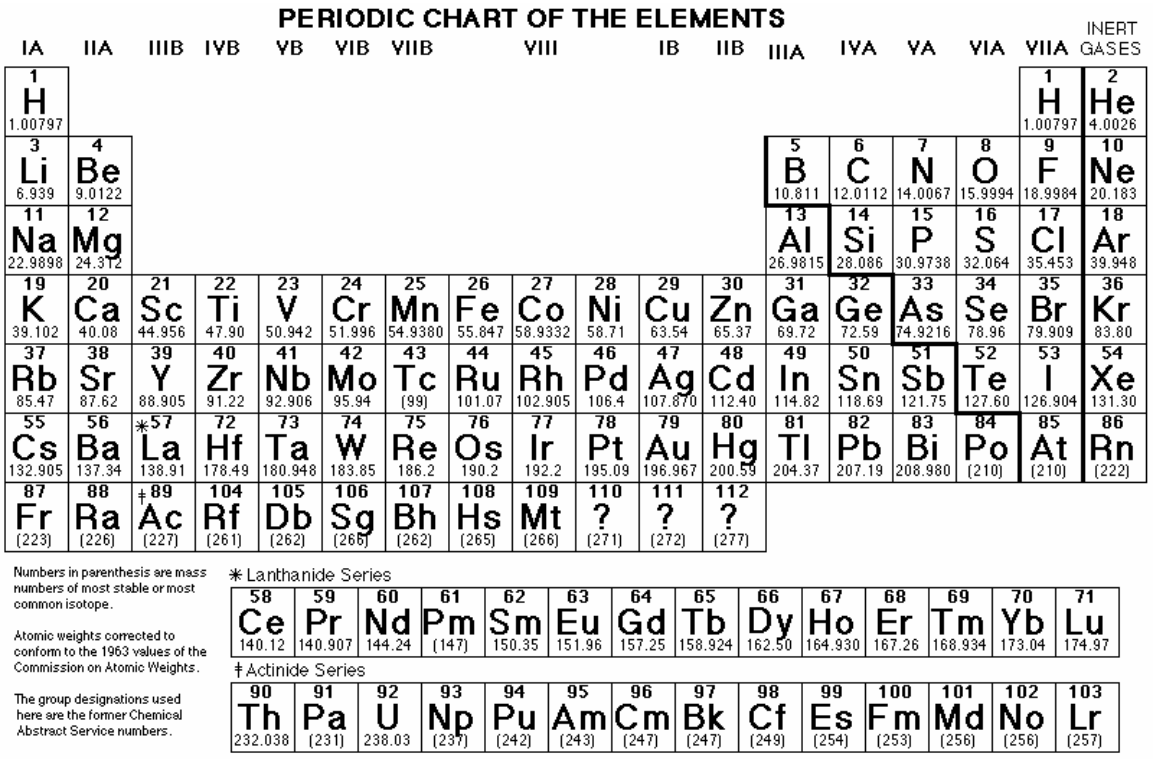
The same element may contain varying numbers of neutrons; these forms of an element are called isotopes. The chemical properties of isotopes are the same, although the physical properties of some isotopes may be different. Some isotopes are radioactive- meaning they "radiate" energy as they decay to a more stable form, perhaps another element half-life: time required for half of the atoms of an element to decay into stable form. Another example is oxygen, with atomic number of 8 can have 8, 9, or 10 neutrons.



4. Periodic table

All matter is made up of elements which are fundamental substances which cannot be broken down by chemical means. There are 92 elements that occur naturally. The elements hydrogen, carbon, nitrogen and oxygen are the elements that make up most living organisms. Some other elements found in living organisms are: magnesium, calcium, phosphorus, sodium, potassium.

By the late 1800's many elements had already been discovered. The scientist Dmitri Mendeleev, a Russian chemist, proposed an arrangement of know elements based on their atomic mass. The modern arrangement of the elements is known as the Periodic Table of Elements and is arranged according to the atomic number of elements.



Atomic number Z tells us the number of electrons and number of protons in the atom.

Atomic mass A tells us the number of neutrons N (N=A-Z)

For example, for Fe: Z=26 (26 electrons, 26 protons), A= 56 (N=56-26=30 neutrons)