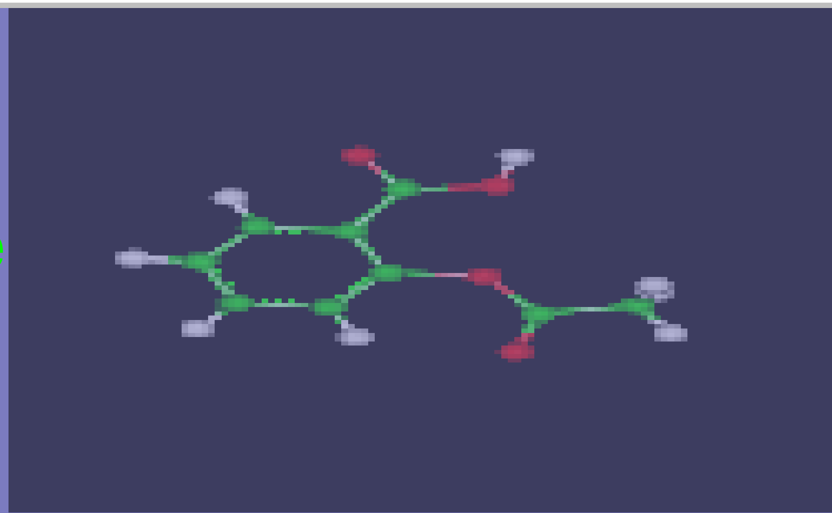
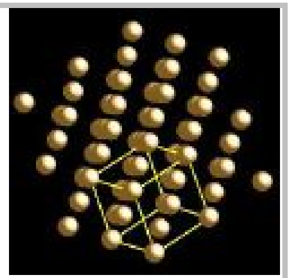
Atoms and the Periodic Table



Dalton's Atomic Theory
1) All elements are composed of atoms, which are indivisible and indestructible particles.
2) All atoms of the same element are exactly alike; in particular, they all have the same mass.
3) All atoms of different elements are different; in particular, they have different masses.
4) Compounds are formed by the joining of atoms of two or more elements. In any compound , the atoms of the different elements in the compound are joined in a definite whole-number ratio, such as 1 to 1, 2 to 1, 3 to 2, etc.

We see the order of God's creation in Atoms

ATOMS



Subatomic particles

Nucleus

Orbitals

Neutrons

Protons

Electrons

Mass

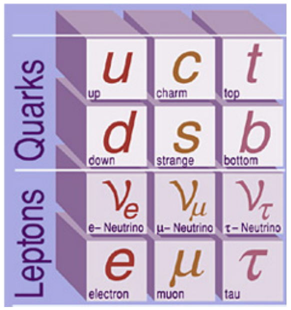
Charge

Important
Facts

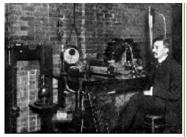
Physicists have discovered that protons and neutrons are composed of even smaller particles called **quarks**.

As far as we know, quarks are like points in geometry. They're not made up of anything else.

After extensively testing this theory, scientists now suspect that quarks and the electron (and a few other things we'll see in a minute) are fundamental.

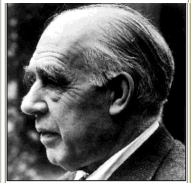


Models



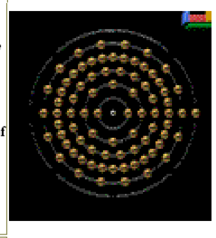
Lord Ernest Rutherford
1871-1937

Ernest Rutherford, who was once a student of Thomson's, is credited with discovering that most of the atom is made up of "empty space." In 1909 he and his assistants conducted the "gold foil" experiment, from which he concluded that "the greater part of the mass of the atom was concentrated in a minute nucleus." In this model, the positively charged nucleus was surrounded by a great deal of "empty space" through which the electrons moved.



Niels Bohr
1913-1963

In 1913, Niels Bohr proposed improvement to Rutherford atomic model. For this reason, the planetary model of the atom is sometimes called the Rutherford-Bohr model. Bohr added the idea of fixed orbits, or energy levels for the electron traveling around the nucleus. This model allowed for the idea that electrons can become "excited" and move to higher energy levels for brief periods of time.



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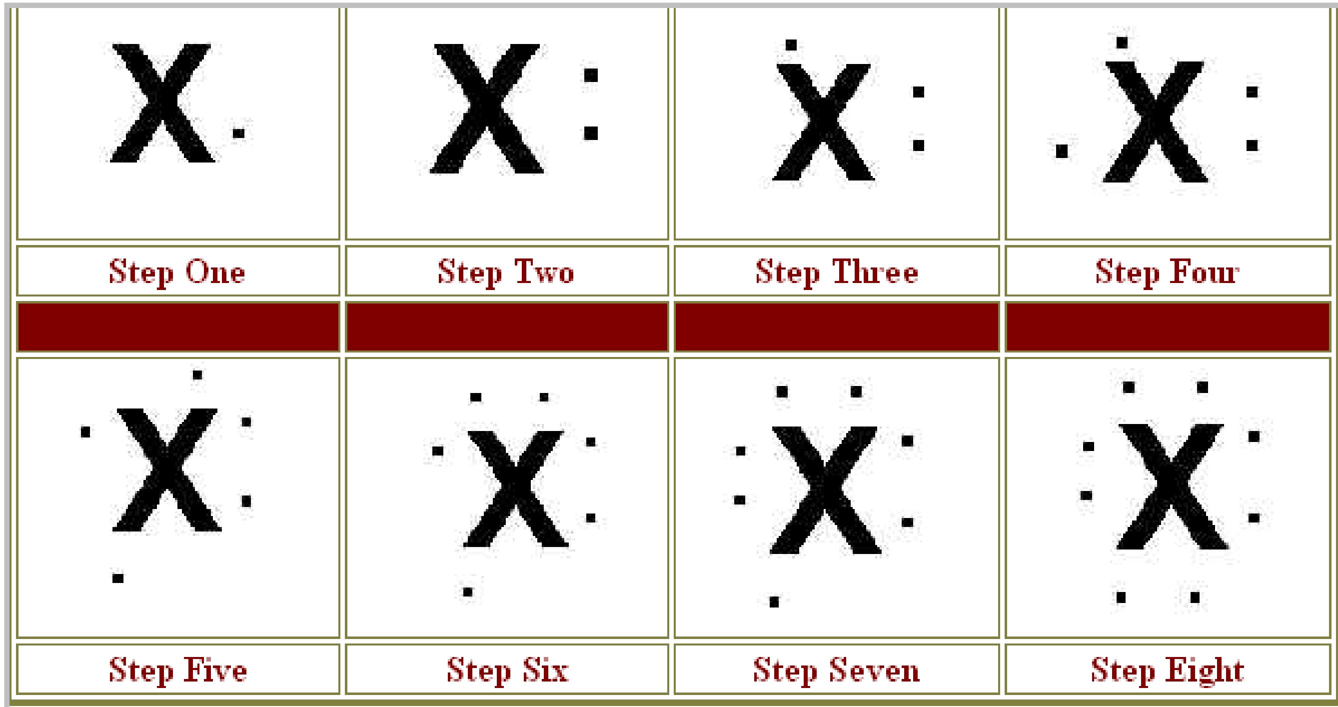
Werner Heisenberg

Heisenberg pointed out that it is impossible to know both the exact position and the exact momentum of an object at the same time. Applying this concept to the electron we realize that in order to get a fix on an electron's position at any time, we would alter its momentum. Any attempt to study the velocity of an electron will alter its position. This concept, called the Heisenberg Uncertainty principle, effectively destroys the idea of electrons traveling around in neat orbits. Any electron that is subjected to photons will have its momentum and position affected.

The Modern Atom Model

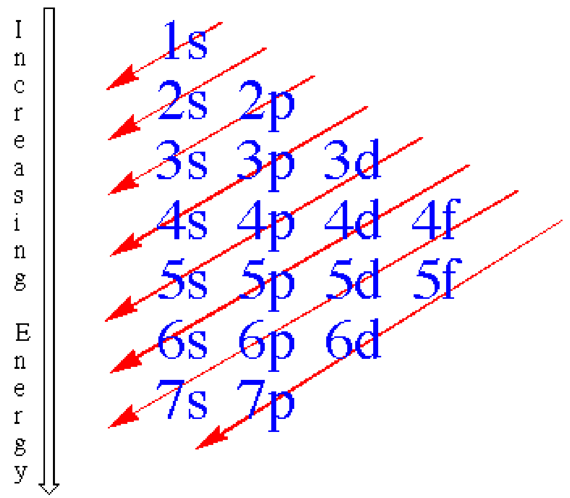
Lewis Dot Diagram

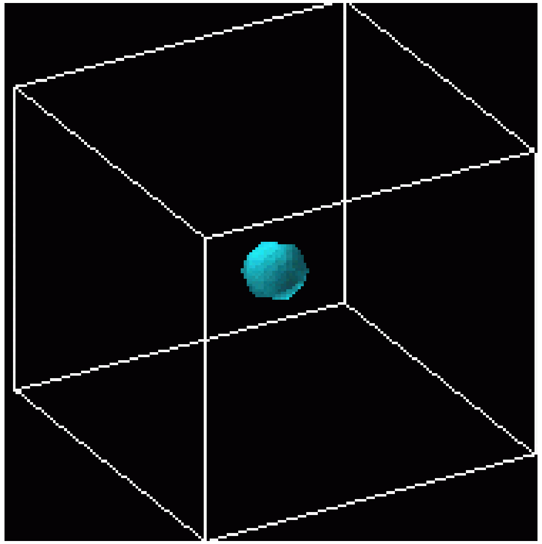


Steps in filling Lewis Dot

Table 3-6b Orbitals and Electron Capacity of the First Four Principle Energy Levels

Principle energy level (n)	Type of sublevel	Number of orbitals per type	Number of orbitals per level (n^2)	Maximum number of electrons ($2n^2$)
1	s	1	1	2
2	s	1	4	8
	p	3		
3	s	1	9	18
	p	3		
	d	5		
4	s	1	16	32
	p	3		
	d	5		
	f	7		





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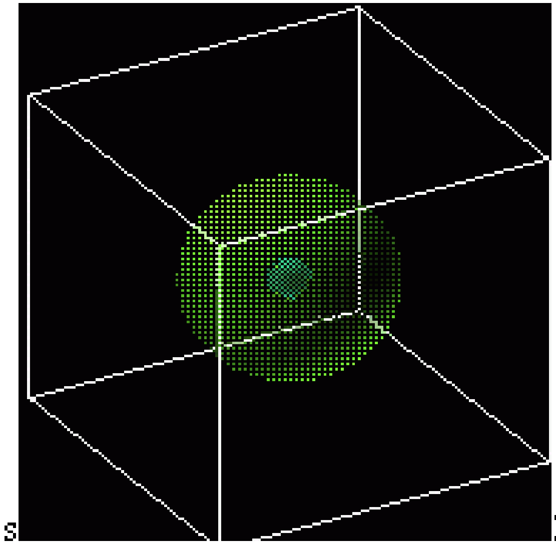
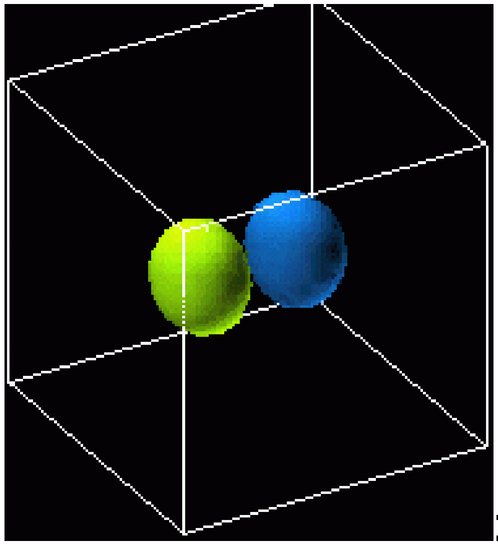


2s

Atomic orbitals do not always have the shape of a sphere. Higher orbitals have very unusual shapes.



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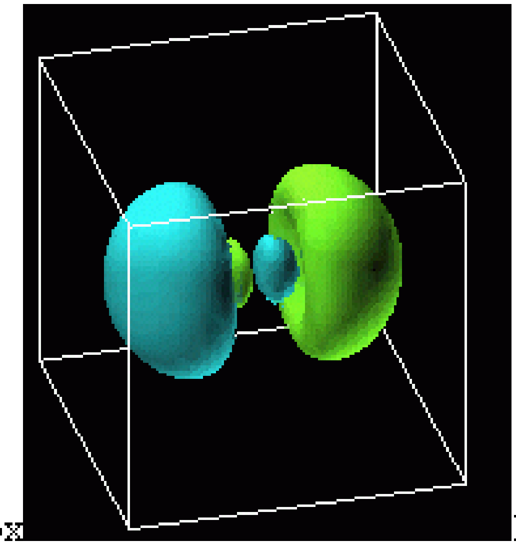

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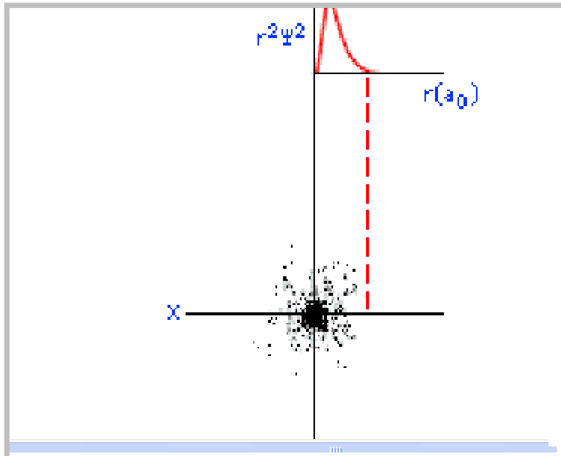

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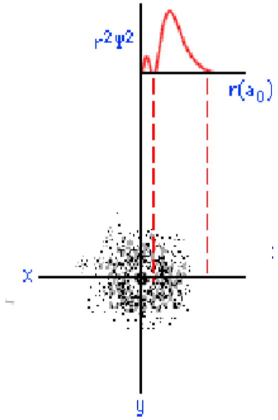

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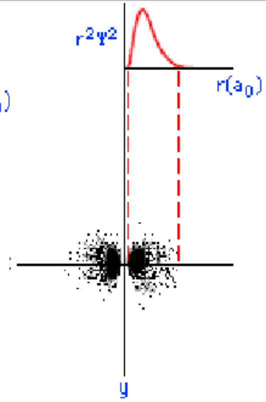
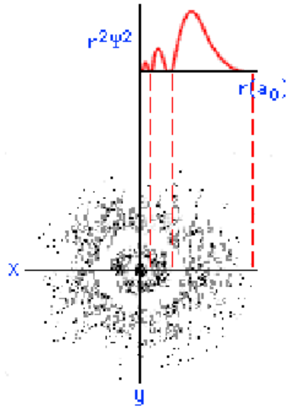


2p



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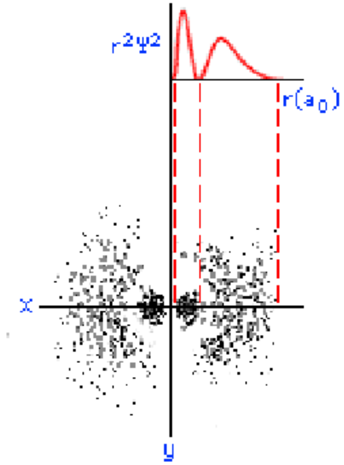

3p

Isotopes

$$^{A}_{Z}X$$

The large "X" represents where you will find the atom's elemental symbol. The **mass number**, which is given the symbol "A", is located in the upper left-hand corner. The **atomic number** (also called nuclear charge), which is given the symbol "Z", is found in the lower left-hand corner.

$^{1}_{1}H$ $^{2}_{1}H$ $^{3}_{1}H$

$$^{40}_{20}Ca^{2+}_{5}$$

This notation shows quite a bit of information. We know that it represents a sample of calcium atoms, based on the elemental symbol "Ca". The mass number, found in the upper left corner, is 40. The atomic number, found in the lower left corner, is 20. The "+2", shown in the upper right corner, represents the charge on the atoms of the sample. Here we see a group of atoms which have lost two electrons each. The number "5", seen in the lower right corner, represents the number of atoms in the sample.

Elemental Notation	$^{20}_{10}Ne$	$^{88}_{38}Sr^{2+}$	$^{80}_{35}Br^{-}$	$^{23}_{11}Na^{+}$
# of Protons				
# of Neutrons				
# of Electrons				