Power Concept
Topics covered: structure of atoms, positive and negative ions.

All matter is made up of atoms. At the center of the atom, is the nucleus which contains positively charged protons.

Also found in the nucleus, are neutrons which have no charge.
Orbiting the nucleus are the negatively charged electrons.
Electrons are held in orbit around the nucleus because their negative charge is attracted to the positive charge of the protons.

Here we have a Helium atom with its two electrons travelling in three-dimensional orbits in the first energy level or shell of the Helium atom. The nucleus is made up of two protons and two neutrons. The number of electrons and protons of an atom is always the same.

Now let's look at a two-dimensional representation of an aluminum atom.
Aluminum has 13 protons and 14 neutrons in its nucleus. 13 electrons occupy various orbits or shells around the nucleus.

The two electrons nearest the nucleus occupy the first shell. The first shell can contain only 2 electrons.

Unlike the Helium atom with its single shell around the nucleus, the Aluminum atom will need additional shells to accommodate its additional electrons.

Thus, the second shell will except its limit of 8 electrons with the third or outer most shell containing the remaining 3 electrons.

The outermost shell of an atom is also called its valence orbit. The electrons in this shell are called valence electrons.

Valence electrons are responsible for giving certain atoms, such as Copper, their important current carrying electrical properties.

Electrons occupy various energy levels or shells around the nucleus of an atom.
As you move farther away from the nucleus, the more electrons can be held in .

For example, the first level can hold a maximum od two electrons, which is Helium, the second level can hold up to eight, the third can hold 18, and the fourth energy level or orbit can hold a maximum of 32 electrons.

The farther electrons are from the nucleus the weaker their attraction to the nucleus. In the case of the Copper atom, after the third shell is filled with its maximum 18 electrons
the remaining electron occupies the outermost fourth shell.

This single electron is loosely held in its valence shell and thus is able to temporarily break away from the atom and become a free electron.

When a valence electron leaves an atom to become a free electron, it takes with it the negative charge. The result is a net positive charge for the Copper atom. This atom with one less electron, than its normal number, is called a positive ion.
When the atom has an extra electron beyond its normal state, it is called a negative ion.

To further investigate how negative and positive ions are formed, lets look at the compound Sodium Chloride or table salt. Sodium Chloride consists of a Sodium and a Chlorine atom.

Sodium has 11 protons and an equal number of electrons. Chlorine has 17 protons with a corresponding 17 electrons in orbits around the nucleus.
Each atom is looking to become more stable. Sodium by giving up its single loosely held electron in its outer shell and Chlorine by gaining an electron to increase its outer shell number to 8.

Thus, when salt is dissolved in water, Sodium will readily give up its loosely held valence electron to Chlorine making both atoms more stable.

With its one less electron, Sodium becomes a positive ion
and Chlorine with the addition of an electron becomes a negative ion.

The positive ionic state of Sodium and the negative ionic state of Chlorine results in the atoms being attracted to each other. This attraction forms an ionic bond that holds the two atoms closely together to create a sodium chloride molecule.

The properties of ions allows certain materials to possess current carrying capacity found in many electrical devices.