

# IONIC BONDS

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Ionic bonds are chemical bonds formed when electrons are *transferred* between two or more atoms. Ionic bonds form *compounds*.

Remember, **ions** are atoms that have a different number of electrons than protons. If they have more electrons than protons, they are negatively charged. If an atom has more protons than electrons, it is positively charged. Since opposite charges attract each other, ions of opposite charges are attracted and can form a chemical bond.

Atoms that have only a few (1-3) valence electrons tend to want to give away those electrons so that they can become more stable. This means they tend to become more positively charged since they give away electrons. An example would be an atom from groups 1, 2, or 3 (metals). These form positive *ions*. Alternatively, atoms from groups 5, 6, and 7 (non-metals) are nearly full of valence electrons and so they tend to want to gain just a few more electrons so that they can fill their outer shell with a total of 8 valence electrons. By filling up with eight valence electrons, they become more stable. For example, an atom like Oxygen has 6 valence electrons. It would prefer to have 8 so it could be more stable, so it will want to gain two electrons from another atom. Since metals tend to give away electrons and become positive ions and non-metals tend to gain electrons to become negative ions, they now have opposite charges. It is for this reason that ionic bonds tend to form between a metal and a non-metal.

Ionic bonds are relatively weak. For this reason, they often easily dissolve in water. When they dissolve in water, the ions floating around have positive and negative charges, so they easily conduct electricity. Ionic compounds have high melting and boiling points. Also, ionic compounds in the solid state tend to form a crystal structure.

Sodium is an element in Group 1, so it has one valence electron. It wants to have a full outer shell. The easiest way to do that is to get rid of the one valence electron. That means it becomes positively-charged ( $\text{Na}^+$ ). Chlorine is an example of a non-metal that has 7 valence electrons. Since it wants to have a full outer shell (8 electrons), it wants to gain one electron. This would make it negatively charged ( $\text{Cl}^-$ ). Sodium can easily transfer an electron to Chlorine to form an ionic bond between the two. After that electron is transferred, each atom now has 8 electrons in its outer shell, making them more stable (like a noble gas). Sodium Chloride ( $\text{NaCl}$ ) is more commonly known as table salt.

# COVALENT BONDS

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Covalent bonds are chemical bonds formed when one or more pairs of electrons are *shared* between two or more atoms. Since all atoms want to become more like the nearest noble gas, the often times want to share electrons with each other. Covalent bonds are formed when atoms share electrons so that each atom can become more *noble* – that is, it can become more stable. Covalent bonds form *molecules*.

When a covalent bond is formed, two or more atoms share electrons so that they can both have a more stable outer shell and then be more ‘noble’. The positively-charged nucleus of each atom is then attracted to the large, shared negatively-charged electron cloud, thus forming the covalent bond between the atoms. The pull between the positive and negative charges keeps these atoms joined.

Covalent bonds normally form just between non-metals instead of the metal to non-metal bond formed by the ionic bond. Covalent bonds are relatively strong. For this reason, they do not easily dissolve in water. Since covalent bonds do not form ions, they are relatively poor conductors of electricity. They also have relatively low boiling and melting points as compared to ionic bonds.

Water is an example of a covalent compound – that is, a compound formed by the sharing of electrons. Notice from the groups on the periodic table that Hydrogen has one valence electron and Oxygen has six. Two hydrogen atoms can each share their single valence electrons with an oxygen atom that has six valence electrons. The sharing of electrons creates a bond and gives oxygen a stable number of eight outermost electrons. At the same time, the oxygen atom shares two of its electrons – one for each hydrogen atom – which gives each hydrogen atom a more stable number of two electrons in its outermost shell instead of just one.

Carbon Dioxide is another great example of a covalent compound. Carbon has four outer electrons but would prefer to have eight. Oxygen has 6 outer electrons and would also prefer to have eight. It works out well then for two atoms of oxygen to each share two electrons with carbon and then the carbon atom has eight in its outer shell while the oxygen atoms each now also share a total of 8, making carbon dioxide relatively stable.

**Sources:**

Holt Earth Science, 2006

[http://en.wikipedia.org/wiki/Ionic\\_bond](http://en.wikipedia.org/wiki/Ionic_bond)

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