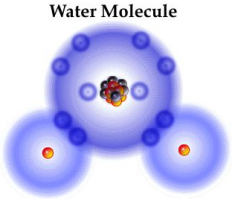
# Compounds: Molecular and Ionic




**Compounds have their atoms interlocked, or chemically bonded**. You can think of the way the atoms are bonded as an attraction between those atoms that want to attain an octet of valence electrons. **As compounds, the properties are entirely different than the properties of the individual elements alone.** Compounds can be made up of two or more atoms of the same element, or from different elements. Ordinary table salt is a combination of the $Na^+$ (sodium) ion and the $Cl^-$ (chloride) ion. Sodium is an unstable, explosive, silvery metal. Chlorine is a deadly poisonous gas. The combination, or compound, of these two elements is a white crystal that is very stable and can be ingested (eaten!) Compounds like table salt that form when **ions** combine, and are known as **ionic compounds.** In **ionic compounds there is a transfer of electrons**. One element takes on one or more electrons (the nonmetal), while the other gives up one or more electrons (the metal). Ionic compounds form very strong bonds, and combine so that their overall charge is neutral.

Chemical compounds make up everything around you. Oxygen that you breathe is a compound. The air consists of oxygen molecules, which are two oxygen atoms bound together, $O_2$. Water is the combination of hydrogen and oxygen, $H_2O$. In this case there are two different elements combining. A glass of water is many individual water molecules together. In **molecular compounds, electrons are shared.** The bonds that are formed when elements share electrons are known as **covalent bonds.** They aren't as strong as ionic bonds. A good way to remember this is, sugar is a molecular compound ($C_6H_{12}O_6$) with the atoms being bonded together as <u>covalent bonds</u> (sharing their electrons.) You can break the bonds in sugar easily by heating the sugar and getting melted caramel and water vapor as a product. You would not be able to melt salt in the same way. The bonds between atoms in salt are ionic bonds, which are much stronger. The melting point of ionic compounds is much higher than those of molecular compounds. You can melt sugar on your stove, but to melt salt you would have to have temperatures reach 801°C.

When writing compounds as formulas **the small number written after the symbol (and below the line) is called the <u>subscript</u>.** It tells you **how many atoms of that element are present.** You use subscripts **only when two or more atoms of an element are in a compound.**

Just as atoms are the smallest particle of an element that cannot be broken down further chemically or physically and still be that element, **molecules, or combined ions, are the smallest unit of a compound that still has the characteristic properties of that compound**. Molecules and bonded ions can be broken down into their individual atoms, providing energy is applied. This process requires energy and can also give off energy. Much more energy is required to

break bonds of ionic compounds (e- being transferred) than molecular compounds (e- being shared.)

Each of the molecular compounds below are given their names as well as their chemical formulas. **On a separate piece of paper, use a table such as the example shown below**, to write down the compound, formula, atoms (of which element) that have combined for each compound, & the total number of atoms of each element in each of the compounds.
**See the example shown:** (Your table will be #'ed 1-9) **Use a ruler and include the example given!**

| **Name of Compound** | **Formula** | **Combining Atoms** | **Total # of Each Atom** |
|---|---|---|---|
| 1.Baking Soda | $NaHCO_3$ | Sodium<br>Hydrogen<br>Carbon<br>Oxygen | 1<br>1<br>1<br>3 |

1. Baking soda (sodium bicarbonate) – $NaHCO_3$
2. Silver tarnish – $Ag_2O$
3. Iron oxide **(rust)** – $Fe_2O_3$
4. Vinegar – $HC_2H_3O_2$
5. Sugar (Glucose) - $C_6H_{12}O_6$
6. Iodine – $I_2$
7. Copper oxide – $CuO$
8. Carbon dioxide – $CO_2$
9. Water – $H_20$

Answer the following questions on a separate piece of paper using **complete sentences**: (Each question is worth 10 points)

1. Which of the compounds listed in your data table has only **one kind of element combining**? What is the minimum number of atoms a compound can have?
2. If the above compounds are all molecular compounds, what kinds of bonds are between each of their atoms? Are the electrons that are bonding between the atoms being shared or transferred?
3. How would you describe the characteristics of the elements that make up a compound to the characteristics of the compound itself? The same? Different?
4. What does iron combine with to make it rust? Should you leave tools that contain iron out in the rain? Why not?
5. Which compound has the **largest number of atoms** in each of its molecules? How many atoms **total** does it have per molecule?
6. What do iron oxide (**rust**), copper oxide, and silver tarnish have in common?

**Read the following:**

Whenever a metal unites with oxygen, oxidation takes place. Oxidation is a reaction that changes the elements involved into something else by combining with the oxygen atoms that are present in the air, or in water. Some reactions of oxidation are considered slow. An example of a slow oxidation would be rust, or iron oxide. The metal iron starts to combine, or react with oxygen. Other oxidation reactions can be very fast. Fire, for example, is an oxidation that reacts very quickly. Remember the lit cotton ball from the beginning of the year? The flame went out as soon as all the oxygen was used up. Explosions are extremely rapid oxidations. Another example of oxidation is the way our bodies use oxygen in order to process food. The speed or rate of food oxidation is called metabolism.