Naming compounds

If symbols of chemical elements are the alphabet of chemistry, then chemical formulas are the words. For example, CO_2 is the chemical formula of carbon dioxide, which is a "word" spelled using the symbol of carbon (C) and oxygen (O). Just like in language, the same two "letters" in the alphabet can be used to spell different words. C and O can also spell CO, or carbon monoxide, a different chemical compound.

Names of chemical compounds follow a reasonably straightforward set of rules. Here are the rules for compounds composed of two nonmetals, such as carbon dioxide (CO_2) and carbon monoxide (CO).

- Name the elements in the order they appear in the chemical formula, modifying the name of the second element to end in –ide. For example, oxygen becomes oxide, and sulfur becomes sulfide.

oxygen → oxide	**fluorine** → fluoride
sulfur → sulfide	**chlorine** → chloride
nitrogen → nitride	**bromine** → bromide
hydrogen → hydride	**iodine** → iodide

- Use prefixes to indicate the number of atoms in the chemical formula. For example, di- means 2, and thus the name carbon dioxide means two oxygen atoms for each carbon atom.

1	mono	6	hexa
2	di	7	hepta
3	tri	8	octa
4	tetra	9	nona
5	penta	10	deca

- If there is only one atom for the first element in the chemical formula, the prefix mono is typically omitted from the name. For example, CO is carbon monoxide, not monocarbon monoxide.

If instead you are writing a chemical formula from a name, keep in mind that the subscript of 1 is not used in chemical formulas. Thus the chemical formula for carbon dioxide is CO_2, not C_1O_2. Similarly, carbon monoxide is CO, not C_1O_1.

Some substances are known by their "common names". For example, ozone (O_3) and ammonia (NH_3). Common names cannot be figured out; you have to know them or look them up to know the composition of the compounds.

The Truth about DIHYDROGEN MONOXIDE

Dihydrogen Monoxide (DHMO) is perhaps the single most prevalent of all chemicals that can be dangerous to human life. Despite this **truth**, most people are not unduly concerned about the dangers of Dihydrogen Monoxide. Governments, civic leaders, corporations, military organizations, and citizens in every walk of life seem to either be ignorant of or shrug off the truth about Dihydrogen Monoxide as not being applicable to them. This concerns us.

Spreading the Truth about Dihydrogen Monoxide

In 1997, the **Dihydrogen Monoxide Research Division** was formed and went online spreading the truth about DIHYDROGEN MONOXIDE. As word has spread, so too has the public awareness of Dihydrogen Monoxide and its implications involving the Internet and accessibility of such information. To that end, the DMRD's web site at **DHMO.org** continues to provide the most comprehensive collection of Dihydrogen Monoxide information available anywhere.

Common Dihydrogen Monoxide Scare Tactics

Unfortunately, some have seen fit to fill many thousands of web pages with purposely slanted propaganda meant more to titillate and sensationalize than to inform. The following "information" about Dihydrogen Monoxide is what you'll commonly find on the Internet. The **Dihydrogen Monoxide Research Division** does not endorse the use of such scare tactics, particularly when telling people about the invisible killer, Dihydrogen Monoxide.

BAN DIHYDROGEN MONOXIDE - THE INVISIBLE KILLER!

Dihydrogen monoxide is colorless, odorless, tasteless, and kills uncounted thousands of people every year.

What are the dangers of Dihydrogen Monoxide?

Most of these deaths are caused by accidental inhalation of DHMO, but the dangers of dihydrogen monoxide do not end there. Prolonged exposure to its solid form causes severe tissue damage. Symptoms of DHMO ingestion can include excessive sweating and urination, and possibly a bloated feeling, nausea, vomiting and body electrolyte imbalance. For those who have become dependent, DHMO withdrawal means certain death.

Dihydrogen Monoxide Facts

Dihydrogen monoxide:

- is also known as hydric acid, and is the major component of acid rain.
- contributes to the *Greenhouse Effect*.
- may cause severe burns.
- contributes to the erosion of our natural landscape.
- accelerates corrosion and rusting of many metals.
- may cause electrical failures and decreased effectiveness of automobile brakes.
- has been found in excised tumors of terminal cancer patients.

Dihydrogen Monoxide Alerts

Contamination is reaching epidemic proportions!

Quantities of dihydrogen monoxide have been found in almost every stream, lake, and reservoir in America today. But the pollution is global, and the contaminant has even been found in Antarctic ice. In the midwest alone DHMO has caused millions of dollars of property damage.

Dihydrogen Monoxide Uses

Despite the danger, dihydrogen monoxide is often used:

- as an industrial solvent and coolant.
- in nuclear power plants.
- in the production of styrofoam.
- as a fire retardant.
- in many forms of cruel animal research.
- in the distribution of pesticides. Even after washing, produce remains contaminated by this chemical.
- as an additive in certain *junk-foods* and other food products.

Stop the horror - Ban Dihydrogen Monoxide

Companies dump waste DHMO into rivers and the ocean, and nothing can be done to stop them because this practice is still legal. The impact on wildlife is extreme, and we cannot afford to ignore it any longer!

THE HORROR MUST BE STOPPED!

The American government has refused to ban the production, distribution, or use of this damaging chemical due to its *importance to the economic health of this nation.* In fact, the navy and other military organizations are conducting experiments with DHMO, and designing multi-billion dollar devices to control and utilize it during warfare situations. Hundreds of military research facilities receive tons of it through a highly sophisticated underground distribution network. Many store large quantities for later use.

IT'S NOT TOO LATE!

Act NOW to prevent further contamination. Find out more about this dangerous chemical. What you don't know CAN hurt you and others throughout the world.

Visit DHMO.org

Is it any wonder that people are skeptical after reading all of that slanted, anti-DHMO propaganda? It's not that the above facts are not entirely true. We object to the tone and tactics, not to the message necessarily.

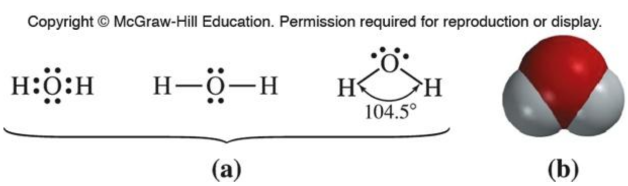
We invite you to visit **DHMO.org** to find out the truth about Dihydrogen Monoxide. Please take the time to visit now, or in the near future. You'll be glad you did.

Water: molecule of life

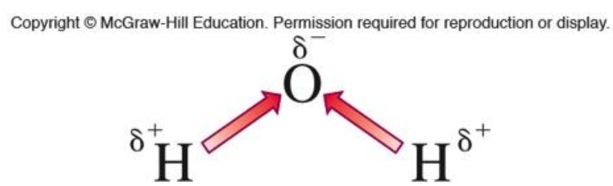
Earth is sometimes called the blue planet because the large quantities of water on its surface make it look blue from outer space. Three quarters of the globe is covered by oceans, and vast ice sheets cover the poles. Large quantities of water are present in soils and rocks on the surface. Water is essential to almost every form of life, has played a key role in human history, and is a significant factor in weather and climate.

Water's importance is linked to its unique properties. Water is a liquid at room temperature (25°C or 77°F) and normal atmospheric pressure. This is surprising because almost all other compounds with similar mass are gases under these conditions. Consider the three gases found in air: N_2, O_2 and CO_2. Their molar masses are 28, 32 and 44 g/mol, respectively, all greater than that of water (18 g/mol). Yet none of them are liquid. Water also has an anomalously high boiling point of 100°C or 212°F. When water freezes, it exhibits another somewhat bizarre property — it expands. As a result, ice floats on water; in contrast, when most substances freeze, the solid sinks in its liquid. More thermal energy is needed to melt ice, heat water and vaporize water than to accomplish these same phase changes for the same mass of almost any other substance. All these unusual properties of water are crucial for the welfare of our planet and our species.

These unusual properties of water derive from their molecular structure. Shown below are different representations of a water molecule. The bar (—) between the O and the H atoms in these representations is a **covalent bond**. Each bar represents TWO electrons shared between the O and the H atoms. Not obvious in these representations is the fact that the electrons are not shared equally by the O and the H atoms. Experiment indicates that the O atom attracts the shared electrons more strongly than does the H atom and the shared electrons are pulled closer to the O atom. As a result, the O atom has a partial negative charge and both H atoms have a partial positive charge.



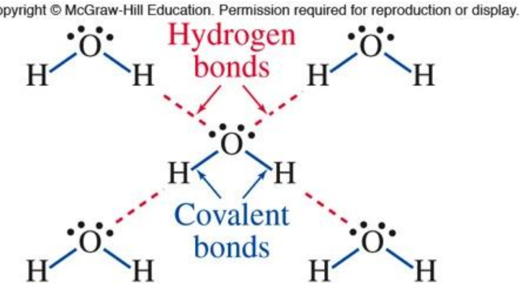
Different representations of a water molecule

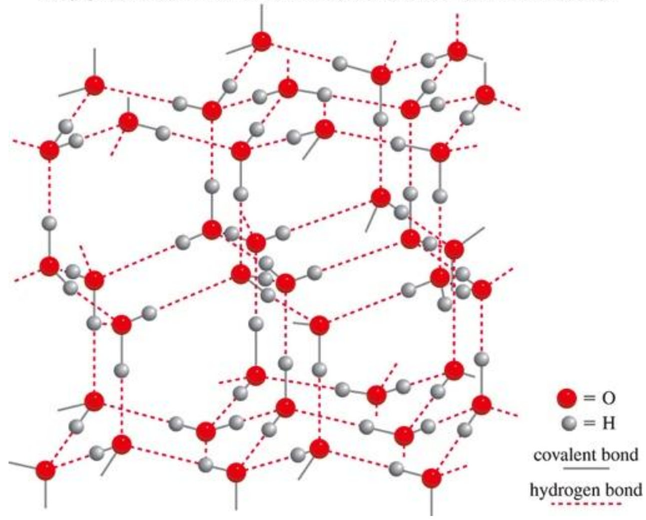


partial charges in water molecule

Hydrogen bond *Vs.* Covalent bond

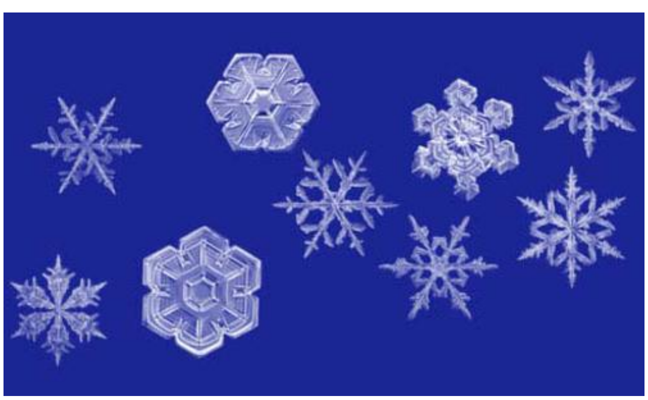
Most of water's unusual properties can be attributed to its unique ability to form hydrogen bonds. When liquid water freezes, a three-dimensional network of water molecules form. Considerable open space is left within the structure of ice, forming empty channels that run through the entire crystal structure of ice, making it less dense than liquid water.

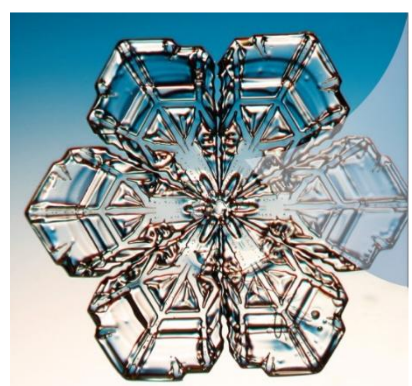




A **hydrogen bond** is an attraction between a *hydrogen* atom which is attached to a F, O or N atom and a F, O or N atom in a nearby molecule. The figure above shows the hydrogen bonds between several water molecules. As you can see from the figure, hydrogen bond is an attraction BETWEEN molecules. A water molecule can form up to 4 hydrogen bonds with its neighbors. A **covalent bond**, on the other hand, is a bond formed between atoms WITHIN a molecule. Each H atom in a water molecule (H_2O) forms a covalent bond with the O atom in the molecule. For each water molecule, there are two covalent bonds.

The extended network of hydrogen bonds between water molecules results in the open space between layers of water molecules in ice, which causes ice to be less dense than water. It is also the reason for the beautiful shape of ice crystals and snowflakes.

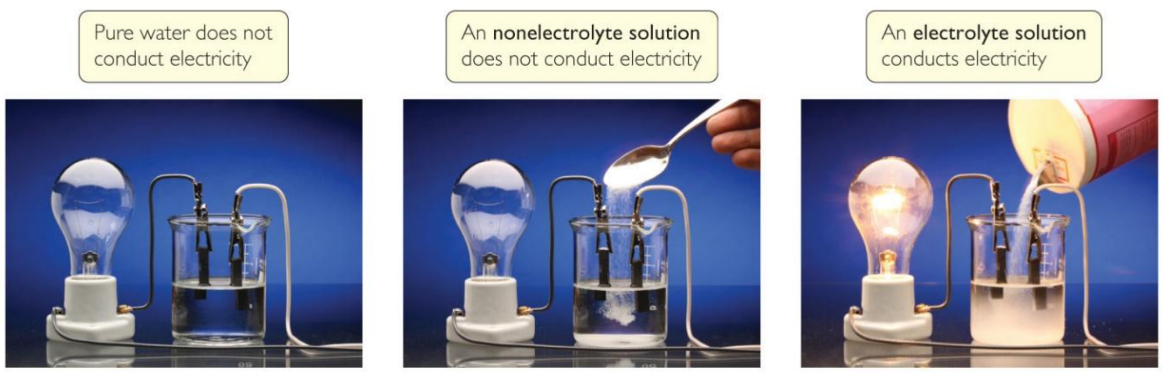




Electrolyte Vs. Nonelectrolyte

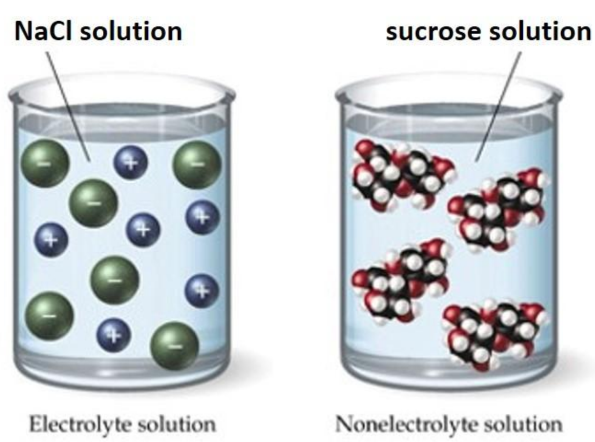
At a young age, we learn not to bring electrical devices into the bathtub so as not to electrocute ourselves. That is a useful lesson because most of the water we encounter in daily life is electrically conducting. Pure water, however, is a very poor conductor of electricity (see the first frame in the figure below). The conductivity of bathwater originates from the substances dissolved in the water, not from the water itself.

Now, let's prepare two solutions – one by dissolving a teaspoon of table salt in a cup of water and the other by dissolving a teaspoon of table sugar in a cup of water. Both solutions are clear and colorless. However, they possess very different electrical conductivities. This is demonstrated in the figure below. When two electrodes connected to the light bulb are dipped into the salt solution, the light bulb lights up; with a sucrose solution, the light bulb doesn't. This tells us that the salt solution is a good conductor of electricity while the sucrose solution, on the other hand, is a poor conductor of electricity.



Pure water, $H_2O(l)$ | Sucrose solution, $C_{12}H_{22}O_{11}(aq)$ | Sodium chloride solution, $NaCl(aq)$

We can understand why the electrical conductivities are so different for the salt solution and the sugar solution by looking at what is going on at the microscopic level when salt and sugar dissolves in water. Examine the figure below and see if you can come up with an explanation yourself.



Microscopic view of an electrolyte (NaCl) solution and a nonelectrolyte (sucrose) solution

NaCl consists of sodium ions (Na^+) and chloride ions (Cl^-), which makes it an ionic compound. When NaCl is dissolved in water, Na^+ and Cl^- become dispersed throughout the solution. Ions are capable of carrying electrical charges from one electrode to the other, connecting the two electrodes electrically and completing the circuit. With a complete circuit, the light bulb turns on. Sucrose consists of $C_{12}H_{22}O_{11}$ molecules, which makes it a molecular compound. The lack of conductivity of sucrose solutions indicates the absence of ions when sugar is dissolved in water. That is exactly what happens, the sucrose solution contains only neutral sucrose ($C_{12}H_{22}O_{11}$) molecules and they remain as neutral molecules when dissolved. Since they are neutral, sucrose molecules don't carry electrical charges and can't connect the two electrodes electrically. There is still a break in the circuit and the light doesn't come on.

A substance (such as table salt, NaCl) that forms ions when it is dissolved in water is called an **electrolyte**. A substance (such as sugar, $C_{12}H_{22}O_{11}$) that does not form ions when dissolved in water is called a **nonelectrolyte**. Ionic compounds such as NaCl are electrolyte and molecular compounds such as sucrose ($C_{12}H_{22}O_{11}$) are nonelectrolyte.