

# COMPARING PROPERTIES OF ISOMERS

Sometimes there is more than one way to connect a given group of atoms into a molecular structure. Given the formula  $C_2H_6O$ , two different isomers are possible: methyl ether and ethanol. They have the same formula but different structures. The word, "isomer", is from the Greek, meaning "same things", referring to their identical content. However, isomers often have very different physical and biological properties.



These two compounds have different physical properties, as you can see in the table below.

| compound       | melting pt, ° C | boiling pt, ° C |
|----------------|-----------------|-----------------|
| dimethyl ether | -138            | -25             |
| ethanol        | -117            | 78              |

Remember, typical room temperature is about 25 °C. That means that at room temperature, dimethyl ether is a gas, because it is above its boiling point. Ethanol, on

the other hand, is a liquid at room temperature. Ethanol at that temperature is well above its freezing point but has not yet reached its boiling point.

Why is that? What is the origin for the differences in physical properties between these two, similar compounds, one of which is a gas at room temperature while the other is a liquid? Both contain carbon-hydrogen and carbon-oxygen bonds. The ethanol also contains a carbon-carbon bond and an oxygen-hydrogen bond.

Certain bonds, or groups of bonds, confer specific behaviors on the compounds in which they are found. For instance, when an OH group is found in an organic compound, it can make the compound moderately acidic. It also makes the compound a little more likely to be a solid or liquid rather than a gas. Why?

The dominant intermolecular attraction between ethanol molecules is hydrogen bonding. What we mean is, although two ethanol molecules may be attracted by London dispersion forces and even by dipoles, both of those factors pale in comparison to the attraction that arises from hydrogen bonding. Hydrogen bonding is the single most important factor holding two ethanol molecules together.

In dimethyl ether, on the other hand, hydrogen bonding is not a factor. In this molecule, the major intermolecular attraction involves regular dipole moments. Because hydrogen bonds are typically much stronger attractions than ordinary dipole moments, a group of ethanol molecules is much harder to separate

from each other than a group of dimethyl ether molecules. The ethanol has a much higher boiling point.

Source : <http://employees.csbsju.edu/cschaller/Principles%20Chem/imf/SPisomers.htm>