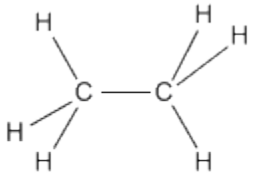
DIPOLE INTERACTIONS

When two different kinds of atoms are connected to each other, the electrons between them are typically not shared evenly. That's because in most cases, two different atoms would have two different electronegativity values. One atom would be more electronegative than the other. It would have a stronger attraction for the electrons in the shared bond, and the electrons would be a little bit more attracted to that atom than the other.

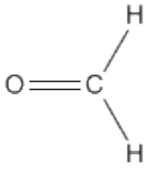
For example, when a carbon atom is bonded to a fluorine atom, there is an electronegativity difference between the two atoms. Fluorine is more electronegative than carbon because it has more protons in the nucleus than carbon. The electrons are pulled closer to the fluorine than to the carbon. A carbon-fluorine bond is polarized towards the fluorine. A molecule like fluoromethane, CH_3F, has a permanent dipole.

You can imagine that molecules with permanent dipoles would interact with each other much more strongly than molecules that rely on temporary dipoles in order to stick together.

Ethane, C_2H_6 (sometimes written CH_3CH_3, suggesting two carbons are each connected to three hydrogens, and also to each other), and formaldehyde, CH_2O, have different formulae but the same molecular weight. Based on weight alone, it would take about the same amount of energy to move an ethane molecule and a molecule of formaldehyde.



ethane

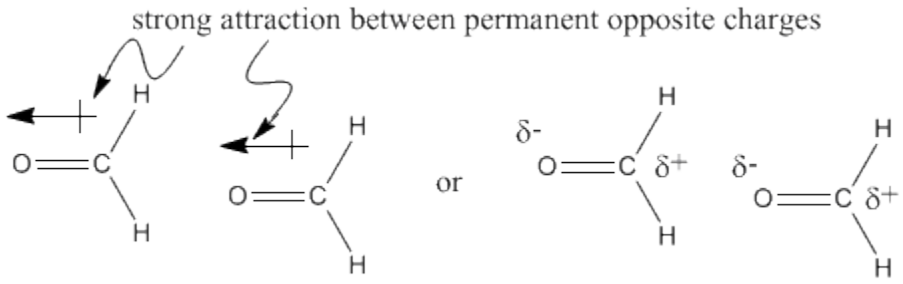


formaldehyde or
methanal

The two molecules also have somewhat similar shapes, unlike neopentane and pentane. At room temperature, ethane and formaldehyde are both gases. Nevertheless the two compounds have very different boiling points; formaldehyde becomes liquid around -20 °C, which would be a very cold winter day in, say, Chicago. Ethane does

not become liquid unless it is cooled to around -90 °C, a cold winter day on Neptune, at which point formaldehyde is just about ready to freeze solid.

The difference between these two molecules must be due to the oxygen atom in formaldehyde. Oxygen, the second most electronegative element in the periodic table, can form some very polar bonds. The permanent dipole that results between the oxygen and carbon makes the formaldehyde molecules much stickier than the ethane molecules, which depend on fleeting London interactions if they are going to hold on to each other.



There are other variations on dipole interactions that are pretty common. For example, you could imagine that a dipolar molecule would interact pretty strongly with an ion. We will take a look at that situation shortly when we think about how mixtures of different compounds interact with each other. However, perhaps the most important variation in organic chemistry is hydrogen bonding.

Source : http://employees.csbsju.edu/cschaller/Principles%20Chem/imf/SPdipoles.htm