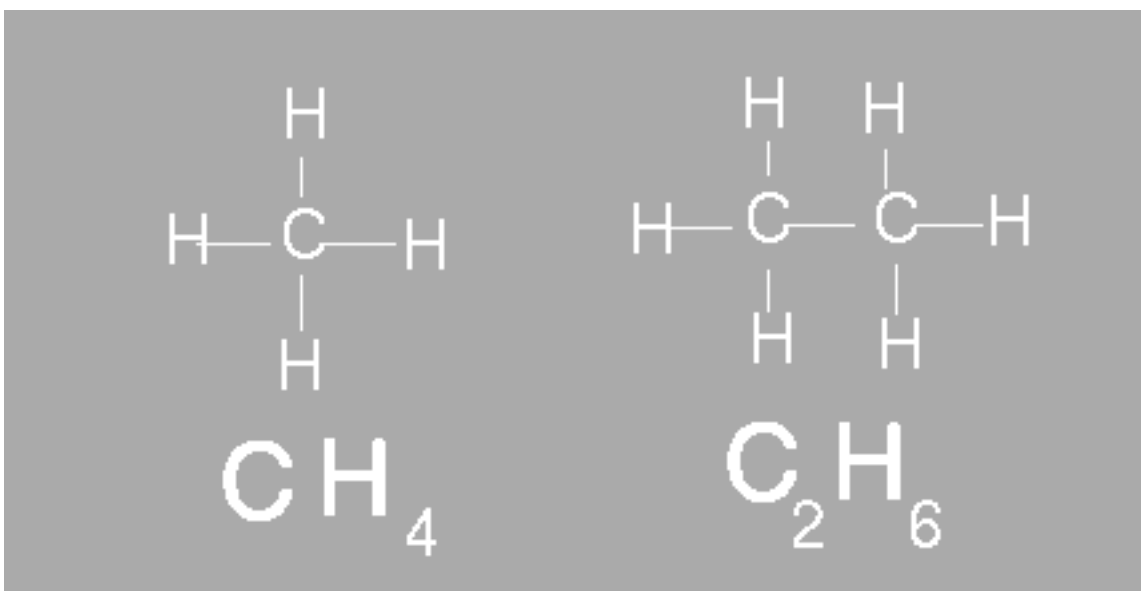


ORGANIC MOLECULES (organic molecules are the molecules of life)

ALL BASED ON CARBON BECAUSE CARBON CAN MAKE 4 BONDS



The C in the figure above represents the atom carbon. A solid line represents a stable chemical bond called a covalent bond...but we will just call it a bond for now. The figures represent the same two chemicals in two different ways. The formula that shows the bonds as lines and what atom is connect to what are called “structural” formulas because you can see from the formula how the atoms are attached to each other. The lower formulas are called condensed formulas and do NOT show how the atoms are arranged in a structure. Condensed formulas are easier to write but less informative. In some cases a single condensed formula can represent many different molecules...more on this later.

Some nomenclature first:

NOMENCLATURE is a fancy word for how things can be named. Nomenclature in science is very exact to keep confusion to a minimum. You are familiar with nomenclature for living organisms. An animal is given a genus and species name. This is a nomenclature for living things. Scientists have given a genus and species name to every living thing we have discovered. *Homo sapiens* is the genus and species nomenclature for humans. Can you guess what animal *Felis domestiucus* is?

Now to the nomenclature for carbon (organic) molecules.

The prefix of a carbon molecule depends on how many carbons are in the molecule.

Prefixes:

1 carbon...meth-
2 carbon...eth-
3 carbon...prop-
4 carbon...but-
5 carbon...pent-
6 carbon...hex-
7 carbon...hept-
8 carbon...oct-

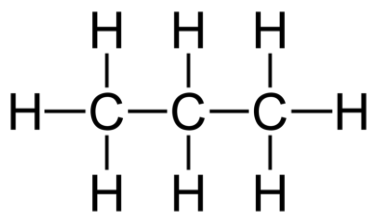
The suffix of a carbon molecule is based on whether the molecule has one or more double or triple bonds between carbon atoms.

Suffixes:

-ane...only single bonds
-ene...contains a double bond
-yne...contains a triple bond

Let's combine the prefix rule and suffix rule:

Propane...has three carbons and all single bonds among the carbon atoms.



can you draw the condensed formula for propane?

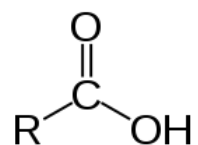
Remember from the milk experiment...Polar molecules have positive and negative charges and are therefore attracted to water molecules because water molecules are also polar. They are said to be **hydrophilic** because they interact with (dissolve in) water by forming hydrogen bonds.

Now we are almost ready to learn about the four classes of biomolecules. These biomolecules behave in certain ways not only because of their carbon structure but also because of what are called functional

groups.

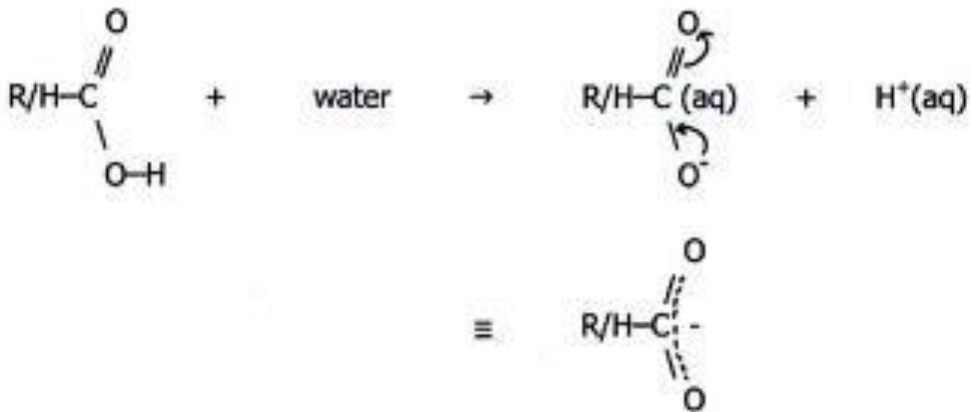
Functional groups are groups of atoms that when found in molecules give those molecules a certain characteristic. For example, any molecule with an acid group will have the potential to act like...you guessed it...an acid. See how logical science is.

This is the functional group called an acid group. Since it is an acid group with carbon it is often called a carboxylic acid group. The capital letter R in the structural formula represents whatever the acid group is attached to.



IN WATER...THE REAL WORLD

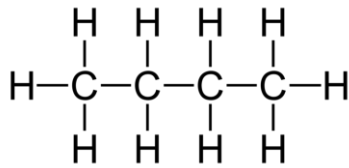
Cells live in a watery environment. When acids are in water they typically become charged. Acid group will lose their hydrogen as a proton to the water. (...remember the typical hydrogen nucleus has no neutrons and always ONLY ONE proton) The acid group that has lost a positively charged proton is then negatively charged and polar.



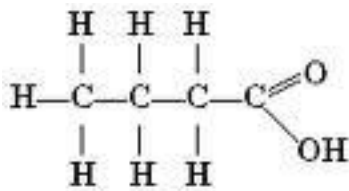
We can now see how an acid group will lend a certain characteristic to a molecule.

The molecule immediately below is a butane molecule. It is uncharged and non-polar (hydrophobic too). It is made of only hydrogen and carbon. It

belongs to the general class of molecules called hydrocarbons...hmmm

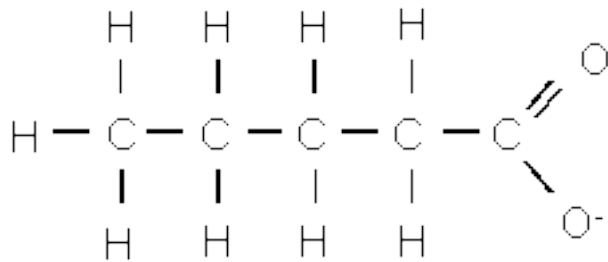


Below, we have attached the acid group to a butane molecule.



Can you name this acid knowing acids have an added suffix of “-oic acid”?
...4 carbons, all single bonds and oic acid....????

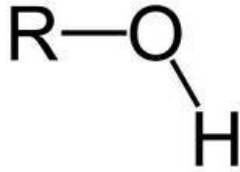
When we put this in water it becomes ionized by losing a proton (a hydrogen).



IS THIS POLAR??????? Is it Hydrophilic?

Here is another important functional groups (remember what the R stands for?):

Alcohol (or hydroxyl) functional group



NOW WE ARE READY!

FOUR CLASSES OF BIOMOLECULES (ALL ORGANIC MOLECULES)

1) CARBOHYDRATES 2) LIPIDS 3) PROTEINS 4) NUCLEIC ACIDS

We begin with carbohydrates

1) Carbohydrates

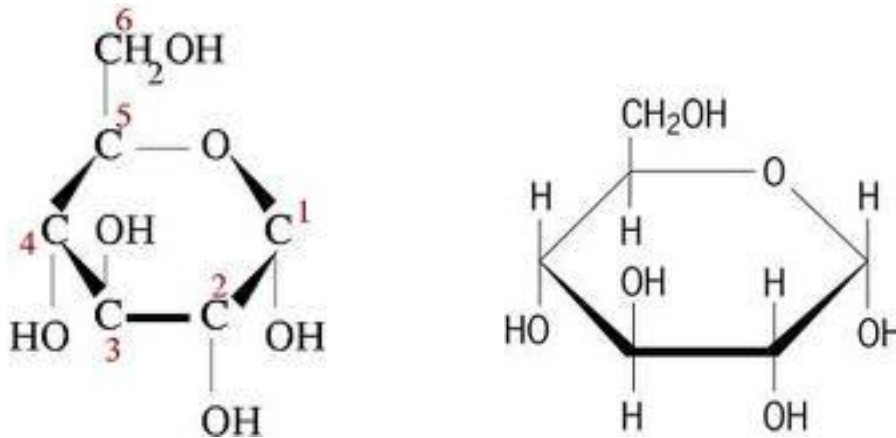
During photosynthesis, water (H_2O) is combined with Carbon from the CO_2 in the air to form CARBO, HYDRATES (when you drink water you get “hydrated”). Adding water to carbon hydrates the carbon.

Carbohydrates (carbon-water) are the most abundant organic compounds (things made of carbon and hydrogen and often some oxygen) on Earth.

Carbohydrates have carbon and the two elements of water (H and O).

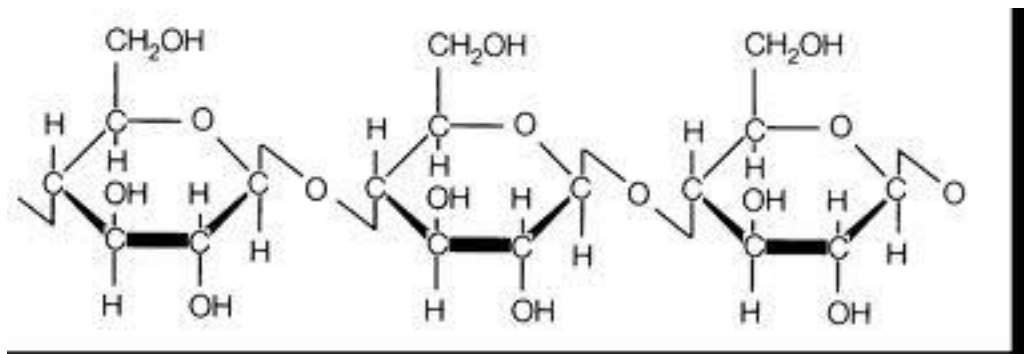
The simplest carbs are single sugar molecules called

monosaccharides. A common single sugar is glucose. Glucose is called a ring structure...guess why?



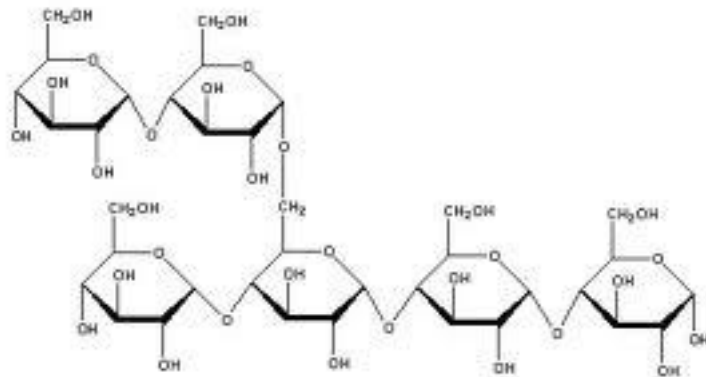
The left formula shows the carbons. The right formula represents most of the carbons as corners in the drawing. Note that the condensed formula for glucose is $C_6H_{12}O_6$

When many sugars are bonded together they are called polysaccharides. Cellulose (plants are mostly cellulose) is the most common polysaccharide (a very big carbohydrate) by weight. Cellulose is a polymer of glucose monomers. Cellulose functions as a structural support molecule in plants but is a food source for many primary consumers and herbivores.



The most common carbohydrate or monosaccharide in mammals is glucose

(from the Greek word glukus meaning sweet), which has the chemical formula $C_6H_{12}O_6$. Starch is a string of glucose molecules strung together. It differs from cellulose in the way the glucose molecules are bonded together.



Fructose (also a $C_6H_{12}O_6$) is a common monosaccharide in fruits (and does not promote tooth decay... so eat lots of fruits).

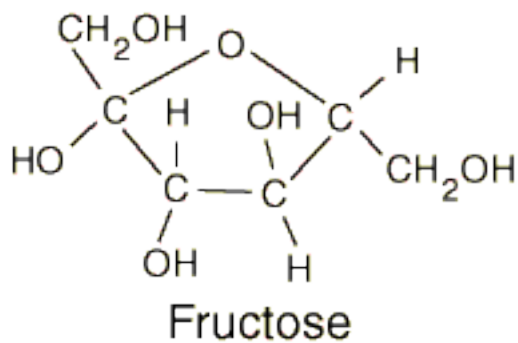
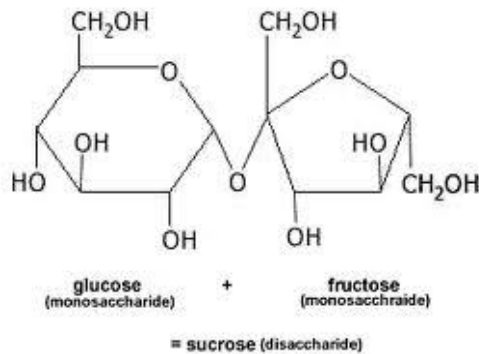


Table sugar or sucrose is a **disaccharide** made of two simple sugars (glucose and fructose bonded together).



Polysaccharides are carbohydrates made of up to thousands of individual sugar molecules (monomers) bonded together in one massive molecule. Starch, glycogen and cellulose are all polysaccharides made of monomers of glucose linked together in slightly different ways.

There are commonly between up to 26,000 glucose monomers in the cellulose molecule and often more than 1,000 glucose monomers in the starch molecule. Remember that the molecules differ mostly in the different manner in which the glucose molecules are joined.

Why can't humans digest cellulose and can digest starch?