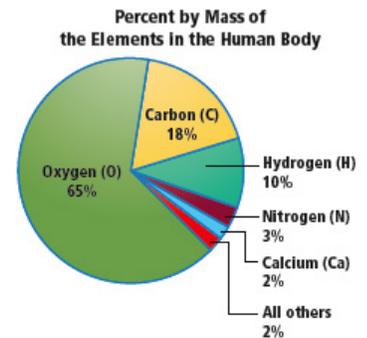


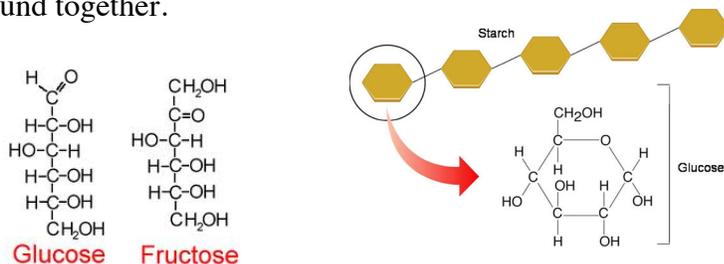
What makes a Molecule "Organic"?

As the science of chemistry was developing, there was a fascination with chemistry that was unique to living things. As we learned more and more about the elements that could be found in living things, we realized that **carbon** was a major component, found in any type of living thing that was analyzed, and in every molecule that was extracted (except water.) Molecules with carbon in them were assumed to be associated with living things, and so were called **organic molecules**. Carbon, with its ability to bond to four other atoms, can form very complex molecular structures, making it an excellent foundation for complex organic molecules. As it turns out, there are carbon compounds in minerals that are not derived from living things, so carbon alone isn't enough; organic molecules need **both carbon and hydrogen**.

Carbon and hydrogen are not the only atoms in living things. In fact, carbon, hydrogen, nitrogen and oxygen are the most common elements in living things. We now know that these elements make up 95% of your body weight. *The organic molecules found in living things fall into four major classes. Each class of molecule has features that determine its use in living systems.*



I. Carbohydrates: The first class of molecules is called **carbohydrates**. The simplest type of these, **simple sugars**, have a basic formula: for every carbon atom, there are two hydrogens and one oxygen (or one water for each carbon. Carbo - hydrate.) **Glucose** is a common carbohydrate that will show up again and again as we discuss cell chemistry: its formula is $C_6H_{12}O_6$. Table sugar, **sucrose**, is two single sugars bound together. Sugars can be anything from a single sugar molecule up to several bound together.

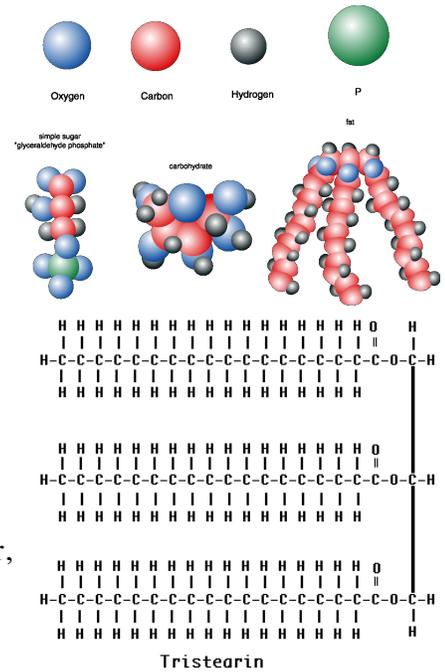


When the same type of molecule is used over and over in a much bigger molecule, the bigger molecules are called **polymers. Starches, proteins, and nucleic acids are all different types of polymers.*

Sugars can be bound together in long chains, which may form branches and even networks: these huge carbohydrates are called **starches**. Both sugars and starches are commonly used as **sources of energy** in cells: sugars are broken apart for the bond energy, and starches are a way to store lots of sugars. Large, stiff starches can also be used as structural molecules: **cellulose** is what holds most plants up. It is the main molecule in the cell wall of plant cells. (That "-ose" ending is a giveaway that something is a carbohydrate, although they don't all end that way.) There are other uses for carbohydrates in living systems, but energy and structure are by far the most common ones.

II. Lipids (Fats): The second class of organic molecules are called **lipids**. Fats and oils are included in this class of molecules. These have a fairly simple structure, starting with the 3-carbon **glycerol** molecule. Each carbon picks up a bit called a **fatty acid**, which can be short or fairly long, and then it's a lipid molecule.

Lipid molecules usually won't dissolve in water and tend to separate out from it (materials that will dissolve in water are **hydrophilic**). Vegetable oil is a lipid - what happens when you mix them? This makes them useful as **water barriers**, and they are found in **cell membranes** as well as such things as waxes and waterproofing oils. They are a great place to store extra energy: the lipids in **fat** are constructed for **longterm energy storage**. Included in this group are **steroid hormones**. Lipids also have other, varied uses, including **insulation** in organisms that need to hold onto heat in unusual conditions, like deep underwater..

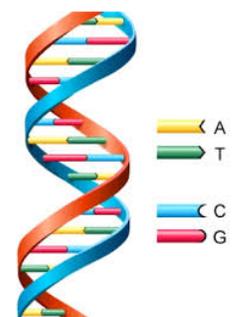


The last two classes of molecules are HUGE polymers.

III. Proteins: Proteins are huge chains of nitrogen-containing molecules called **amino acids**. These huge chains fold in on themselves in many layers to make large 3-dimensional shapes. Because of their many different shapes, they have a broad range of functions. What follows is just a partial list, some of the major things that proteins do in living systems.

- **Structure.** Cells are often held together with protein-based structures. Protein is an important cstructure in fungi, in animals in exoskeletons, and in things like tendons, ligaments, and cartilage.
- **Movement.** A single cell moves, or swims, using a protein-based movement system. Animal muscle depends upon two proteins, **actin** and **myosin**, contracting cells. Membranes have proteins that help move things through the barrier.
- **Communication.** Cells often send signals to each other using various types of proteins. Many **hormones** are proteins, as well as **pheromones** (signals-by-scent). Proteins also carry signals between nerve cells. **Antibodies** are proteins made specifically to attach to "foreign" molecules.
- **Chemistry.** The reactions that happen in cells often need a boost to get going, and that boost is supplied by **enzymes**, most of which are proteins.

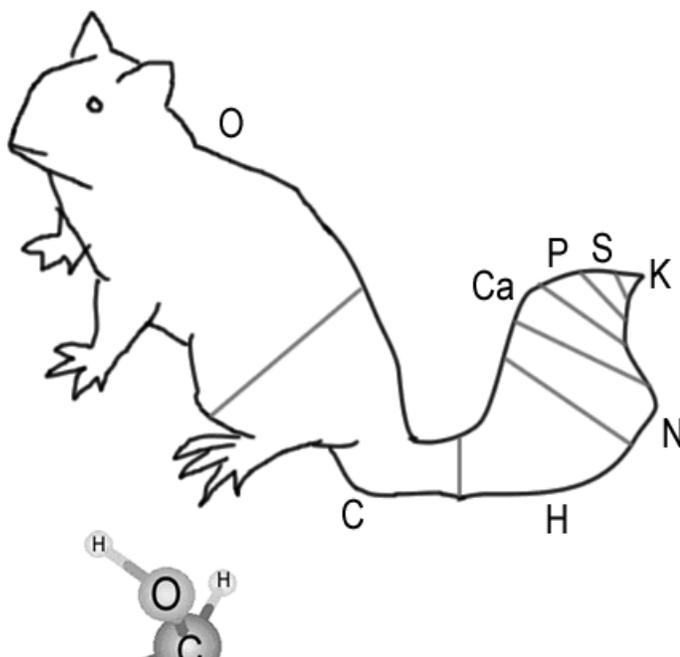
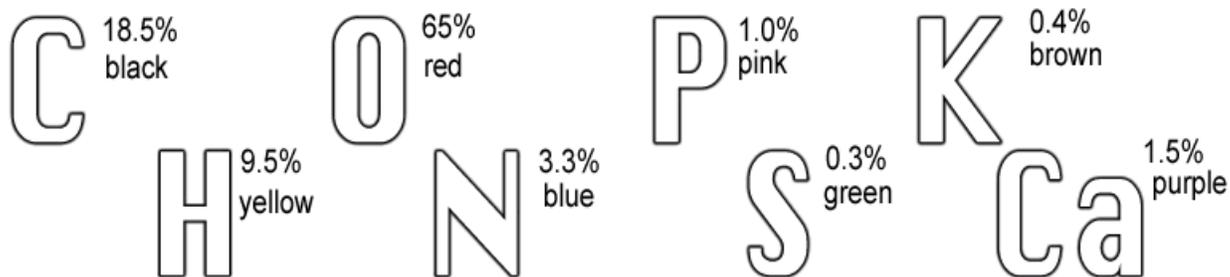
IV. Nucleic Acids: The last group of organic molecules is the **nucleic acids**. There are two varieties: **RNA** and **DNA**. These polymers are long chains of molecules called **bases**. The DNA in a cell is what makes up its **genes**. DNA carries the instructions for building molecules and cells. It is the code from which living things are made.



Organic Molecules Worksheet

Read the Article: "What makes a molecule organic?" Then answer the following questions.

1. Which element is the foundation of all organic molecules?
2. Name the 4 most common elements in living things.
3. Under each letter, write the name of the element. Then, color the diagram below to show the percent of each element in animals and plants:



(continued on back)

4. As you read, fill in the chart below...

Organic Molecules			
Name of Molecule	Examples/Types	Structure of Molecule	Functions
I. Carbohydrates			
II. Lipids (Fats)			
III. Proteins			
IV. Nucleic Acids			

5. What is a polymer? Give an example.

6. How can you tell if a molecule is organic?

7. What have you learned about organic molecules?