3.14 MONOSACCHARIDES ARE THE MONOMERS FROM WHICH CARBOHYDRATE POLYMERS ARE BUILT

Carbohydrates are diverse, as are all of the organic molecules. The most basic form of a carbohydrate is a **monosaccharide.** A monosaccharide is a sugar that has between three and seven carbon atoms per molecule.

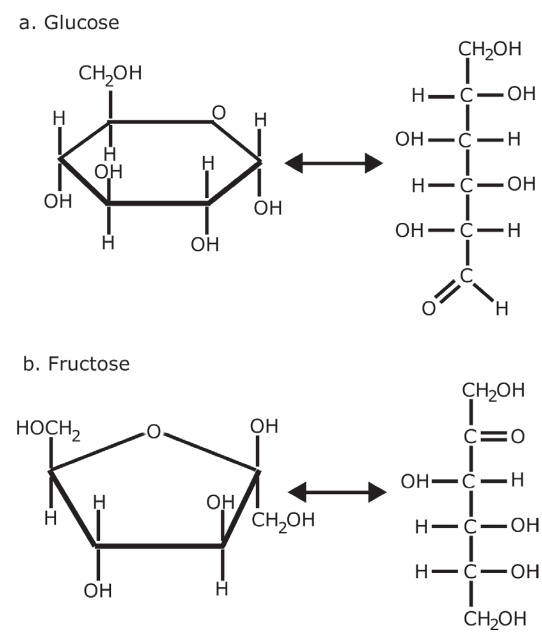
Glucose and fructose are common monosaccharides. **Glucose** is the sugar that animals use for their fuel source, while **fructose** is the plant sugar that makes many fruits sweet. Note that glucose and fructose both have the molecular formula of $C_6H_{12}O_6$, which means that these two molecules are isomers.

Monosaccharides are the monomer units from which carbohydrates are built. Carbohydrates are polymers of monosaccharides.

Figure 3.14.1

Common Monosaccharides

Two of the most common monosaccharides are shown to the right. The molecule depicted in (a) is glucose; the molecule depicted in (b) is fructose. Glucose is the carbohydrate that is metabolized during cellular respiration to produce the energy molecule ATP. Fructose is a common sugar that makes fruit sweet. Note that the molecular formula for both of these monosaccharides is $C_6H_{12}O_6$, but they have distinctly different structures. Since isomers are two or more molecules with the same chemical formulae but different structural formulae, that means that fructose and glucose are isomers. In addition, the arrow indicates that these molecules exist in two different structural forms. Different structural forms of the same molecule are called conformations. One conformation for glucose and fructose is a ring molecule. The other conformation is a linear (or straight) molecule. The arrow between the two conformations indicate the molecule can exist as either/or. Most sugars take on the ring structure because it is more stable. However, if we were to take a blood sample from a person and look at the glucose molecules in the blood, we would see that most of the molecules were in the ring structure, but some would be linear. A final note on the way the ring structures are drawn: notice that at each "point" of the ring, there is no indication of what atom is there, with the exception of oxygen. Carbon often goes unlabelled in organic chemistry's structural formulae because it is such an important atom. It is therefore assumed that, unless the atom is specifically labeled otherwise, the "points" of the ring structures are carbon atoms. This is the case for all molecules in organic chemistry, not just carbohydrates. Any time there are bonding lines that intersect, and the atom at the intersection is not identified, it is assumed the atom is carbon.



3.15 MONOSACCHARIDE ISOMERS AND CONFORMATION

There are two forms in which the monosaccharides can exist—**cyclic** (ring) and **straight chain**. This is possible because, depending on the conditions around the molecule, the nature of the monosaccharide molecules favors different isomers. Notice that the ring structures do not have any specific atom listed at the "corners" of the molecule. Organic chemistry has adopted this notation with ring structures, and it is assumed that the atom at the corners of the ring structures is carbon, unless otherwise noted.

It is not important to remember the actual molecular structures, but it is important to know that the monosaccharides can easily change their **conformation** (or structural appearance) depending on conditions. It is also important to know the isomers of the monosaccharides exist in the straight chain and cyclic form. Usually most monosaccharides exist in the cyclic form. You will learn much more about this in chemistry.