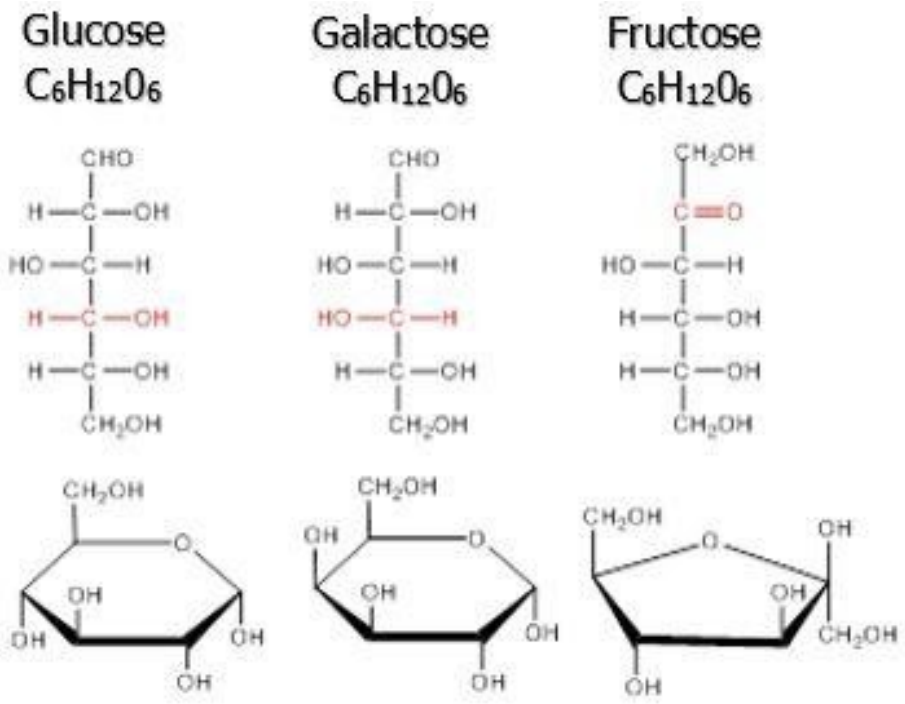
3.1.1

Monosaccharides

Monosaccharides (mono = one, saccharide = sugar) are the basic subunits of carbohydrates. They contain from 3–7 carbons and have the general formula of $(CH_2O)n$ where n ranges from 3–7 (5 or 6 being the most common). For example, if n = 6, the formula for the monosaccharide would be $C_6H_{12}O_6$. Please note that the ratio of carbon to water (H_2O) is 1:1 in a monosaccharide, giving credence to the name carbohydrate. Note also that monosaccharides contain a significant amount of oxygen. Carbohydrates have the highest oxygen to carbon ratio of any of the important organic molecules. These oxygens can increase the solubility of carbohydrates in water (due to the increased number of polar covalent bonds). This is evident in tissues like cartilage, which contains a lot of polysaccharide molecules that act as molecular sponges to hold water, maintaining the cushioning and lubricative functions of certain cartilage types.

Common monosaccharides include **glucose**, **fructose**, **galactose**, **ribose**, **and deoxyribose**. Notice that the name of each of these sugars ends with the suffix -ose. This suffix, -ose, means full, specifically full of oxygen. The names of most sugars will end with this suffix. The structures of three common dietary monosaccharides are shown in the figure below. Note that the molecules can exist in two different forms. When they are in a dry or powdered state, they exist as a linear molecule (top), but when dissolved in water, they adopt a ringed form with oxygen being one of the members of the ring (bottom). Since all of the molecules in our bodies exist as aqueous solutions, the ringed form is how we find monosaccharides in the body. Note also that all three of these compounds have six carbons; hence, they have the same molecular formula, $C_6H_{12}O_6$. However, their structural formulas are different (see figure below). Molecules with the same molecular formula but different structures are called **isomers**.



Linear and Ring Structure of Isomers of $C_6H_{12}O_6$. *Image created by MG 2013*

Glucose, also called dextrose, is the predominant sugar in our blood. When we speak of blood sugar levels, we are really talking about blood glucose levels. Our bodies get glucose primarily from the digestion of disaccharides and polysaccharides. Once these carbohydrates are broken down to glucose in the small intestine, the glucose is absorbed into the blood and transported to the various organs of the body. There, it can be metabolized to provide fuel for cellular metabolism. If it is not immediately needed for metabolism it can be stored as glycogen (more about this complex carbohydrate later) in the liver and muscle or converted to triglycerides (fat) and stored in the fat cells. Importantly, in the absence of carbohydrate ingestion (a low-carb diet for example), the body can actually make its own glucose in a process called gluconeogenesis.