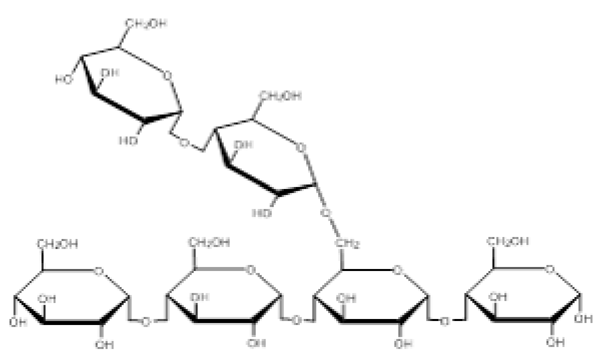
3.3.3

Polysaccharides

Polysaccharides are long chains of monosaccharide subunits linked together through dehydration synthesis reactions. Typically, these chains contain hundreds to thousands of monosaccharides linked together through glycosidic linkages. Because of their length, polysaccharides are considered **complex carbohydrates**., Polysaccharides can be classified into two categories based on their function as either energy storage or anatomical structure. When monosaccharides form rings they adopt one of two possible orientations. The first orientation involves the anomeric carbon hydroxyl group being located below the ring called the **alpha** orientation. The other orientation involves the hydroxyl group on the anomeric carbon being above the ring called the **beta** orientation. Storage polysaccharides are made from alpha monomers with glycosidic linkages at the anomeric carbon and the 4^{th} or 6^{th} carbon of the other monomer (alpha 1-4, alpha 1-6). Alpha 1-4 bonds are linear whereas alpha 1-6 bonds form branches. Structural polysaccharides are made from the beta monomers with glycosidic linkage occurring at the anomeric carbon and 4^{th} carbon of the other monomer (beta 1-4).

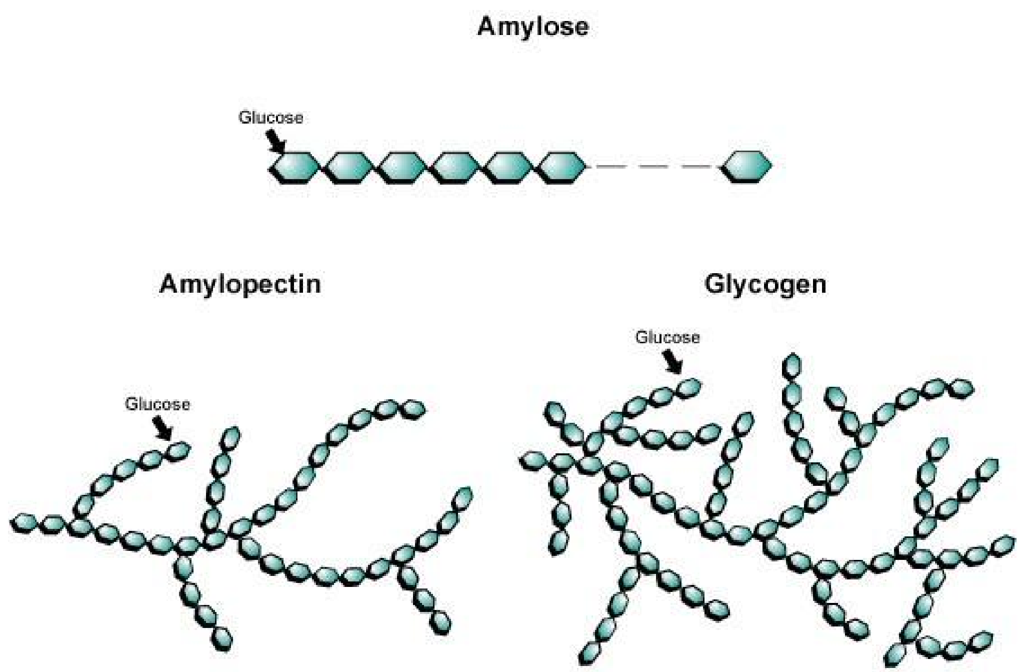
Storage polysaccharides: Storage polysaccharides include starch and glycogen. Plants and animals store sugar for energy use in the form of glycogen (animals) and starch (plants). **Starch** is a large polymer of glucose subunits and may be branched (alpha 1-6) or linear (alpha 1-4). **Amylose** is a long, unbranched chain of glucose subunits. **Amylopectin,** on the other hand, has a branched structure (see figure below). In mammals, it is the proportion of each form of starch in a particular food that determines the food's ability to be digested. Foods with a large amount of amylopectin are digested and absorbed rapidly because of the many branches, which facilitates hydrolysis. Foods that have higher levels of amylose break down at a slower rate. Some examples of starches include seeds, grains, corn, beans, potatoes, and rice.



Branched Polysaccharide Amylopectin: *Image created by MG, 2013*

The image above shows branching in a polysaccharide molecule. Branching allows increased enzymatic breakdown and faster digestion.

Glycogen is the storage form of carbohydrates in animals. Glycogen, like starch, is a polymer of glucose subunits. It is similar in structure to amylopectin, but it is even more highly branched. The branched structure of glycogen allows for easy breakdown by enzymes to release the glucose, so it can be utilized for energy.



Amylose, Amylopectin & Glycogen Structure. *Image created by BYU-I student Hannah Crowder, 2013*

This image above shows different degrees of branching in amylose, amylopectin, and glycogen.

Structural polysaccharides: **Cellulose** is an important structural molecule in plants. Cellulose is a polymer of glucose but is assembled using different glycosidic linkages (beta 1-4). Most animals do not contain enzymes that can break beta 1- 4 bonds. These bonds are found in cellulose (fiber), however, certain types of bacteria can breakdown the bonds. Cows or animals that eat grass (high in fiber) have large amounts of bacteria in different chambers of their stomachs that help them break down the fiber to usable sources of monosaccharides.