

Disaccharides

Sucrose, also known as table sugar, is a common disaccharide. It is composed of two monosaccharides: D-glucose (left) and D-fructose (right). Main article: Disaccharide

Two joined monosaccharides are called a disaccharide and these are the simplest polysaccharides. Examples include sucrose and lactose. They are composed of two monosaccharide units bound together by a covalent bond known as a glycosidic linkage formed via a dehydration reaction, resulting in the loss of a hydrogen atom from one monosaccharide and a hydroxyl group from the other. The formula of unmodified disaccharides is $C_{12}H_{22}O_{11}$. Although there are numerous kinds of disaccharides, a handful of disaccharides are particularly notable.

Sucrose, pictured to the right, is the most abundant disaccharide, and the main form in which carbohydrates are transported in plants. It is composed of one D-glucose molecule and one D-fructose molecule. The systematic name for sucrose, O- α -D-glucopyranosyl-(1 \rightarrow 2)-D-fructofuranoside, indicates four things:

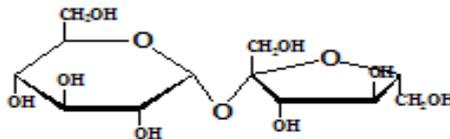
Its monosaccharides: glucose and fructose
Their ring types: glucose is a pyranose and fructose is a furanose
How they are linked together: the oxygen on carbon number 1 (C1) of α -D-glucose is linked to the C2 of D-fructose. The -oside suffix indicates that the anomeric carbon of both monosaccharides participates in the glycosidic bond. Lactose, a disaccharide composed of one D-galactose molecule and one D-glucose molecule, occurs naturally in mammalian milk. The systematic name for lactose is O- β -D-galactopyranosyl-(1 \rightarrow 4)-D-glucopyranose. Other notable disaccharides include maltose (two D-glucoses linked α -1,4) and cellobiose (two D-glucoses linked β -1,4). Disaccharides can be classified into two types: reducing and non-reducing disaccharides. If the functional group is present in bonding with another sugar unit, it is called a reducing disaccharide or biose. Carbohydrate consumed in food yields 3.87 kilocalories of energy per gram for simple sugars,[20] and 3.57 to 4.12 kilocalories per gram for complex carbohydrate in most other foods.[21] Relatively high levels of carbohydrate are associated with processed foods or refined foods made from plants, including sweets, cookies and candy, table sugar, honey, soft drinks, breads and crackers, jams and fruit products, pastas and breakfast cereals. Lower amounts of carbohydrate are usually associated with unrefined foods, including beans, tubers, rice, and unrefined fruit.[22] Animal-based

foods generally have the lowest carbohydrate levels, although milk does contain a high proportion of lactose. Organisms typically cannot metabolize all types of carbohydrate to yield energy. Glucose is a nearly universal and accessible source of energy. Many organisms also have the ability to metabolize other monosaccharides and disaccharides but glucose is often metabolized first. In *Escherichia coli*, for example, the lac operon will express enzymes for the digestion of lactose when it is present, but if both lactose and glucose are present the lac operon is repressed, resulting in the glucose being used first (see: Diauxie). Polysaccharides are also common sources of energy. Many organisms can easily break down starches into glucose; most organisms, however, cannot metabolize cellulose or other polysaccharides like chitin and arabinoxylans. These carbohydrate types can be metabolized by some bacteria and protists. Ruminants and termites, for example, use microorganisms to process cellulose. Even though these complex carbohydrates are not very digestible, they represent an important dietary element for humans, called dietary fiber. Fiber enhances digestion, among other benefits.[23] The Institute of Medicine recommends that American and Canadian adults get between 45–65% of dietary energy from whole-grain carbohydrates.[24] The Food and Agriculture Organization and World Health Organization jointly recommend that national dietary guidelines set a goal of 55–75% of total energy from carbohydrates, but only 10% directly from sugars (their term for simple carbohydrates

Digestible Disaccharides in Food

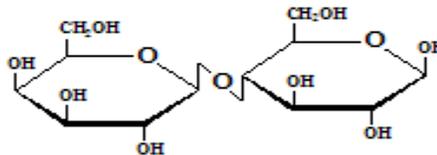
Sucrose

(Glucose-fructose)



Lactose

(Galactose-glucose)



Maltose

(Glucose-glucose)

