

Reading- HONC While You're CLPN- Macromolecules of Life

You and all living things are predominantly made up of 4 large organic molecules: **carbohydrates**, **lipids**, **proteins**, and **nucleic acids** (CLPN). These organic (aka carbon containing) molecules are often called **macromolecules** because they may be very large, containing thousands of the carbon and hydrogen atoms covalently bonded together. In fig. 1a,

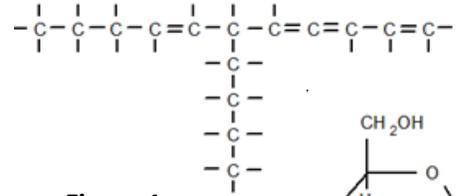


Figure 1a

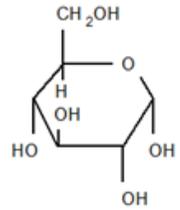


Figure 1b

usually from these 4 elements your body is able to make an enormous range of critical molecules. Carbon's flexibility to form single, double, triple bonds, and even form ring structures (see figure 1b) accounts for this variety in living things.

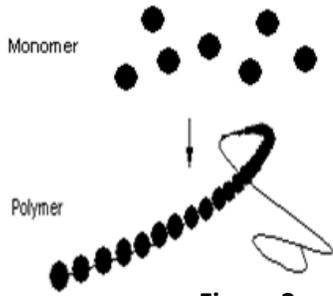


Figure 2

These large CLPN macromolecules are also known as **polymers** ("poly"= many) are actually synthesized from smaller building blocks known as **monomers** ("mono" = one). You will need to be familiar with each of the 4 main macromolecules polymers, monomers, and their purpose in the human body.

Carbohydrates: Carbohydrates, commonly known as "carbs," include the small sugar molecules dissolved in soft drinks as well as the long starch molecules we consume in pasta. In animals, carbohydrates serve as a primary source of dietary energy.

Carbohydrates are made up of monomers called **monosaccharides**. These are often referred to as simple sugars and include glucose, found in sports drinks, and fructose found in

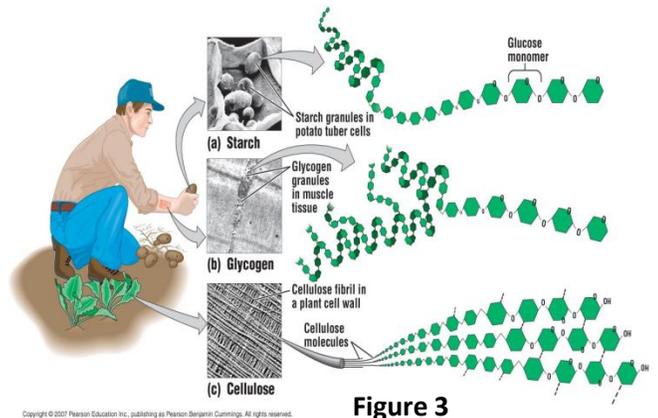


Figure 3

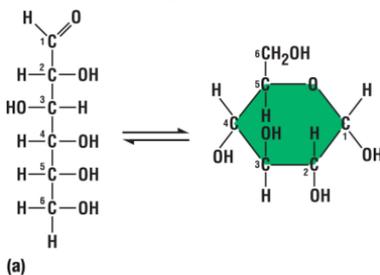


Figure 4

fruits. Sucrose, commonly known as table sugar, is a disaccharide; made up of two monomers, glucose and fructose. Starches, or complex carbohydrates, are larger than sugars and are called **polysaccharides** (made up of many monosaccharides).

Monosaccharides can exist in two forms, a carbon chain or a ring (see fig. 4).

Monosaccharides are found as rings when they are part of larger polymers or as single monomers dissolved in water.

Lipids: Lipids, commonly referred to as "fats," are large, mostly non-polar molecules that do not dissolve in water. They function as long term energy storage molecules in plant and animal cells.

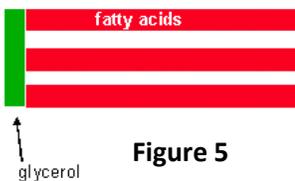
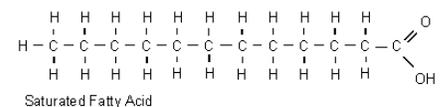


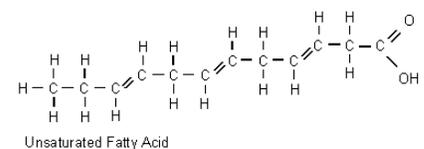
Figure 5

Lipid polymers are made up of two different monomers: **glycerol** and **fatty acids**. Glycerol is a three carbon molecule that is polar and hydrophilic (meaning it is attracted to polar water molecules). Fatty acids are long, non-polar hydrocarbon chains that are hydrophobic (meaning that they are "afraid" of water).

Two different types of fatty acid chains are commonly found in nature; **saturated** and **unsaturated** fatty acids (see fig. 6). Saturated fatty acids chains contain only single bonds and are typically found in the fats of animals, whereas, unsaturated fatty acids contain double bonds between carbon atoms. This double bond causes the fatty acid monomer to take on a bent shape. Unsaturated fatty acids are typically found in the fat molecules of plants.



Saturated Fatty Acid



Unsaturated Fatty Acid

Figure 6

Lipid molecules consist of a variety of different polymers. The lipid polymer that is used for energy storage is called a **triglyceride**. It is made up of a single glycerol molecule and three fatty acid chains. The fatty acid chains attached directly to the glycerol molecule (see fig. #).

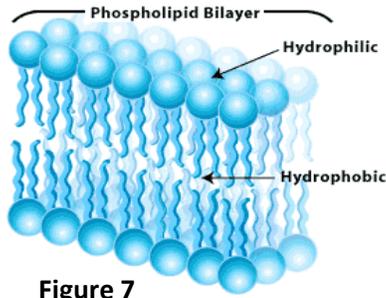


Figure 7

A second class of lipids is called **phospholipids**. Phospholipid polymers are essentially made up of a glycerol “head” and two fatty acid chains (see fig. 7). Phospholipids make up the plasma membrane of all cells. The membrane structure consists of two layers of phospholipids with the polar glycerol heads lining the inside and outside of the membrane where water is found. The non-polar fatty acid “tails” make up the inside of the membrane where they will not interact with water molecules. This provides a protective layer for cells.

Proteins: Proteins are considered to be the building blocks of life. The actual structure of cells is mostly made up of protein molecules. Specialized proteins, called **enzymes**, also control and speed up many of the chemical reactions that occur in living organisms.

The monomers of proteins are **amino acids**. There are twenty amino acids that are common in all living organisms. These amino acids join together in a variety of combinations to form all of the proteins that account for the differences in the many species of organisms on Earth. Amino acids join together forming bonds called peptide bonds (see fig. 8). A polymer of proteins, which is made up of many peptide bonds, is called a **polypeptide chain**.

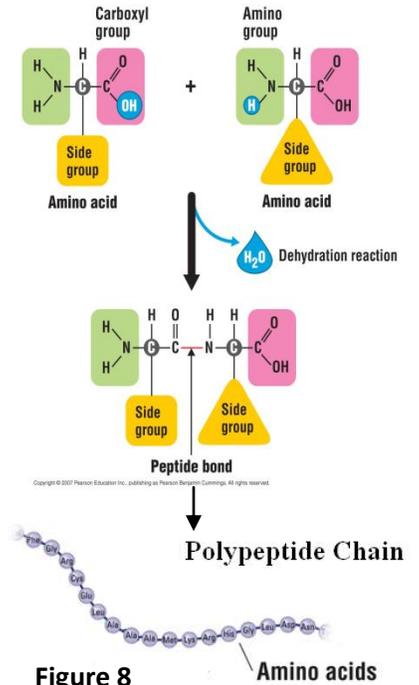


Figure 8

Nucleic Acids: Nucleic acids are the hereditary material that is passed on from parent to offspring. Nucleic acids are directly involved in making proteins and proteins control the physical characteristics of cells. There are two nucleic acid polymers: **deoxyribonucleic acid (DNA)** and **ribonucleic acid (RNA)**. The function of DNA is to store genetic information. RNA, however, is directly involved in making proteins.

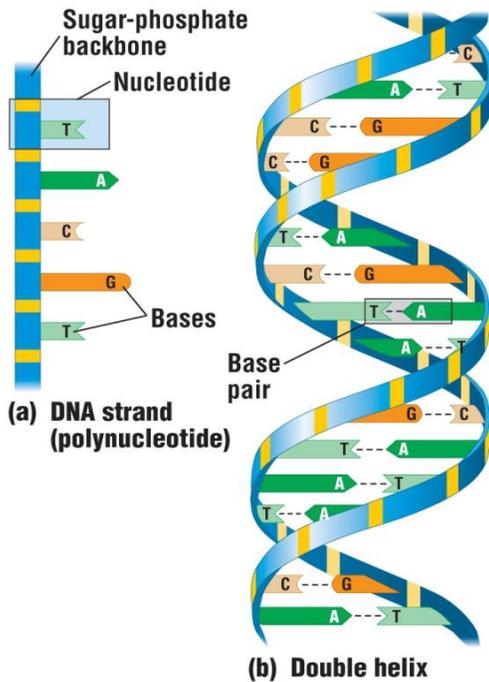


Figure 9

Nucleic acids are made up of monomers called **nucleotides**. There are four different nucleotide monomers found in DNA polymers. These are guanine (G), cytosine (C), adenine (A) and thymine (T). The overall shape of a DNA molecule is a double helix (sometimes called a twisted ladder). The molecule is made up of two strands of nucleotides held together by **hydrogen bonds**. A hydrogen bond will readily form between G and C or A and T. The formation of these hydrogen bonds give DNA its “ladder” shape (see fig. 9). The genetic code is simply the sequence of nucleotide monomers that makes up each side of the DNA molecule. In order for genes to be “read” and proteins to be made, any enzyme must break the hydrogen bonds that hold the two sides of the molecule together and expose the genetic code hidden within.

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