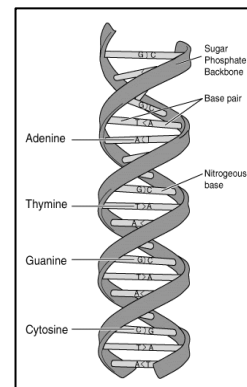


CA State Standard 1h – Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.

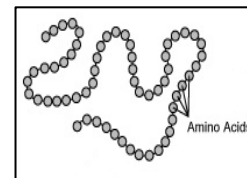
Cells are constantly manufacturing and breaking down very **large carbon-based molecules**. These large molecules are called **macromolecules**.

WHICH LARGE MOLECULES ARE BIOLOGICALLY IMPORTANT?

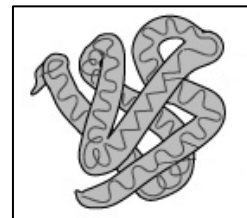
There are several large **macromolecules** necessary for life. **Nucleic acids** hold genetic information. **Proteins** participate in almost all cellular activities. **Lipids** make up cell membranes and store chemical energy. **Polysaccharides** provide energy and structural support to cells. All of these molecules are macromolecules, large molecules made of smaller molecules. **Polymers** are molecules that are made of many **monomers**. As an analogy, consider the beads on a necklace. Each bead is a small unit, resulting in a large product, the necklace. In molecular terms, the beads represent smaller molecules called **monomers**. The necklace is similar to a long chain of monomers called a polymer. Many macromolecules are polymers, for example, polysaccharides, nucleic acids, and proteins. (When thinking about polymers and monomers, remember that the prefix *poly-* means "many" and the prefix *mono-* means "one.")



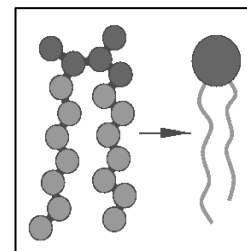
WHAT MOLECULES MAKE UP NUCLEIC ACIDS? **Nucleotides** are the molecules that are bonded together to form nucleic acids. Deoxyribonucleic acid (DNA) is a two-stranded molecule; each strand contains four types of **nucleotides** linked together. Ribonucleic acid (RNA) is a single-stranded molecule. RNA contains three of the four nucleotides found in DNA, plus one nucleotide that is not found in DNA.



WHAT ARE PROTEINS MADE OF? Proteins are formed from **amino acids**. Although the number of possible proteins is nearly limitless, only 20 amino acids are commonly found in the proteins in organisms. Amino acids are bonded together by covalent bonds, called **peptide bonds**, to form polypeptide chains called polypeptides. Proteins are made of one or more **polypeptides**. The number, type, and order of amino acids in each protein are unique.



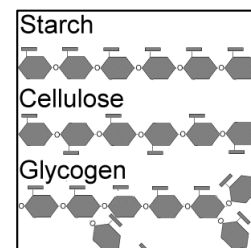
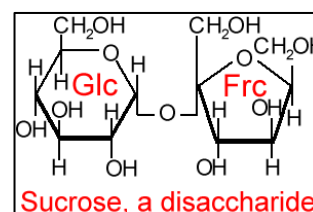
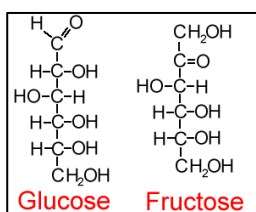
WHAT ARE LIPIDS? These are fats and oils that can be found in both plants and animals. Unlike polysaccharides, nucleic acids, and proteins, lipids are not made of repeating subunits. However, many lipids contain **fatty acids**, which are chains of carbon atoms attached to hydrogen atoms. Lipids may also contain a three-carbon molecule called **glycerol**. Phospholipids in cell membranes, for example, are composed of two fatty acid chains, glycerol, and a phosphate group.



HOW ARE POLYSACCHARIDES FORMED? A polysaccharide is made of several **monosaccharides** or simple sugars through the process of a condensation reaction (water molecule comes out when sugars are linked). An example of a monosaccharide is the sugar glucose; examples of polysaccharides are starches, which are made of branching chains of glucose.

Answer the following questions:

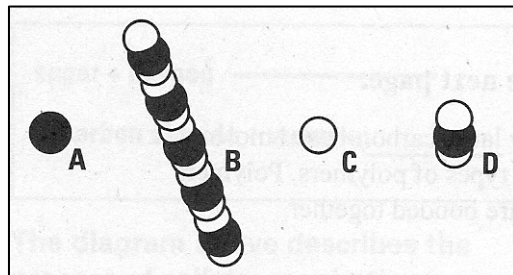
1. What is the difference between a polymer and monomers?



2. Which monomers are bonded together to form polysaccharides? Which molecules are bonded together to form nucleic acids?

3. Each of the structures to the right represents a molecule. Which of the structures *best* represents a polymer or a macromolecule?

- A) Structure A
- B) Structure B
- C) Structure C
- D) Structure D.



4. DNA is the genetic material that codes for a sequence of amino acids. Many amino acids make up a protein. Which is the monomer?

- A) cellulose
- B) protein
- C) amino acids
- D) DNA

5. Fats and oils are examples of

- A) lipids
- B) proteins
- C) nucleic acid
- D) carbohydrates.

6. When you eat, enzymes work to break up the polysaccharides in your food into smaller pieces. If the polysaccharide is a polymer, what are the smaller units that are formed?

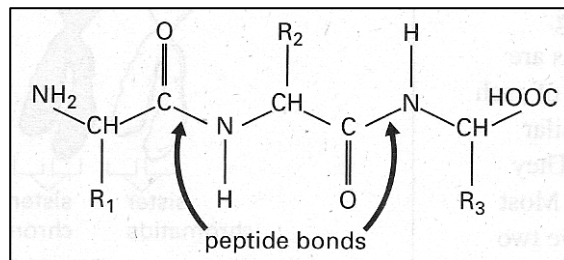
- A) proteins
- B) monosaccharides
- C) macromolecules
- D) amino acids

7. Which of the following *best* describes a macromolecule?

- A) a molecule that is part of a larger molecule
- B) a molecule that is a repeating subunit
- C) a molecule that is a much larger version of a polymer
- D) a molecule that is made up of smaller molecules

Use the diagrams below to answer the following questions.

8. The figure to the right shows three molecules bonded together by peptide bonds. Which macromolecule would contain these molecules? How do you know this?



The formation of sucrose from glucose and fructose is represented by the process of condensation shown below. Notice that this reaction can proceed in either direction.

9. Identify the monosaccharides:

10. Identify the disaccharide:

11. What is removed when 2 sugars are linked to form the larger sugar molecule?

