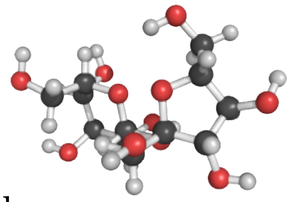
Name: ____________________ Date: __________ **Class Notes IPC**



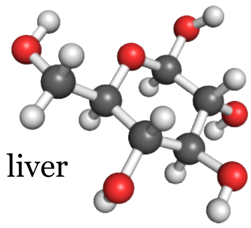
Macromolecules

The most interesting molecules in living organisms are the **macromolecules**. These are the large organic molecules supplying the cell's energy, making up its structure and creating the processes for its activities. Many of these molecules are long polymer chains, some are branched molecules and others are formed by organic rings. But all are important to the survival of an organism.

There are four main groups of macromolecules: carbohydrates, lipids, proteins and nucleic acids. Each group consist of many smaller molecules chemically joined together to create the different macromolecules. The cell must collect and assemble the needed **monomers** (single molecules) to build the **polymers** (molecule chains) or branched molecules needed by the cell. Therefore, if you are to understand the cell, you must know something about these molecules.

Carbohydrates

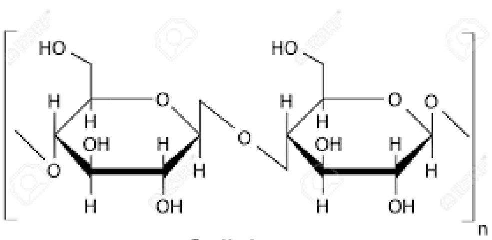
Carbohydrates are macromolecules made of carbon, hydrogen and oxygen in a 1:2:1 ratio respectively. Carbohydrates are the main source of energy for the cell, a source of fiber and used for structural purposes by many organisms.



The building blocks for carbohydrates are natural sugars called **saccharides**. There are two main saccharide groups: monosaccharides (single sugars) and polysaccharides (long sugar chains). The monosaccharides are single sugars like glucose, fructose and galactose. Glucose is the main source of energy for the cell, but the liver can convert fructose or galactose into glucose for use as energy.

The linking of two monosaccharides creates a **disaccharide** (double sugar). Two very common disaccharides are lactose and sucrose. Lactose is the most abundant sugar found in milk and sucrose is the main product of plant photosynthesis.

Polysaccharides are created by linking chains of monosaccharides into long polymers. These polysaccharides function as glucose storage tanks or structural components. The most common storage carbohydrate in animals is **glycogen**, a long, branched polymer of glucose molecules stored in the liver and used for energy between meals.

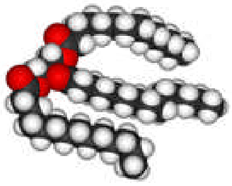


Cellulose

In plants the main storage carbohydrate is **starch**, also a glucose polymer found in two forms: the unbranched form amylose and the branched form amylopectin. The most common structural polysaccharide is **cellulose**, an unbranched polymer of glucose found in plant cell walls. Cellulose cannot be digested by humans but is important to the diet as fiber. It is also the most abundant organic chemical on the planet.

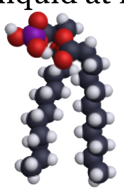
Lipids

Lipids are large macromolecules that do not form long polymer chains like carbohydrates or proteins. They are insoluble in water but soluble in organic solvents like acetone or alcohol. The primary functions of lipids are energy storage, parts for biological membranes, chemical messengers and waterproofing. Lipids include fats, oils, fat soluble vitamins, steroids and waxes.

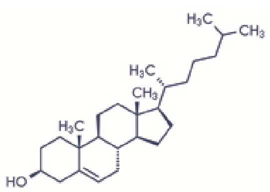


Fats and oils (**triglycerides**) store energy and are formed by combining one glycerol molecule with three fatty acids. Fats are divided into two groups, **saturated** fats which only have single bonds in the triglyceride tails and **unsaturated** fats that have double or triple bonds in the triglyceride tails. Due to the structure of a saturated fat it is tightly packed, has a high melting point and is solid at room temperature.

In contrast, unsaturated fats are not tightly packed, have low melting points, and are liquid at room temperature. The exception to this are trans fats, which have double or triple bonds but because of the structure trans fats are tightly packed.



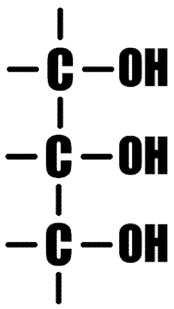
Phospholipids which are created by replacing one of the fatty acids with a phosphate ion make up the cell membranes and help control the traffic in and out of the cell.



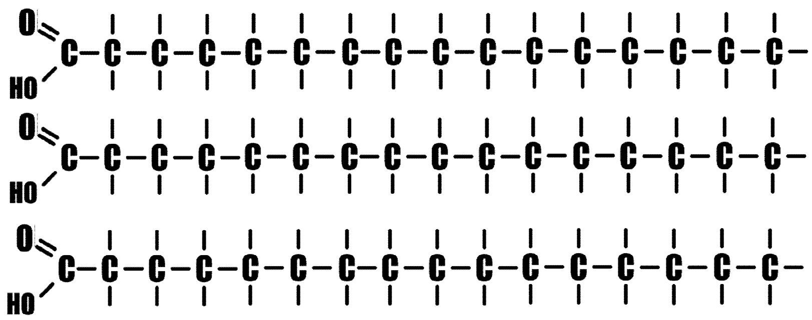
Steroids are specialized lipids composed of four carbon rings arranged in a specific configuration. Three cyclohexane rings and one cyclopentane ring are fused together to form the main structure and functional groups are attached to create the various types of steroids. Steroids primary functions are as cell membrane components and chemical messengers. Examples of steroids are cholesterol, testosterone, estrogen and oil soluble vitamins.

Waxes are lipids formed by the linking of one long-chained fatty acid and one long-chained alcohol into a molecule. Waxes are solid at room temperatures, soft and malleable, insoluble in water but soluble in polar solvents. Many animals and plants make waxes that function as waterproof coatings or housing structures. Two common animal waxes are lanolin from wool and beeswax. A very useful plant wax used in many products is carnauba wax also called Brazil wax or palm wax.

Draw the structure of a triglyceride.



glycerol

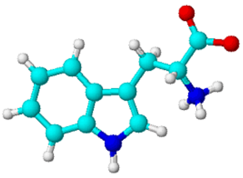


fatty acids

Proteins

Proteins are large molecules of carbon, hydrogen, oxygen and nitrogen; formed by linking amino acids together with a **peptide bond** thus creating various long polymers. These long amino acid polymers are called **polypeptides** and are rarely shorter than thirty units long.

There are twenty-two amino acids that are the building blocks (monomers) of proteins. Amino acids consist of a central carbon atom bonded to an amino group (NH_2), a carboxyl group (COOH), a hydrogen atom and a side chain (R). The difference in amino acids is in the side chain. It can vary in size, shape, charge, hydrophobicity and reactivity.

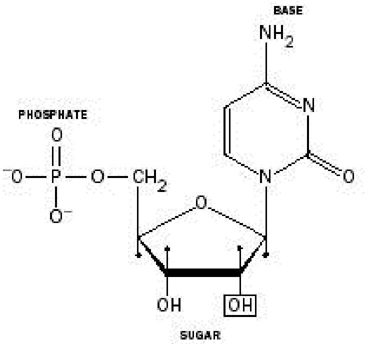


Proteins have several functions involved in the growth of an organism. Proteins serve as catalysts (enzymes) for metabolic reactions, assist in the replication of DNA, help with responding to stimuli and transporting molecules within the organism. The difference in proteins is due to the arrangement of the amino acids determined by the nucleotide sequence in the organism's DNA. This results in a certain folding of the protein molecule and determines the protein's function.

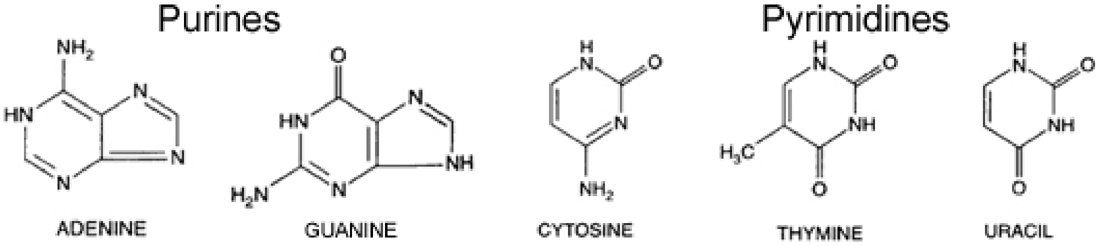
Draw the structure of an amino acid.

Nucleic Acids

Nucleic acids are long unbranched polymer chains of nucleotides (monomers) that contain the information with the amino acid sequence for building proteins and assist the organelles with linking amino acids in the correct order. There are two main types of nucleic acids, deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).



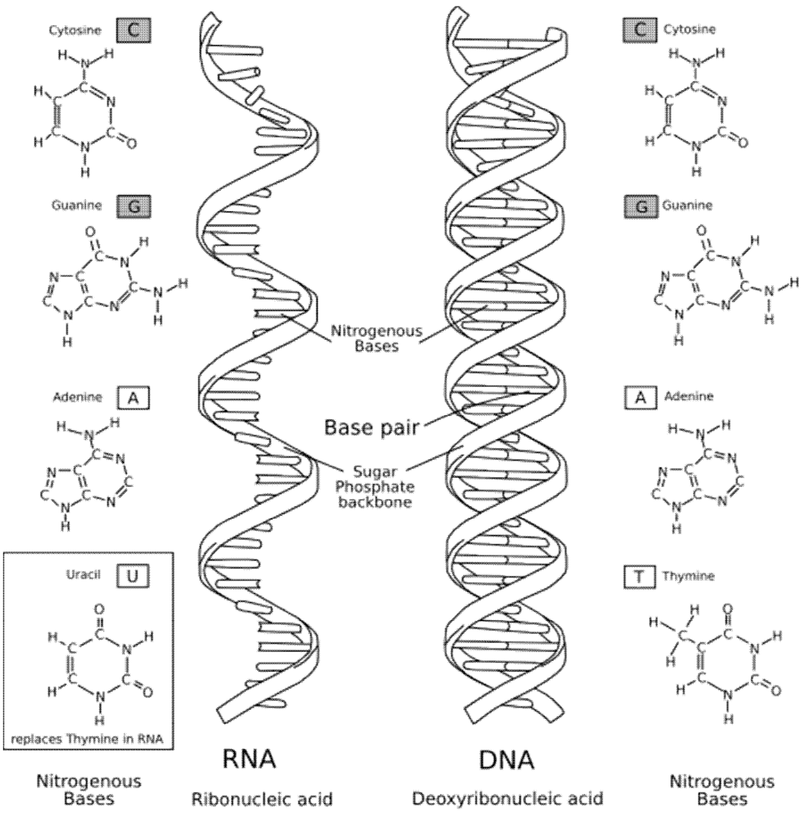
Both DNA and RNA are made from nucleotides that consist of a base, a five-carbon sugar (deoxyribose or ribose) and a phosphate group. The five bases used are in two groups, purines adenosine (A) and guanine (G) and cytosine (C), thymine (T) and uracil (U) are pyrimidines. Adenine, guanine and cytosine are in both DNA and RNA but thymine is replaced in RNA with uracil.



The code created by the bases was discovered by James Watson and Francis Crick in 1953 and led to their receiving a Nobel prize. They determined that the structure of DNA consist of two polynucleotide strands wound together to form a double helix connected by hydrogen bonds between base pairs. The backbone of the double helix is created by the sugar-phosphate group and the base pairs (A-T or G-C) make up the interior of the double helix.

DNA is the storehouse of information for the cell. It contains all the instructions needed to build the tissues and organ of an organism. This information is organized into units called genes and this genetic material carries all the amino acid sequences. These sequences are transcribed into three different types of RNA: messenger RNA (mRNA), transfer RNA (tRNA) and ribosomal RNA (rRNA). It is the function of these RNAs to synthesize proteins.

RNA is like DNA in that it is made of nucleotides but instead of two strands it has only one and replaces thymine with uracil for its base pairs. The function RNA is to transcribe and translate the genetic code contained in DNA**.** **Transcription** is the process of making mRNA from the DNA using **RNA polymerase**. Next, the mRNA leaves the nucleus and **translation** begins by creating tRNA from the mRNA. The tRNA contains the codons for the amino acids needed to create proteins. Finally, the **ribosomes** take the tRNA and assembles the amino acids into proteins.



"Successful people are successful because they are willing to do what others don't want to do." --wiseman