Macromolecules

word scramble

Unscramble the words below:

1. uloreomealmcc_____
2. iteprno_____
3. ipldi_____
4. cortahraybde_____
5. nad_____
6. aursg_____
7. aft_____
8. opiypdtlpee_____
9. nituertn_____
10. rsctah_____

Macromolecules (Chapter 5)

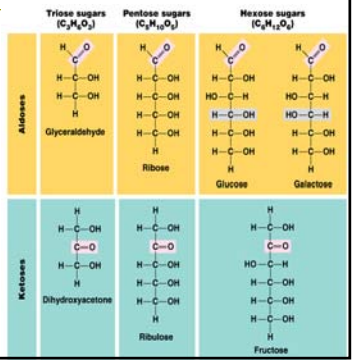
- Cells join small organic molecules together to form large molecules.
- These larger molecules, **macromolecules**, may be made of thousands of atoms and weigh over 100,000 daltons.
- The four major classes of macromolecules are: carbohydrates, lipids, proteins, and nucleic acids

Carbohydrates

- Carbohydrates are also called sugars and they can be simple or complex. Simple sugars are called **monosaccharides**. There is also **disaccharides** that consist of 2 monosaccharides linked together. Finally there are polysaccharides which are many monosaccharides linked together.
- Carbs. Are the most numerous molecules in life.

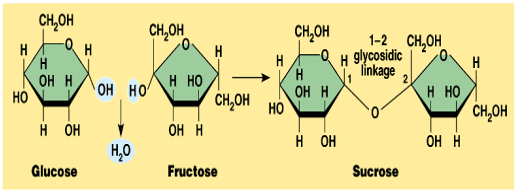
Monosaccharides

- Monosaccharides generally have molecular formulas that are some multiple of CH_2O. Ex. Glucose.
- Monosaccharides are classified by the number of carbons in the backbone.



Oligo or Disaccharides

- Characterized by the joining of two monosaccharides usually in some aqueous solution due to a dehydration reaction.

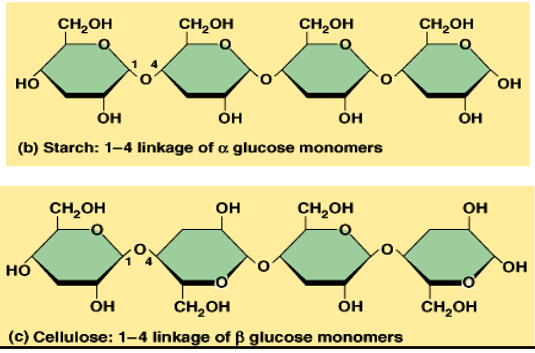


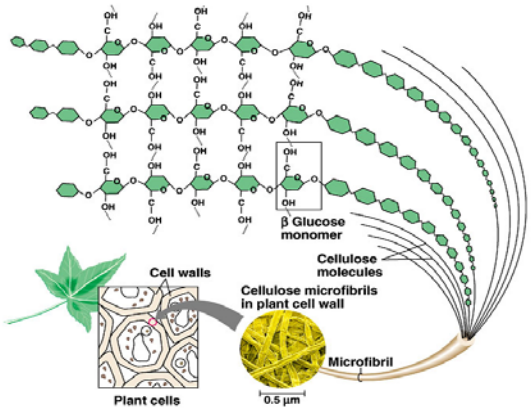
(b) Dehydration synthesis of sucrose

Polysaccharides

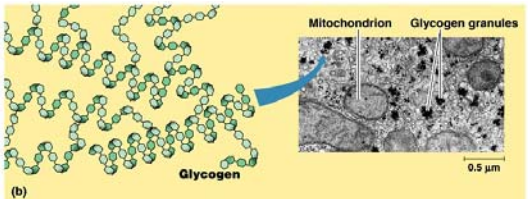
- **Polysaccharides** hundreds to thousands of monosaccharides joined by glycosidic linkages
- One function of polysaccharides is to store energy. Other polysaccharides serve as building materials for the cell or whole organism.
- **Starch** is a storage polysaccharide composed entirely of glucose monomers. Found in plants they use it to store energy in other word it is plant fat. Then we or something else eats the plant and the circle of energy continues.
- Animals too store glucose in a polysaccharide called **glycogen**.

Cont…..





Glycogen

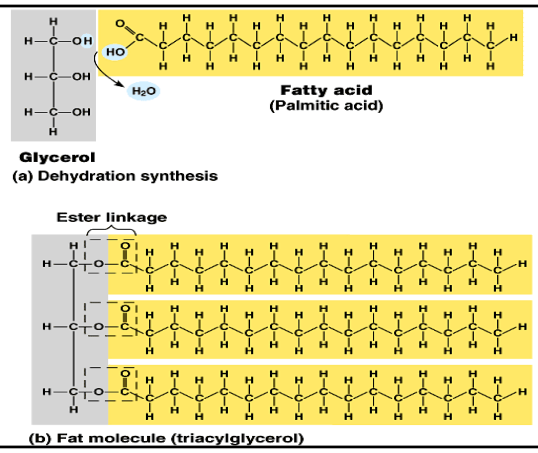


Chitin

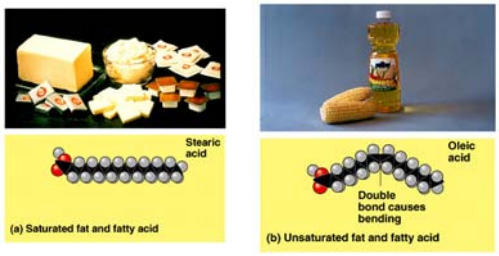
- Another important structural polysaccharide is **chitin**, used in the exoskeletons of arthropods (including insects, spiders, and crustaceans).

Lipids or FATS

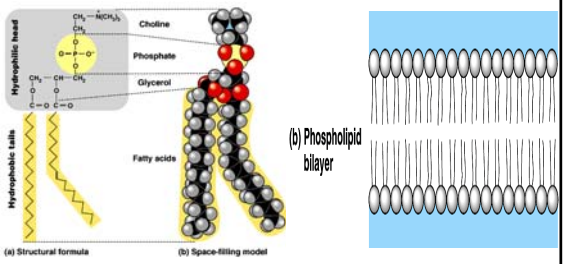
- Lipids have 1-3 fatty acids attached to a glycerol molecule. There are saturated and unsaturated fats. Unsaturated fats have double bond and saturated do not.
- Triglycerides are the most common lipids in the body and its best energy source.
- Phospholipids have 2 fatty acid tails and a polar head. They make up cell membranes.
- Sterols are very important, they have no fatty acids. Ex. Cholesterol, membrane components in cells they can change into other things like vitamin D, steroids, bile and salts.



Saturated & unsaturated

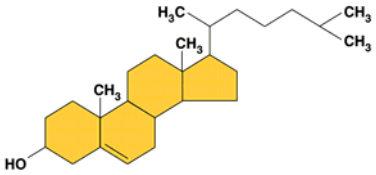


Phospholipid Bilayer



Steroids

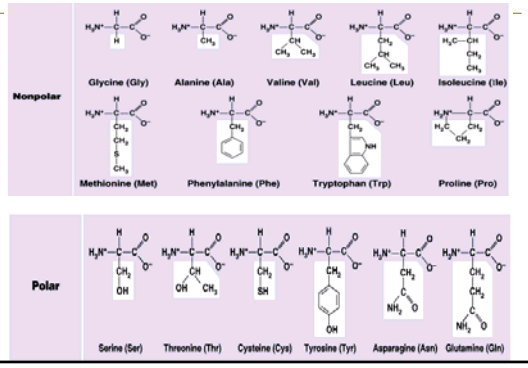
- Steroids are lipids with a carbon skeleton consisting of four fused carbon rings.
  - Different steroids are created by varying functional groups attached to the rings.



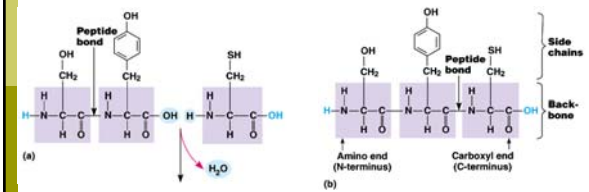
Proteins

- **Proteins** are influential in about everything that an organism does.
  - Functions include storage, structural support, transport of other substances, intercellular signaling, movement, and defense against foreign substances.
  - Proteins are the overwhelming enzymes in a cell and regulate metabolism by selectively accelerating chemical reactions.
- Humans have tens of thousands of various proteins, each with its own structure and function.
- Proteins are the most structurally complex molecules known.
- They are made of polypeptides which are polymers of amino acids. There are 21 of them.

Amino Acids



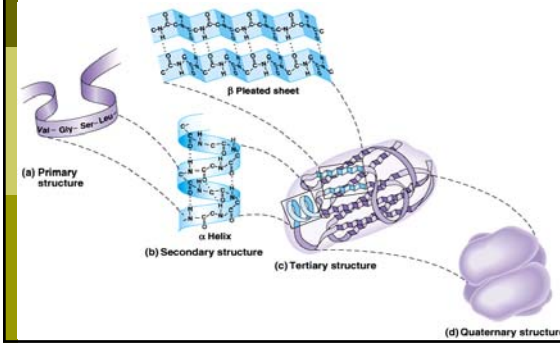
- Amino acids are joined together when a dehydration reaction removes a hydroxyl group from the carboxyl end of one amino acid and a hydrogen from the amino group of another.
  - The resulting covalent bond is called a **peptide bond**.

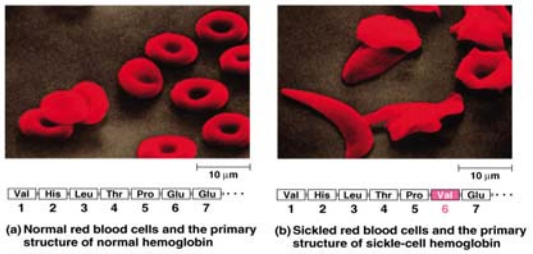


Function of Proteins

- It all depends on shape.
- In almost every case, the function depends on its capacity to recognize and bind to some other molecule.
  - For example, antibodies bind to particular foreign substances that fit their binding sites.
  - Enzyme recognize and bind to specific substrates, to initiate a chemical reaction.
  - Neurotransmitters pass signals from one cell to another by binding to receptor sites on proteins in the membrane of the receiving cell.

Structure

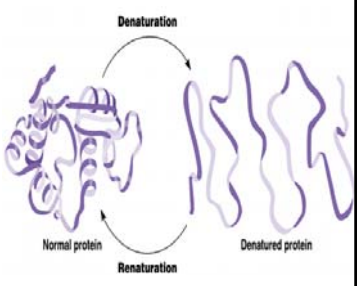




- The structural properties of silk are due to beta pleated sheets.
  - The presence of so many hydrogen bonds makes each silk fiber stronger than steel.

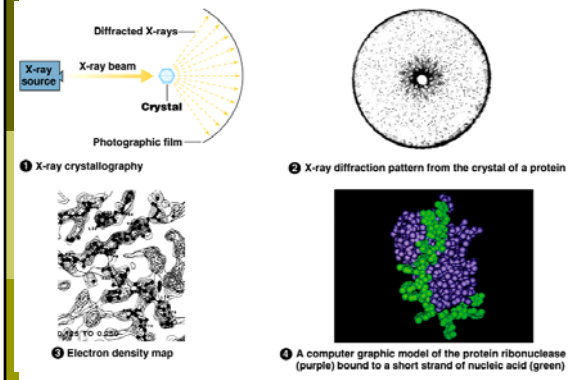
Protein structure can change

- A protein's stucture can change in response to the physical and chemical conditions.
- Changes in pH, salt concentration, temperature, or other factors can unravel or **denature** a protein
- One amino acid difference can cause a huge change.



How do we Know

- At present, scientists use **X-ray crystallography** (or nuclear magnetic resonance) to determine protein conformation.
  - This technique requires the formation of a crystal of the protein being studied.
  - The pattern of diffraction of an X-ray by the atoms of the crystal can be used to determine the location of the atoms and to build a computer model of its structure.



The Instructions for Life Nucleic Acids

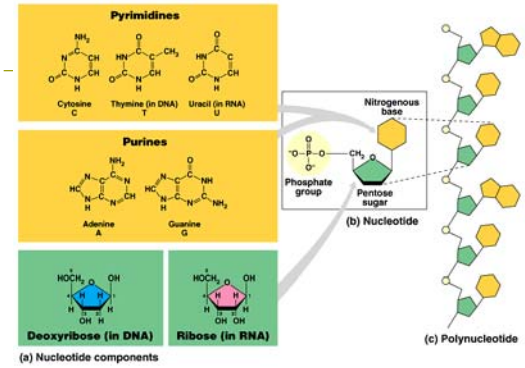
- Proteins which control or make a vast majority of our body are made from codes written on genes. Genes are parts of DNA that contain nucleotides in a particular order.
- There are two types of nucleic acids: **ribonucleic acid (RNA)** and **deoxyribonucleic acid (DNA)**.
- DNA gives direction for its own replication.
- DNA also directs RNA synthesis and, through RNA, controls protein synthesis.
- Organisms inherit DNA from their parents.
  - Each DNA molecule is extremely long and typically consists of hundreds to thousands of genes.
  - When a cell reproduces itself by mitosis or division, its DNA is copied and passed to the next generation of cells.

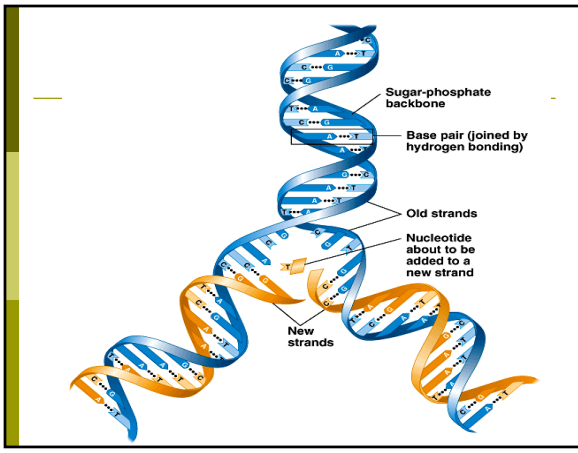
Nucleic Acids

- Nucleic acids are many **nucleotides joined together.**
- Each nucleotide consists of three parts: a nitrogen base, a pentose, 5 carbon, sugar, and a phosphate group

Purines and pyrimidines are the 2 types of nucleotides.

- Pyrimidines have a single six-membered ring.
- The three different pyrimidines, cytosine (C), thymine (T), and uracil (U)—part of RNA
- Purine have a six-membered ring joined to a five-membered ring. So have 2 rings not 1
- The two purines are adenine (A) and guanine (G).





Resource pg.

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Polymers
• Large molecules built up from small units (monomers)

Biopolymers

• Polymers that occur in nature
• Formed in condensation reactions of monomers catalysed by specific enzymes
– loss of water (or another small molecule)
• Biodegradable
– intra- and extracellular reactions catalysed by specific enzymes

Major classes of natural polymers

- Proteins
- Polysaccharides
- Nucleic acids

– occur in all living cells

- Polyisoprenoids
- Polyhydroxyalkanoates
- Lignin

– limited distribution in nature

Examples of economically important biopolymers

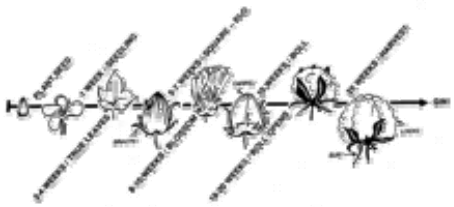
Starch	Polysaccharide	Food, industrial
Cellulose	Polysaccahride	Fibre, industrial
Galactomannan	Polysaccharide	Food
Pectin	Polysaccharide	Food
Silk	Protein	Fibre
Wool	Protein	Fibre
Gluten	Protein	Food, industrial
Rubber	Polyisoprenoid	Industrial
Gutta percha	Polyisoprenoid	Industrial
Polyhydroxybutyrate	Polyester	Industrial, medical
DNA	Polynucleotide	Biotechnology
RNA	Polynucleotide	Biotechnology

Making silk

Cellulose

- Most abundant form of C in nature

– cotton is 98% cellulose



Polyhydroxyalkanoates

- Polyesters that accumulate as C reserve in some bacterial species, usually in response to nutrient limitation (N, O2, P)

- Biodegradable, environmentally friendly plastics (Biopol)
  - packaging films, bottles, utensils, nappy liners, disposable household items)
  - medical - surgical thread, pins, swabs

- Price is still much higher than petrochemical-based polyethylene ($10-20/kg; 5x PET)
- Poor melt stability, brittleness

PHB granules in bacteria