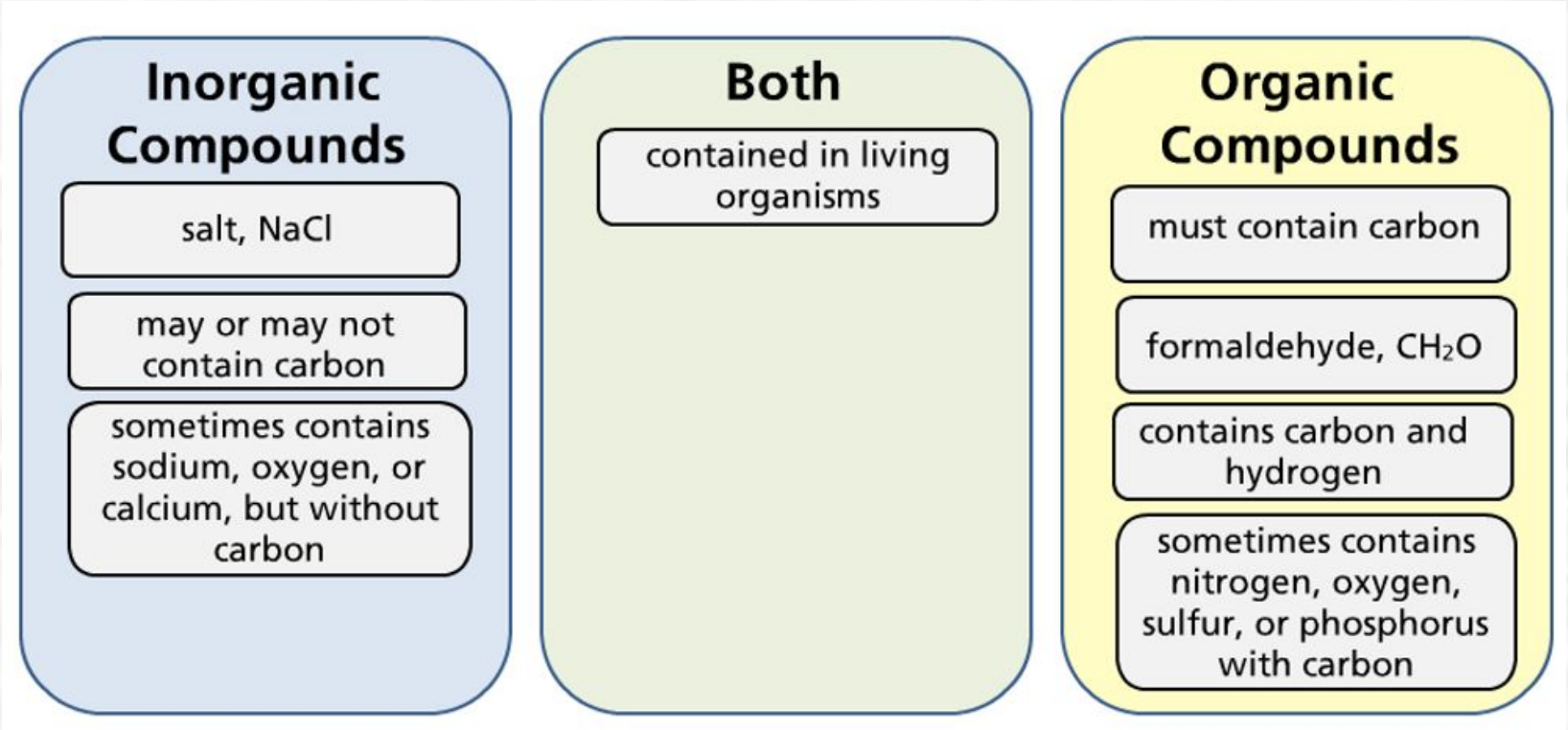
Organic Molecules

The Molecules of Life

Inorganic Vs. Organic

- **Inorganic molecules** do not contain carbon and hydrogen together. Can have either C or H alone, but not both
- **Organic molecules** do contain C and H bonded together.
- Organic molecules are more complex structures containing carbon atoms arranged in rings or chains.


Inorganic Compounds
salt, NaCl
may or may not contain carbon
sometimes contains sodium, oxygen, or calcium, but without carbon
Both
contained in living organisms
Organic Compounds
must contain carbon
formaldehyde, CH_2O
contains carbon and hydrogen
sometimes contains nitrogen, oxygen, sulfur, or phosphorus with carbon

Biochemistry

- **Biochemistry** is the chemistry of living things.
- Biochemistry is closely linked to organic chemistry.

Macromolecules

- **Macromolecules** (macro = large) are very large organic molecules.
- Four important kinds of macromolecules:
  - Carbohydrates.
  - Proteins.
  - Nucleic acids.
  - Lipids.

Polymers

- **Polymers** are combinations of many smaller, similar building blocks called **monomers** (mono = single) bonded together.
- Carbohydrates, proteins, lipids, and nucleic acids are all polymers.
- The monomers in a polymer are usually combined by a dehydration synthesis reaction.

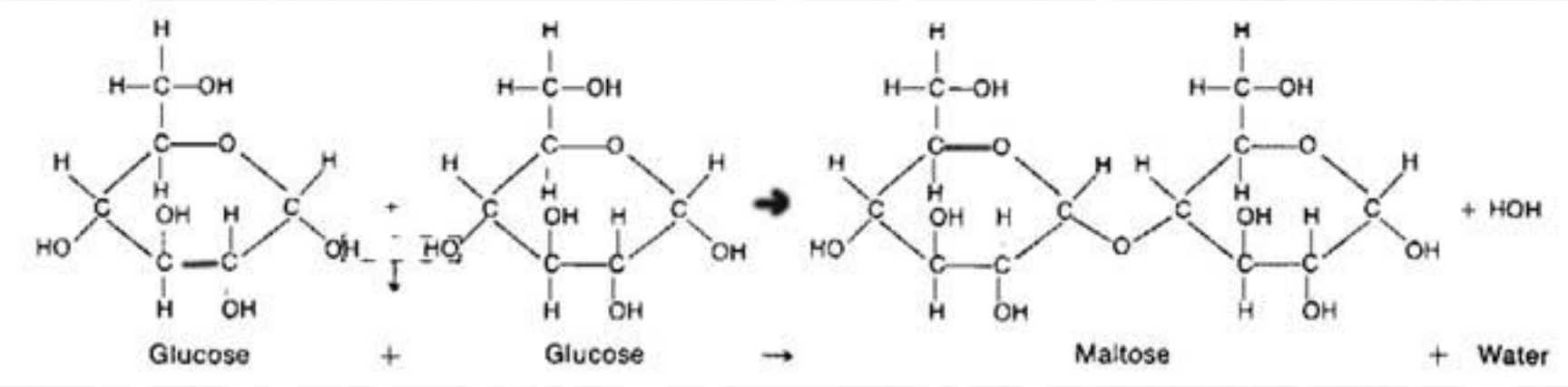
Dehydration Synthesis

- **Dehydration synthesis** (de = remove; Hydro = water; Synthesis = combine) involves combining two molecules through the remove of one molecule of water.

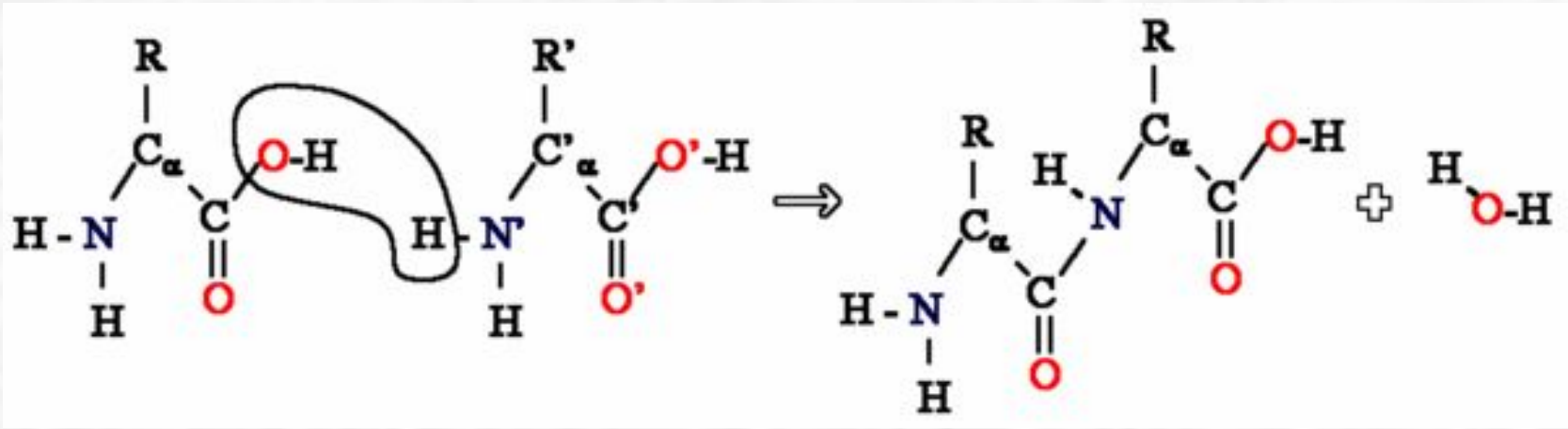
Dehydration Synthesis

- This reaction occurs when two functional groups (smaller molecules) come close enough to have an –OH removed from one and an –H removed from the other.
- These are combined to form a molecule of water and the remaining two segments are combined to form a macromolecule.

Dehydration Synthesis: Carbohydrate



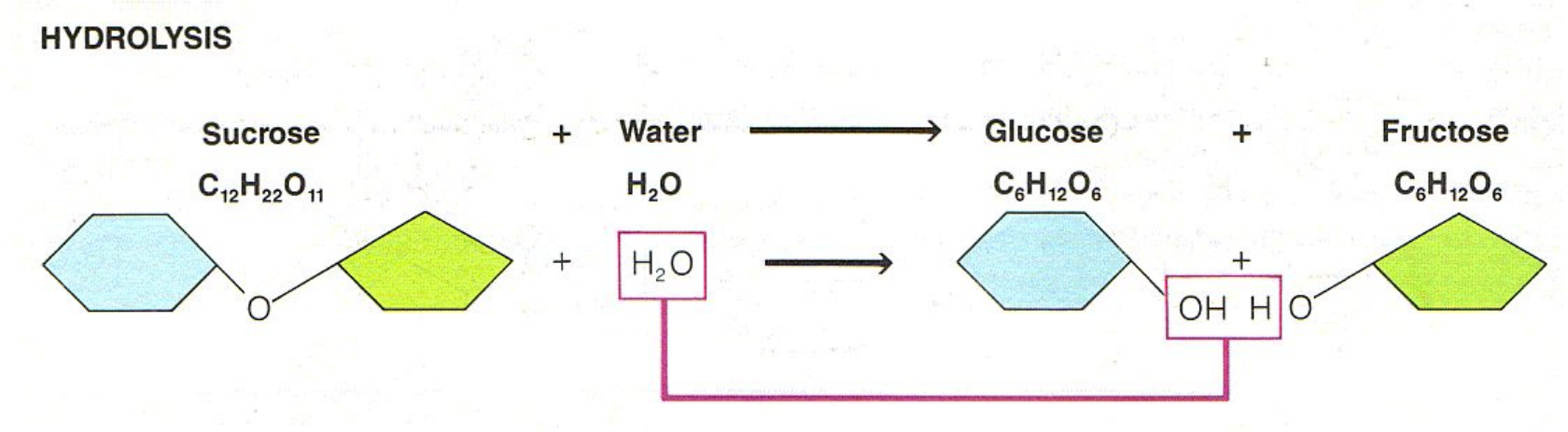
Dehydration Synthesis: Protein



Hydrolysis

- The reverse of a dehydration synthesis reaction is known as hydrolysis (hydro = water; lyse = to split or break).
- **Hydrolysis** is the process of splitting s larger organic molecule into two or more parts by adding water.

Hydrolysis Of Sucrose



Levels Of Chemical Organization

- Atoms ☐ molecules ☐ monomers (small building blocks) ☐ polymers (macromolecules) ☐ carbohydrate, protein, or nucleic acid.

Carbohydrates

- Carbohydrates are composed of carbon, hydrogen, and oxygen atoms linked together to form monomers called simple sugars or monosaccharides (mono = single; Saccharine = sweet, sugar).
  - contain carbon, hydrogen, and oxygen (C, H & O) in the ratio of 1:2:1 ($C_6H_{12}O_6$)

Carbohydrate Use In Living Cells

- Immediate source of energy.
- Provide shape to certain cells (I.E. Cellulose in plant walls).
- Components of coenzymes and antibiotics.
- Components of nucleic acids DNA and RNA.

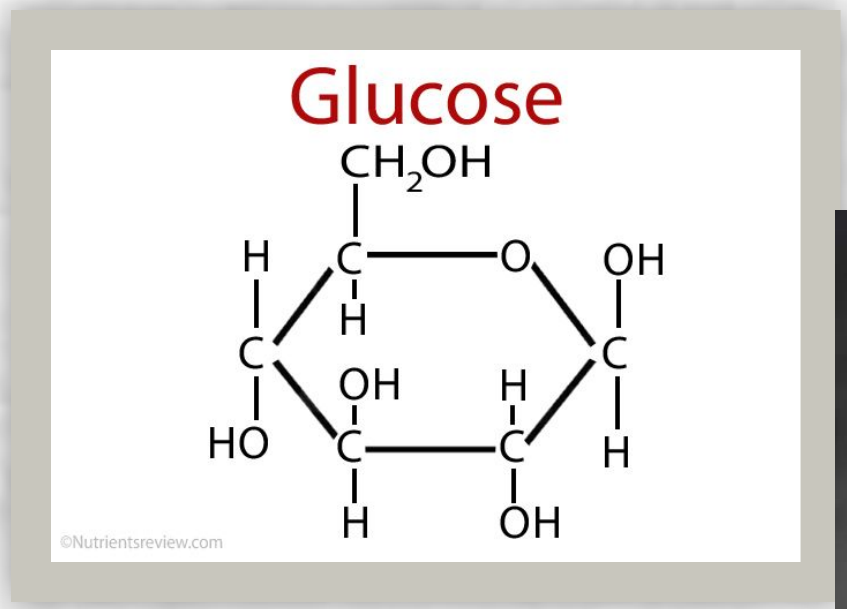
Simple Sugars

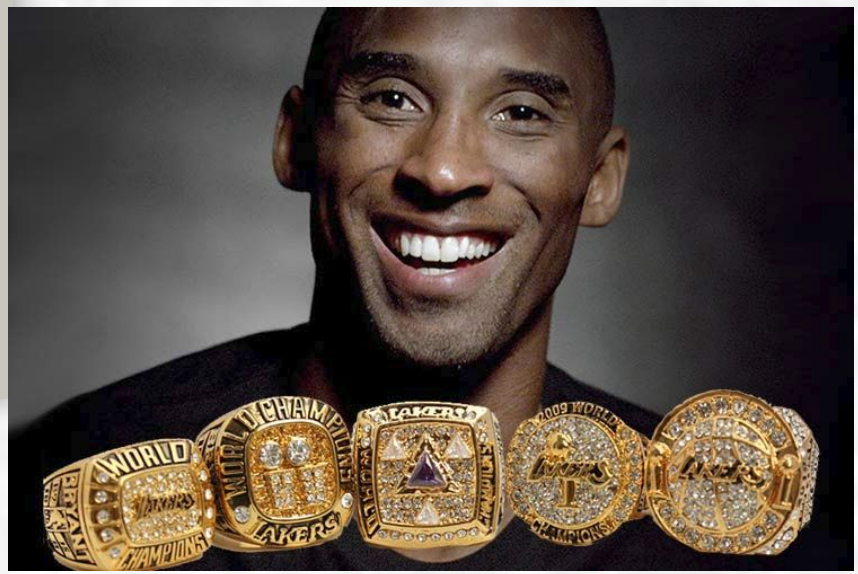
- Simple sugars such as glucose, galactose, and fructose provide chemical energy in the human body.
- The ending –ose indicates a sugar.

Glucose

- Glucose is called blood sugar in the human bloodstream.
- It is found in the sap of plants.
- It is the most abundant carbohydrate.
- It is a basic building block for other carbohydrates.

You recognize Carbs by their ring structure!





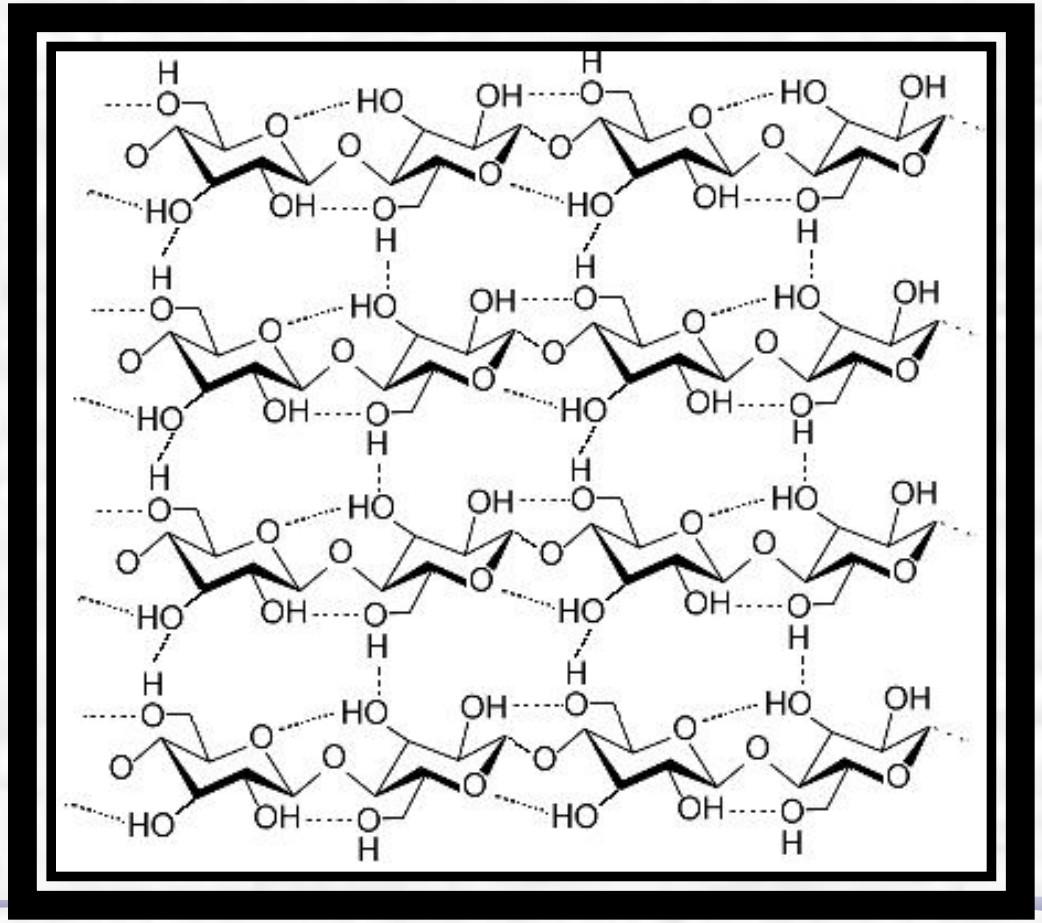
Complex Carbohydrates

- Complex carbohydrates are formed when simple sugars are combined.
- Disaccharide – two simple sugars bonded together.
- Trisaccharide – three simple sugars bonded together.
- Polysaccharide – more than three simple sugars bonded together.

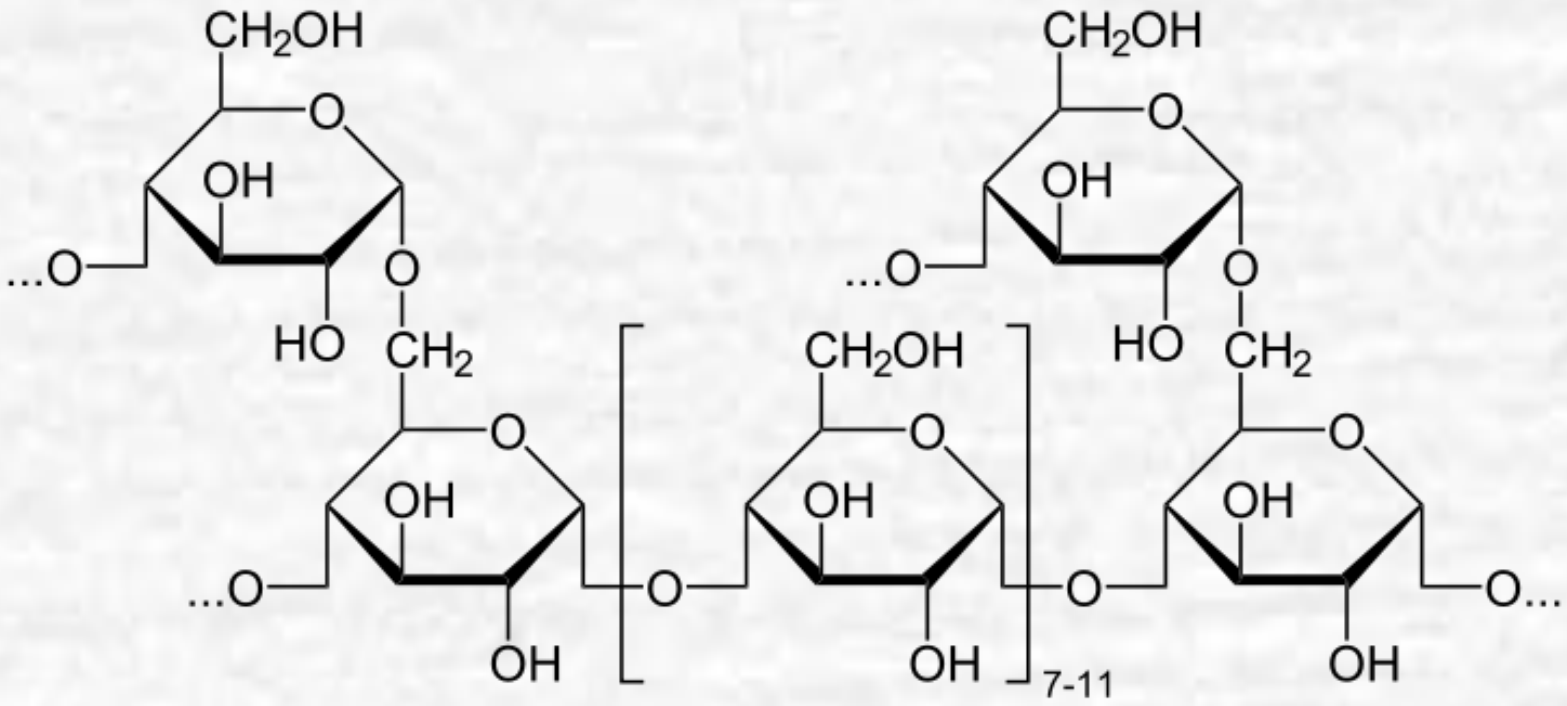
Examples:

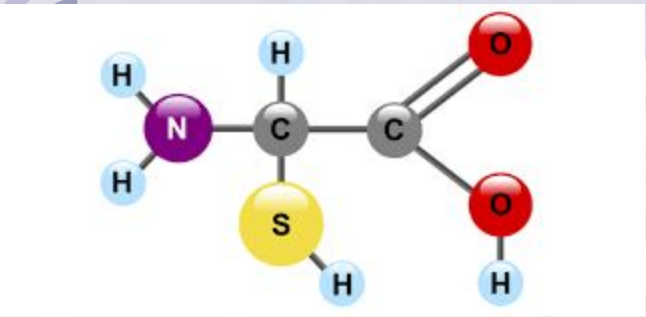
- Starch (form of energy storage in plants)
- Glycogen (form of energy storage in animals)
- Cellulose (provides structural support for plants; not digestible by humans)
- Chitin (found in cell walls of fungi & in the exoskeletons of insects and arthropods)

Cellulose



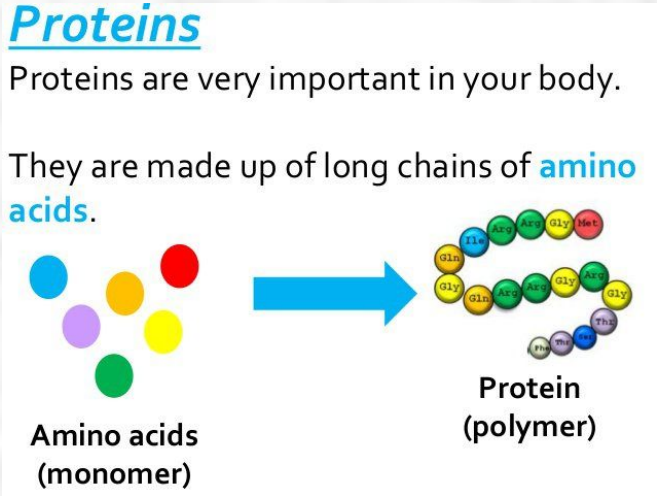
Glycogen





Proteins

- Amino acid monomers join to form the polymer know as protein.
- There are about 20 different amino acids.



Proteins

- Dehydration synthesis combines two amino acids to form a protein.
- This bonding forms a **peptide bond**.

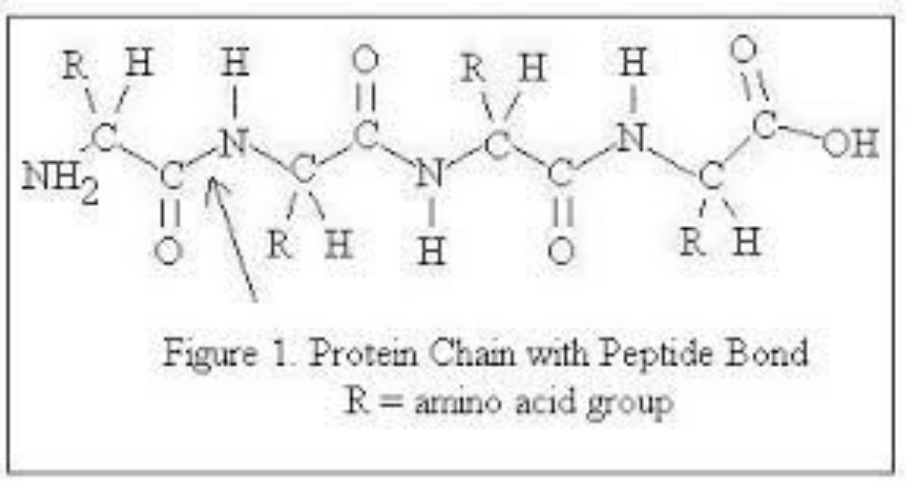


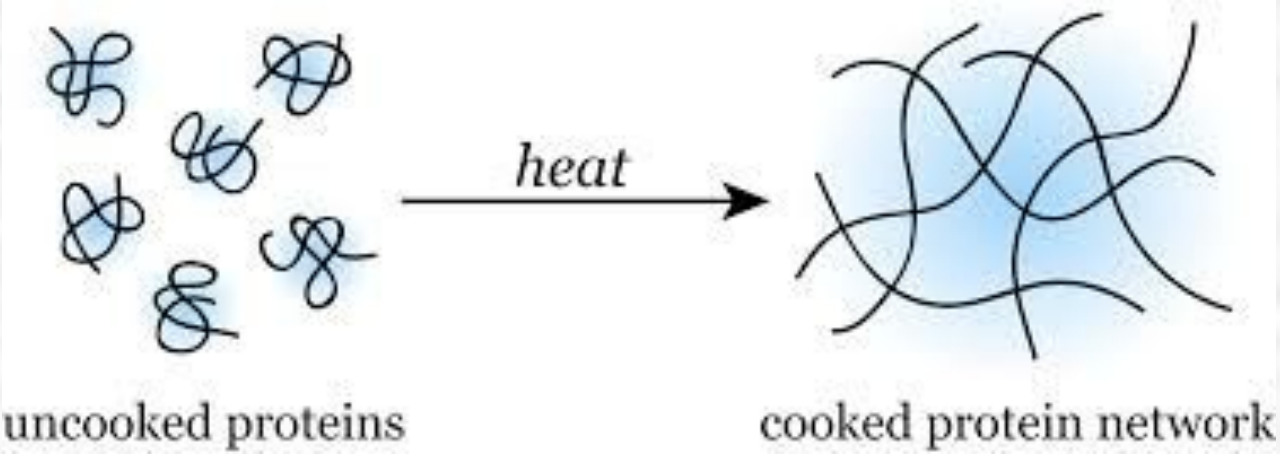
Figure 1. Protein Chain with Peptide Bond
R = amino acid group

Proteins

- Elements: contain carbon, hydrogen, and oxygen & nitrogen (C, H, O & N)
- Function: promote chemical reactions in your body (enzymes), provide structural support (muscles, collagen, cartilage, hair, nails)
- Monomer: amino acids
- Common food sources: meat, legumes, nuts, vegetables (very small amount)

Denatured Proteins

- Energy in the form of heat or light can break down higher levels of protein structure by breaking hydrogen bonds within the molecule. The protein is then said to be **denatured**.
- Brown bottles and refrigeration protect some medications such as insulin from becoming denatured.

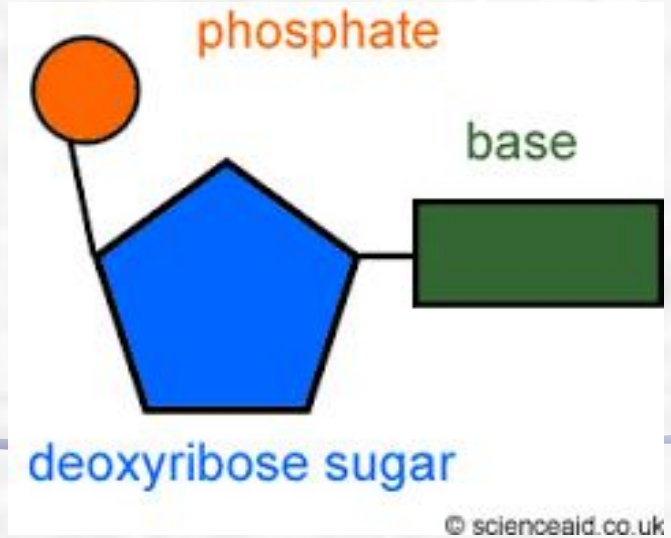

heat
uncooked proteins
cooked protein network

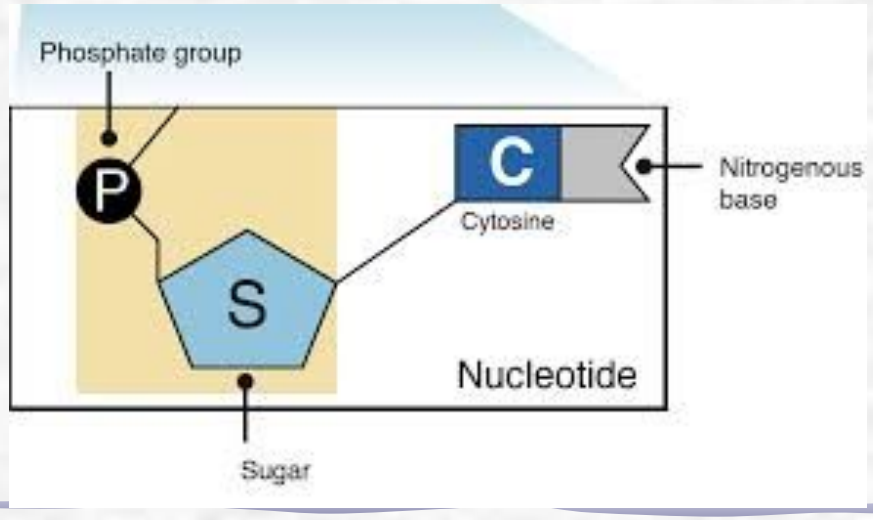
Nucleic Acids

- **Nucleic acids** are complex organic polymers that store and transfer genetic information within the cell.
- Two types:
  - Deoxyribonucleic acid (DNA).
  - Ribonucleic acid (RNA).
- Nucleic acids are constructed of monomers known as **nucleotides**.
- Elements: contain carbon, hydrogen, and oxygen, nitrogen & phosphorous (C, H, O, N & P)

Nucleotides

- Three parts of a nucleotide:
  - 1. A 5-carbon simple sugar molecule (either deoxyribose or ribose).
  - 2. A phosphate group.
  - 3. A nitrogenous base.





Draw one on your notes!

Lipids

- Composed of glycerol and fatty acid chain
- Types of lipids
  - Phospholipids (component of cell membranes)
  - Steroids (some hormones)

Lipids

- Elements: contain carbon, hydrogen, and oxygen (C, H & O)
- Function: long-term energy storage, makes up cell membranes, makes up our hormones, insulates and protects organs
- Monomer: a typical fat contains glycerol & fatty acids

Lipids

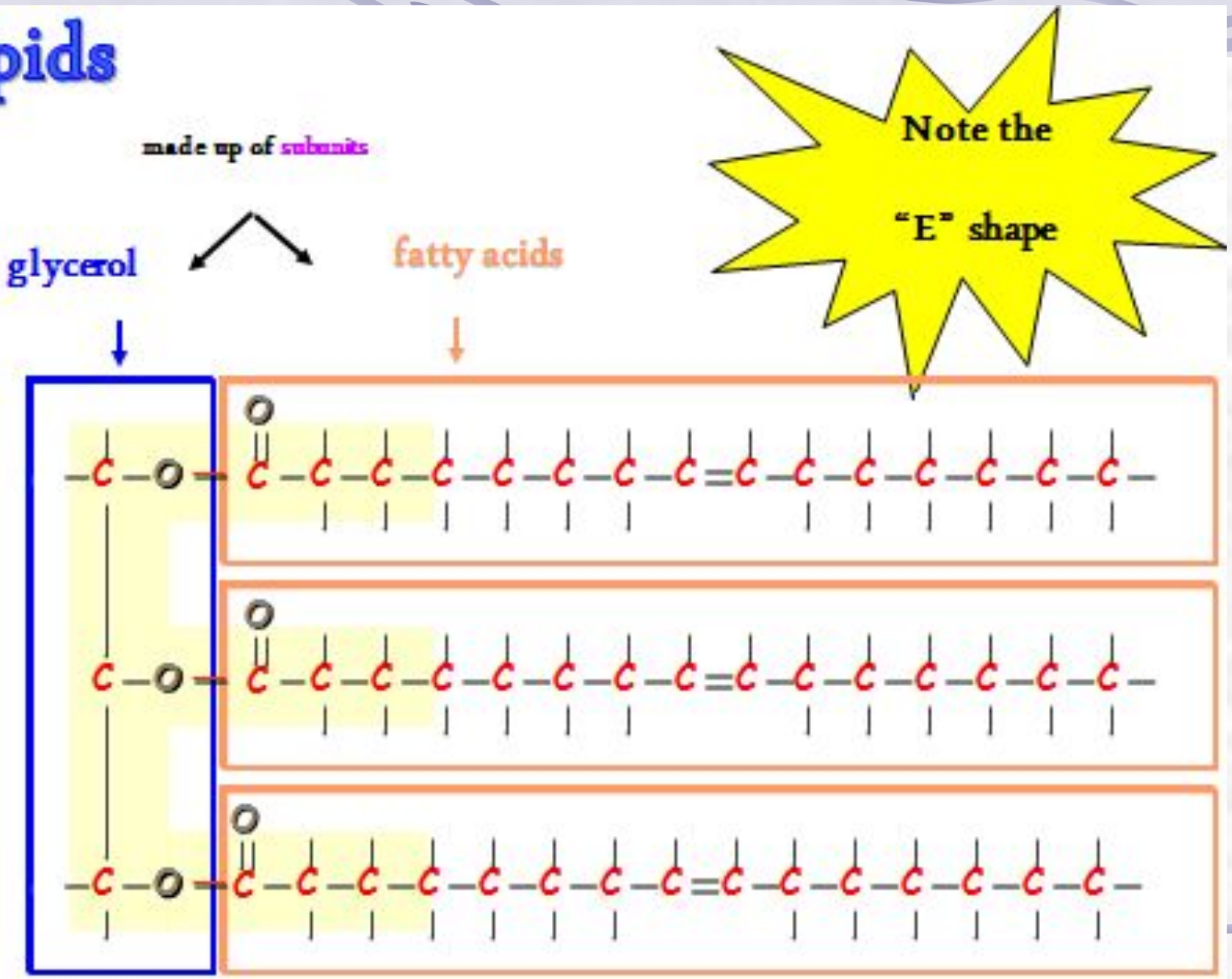
- Characteristics: not soluble in water, saturated fats are solid at room temperature, unsaturated fats are liquid (oils) at room temperature
- Examples: fats, oils, phospholipids, steroids (ie cholesterol), waxes

Lipids

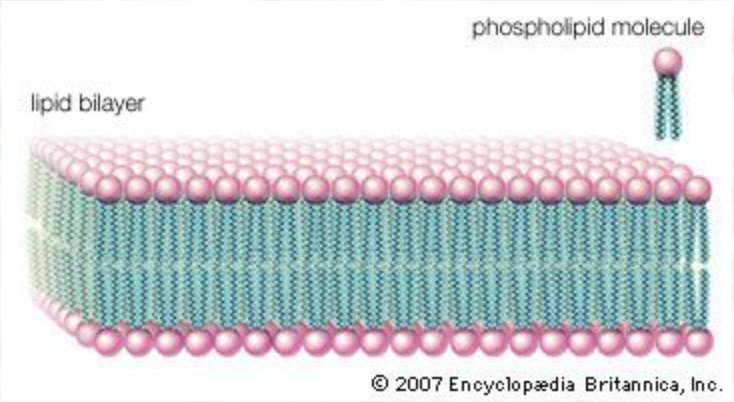
made up of subunits

glycerol

fatty acids




wiseGEEK


phospholipid molecule
lipid bilayer
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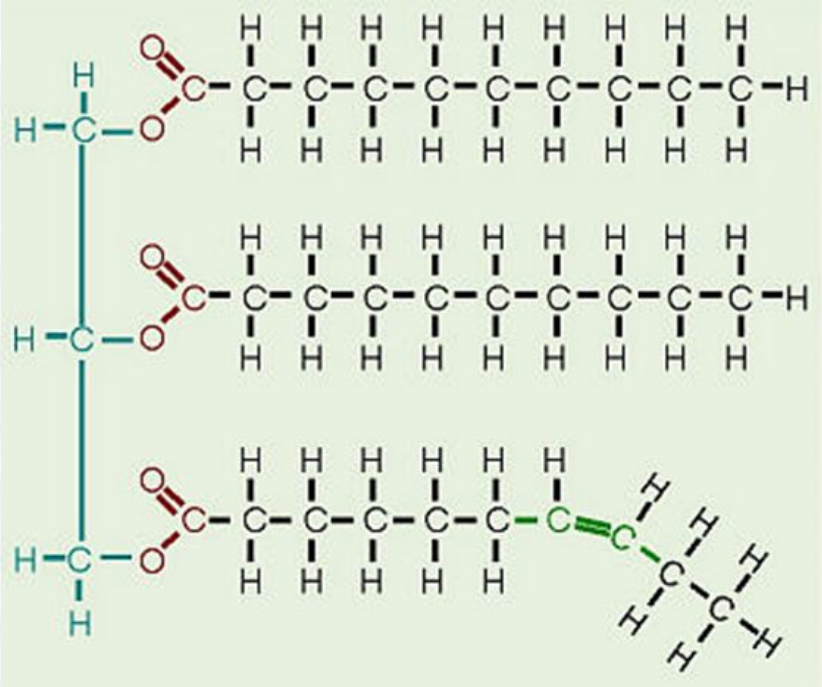

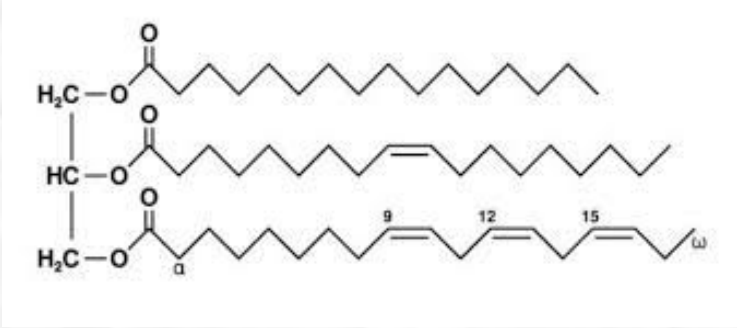
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