2.3 Carbon-Based Molecules

KEY CONCEPT

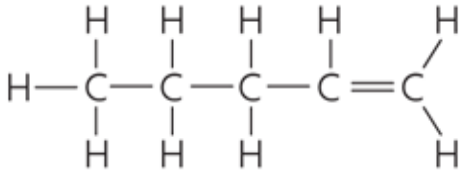
Carbon-based molecules are the foundation of life.

2.3 Carbon-Based Molecules

Carbon atoms have unique bonding properties.

- Carbon forms covalent bonds with up to four other atoms
- Carbon-based molecules have three general structures.
  - straight chain
  - branched chain
  - ring

Straight chain

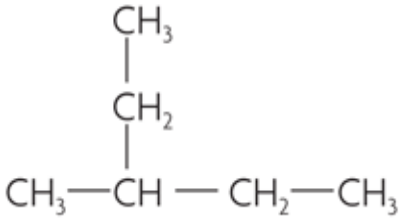


A simplified structure can also be shown as:

$CH_3—CH_2—CH_2—CH=CH_2$

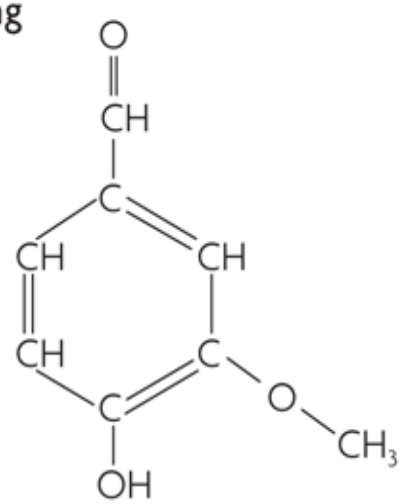
Pentene

Branched chain



Hexane

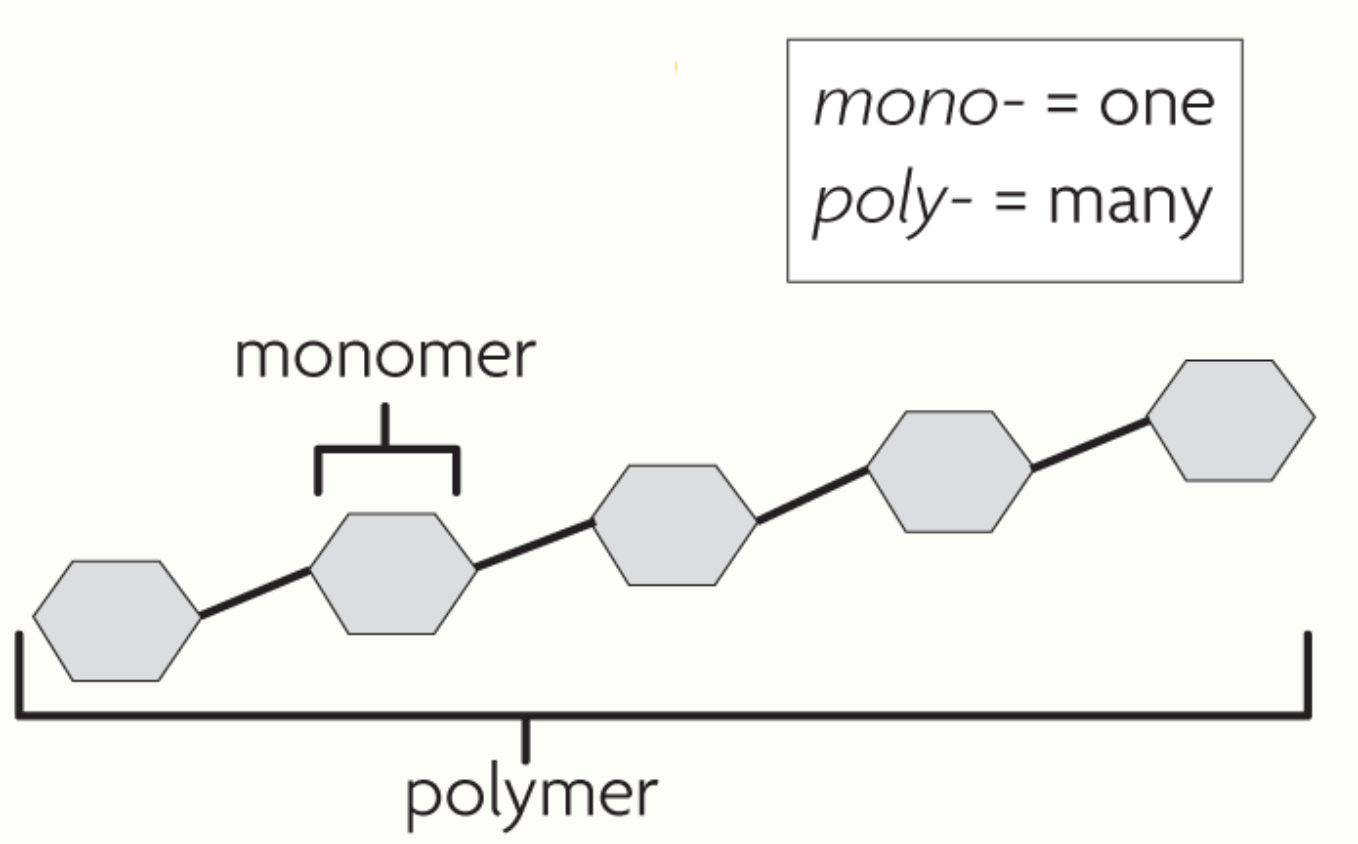
Ring



Vanillin

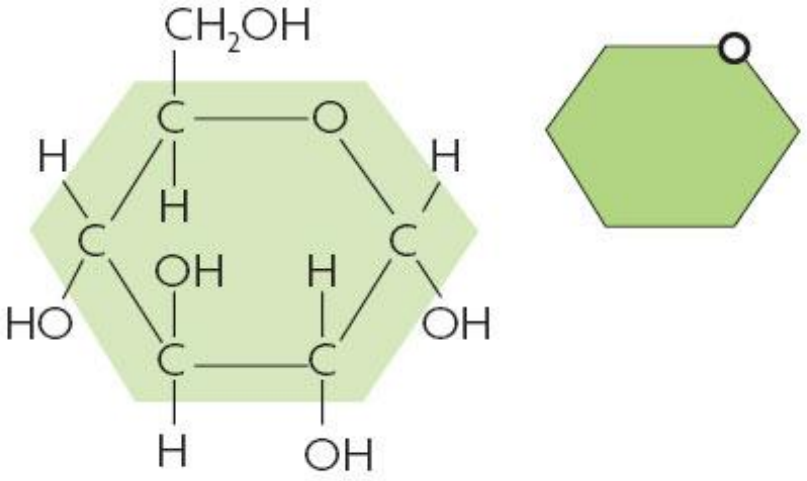
2.3 Carbon-Based Molecules

- Many carbon-based molecules are made of many small subunits bonded together.
  - Monomers are the individual subunits.
  - Polymers are made of many monomers.



2.3 Carbon-Based Molecules

- **Four main types of carbon-based molecules are found in living things.**
  - Carbohydrates are made of carbon, hydrogen, and oxygen.



Glucose ($C_6H_{12}O_6$) can be ring shaped and is often shown as a simplified hexagon.

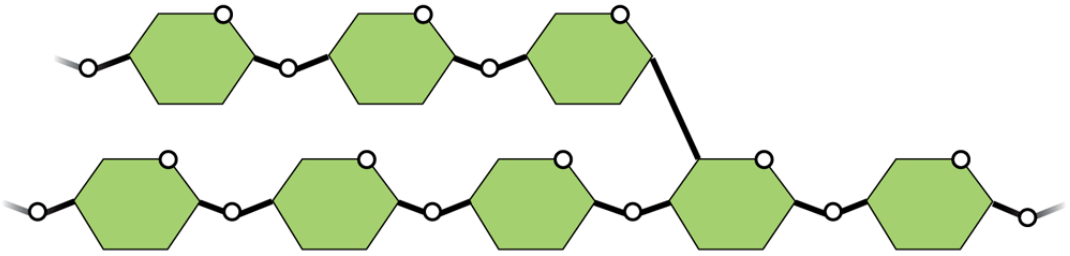
2.3 Carbon-Based Molecules

- **Four main types of carbon-based molecules are found in living things.**
  - Carbohydrates are made of carbon, hydrogen, and oxygen.
    - Carbohydrates include sugars and starches.
    - Monosaccharides are simple sugars.
    - Polysaccharides include starches, cellulose, and glycogen.

2.3 Carbon-Based Molecules

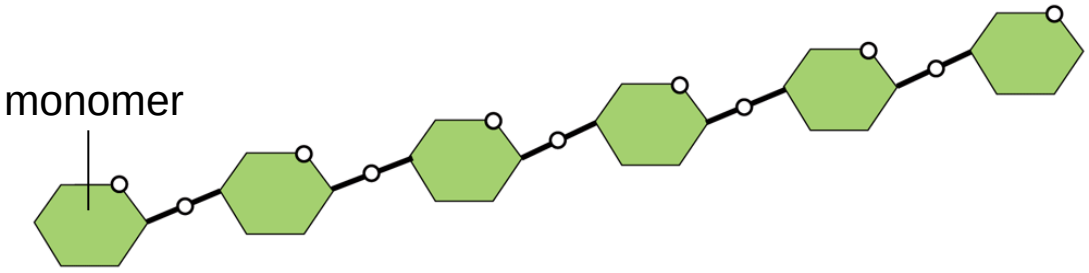
- Carbohydrates can be broken down to provide energy for cells.
- Some carbohydrates are part of cell structure.

Polymer (starch)



Starch is a polymer of glucose monomers that often has a branched structure.

Polymer (cellulose)



Cellulose is a polymer of glucose monomers that has a straight, rigid structure

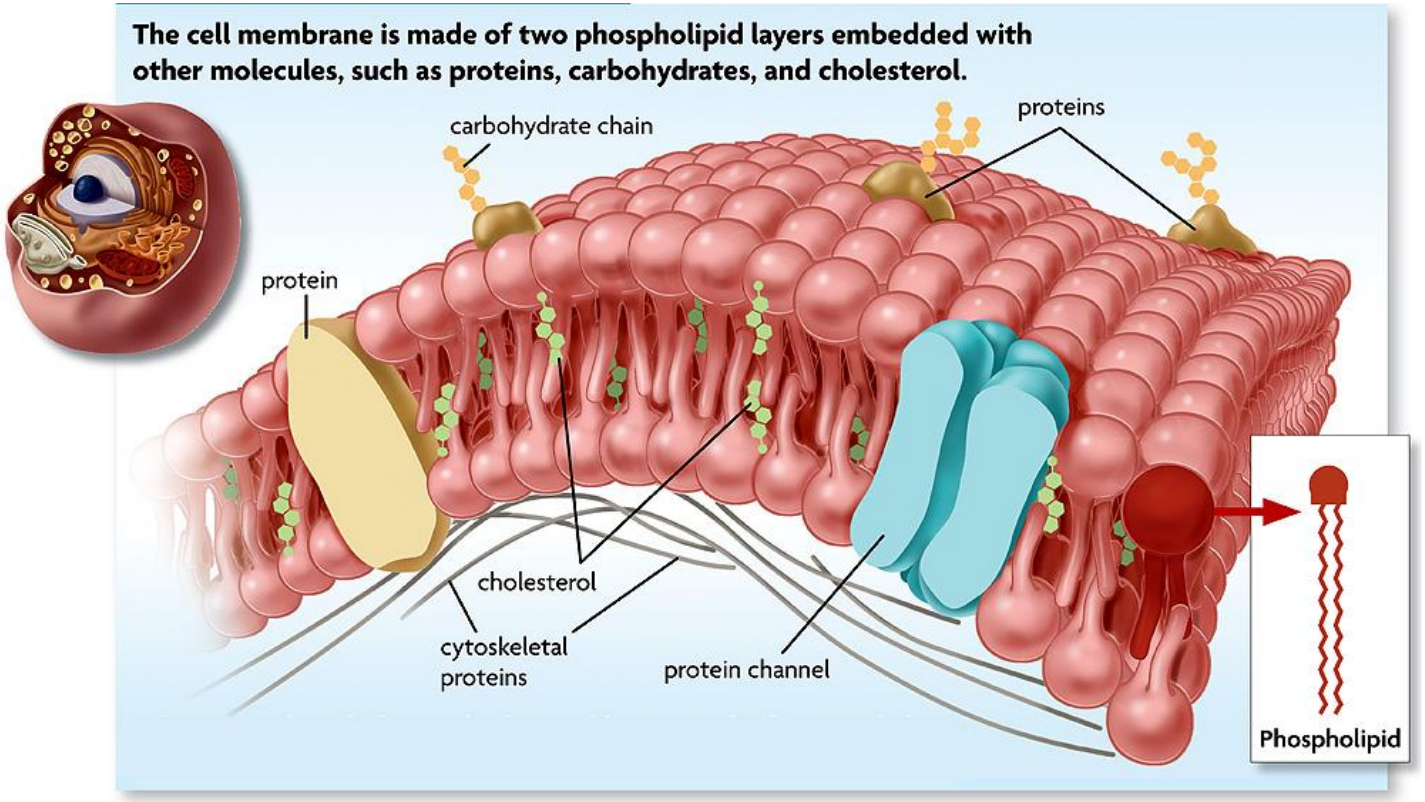
2.3 Carbon-Based Molecules

- Lipids are nonpolar molecules that include fats, oils, and cholesterol.
  - Many contain carbon chains called fatty acids.
  - Fats and oils contain fatty acids bonded to glycerol.

Triglyceride

2.3 Carbon-Based Molecules

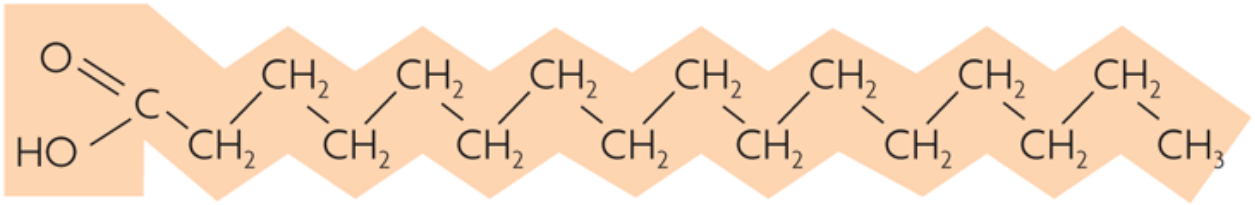
- Lipids have several different functions.
  - broken down as a source of energy
  - make up cell membranes
  - used to make hormones



2.3 Carbon-Based Molecules

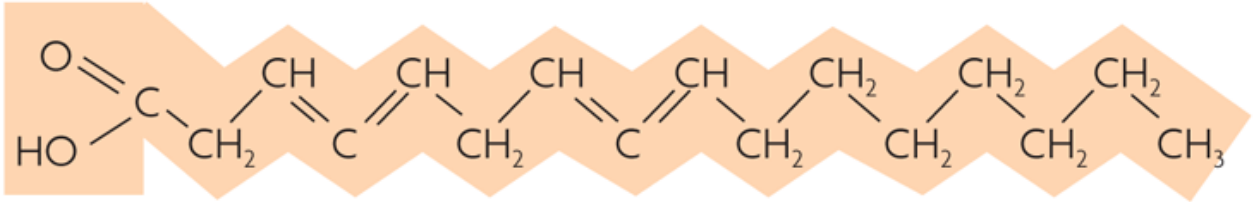
- Fats and oils have different types of fatty acids.
  - saturated fatty acids
  - unsaturated fatty acids

Saturated fatty acid



Saturated fats contain fatty acids in which all carbon–carbon bonds are single bonds.

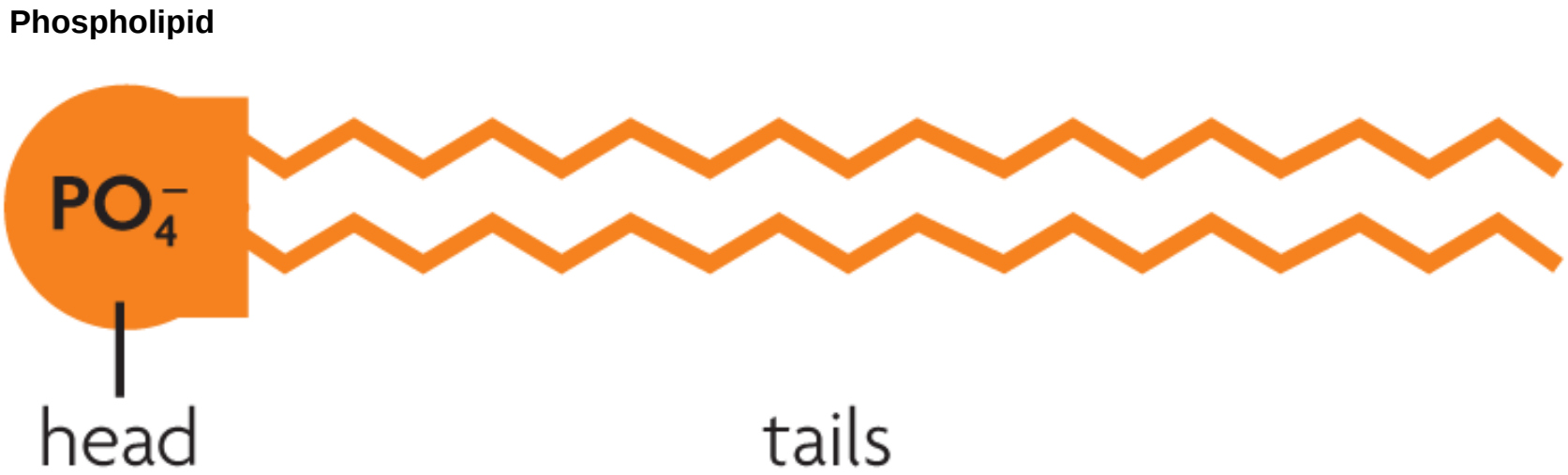
Unsaturated fatty acid



Unsaturated fats have fatty acids with at least one carbon–carbon double bond.

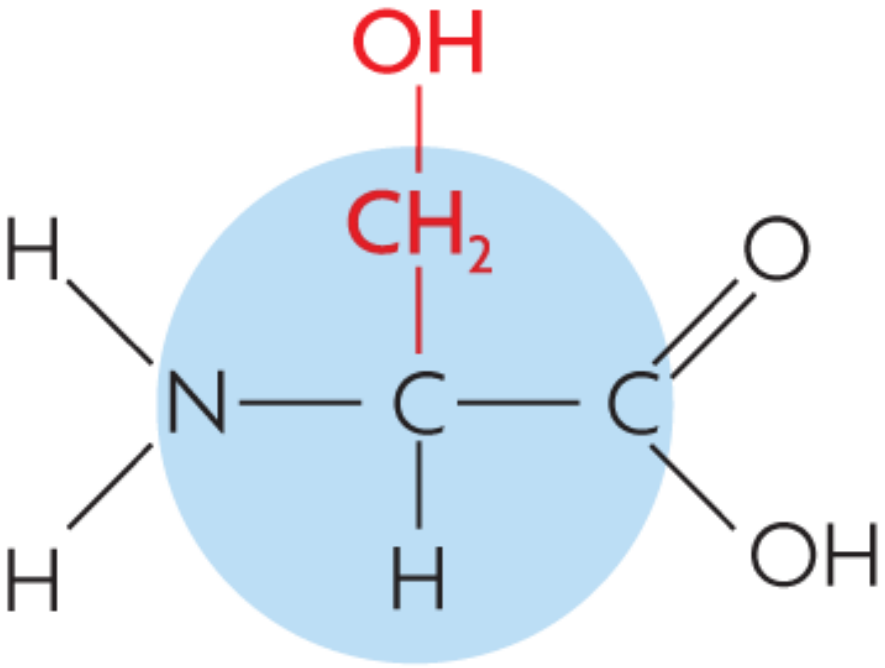
2.3 Carbon-Based Molecules

- Phospholipids make up all cell membranes.
  - Polar phosphate “head”
  - Nonpolar fatty acid “tails”



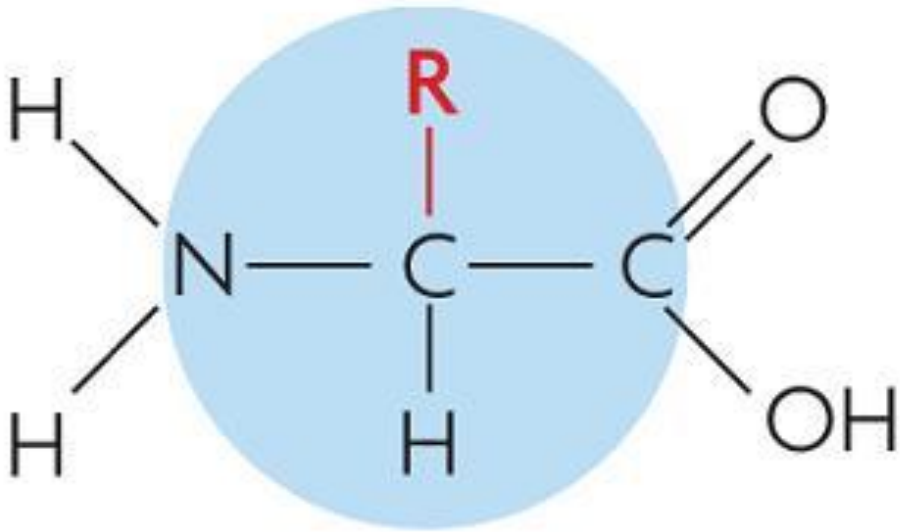
2.3 Carbon-Based Molecules

- Proteins are polymers of amino acid monomers.
  - Twenty different amino acids are used to build proteins in organisms.



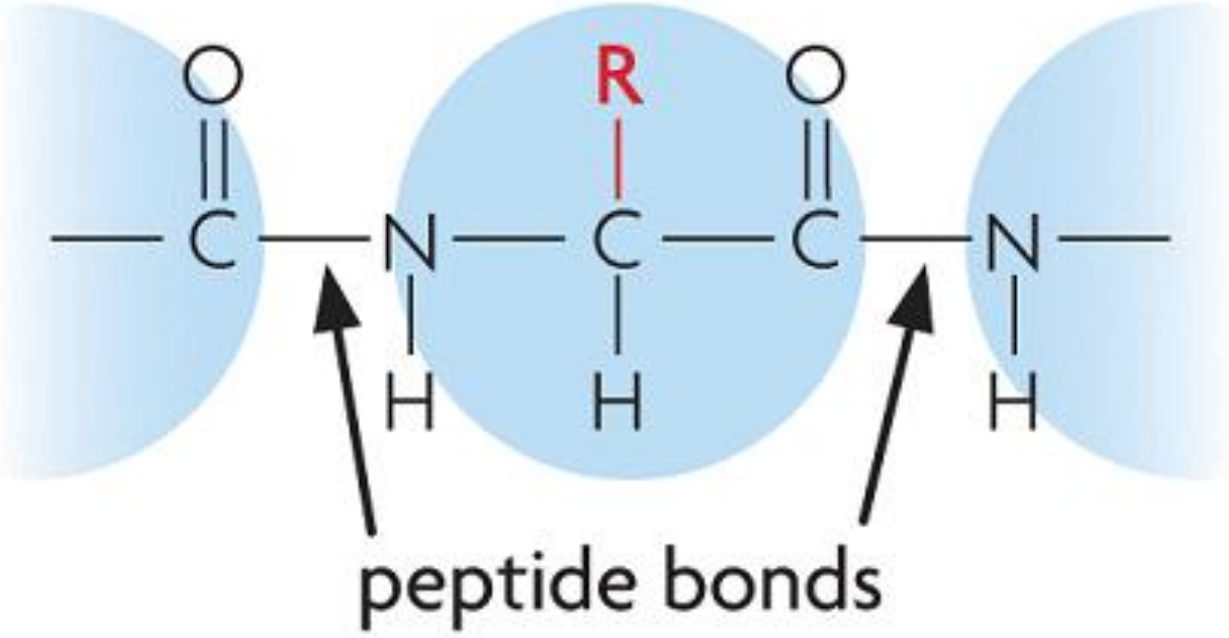
2.3 Carbon-Based Molecules

- Proteins are polymers of amino acid monomers.
  - Twenty different amino acids are used to build proteins in organisms.
  - Amino acids differ in side groups, or R groups.



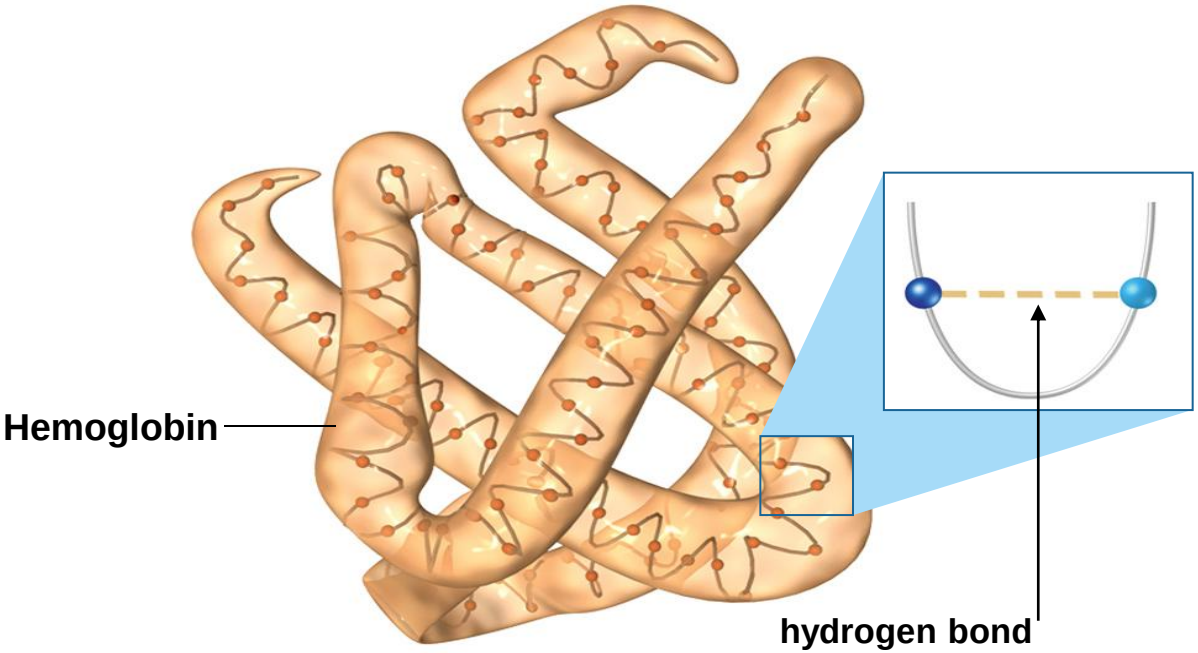
2.3 Carbon-Based Molecules

- Proteins are polymers of amino acid monomers.
  - Twenty different amino acids are used to build proteins in organisms.
  - Amino acids differ in side groups, or R groups.
  - Amino acids are linked by peptide bonds.



2.3 Carbon-Based Molecules

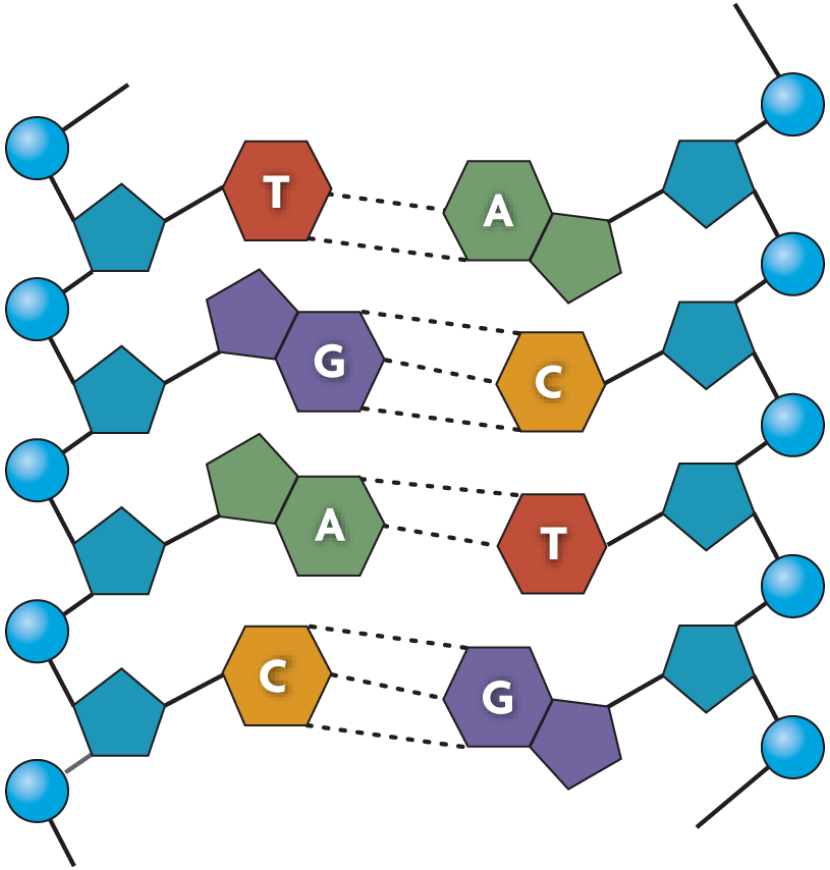
- Proteins differ in the number and order of amino acids.
  - Amino acids interact to give a protein its shape.



  - Incorrect amino acids change a protein's structure and function.

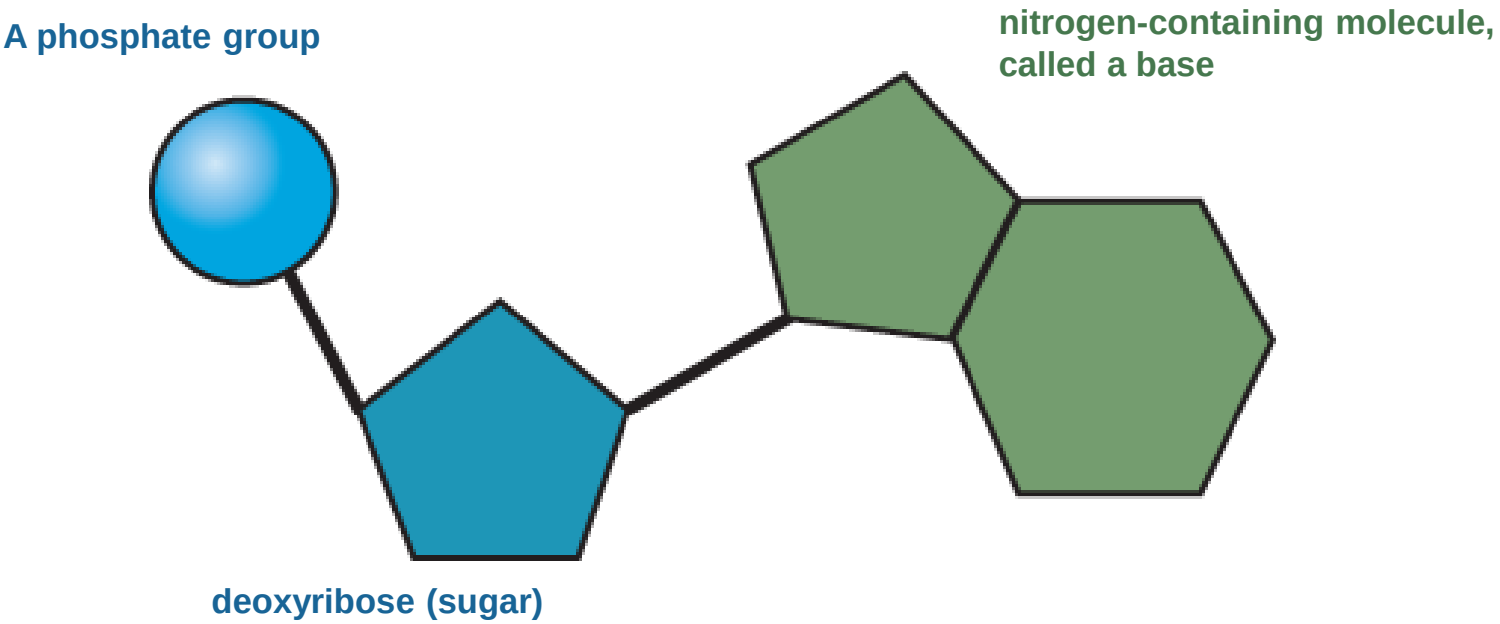
2.3 Carbon-Based Molecules

- Nucleic acids are polymers of monomers called nucleotides.



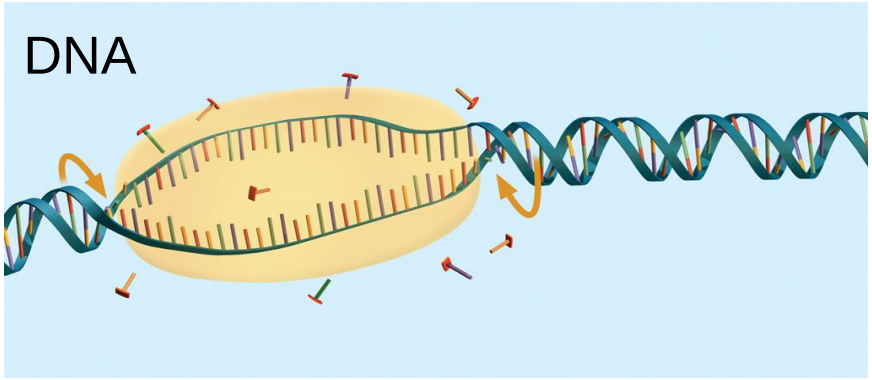
2.3 Carbon-Based Molecules

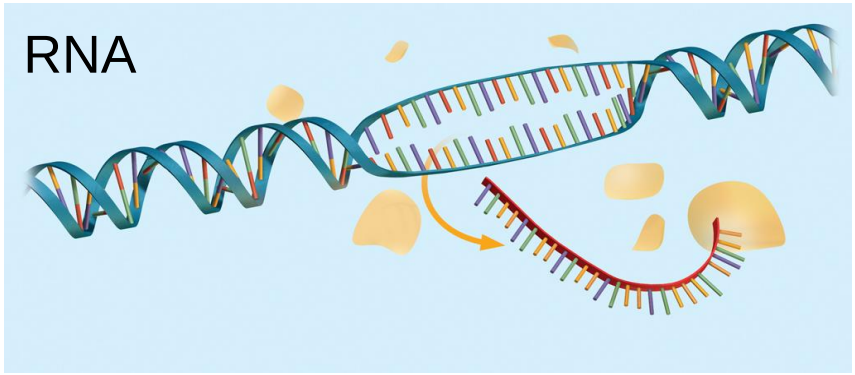
- Nucleic acids are polymers of monomers called nucleotides.
  - Nucleotides are made of a sugar, phosphate group, and a nitrogen base.



2.3 Carbon-Based Molecules

- Nucleic acids are polymers of monomers called nucleotides.
  - Nucleotides are made of a sugar, phosphate group, and a nitrogen base.
  - DNA stores genetic information.
  - RNA builds proteins.





2.3 Carbon-Based Molecules

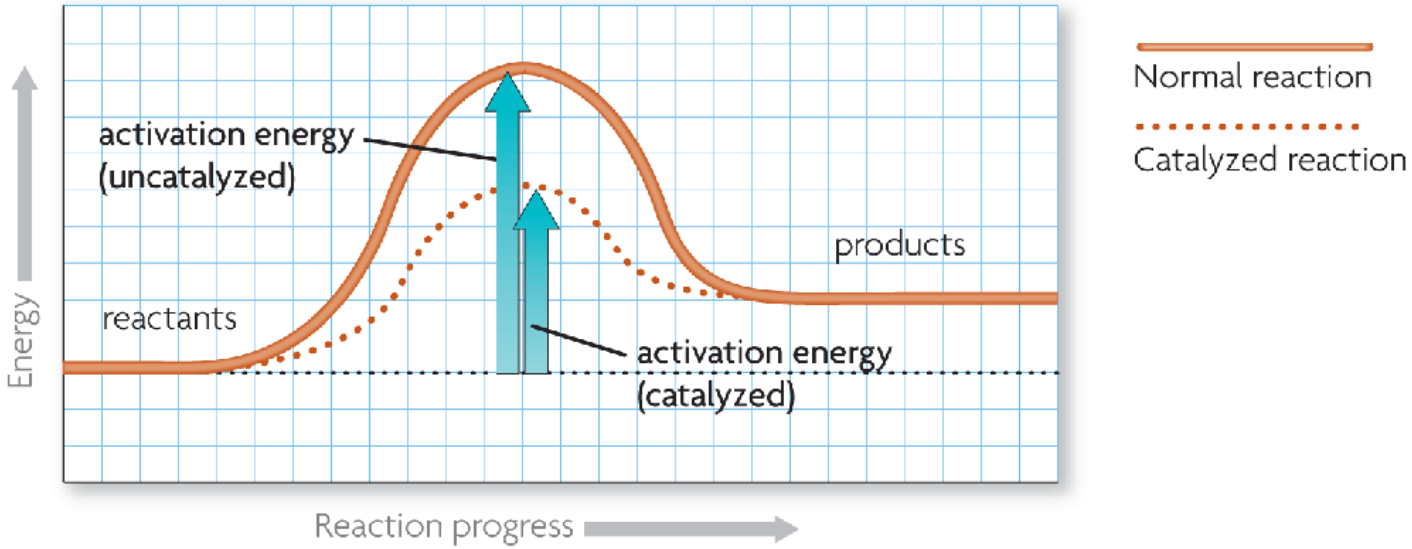
KEY CONCEPT

Enzymes are catalysts for chemical reactions in living things.

2.3 Carbon-Based Molecules

A catalyst lowers activation energy.

- Catalysts are substances that speed up chemical reactions.
  - decrease activation energy
  - increase reaction rate



2.3 Carbon-Based Molecules

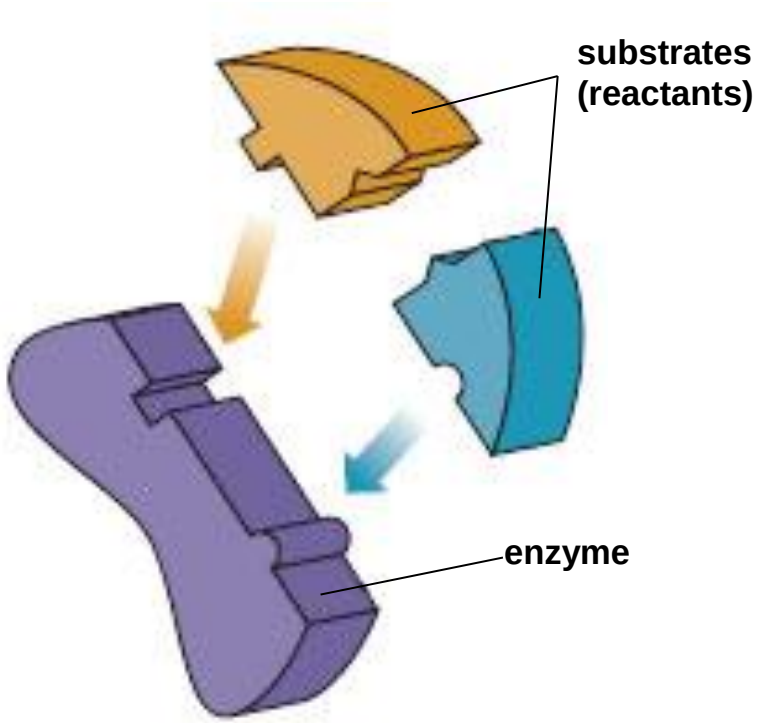
- **Enzymes allow chemical reactions to occur under tightly controlled conditions.**
  - Enzymes are catalysts in living things.
    - Enzymes are needed for almost all processes.
    - Most enzymes are proteins.

2.3 Carbon-Based Molecules

- Disruptions in homeostasis can prevent enzymes from functioning.
  - Enzymes function best in a small range of conditions.
  - Changes in temperature and pH can break hydrogen bonds.
  - An enzyme's function depends on its structure.

2.3 Carbon-Based Molecules

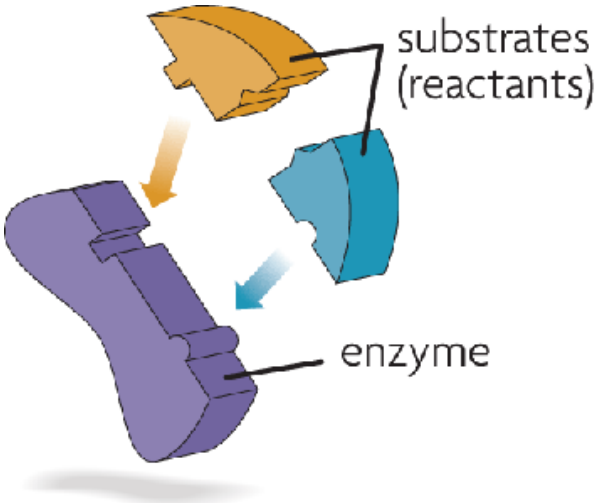
- An enzyme's structure allows only certain reactants to bind to the enzyme.
  - substrates
  - active site



Substrates bind to an enzyme at certain places called active sites.

2.3 Carbon-Based Molecules

- The lock-and-key model helps illustrate how enzymes function.
  - substrates brought together
  - bonds in substrates weakened



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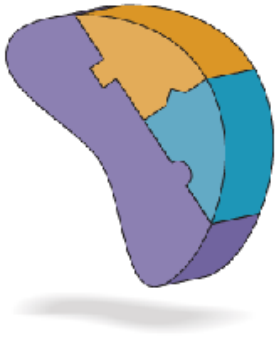
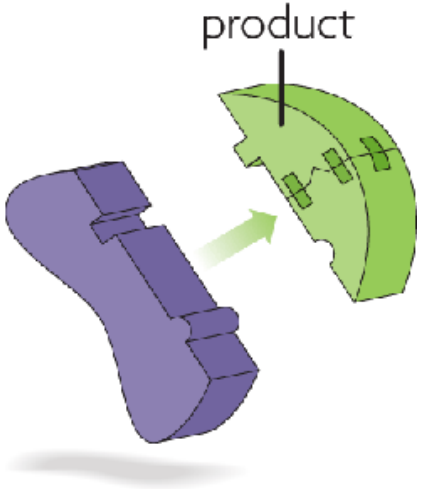


The enzyme brings substrates together and weakens their bonds.



The catalyzed reaction forms a product that is released from the enzyme.