

Chemistry

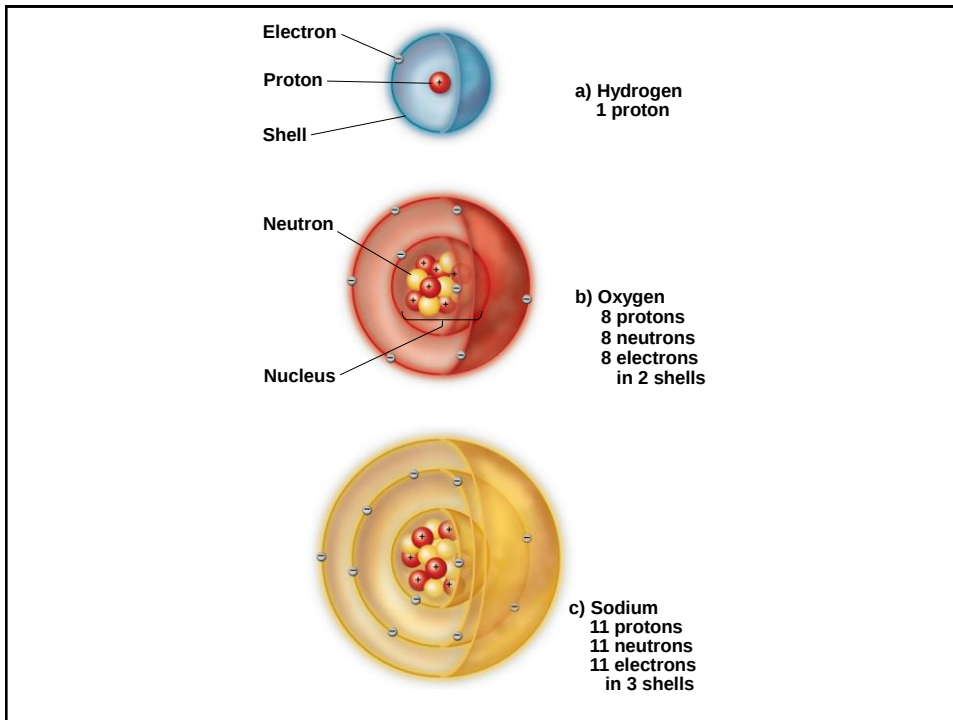


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All Matter Consists of Elements

- **Chemistry** is the study of matter
- **Matter is:**
 - Anything that has mass and occupies space
 - Composed of elements
- **Elements**
 - Cannot be broken down to a simpler form
 - Periodic table of elements – lists all known elements

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More About Atoms

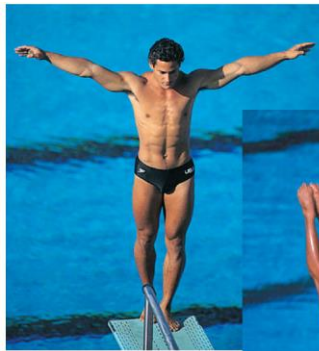
- **Atomic symbol:** one or two letters
 - Na: sodium
 - O: oxygen
- **Atomic number**
 - Number of protons
- **Atomic mass**
 - Roughly equal to number of protons plus neutrons

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Energy Fuels Life's Activities

- **Energy:** the capacity to do work
- **Potential energy:** stored energy
- **Kinetic energy:** energy in motion, doing work
- Potential energy can be transformed into kinetic energy

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a) Potential energy is locked up in the chemical bonds of energy-storage molecules in Greg Louganis' tissues.



b) Kinetic energy is energy in motion.

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Life Depends on Water

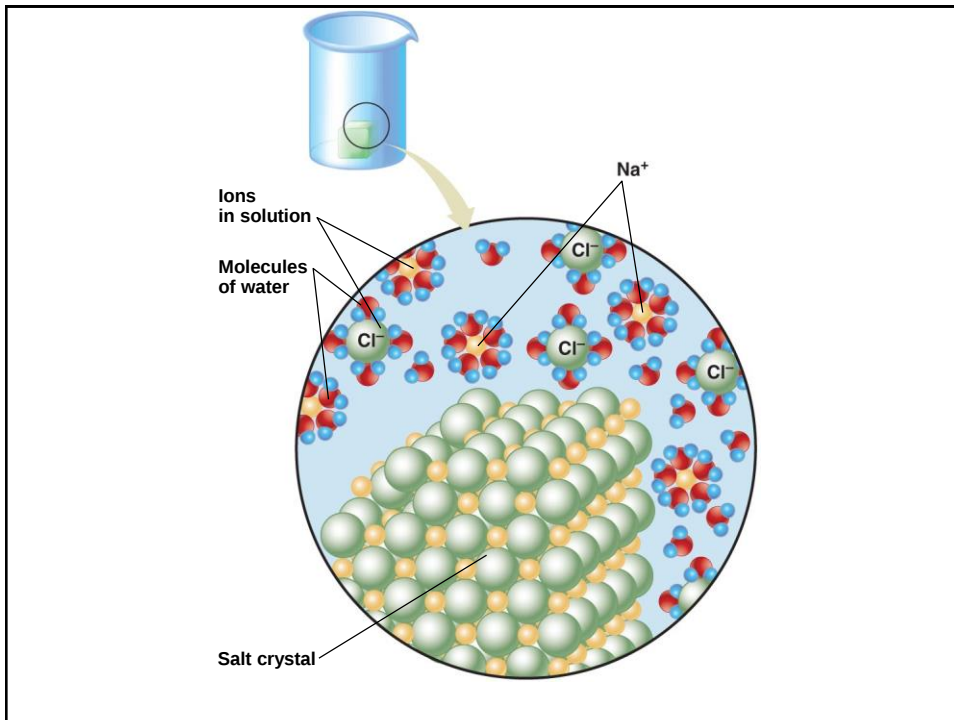
- Water molecules are polar
- Water is liquid at body temperature
- Water can absorb and hold heat energy
- Water is the biological solvent
- Water helps regulate body temperature

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Water Is the Biological Solvent

- **Solvent:** liquid in which other substances dissolve
- **Solute:** any dissolved substance
- **Hydrophilic:** molecules that are attracted to water and interact easily with water
- **Hydrophobic:** molecules that do not interact with or dissolve in water

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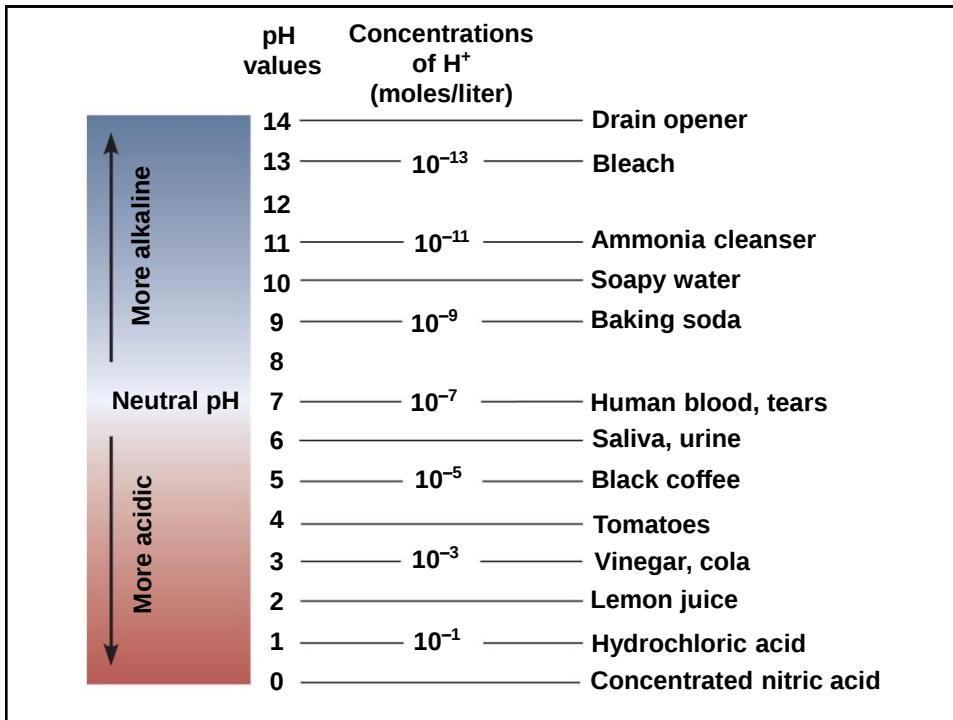


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The Importance of Hydrogen Ions

- Acids:
 - Donate hydrogen ions (protons)
 - Increase hydrogen ion concentration in solutions
- Bases
 - Accept hydrogen ions (protons)
 - Lower hydrogen ion concentration in solutions
- pH Scale
 - A measure of hydrogen ion concentration

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Buffers

- Minimize pH change
- Help maintain stable pH in body fluids
- Carbonic acid and bicarbonate act as one of the body's most important buffer pairs
 - $\text{HCO}_3^- + \text{H}^+ \rightarrow \text{H}_2\text{CO}_3$

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The Organic Molecules of Living Organisms

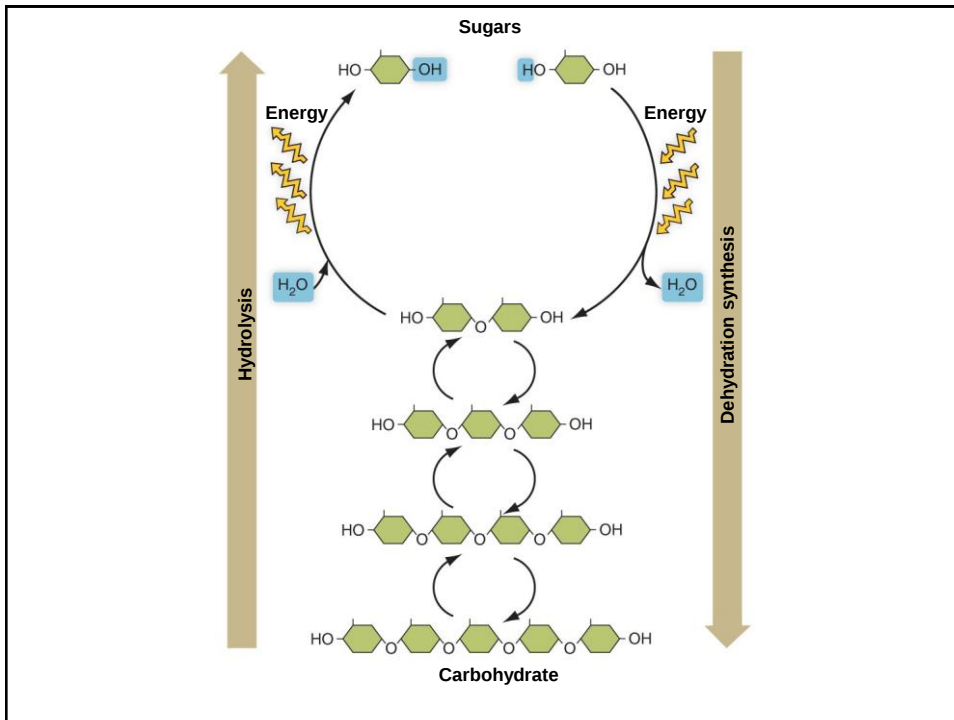
- Carbon
 - The building block of living things
 - Comprises ~18% of the body by weight

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Macromolecules Are Synthesized and Broken Down within the Cell

- Dehydration synthesis
 - Removes equivalent of a water molecule
 - Requires energy
 - Builds macromolecules from smaller subunits
- Hydrolysis
 - Adds the equivalent of a water molecule
 - Releases energy
- Dehydration synthesis is the reverse of hydrolysis

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Carbohydrates: Used for Energy and Structural Support

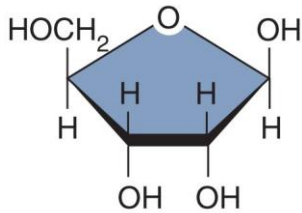
- General formula: $C_n(H_2O)_n$
- Monosaccharides: simple sugars
 - Glucose
 - Fructose
 - Galactose
 - Ribose
 - Deoxyribose

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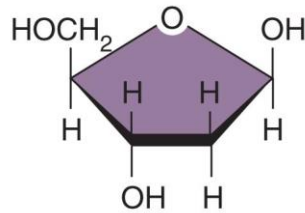
Oligosaccharides: More than One Monosaccharide Linked Together

- Monosaccharides can be linked together via dehydration synthesis
- Disaccharides: two monosaccharides linked together
 - Sucrose: glucose + fructose
 - Maltose: glucose + glucose
 - Lactose: glucose + galactose

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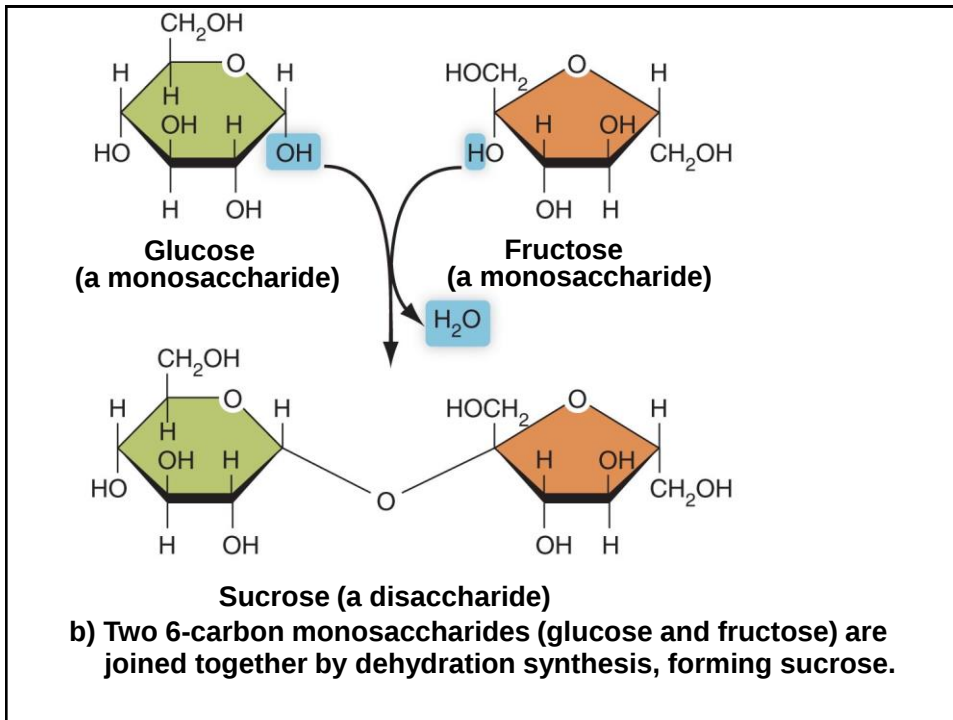
Ribose



Deoxyribose

a) The five-carbon monosaccharides ribose and deoxyribose.

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Polysaccharides Store Energy

- Polysaccharides: thousands of monosaccharides joined in chains and branches
 - Starch: made in plants; stores energy
 - Glycogen: made in animals; stores energy
 - Cellulose: indigestible polysaccharide made in plants for structural support

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Triglycerides

- Also known as fats and oils
- Composed of glycerol and three fatty acids
 - Fatty acids
 - Saturated (in fats)
 - Unsaturated (in oils)
- Energy storage molecules

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Phospholipids

- Structure
 - Glycerol + two fatty acids and phosphate group
 - One end of molecule is water soluble (hydrophilic)
 - Other end of molecule is water insoluble (hydrophobic)
- Function
 - Primary component of cell membranes

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Steroids

- Structure

- Composed of four carbon rings

- Examples:

- Cholesterol

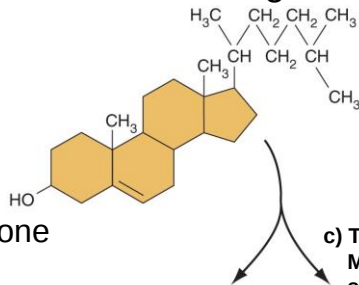
- Hormones

- Estrogen

- Testosterone

b) Estrogen (estradiol):

Female sex hormone synthesized from cholesterol.



a) Cholesterol:

A normal component of the cell membrane.

c) Testosterone:

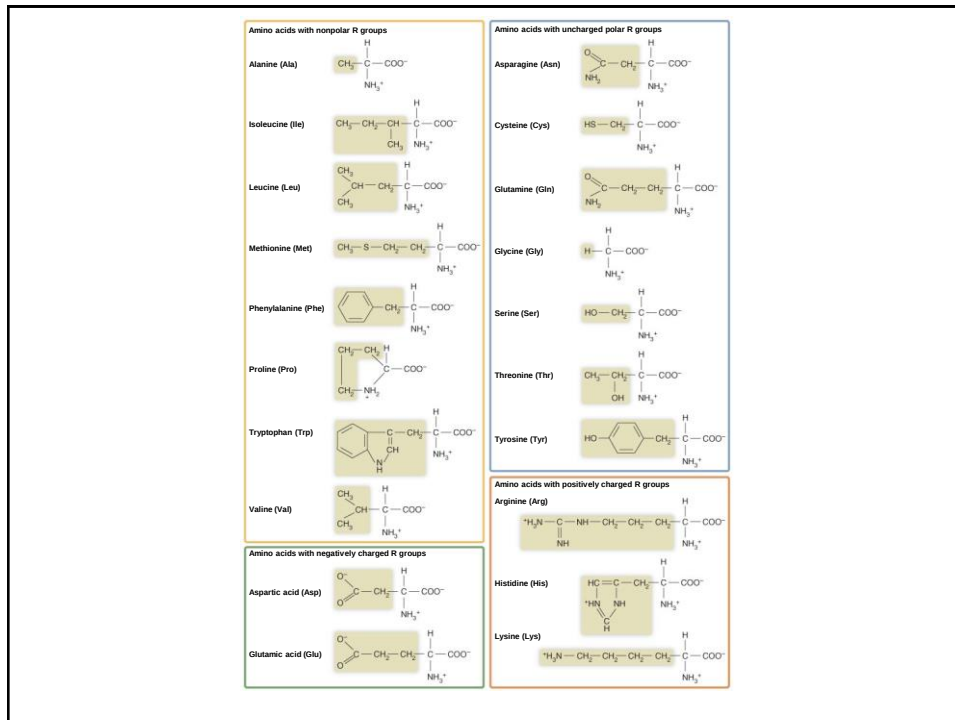
Male sex hormone synthesized from cholesterol.

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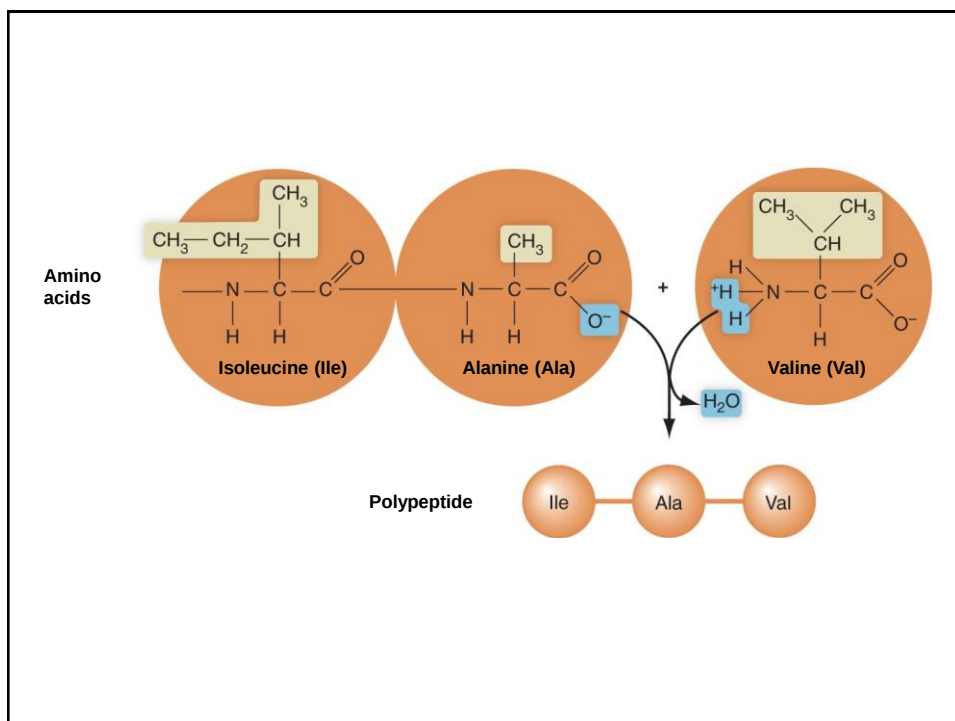
Proteins

- Long chains (polymers) of subunits called amino acids
- Amino acids
 - 20 different types
 - Amino end, carboxyl end, R group
- Amino acids are joined by peptide bonds
 - produced by dehydration synthesis reactions

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Nucleic Acids Store Genetic Information

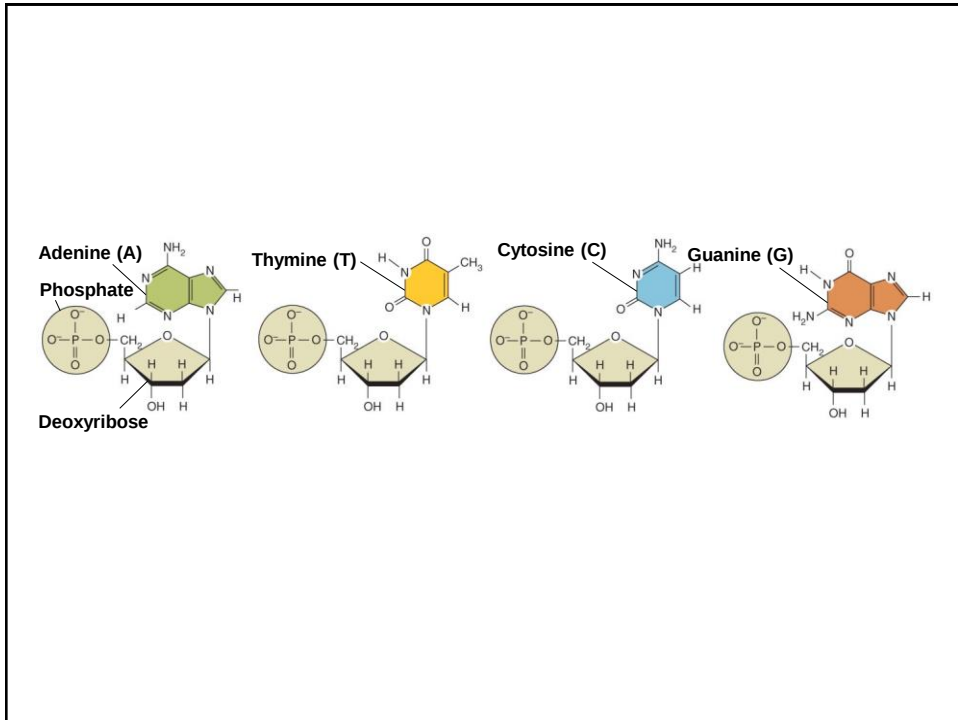
- Two types
 - DNA: deoxyribonucleic acid
 - RNA: ribonucleic acid
- Functions
 - Store genetic information
 - Provide information used in making proteins
- Nucleic acids are long chains containing subunits known as nucleotides

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Nucleic Acids Store Genetic Information

- **Nucleotides:** building blocks of nucleic acids
- Each nucleotide contains
 - 5 carbon sugar
 - DNA nucleotides: deoxyribose
 - RNA nucleotides: ribose
 - Nitrogenous base
 - Phosphate group

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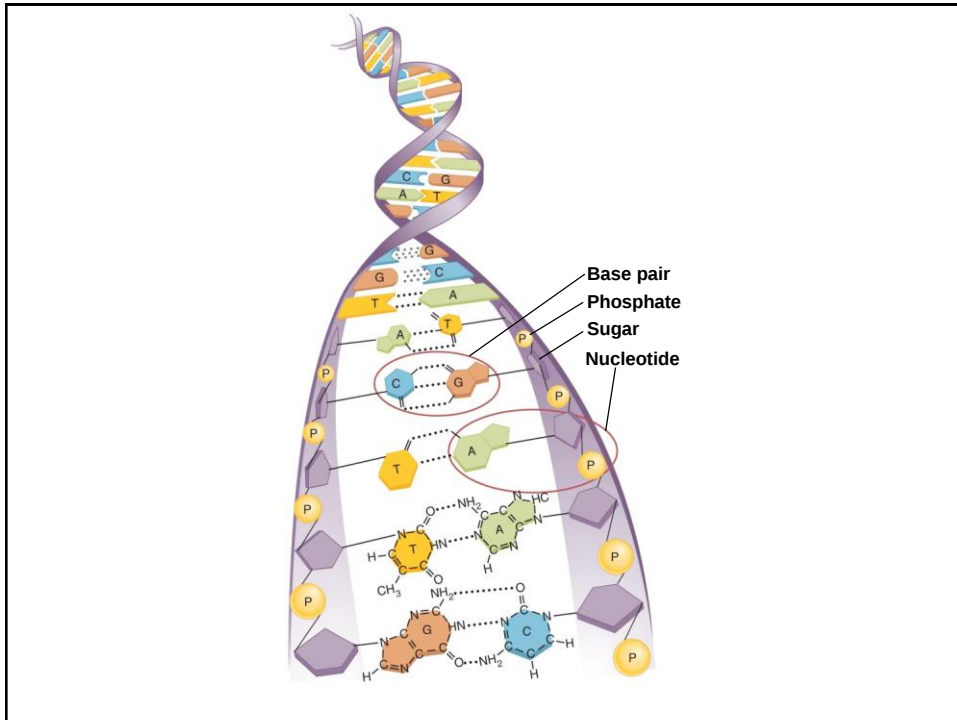


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Nucleic Acids Store Genetic Information

- Structure of DNA (deoxyribonucleic acid)
 - Double-stranded
 - Nucleotides contain
 - Deoxyribose (sugar)
 - Nitrogenous bases
 - Adenine
 - Guanine
 - Cytosine
 - Thymine
 - Pairing
 - Adenine (A) – Thymine (T)
 - Guanine (G) – Cytosine (C)

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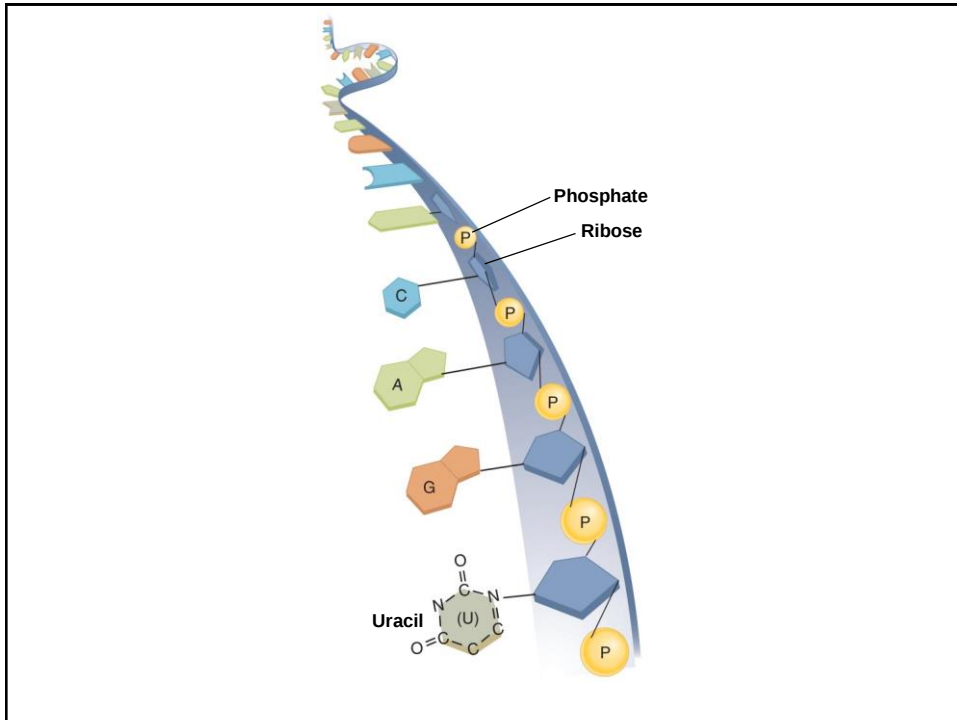


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Nucleic Acids Store Genetic Information

- Structure of RNA (ribonucleic acid)
 - Single-stranded
 - Nucleotides contain
 - Ribose
 - Nitrogenous bases
 - Adenine (A)
 - Guanine (G)
 - Cytosine (C)
 - Uracil (U)

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Nucleic Acid Function --- Nucleic Acids Store Genetic Information

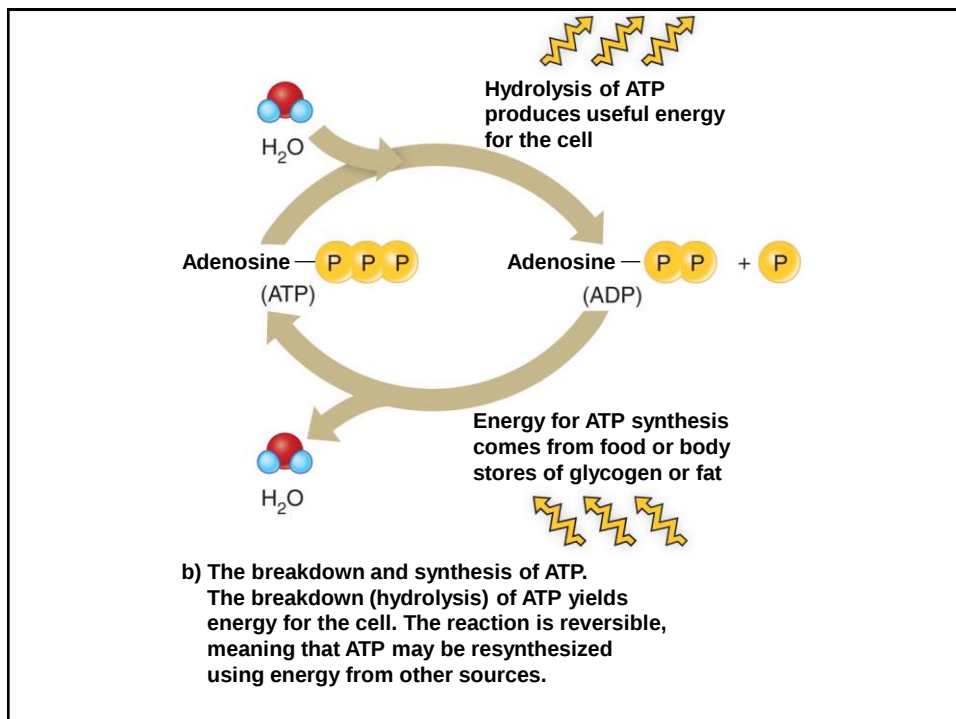
- Nucleic acid function
 - DNA: instructions for making RNA
 - RNA: instructions for making proteins
 - Proteins: direct most of life's processes
 - DNA → RNA → Proteins

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ATP Carries Energy

- Structure and function of adenosine triphosphate (ATP)
 - Universal energy source
 - Bonds between phosphate groups contain potential energy
 - Breaking the bonds releases energy
 - $\text{ATP} \rightarrow \text{ADP} + \text{P} + \text{energy}$

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