Macromolecules 2: Proteins and Nucleic Acids

- Proteins
  - Amino Acids
  - Kinds of R groups
  - 4 Levels of protein structure
- Nucleic Acids
  - Nucleotide structure
  - Base pairing
- Cells (if time)

Amino Acids differ only by their “R” group

- 20 kinds of amino acids
  - Same chassis, different cargo

Nonpolar Amino Acids

Polar and Charged Amino Acids

The amino and acid groups couple the monomers together

- Can make polymers that are 100s or 1000s of amino acids long

Building a polypeptide

- Dehydration reaction releases a water molecule
- Last peptide bond formed in the growing chain of amino acids

Like Fig 5.18
Formation of Peptide Bonds

Requires
- Energy
- and Information

4 Levels of Structure

Primary Structure:
Amino acid sequence

Secondary Structure:
Local folding
- helix and sheet

Tertiary Structure:
3-D shape of one polypeptide
- Mostly helices
- Mostly sheet

Quaternary Structure:
Assembly of several polypeptides to form one functional protein

Secondary structure
α helix

Secondary structure
β sheet

R groups are on the outside
Means that the R groups can interact with other molecules

Tertiary Structure
(3-D shape of the entire peptide)
- Formed by interactions among R groups
- Mostly helices
- Mostly sheet
- Mixture
3D structure stabilized by interactions among R groups

Quaternary Structure
- Sometimes a single functional PROTEIN is made of several POLYPEPTIDES that work together as a unit

Hemoglobin
Postassium Channel

Nucleic Acids

Nucleotides have three components
- Sugar
- Base
- Phosphate

Use dehydration reactions to connect these molecules
Nucleotides are the monomers of the nucleic acids.
Carbons in the sugar are numbered with primes

Nucleotides

Purines
- A, G

Pyrimidines
- C, T, U

Can you think of a good mnemonic?
The bases each have a polar edge for hydrogen bonding

Thymine

Adenine

Cytosine

Guanine

The nucleotide ATP is a common energy carrier

These are high-energy phosphate bonds

example: ATP (or ADP)

Also GTP, CTP, etc.

Polynucleotide (DNA, RNA) chains are assembled by yet another type of dehydration reaction

• Link the -OH on the 3' carbon of one nucleotide
• to the phosphate on the 5' carbon of the next.

DNA copying is the basis of heredity

The sequences of bases is the hereditary information

RNA

DNA

DNA copying is the basis of heredity

The sequences of bases is the hereditary information

RNA

DNA

RNA

DNA

Cells

Bacterial cell
(Prokaryote)

Animal Cell
(Eukaryote)
Common features of all cells
- **Plasma Membrane**
  - defines inside from outside
- **Cytosol**
  - Semifluid “inside” of the cell
- **DNA “chromosomes”**
  - Genetic material – hereditary instructions
- **Ribosomes**
  - “factories” to synthesize proteins

**Why are Cells Small?**

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<th>Surface Area</th>
<th>Volume</th>
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<tr>
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<td>64,000</td>
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<tr>
<td>60 x 60 x 100</td>
<td>60,000</td>
</tr>
<tr>
<td>60 x 100 x 100</td>
<td>60,000</td>
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</tbody>
</table>

**Bacterial (Prokaryotic) Cell**
- Fimbriae
- Nucleoid
- Ribosomes
- Plasma membrane
- Cell wall
- Capsule
- Flagella
- Bacterial chromosome

No internal membranes

**Animal (Eukaryotic) Cell**
- Rough ER
- Smooth ER
- Centrosome
- Cytoskeleton
- Microfilaments
- Intermediate filaments
- Microtubules
- Peroxisome
- Lysosome
- Golgi apparatus
- Ribosomes
- Cytosol
- Mitochondrion
- Nucleus

Contains internal organelles

**Plasma membrane**
- Phospholipid bilayer
- Proteins

You should know everything in Fig 6.9