Nucleic Acids

Nucleotides are the building blocks of nucleic acids such as DNA and RNA. Individual nucleotides are each composed of a nucleoside (A, T/U, G, or C), either a deoxyribose (DNA) or ribose (RNA) sugar, and a phosphate group. Nucleotides also serve as energy storage molecules in the cell, primarily in the form of ATP and GTP.

Carbohydrates

Carbohydrates are important to all organisms structurally and as a source of energy. Carbohydrates can exist as simple sugars or as long polymers of simple sugars. The carbohydrate cellulose is the most abundant naturally-occurring polymer.

Proteins

Proteins are built from amino acids and are the most diverse class of molecules in the cell. They play a role in the structure and function of the cell, communication between cells, and transport of other molecules in and out of cells. Proteins perform nearly all the biochemical functions of a cell.

Lipids

Lipids are a structurally diverse class of molecules that share the common feature of being relatively insoluble in water. In cells, lipids serve as an energy source and as a form of stored energy (triglycerides), an essential component of cell membranes (phospholipids and cholesterol), and important signaling molecules within and between cells (steroids).

20 Common Amino Acids

- Alanine (Ala)
- Arginine (Arg)
- Aspartic acid (Asp)
- Asparagine (Asn)
- Cysteine (Cys)
- Glutamine (Gln)
- Glutamic Acid (Glu)
- Glycine (Gly)
- Histidine (His)
- Isoleucine (Ile)
- Leucine (Leu)
- Lysine (Lys)
- Methionine (Met)
- Phenylation (Phe)
- Proline (Pro)
- Serine (Ser)
- Threonine (Thr)
- Tryptophan (Trp)
- Tyrosine (Tyr)
- Valine (Val)
- Thymine (DNA)
- Uric (RNA)
- Cytosine
- Guanine
- Uric (RNA)
**Cell Models**

**Prokaryote: Bacterium**
- Ribosomes
- Chromosome/DNA
- Cytoplasm
- Cell Wall
- Cell Membrane

**Eukaryote: Animal**
- Ribosomes
- Endoplasmic Reticulum
- Mitochondrion
- Nucleus
- Cytoskeleton

**Eukaryote: Plant**
- Ribosomes
- Cell Membrane
- Endoplasmic Reticulum
- Mitochondrion
- Nucleus
- Cytoplasm

**Organelles**

<table>
<thead>
<tr>
<th>Prokaryotic and Eukaryotic</th>
<th>Prokaryotic: Bacterial</th>
<th>Eukaryotic: Animal</th>
<th>Eukaryotic: Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cell Membrane</strong></td>
<td>Lypids &gt; Proteins &gt; Carbohydrates</td>
<td>Semipermeable surface for exchange of molecules and substances</td>
<td><strong>Cell Membrane</strong></td>
</tr>
<tr>
<td><strong>Cytoskeleton</strong></td>
<td>Prokaryote: Bacteria</td>
<td><strong>Prokaryote: Bacterial</strong></td>
<td><strong>Prokaryote: Bacterial</strong></td>
</tr>
<tr>
<td><strong>Chromosomes (DNA)</strong></td>
<td>Nucleic Acids &gt; Proteins</td>
<td>Code for everything including building proteins for cell growth and maintenance</td>
<td><strong>Nucleus</strong></td>
</tr>
<tr>
<td><strong>Ribosome</strong></td>
<td>Proteins &gt; Nucleic Acids</td>
<td>Build proteins; site of translation</td>
<td><strong>Nucleus</strong></td>
</tr>
<tr>
<td><strong>Cell Wall</strong></td>
<td>Carbohydrates &gt; Proteins</td>
<td>Structural support for maintaining cell shape</td>
<td><strong>Nucleus</strong></td>
</tr>
<tr>
<td><em>Not in animal cells</em></td>
<td>Bacteria: peptidoglycan; Plants: Cellulose; Fungi: Chitin</td>
<td><strong>Nucleus</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Prokaryotic Membrane-Bound Organelles**
- **Nucleus**
  - Houses chromosomes; site of transcription
- **Smooth Endoplasmic Reticulum**
  - Builds and breaks down fats and steroids; Breaks down toxins; Regulates calcium ion levels
- **Rough Endoplasmic Reticulum**
  - Site of protein synthesis; tagging, folding, quality control, and dispatch
- **Golgi Complex**
  - Final preparation and tagging of proteins for delivery to organelles or membrane
- **Endosome**
  - Transport vesicle
- **Lysosome**
  - Breakdown of ingested materials or non-functional organelles or macromolecules for recycling
- **Peroxisome**
  - Catabolism of long chain fatty acids; Reduction of hydrogen peroxide (ROS) by catalase; glyoxylate cycle in plants

**Eukaryotic Membrane-Bound Organelles**
- **Mitochondrion**
  - Production of ATP by Citric Acid Cycle and Electron Transport Chain (ETC); An important component of the catabolism of glucose: C₆H₁₂O₆ + 6O₂ → 6H₂O + 6CO₂ + 38 ATP
- **Chloroplast**
  - Production of carbohydrates by light reactions and Calvin Cycle (dark reactions). An important component in the anabolism of glucose: 6H₂O + 6CO₂ + light energy → C₆H₁₂O₆ + 6O₂

**Mitosis**

**Prophase**

**Metaphase**

**Anaphase**

**Telophase**

**Cytokinesis**

**Meiosis**

**Prophase I**

**Metaphase I**

**Anaphase I**

**Telophase I**

**Cytokinesis**

**Prophase II**

**Metaphase II**

**Anaphase II**

**Telophase II**

**Cell Cycle Mnemonics**

<table>
<thead>
<tr>
<th><strong>Pro</strong></th>
<th><strong>Prepare</strong></th>
<th><strong>Telo</strong></th>
<th><strong>End</strong></th>
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<td><strong>Meta</strong></td>
<td><strong>Middle</strong></td>
<td><strong>Kines</strong></td>
<td><strong>Separ</strong></td>
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<td><strong>Ana</strong></td>
<td><strong>Away</strong></td>
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