A TOUR OF THE CELL

THE FUNDAMENTAL UNITS OF LIFE

Cells are the basic units of structure and function of all organisms. They range from 0.1 nm to 1.0 m. Size of cells limited due to surface-volume ratio.

Since they are small in size and have a complex internal structure, microscopes are required to facilitate study of their structure and behavior.

Improvements in microscope technology lead to new discoveries in the structure and behavior of living cells. Schleiden, Schwann and Virchow summarized all early research on cells in their “Cell Theory” in the mid 1800's.

6.1 TO STUDY CELLS, BIOLOGISTS USE MICROSCOPES AND THE TOOLS OF BIOCHEMISTRY

Microscopy:

<table>
<thead>
<tr>
<th>Light Microscopes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brightfield</td>
</tr>
<tr>
<td>Confocal</td>
</tr>
<tr>
<td>Fluorescence</td>
</tr>
<tr>
<td>Nomarski Interference</td>
</tr>
<tr>
<td>Phase Contrast</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electron Microscopes (EM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scanning EM</td>
</tr>
<tr>
<td>Transmission EM</td>
</tr>
</tbody>
</table>

Testing:

<table>
<thead>
<tr>
<th>Cell Fractionation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeze-Fracture</td>
</tr>
<tr>
<td>Freeze-Etch</td>
</tr>
</tbody>
</table>
6.2 EUKARYOTIC CELLS HAVE INTERNAL MEMBRANES THAT COMPARTMENTALIZE THEIR FUNCTIONS

Eukaryotic cells have an internal, interconnecting membrane system that extends from their cell membrane. The cytoplasm of eukaryotic cells contains many membrane-bound or membrane associated structures (known as organelles), which perform tasks geared towards survival and homeostasis.

COMPARING PROKARYOTIC AND EUKARYOTIC CELL DESIGNS

- **Prokaryote**: lacks a membrane-covered nucleus (often has no nuclear region at all). Lacks membrane-bound organelles.

- **Eukaryote**: has a nucleus bordered by a double-layered membrane.

<table>
<thead>
<tr>
<th>Cell Membrane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protoplasms</td>
</tr>
<tr>
<td>Cytoplasm</td>
</tr>
<tr>
<td>Nucleoplasm</td>
</tr>
</tbody>
</table>

6.3 THE EUKARYOTIC CELL’S GENETIC INSTRUCTIONS ARE HOUSED IN THE NUCLEUS AND CARRIED OUT BY THE RIBOSOMES

<table>
<thead>
<tr>
<th>Nucleus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear membrane</td>
</tr>
<tr>
<td>Chromosomes</td>
</tr>
<tr>
<td>Chromatin</td>
</tr>
<tr>
<td>Nucleoli (Nucleolus)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ribosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Ribosomes</td>
</tr>
<tr>
<td>Bound Ribosomes</td>
</tr>
</tbody>
</table>

6.4 THE ENDOMEMBRANE SYSTEM REGULATES PROTEIN TRAFFIC AND PERFORMS METABOLIC FUNCTIONS IN THE CELL

<table>
<thead>
<tr>
<th>ER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth ER</td>
</tr>
<tr>
<td>Rough ER</td>
</tr>
<tr>
<td>----------</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Golgi Bodies</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Lysosomes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Proteasomes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>P-Bodies</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Vacuoles</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Vesicles</th>
</tr>
</thead>
</table>

### 6.5 Mitochondria and Chloroplasts Change Energy from One Form to Another

<table>
<thead>
<tr>
<th>Mitochondria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Membrane</td>
</tr>
<tr>
<td>Intermembrane Space</td>
</tr>
<tr>
<td>Inner Membrane</td>
</tr>
<tr>
<td>Cristae</td>
</tr>
<tr>
<td>Matrix</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plastids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloroplasts</td>
</tr>
<tr>
<td>Chromoplasts</td>
</tr>
<tr>
<td>Leukoplasts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Microbodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peroxisomes</td>
</tr>
<tr>
<td>Glyoxysome</td>
</tr>
</tbody>
</table>
### 6.6 The Cytoskeleton is a Network of Fibers That Organizes Structures and Activities Within the Cell

<table>
<thead>
<tr>
<th>Cytoskeleton</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Centrosome</td>
<td></td>
</tr>
<tr>
<td>Cilia</td>
<td></td>
</tr>
<tr>
<td>Flagella</td>
<td></td>
</tr>
<tr>
<td>Flagella</td>
<td></td>
</tr>
<tr>
<td>Flagella</td>
<td></td>
</tr>
<tr>
<td>Microtubules</td>
<td></td>
</tr>
<tr>
<td>Microfilaments</td>
<td></td>
</tr>
<tr>
<td>Intermediate Filaments</td>
<td></td>
</tr>
<tr>
<td>Motor Molecules</td>
<td></td>
</tr>
</tbody>
</table>

### 6.7 Extracellular Components and Connections Between Cells Help Coordinate Cellular Activities

**Plants:**

| Cell Wall |          |

**Animals:**

| Extracellular Matrix |          |

### Intercellular Junctions

These structures provide a mechanism for attachment in addition to often facilitating cellular communication ("cell signaling").

<table>
<thead>
<tr>
<th>Plasmodesmata</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tight Junctions</td>
<td></td>
</tr>
<tr>
<td>Desmosomes</td>
<td></td>
</tr>
<tr>
<td>Gap Junctions</td>
<td></td>
</tr>
</tbody>
</table>