BIO 103 Introduction

Lecture Outline
Introduction/Organic Molecules/Cells/Cell Division

Hole’s *Human Anatomy & Physiology*  
[Chapters 1, 2 (p. 61-69), 3, 4, 22 (p. 835-837, 849-852)]

**Introduction**  [Chapter 1]

A. **Anatomy**
   -

B. **Physiology**
   -

   Structure is always related to ____________.

C. **A&P go together**
   -
   -

   Ex. Heart
   
   LV →
   
   RV →

**Levels of Organization** (Simplest ---> Complex)

Subatomic particles -
Atom -

Molecule -
Macromolecule -

Organelle

**Cell** -
Tissue -

Organ -
Organ System -

Organism -
Characteristics of Life
Movement –
Responsiveness –
Growth –
Reproduction –
Respiration –
Digestion –
Absorption –
Circulation –
Assimilation –
Excretion –

Requirements of Organisms
Water
- required for ___________ & ______________
- regulates ______________

Food
- provides ______________
- supplies ______________

Oxygen (Gas)
- used to release energy from nutrients

Heat
- form of energy
- 

Pressure
- applying force on an object
- atmospheric pressure - ______________
- hydrostatic pressure - ______________
Homeostasis

A. Def.

B. Homeostatic Mechanisms
   1. Receptors –
   2. Control Center –
   3. Effectors -

       Body temperature:

       Too high   Too low

C. Negative Feedback
   -
   -
   Ex.

D. Positive Feedback
   -
   Ex.

Membranes & Cavities

A. Cranial Cavity –

B. Vertebral Canal (Spinal Cavity) –
C. Thoracic Cavity
   o Pleural Cavities – lungs
   o Mediastinum –
   o Pericardial Cavity – heart

D. Abdominalpelvic Cavity
   o Abdominal Cavity –
   o Pelvic Cavity –

Visceral layer –

Parietal layer –

E. Thoracic Membranes
   o 
     o visceral
     o parietal
     
   o 
     o visceral
     o parietal

F. Abdominopelvic Membranes
   o 
     o visceral
     o parietal

Thoracic cavity

a) Pleural membranes
   - parietal pleura
     <pleural cavity>
   - visceral pleura

b) Pericardium
   i. Fibrous pericardium
   ii. Serous pericardium
      - parietal
         <pericardial cavity>
      - visceral
Abdominopelvic cavity

Peritoneum
- visceral peritoneum
  <peritoneal cavity>
- parietal peritoneum

Definitions:

Serous Fluid:

Retroperitoneal:

Mesentery:

11 Major Organ Systems

Body Covering:
- __________________

Support & Movement:
- __________________
- __________________

Integration and Coordination:
- __________________
- __________________

Transport:
- __________________
- __________________

Absorption & Excretion
- __________________
- __________________
- __________________

Reproduction:
- __________________
Organ Systems

1. Integumentary System
   Organs:
   Functions:

2. Skeletal System
   Organs:
   Functions:

3. Muscular System
   Organs
   Functions:

4. Nervous System
   Organs:
   Functions:

5. Endocrine System
   Organs:
   Functions:

6. Cardiovascular System
   Organs:
   Functions:

7. Lymphatic System
   Organs:
   Functions:

8. Digestive System
   Organs:
   Functions:

9. Respiratory Systems
   Organs:
   Functions:

10. Urinary System
    Organs:
    Functions:

11. Reproductive Systems
    Organs:
    Functions:
Anatomical Terminology

A. Anatomical Position

B. Terms of Relative Position
   - Superior
   - Inferior
   - Anterior
   - Posterior
   - Dorsal
   - Ventral
   - Cranial (Cephalad)
   - Caudal
   - Medial
   - Lateral
   - Proximal
   - Distal
   - Superficial
   - Deep

C. Body Sections/Planes
   - Sagittal / Midsagittal / Parasagittal
   - Transverse or Cross-section
   - Coronal or Frontal
   - Oblique
   - Longitudinal / Horizontal
D. Abdominal Subdivision

_Nine (9) Abdominopelvic Regions:_

<table>
<thead>
<tr>
<th></th>
<th>Right Hypochondriac</th>
<th>Epigastic</th>
<th>Left Hypochondriac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Lumbar</td>
<td></td>
<td>Umbilical</td>
<td></td>
</tr>
<tr>
<td>Left Inguinal (Iliac)</td>
<td></td>
<td>Hypogastric (Pubic)</td>
<td>Left Inguinal (Iliac)</td>
</tr>
</tbody>
</table>

_Four (4) Abdominopelvic Quadrants:_

<table>
<thead>
<tr>
<th></th>
<th>RUQ</th>
<th>LUQ</th>
<th>RLQ</th>
<th>LLQ</th>
</tr>
</thead>
</table>

E. Body Regions

- Antebrachial –
- Axillary –
- Brachial –
- Cervical –
- Costal –
- Crural –
- Femoral –
- Gluteal –
- Mammary –
- Nasal –
- Occipital –
- Pectoral –
- Sternal –
- Tarsal –
- Vertebral –
Chemical Basis of Life [Chapter 2]

A. Why study chemistry in Anatomy & Physiology class?

- biochemistry helps to explain physiology

B. Organic versus Inorganic

1. Organic Molecules
   - contain _______ and _______
   - water soluble
   - ______________, ____________, _____________, and ______________

2. Inorganic Molecules
   - do not contain C (usually)
   - dissociate in water to form __________
   - __________, __________, __________, inorganic salts

C. Inorganic Substances

1. Water
   - ~ two-thirds of body wt.
   - medium for ______________
   - transports ______________
   - absorbs and transports ______________

2. Oxygen
   - used by organelles to ______________
   - necessary for survival

3. Carbon dioxide
   - ______________
4. Inorganic salts
   • source of ions (_____, ______, ______, ______)
   • important role in metabolism

D. Organic Substances
   Four (4) major classes of organic compounds:

1. **Carbohydrates**
   - provide ___________ to cells
   - supply materials to ______________
   - ratio of H to O close to 2:1 (C₆H₁₂O₆)

   **Examples:**
   - ______________ – glucose, fructose
   - ______________ – sucrose, lactose
   - ______________ – glycogen, cellulose

2. **Lipids**
   - Insoluble in water

   **Examples:**
   - 
   - 
   - 

   **fats (triglycerides)**
   - used primarily for energy; most common lipid in body
   - contain C, H, and O but less O than carbohydrates (C₅₇H₁₁₀O₆)
     - building blocks = 1__________ + 3 ____________
     - saturated and unsaturated

   **phospholipids**
   - building blocks = 1 _______ 2 _______, and 1 phosphate per molecule
   - hydrophilic and hydrophobic
   - major component of cell membranes
steroids
• four carbon rings
• component of ______________________
• cholesterol
• used to synthesize _______________

3. Proteins
• structural material
• energy source
• hormones
• receptors
• enzymes
• antibodies

• Building blocks are __________ _________

4. Nucleic Acids
• carry genes
• encode amino acid sequences of proteins

• building blocks = ______________

• DNA (__________________) – double polynucleotide

• RNA (__________________) – single polynucleotide

E. ATP Molecules
(Adenosine triphosphate)
• each ATP molecule has three parts:
  • an adenine molecule
  • a ribose molecule
  • three phosphate molecules in a chain

• third phosphate attached by high-energy bond

• ATP <===> ADP + P + E

Cells & Cellular Metabolism [Chapters 3 & 4]

A. Introduction to Cells
• vary in __________ and _________
• measured in ________________ (μm)
• somatic –
• sex – (sperm, oocytes)
B. Composite Cell
   Major parts
   •
   •
   •

C. Cell Membrane
   • barrier
   • selectively permeable
     - ______________
   • phospholipid bilayer
     - ______________ “heads” form surfaces
     - ______________ “tails” form interior
     - permeable to ______________
   • cholesterol - stabilizes the membrane
   • proteins
     o receptors – bind hormones
     o pores, channels, carriers [integral proteins]
       - ______________
     o enzymes ______________
   o CAMS (cellular adhesion molecules)
     - ______________
   o self-markers – ______________

D. Cytoplasmic Organelles

1. Endoplasmic Reticulum
   • membrane-bound sacs & vesicles
   • Ex.
     • rough ER (RER)
       - ______________
       - ______________
     • smooth ER (SER)
       -
       -
       -
2. Ribosomes
   -

3. Golgi apparatus
   -

4. Vesicles
   -

5. Mitochondria
   -

6. Lysosomes
   -

7. Peroxisomes
   -

8. Centrosomes
   -

9. Microvilli
   -

10. Cilia
    -

11. Flagellum
    -

12. Microfilaments and microtubules
    -

13. Inclusions - storage of ___________, ____________
E. Cell Nucleus
   - control center of cell
   - nuclear envelope
   - nucleolus
   - chromatin
     - fibers of DNA and proteins
     - stores information for protein synthesis

F. Nucleic Acids and Protein Synthesis
   Genetic information –
   Gene -
   Genome –
   Genetic Code –

G. Structure of DNA
   - two polynucleotide chains
   - N-bases pair specifically
     - (_______ and _______)
   - forms a _______________
   - chromosomes = _______________

H. RNA Molecules
   1. Messenger RNA (mRNA) -
      - delivers genetic information from nucleus to the cytoplasm
      - __________
      - DNA is template
      - RNA nucleotides are complementary to DNA nucleotides
        [exception:
         - no ___________ in RNA; replaced with ________]
      - making of mRNA (from DNA) is ______________
DNA & RNA Practice Exercise:

| **DNA** | **DNA** | **mRNA** |

2. Transfer RNA (tRNA) -
   - carries ________________ to mRNA
   - carries ________________ to mRNA
   - translates a codon of mRNA into an amino acid

3. Ribosomal RNA (rRNA) –
   - provides structure and enzyme activity for ribosomes

I. Protein Synthesis
   1. Transcription of mRNA
      - DNA serves as template for ________________

2. Translation
   - mRNA converted into sequence of ________ → ________

J. Mutations
   Mutations –
   Result when –
   May or may not change the protein.

K. Clinical Application
   **Phenylketonuria**
   - enzyme that breaks down the a.a. phenylalanine (phe) is missing
   - build up of phe causes mental retardation
   - treated by diets very low in phenylalanine
## L. Movements Into and Out of the Cell

<table>
<thead>
<tr>
<th>Passive (Physical) Processes</th>
<th>Active (Physiological) Processes</th>
</tr>
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<tbody>
<tr>
<td>• require no energy</td>
<td>* require energy (ATP)</td>
</tr>
<tr>
<td>• simple diffusion</td>
<td>* active transport</td>
</tr>
<tr>
<td>• facilitated diffusion</td>
<td>* endocytosis</td>
</tr>
<tr>
<td>• osmosis</td>
<td>* exocytosis</td>
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1. **Simple Diffusion**  
   • movement of substances from _____ concentration to ______ concentration  
   [down concentration gradient]  
   [to achieve equilibrium]  
   • O₂, CO₂, lipid-soluble substances

2. **Facilitated Diffusion**  
   • diffusion across a membrane with aid of _______________  
   •

3. **Osmosis**  
   • movement of __________ through a  
   ________________ from high water conc. to low water conc.  
   • water moves toward a higher conc. of solutes

**Osmotic Pressure** – ability of osmosis to generate enough pressure to move a volume of water

Osmotic pressure increases as the concentration of nonpermeable solutes increases

• hypertonic –  
• hypotonic –  
• isotonic –
Bio 103 Introduction

Solution is ________ to RBC.

Solution is ___________ to RBC.
Water moves out of cell ➔ ______________.

Solution is ___________ to RBC.
Water moves into cell ➔ ______________.

4. Filtration
   •
     • due to
     • molecules leaving blood capillaries

5. Active Transport
   • _____________ transport substances across a membrane
   • movement ___________the conc. gradient (low to high conc.)
     • requires __________
     • sugars, a.a., Na+, K+

6. Endocytosis
   • cell engulfs a substance
   • three types:
     • pinocytosis –
     • phagocytosis –
     • receptor-mediated endocytosis –

7. Exocytosis
   • “cell-vomiting”
   • substances in a vesicle fuse with C.M.
   • release of neurotransmitters from nerve cells
Bio 103 Introduction

The Cell Cycle
• Life of the cell

• Stages
  • interphase
  • mitosis
  • cytokinesis

A. Interphase
• cell prepares to divide
  - replicates
  - synthesizes new

• G phases –
• S phase –

B. Mitosis (Somatic cell division)
• produces two daughter cells from diploid parent cell

• nucleus divides –

• cytoplasm divides -
• 4 stages
  Stage 1: Prophase
  -
  -

  Stage 2: Metaphase
  -
  -

  Stage 3: Anaphase
  -

  Stage 4: Telophase
  -
Cytokinesis
• takes place during telophase
• 2 new daughter cells formed

C. **Meiosis** (Reproductive Cell Division)
• occurs only in production of gametes
• takes place in 2 successive nuclear divisions:
  Meiosis I
  Meiosis II

Interphase - Chromosomes replicate

**Meiosis I**

*Prophase I*
- chromosomes line up in homologous pairs *(synapsis)*
- **tetrad formation**
- **crossing over** = exchange of genes
  ==> variety in the species

*Metaphase I*
- paired chromosomes line up on equator of cell
- centromeres attach to spindle fibers

*Anaphase I*
- separation of homologous pair to opposite poles
  - **centromeres do not split**

*Telophase I*
- cytokinesis

**Meiosis II**
[No real interphase]
Prophase II
Metaphase II
Anaphase II
Telophase II

**Spermatogenesis**
- 4 _____________ produced

**Oogenesis**
- 4 cells produced:
  _______
  _______
Meiosis I:
  Reduction division
  Start with 2n parent cell ==> ______________

Meiosis II:
  Equatorial division
  Each haploid cell divides ==> ______________

D. Control of Cell Division
  • cell division varies among cell types
    • skin and blood cells divide often and continually
    • neuron cells divide a specific number of times then cease
  • growth factors and hormones stimulate cell division
    • hormones stimulate mitosis of SMC in uterus
    • epidermal growth factor stimulates growth of new skin
  • contact (density dependent) inhibition
  • tumors are the consequence of a loss of cell cycle control

E. Tumors
  Two types of tumors
  • benign – usually remains localized
  • malignant – invasive and can metastasize; cancerous

  Two major types of genes cause cancer
  • oncogenes – activate other genes that increase cell division
  • tumor suppressor genes – normally regulate mitosis; if inactivated they are unable to regulate mitosis

F. Stem and Progenitor Cells
  Stem cell
  • can divide to form two new stem cells
    - self-renewal
  • can divide to form a stem cell and a progenitor cell
  • totipotent – can give rise to every cell type
  • pluripotent – can give rise to a restricted number of cell types

  Progenitor cell
  • committed cell
  • can divide to become any of a restricted number of cells
  • pluripotent