

## Bio 103 Introduction

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**BIO 103**

### 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 -

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### 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 - \_\_\_\_\_

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### 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
  - Pleural Cavities – lungs
  - Mediastinum –
  - Pericardial Cavity - heart

Visceral layer –

Parietal layer –

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### D. Thoracic Membranes

- \_\_\_\_\_
  - visceral
  - parietal
  
- \_\_\_\_\_
  - visceral
  - parietal

### E. Abdominopelvic Membranes

- \_\_\_\_\_
  - visceral
  - 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:

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### 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.:

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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

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- 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:*

Right Hypochondriac	Epigastric	Left Hypochondriac
Right Lumbar	Umbilical	Left Lumbar
Right Inguinal (Iliac)	Hypogastric (Pubic)	Left Inguinal (Iliac)

*Four (4) Abdominopelvic Quadrants:*

RUQ	LUQ
RLQ	LLQ

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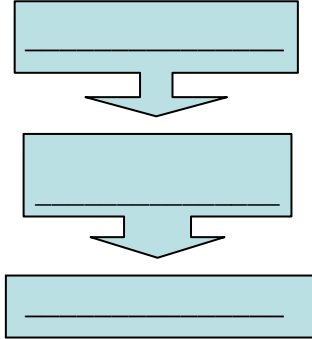
### E. Body Regions

- Antebrachial –
- Axillary –
- Brachial –
- Cervical –
- Costal -
- Crural -
- Femoral -
- Gluteal -
- Mammary -
- Nasal -
- Occipital –
- Pectoral –
- Sternal –
- Tarsal -
- Vertebral -

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## 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

- \_\_\_\_\_

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### 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 ( $C_6H_{12}O_6$ )

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  
( $C_{57}H_{110}O_6$ )

- 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

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### 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  $\rightleftharpoons$  ADP + P + E**

## Cells & Cellular Metabolism [Chapters 3 & 4]

### A. Introduction to Cells

- vary in \_\_\_\_\_ and \_\_\_\_\_
- measured in \_\_\_\_\_ ( $\mu\text{m}$ )
- somatic –
- sex – \_\_\_\_\_ (sperm, oocytes)

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### 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
  - receptors – bind hormones
  - pores, channels, carriers [integral proteins]
    - \_\_\_\_\_
  - enzymes \_\_\_\_\_
  - CAMS (cellular adhesion molecules)
    - \_\_\_\_\_
  - self-markers – \_\_\_\_\_

### D. Cytoplasmic Organelles

#### 1. Endoplasmic Reticulum

- membrane-bound sacs & vesicles
- 

#### Ex.

- rough ER (RER)
  - \_\_\_\_\_
  - \_\_\_\_\_
- smooth ER (SER)
  - 
  - 
  -

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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 \_\_\_\_\_, \_\_\_\_\_

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### E. Cell Nucleus

- control center of cell
- nuclear envelop
  - 
  -
- 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 \_\_\_\_\_

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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

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### L. Movements Into and Out of the Cell

#### Passive (Physical) Processes

- require no energy
- simple diffusion
- facilitated diffusion
- osmosis

#### Active (Physiological) Processes

- \* require energy (ATP)
- \* active transport
- \* endocytosis
- \* exocytosis

#### 1. Simple Diffusion

- movement of substances from \_\_\_\_\_ concentration to \_\_\_\_\_ concentration  
[down concentration gradient]  
[to achieve equilibrium]
- O<sub>2</sub>, CO<sub>2</sub>, 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 –

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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<sup>+</sup>, K<sup>+</sup>

### 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

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### 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

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### 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 ==> \_\_\_\_\_

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### 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