Unit 1
The Human Body: An Orientation
Overview of Anatomy and Physiology

- **Anatomy** – the study of the *structure* of body parts and their relationships to one another (static)
  - Word “anatomy” comes from the Greek words that mean “to cut apart”

- **Physiology** – the study of the *function* of the body’s structural machinery (dynamic)
  - How the parts work & carry out life sustaining activities
Topics of Anatomy

- **Gross Anatomy** – study of large body structures
  - **Regional** – study of all structures in one part of the body (such as the leg)
  - **Systemic** – study of the body system by system (such as digestive system)
  - **Surface** – study of internal structures as they relate to the overlying skin
Topics of Anatomy

- **Microscopic Anatomy** – study of very small structures of body
  - **Cytology** – study of the cells of the body
    - Cell anatomy
  - **Histology** – study of tissues of the body
Topics of Anatomy

- **Developmental Anatomy** – study of structural change throughout life, from conception to old age
  - **Embryology** – study of developmental changes of the body before birth
Physiology

- Considers the operation of specific organ systems
  - Renal – kidney function
  - Neurophysiology – workings of the nervous system
  - Cardiovascular – operation of the heart and blood vessels
- Focuses on the functions of the body, often at the cellular or molecular level
Understanding physiology also requires a knowledge of physics, which explains electrical currents, blood pressure, and the way muscle uses bone for movement.
States that an anatomical structure usually reflects its function

Form follows function

What a structure can do depends on its specific form

› Anatomy = form & Physiology = function
Levels of Structural Organization

- Chemical – atoms combine to form molecules
  - **Atoms** – simplest level, tiny building blocks of matter
  - **Molecules** – two or more different types of atoms

- Cellular – cells are made of molecules
  - **Cells** – living structural and functional units of an organism

- Tissue – consists of similar types of cells
  - **Epithelium tissue** – body surfaces and lines cavities
  - **Muscle tissue** – causes movement
  - **Connective tissue** – supports body & protects organs
  - **Nervous tissue** – provides rapid internal communication by transmitting electrical impulses
Levels of Structural Organization

- **Organ** – made up of different types of tissues
  - Each organ has a highly specialized function that no other organ can perform
- **Organ system** – consists of different organs that work closely together
- **Organism** – made up of all the organ systems
Levels of Organization

1. Chemical level: Atoms combine to form molecules.

2. Cellular level: Cells are made up of molecules.

3. Tissue level: Tissues consist of similar types of cells.

4. Organ level: Organs are made up of different types of tissues.

5. Organ system level: Organ systems consist of different organs that work together closely.
Integumentary system

- Forms the external body covering
- Composed of the skin, sweat glands, oil glands, hair, and nails
- Protects deep tissues from injury and synthesizes vitamin D
Organ Systems of the Body

- Skeletal system
  - Composed of bone, cartilage, and ligaments
  - Protects and supports body organs
  - Provides the framework for muscles
  - Site of blood cell formation
  - Stores minerals
Organ Systems of the Body

Muscular system

- Composed of muscles and tendons
- Allows manipulation of the environment, locomotion, and facial expression
- Maintains posture
- Produces heat
Nervous system

- Composed of the brain, spinal column, and nerves
- Is the fast-acting control system of the body
- Responds to stimuli by activating muscles and glands
- Communication throughout body, mental activities, maintaining homeostasis
Organ Systems of the Body

- Cardiovascular system
  - Composed of the heart, blood vessels, and blood
  - The heart pumps blood
  - The blood vessels transport blood throughout the body
  - Transports materials throughout the body
Lymphatic system

- Composed of red bone marrow, thymus, spleen, lymph nodes, and lymphatic vessels
- Picks up fluid leaked from blood vessels and returns it to blood
- Disposes of debris in the lymphatic stream
- Houses white blood cells involved with immunity
Respiratory system

- Composed of the nasal cavity, pharynx, trachea, bronchi, and lungs
- Keeps blood supplied with oxygen and removes carbon dioxide
Organ Systems of the Body

- Digestive system
  - Composed of the oral cavity, esophagus, stomach, small intestine, large intestine, rectum, anus, and liver
  - Breaks down food into absorbable units that enter the blood
  - Eliminates indigestible foodstuffs as feces
Organ Systems of the Body

- Urinary system
  - Composed of kidneys, ureters, urinary bladder, and urethra
  - Eliminates nitrogenous wastes from the body
  - Regulates water, electrolyte, and pH balance of the blood
  - Removes wastes from blood
Organ Systems of the Body

- Male reproductive system
  - Composed of prostate gland, penis, testes, scrotum, and ductus deferens
  - Main function is the production of offspring
  - Testes produce sperm and male sex hormones
  - Ducts and glands deliver sperm to the female reproductive tract
Organ Systems of the Body

- Female reproductive system
  - Composed of mammary glands, ovaries, uterine tubes, uterus, and vagina
  - Main function is the production of offspring
  - Ovaries produce eggs and female sex hormones
  - Remaining structures serve as sites for fertilization and development of the fetus
  - Mammary glands produce milk to nourish the newborn
Organ System Interrelationships

- The integumentary system protects the body from the external environment
- Digestive and respiratory systems, in contact with the external environment, take in nutrients and oxygen
Nutrients and oxygen are distributed by the blood.

Metabolic wastes are eliminated by the urinary and respiratory systems.
Necessary Life Functions

- **Maintaining boundaries** – the internal environment remains distinct from the external
  - Cellular level – accomplished by plasma membranes
  - Organismal level – accomplished by the skin
- **Movement** – locomotion, propulsion (peristalsis), and contractility
- **Responsiveness** – ability to sense changes in the environment and respond to them
- **Digestion** – breakdown of ingested foodstuff
Metabolism – all the chemical reactions that occur in the body

Excretion – removal of wastes from the body

Reproduction – cellular and organism levels
  > Cellular – an original cell divides and produces two identical daughter cells
  > Organism – sperm and egg unite to make a whole new person

Growth – increase in size of a body part or of the organism
Survival Needs

- **Nutrients** – chemical substances used for energy and cell building
- **Oxygen** – needed for metabolic reactions
- **Water** – provides the necessary environment for chemical reactions
- **Maintaining normal body temperature** – necessary for chemical reactions to occur at life-sustaining rates
- **Atmospheric pressure** – required for proper breathing and gas exchange in the lungs
Homeostasis

- **Homeostasis** is the ability to maintain a relatively stable internal environment in an ever-changing outside world.
- The internal environment of the body is in a dynamic state of equilibrium.
- Chemical, thermal, and neural factors interact to maintain homeostasis.
Homeostatic Control Mechanisms

- Variable produces a change in the body
  - **Receptor** monitors the environments and responds to changes (stimuli)
  - **Control center** determines the set point at which the variable is maintained
  - **Effector** provides the means to respond to the stimulus
Homeostatic Control Mechanism

1. Stimulus: Produces change in variable
2. Change detected by receptor
3. Input: Information sent along afferent pathway to control center
4. Output: Information sent along efferent pathway to effector
5. Response of effector feeds back to influence magnitude of stimulus and returns variable to homeostasis
Negative Feedback

- In negative feedback systems, the output shuts off the original stimulus.

- Example: Regulation of blood glucose levels.
In positive feedback systems, the output enhances or exaggerates the original stimulus.

Example: Regulation of blood clotting.
Disturbance of homeostasis or the body’s normal equilibrium caused by disease

Overwhelming of negative feedback mechanisms allowing destructive positive feedback mechanisms to take over
Frames of Reference For Anatomical Studies

Part II of Unit 1
Anatomical Position

- Body erect, feet slightly apart, palms facing forward, thumbs point away from the body
- Standard position
Directional terms are used by medical personnel and scientists to explain where one body structure is in relation to another.

- Ex. ears are lateral and superior to the nose.

- **Superior** and **inferior** – toward and away from the head, respectively.

- **Anterior** and **posterior** – toward the front and back of the body.

- **Medial, lateral, and intermediate** – toward the midline, away from the midline, and between a more medial and lateral structure.
Directional Terms

- **Proximal** and **distal** – closer to and farther from the origin of the body
- **Superficial** and **deep** – toward and away from the body surface
## Orientation and Directional Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superior (cranial)</td>
<td>Toward the head end or upper part of a structure or the body; above</td>
<td>The head is superior to the abdomen</td>
</tr>
<tr>
<td>Inferior (caudal)</td>
<td>Away from the head end or toward the lower part of a structure or the body; below</td>
<td>The navel is inferior to the chin</td>
</tr>
<tr>
<td>Anterior (ventral)*</td>
<td>Toward or at the front of the body; in front of</td>
<td>The breastbone is anterior to the spine</td>
</tr>
</tbody>
</table>
### Directional Terms

#### TABLE 1.1 Orientation and Directional Terms

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<thead>
<tr>
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<tr>
<td>Posterior (dorsal)*</td>
<td>Toward or at the back of the body; behind</td>
<td>The heart is posterior to the breastbone</td>
</tr>
<tr>
<td>Medial</td>
<td>Toward or at the midline of the body; on the inner side of</td>
<td>The heart is medial to the arm</td>
</tr>
<tr>
<td>Lateral</td>
<td>Away from the midline of the body; on the outer side of</td>
<td>The arms are lateral to the chest</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Between a more medial and a more lateral structure</td>
<td>The collarbone is intermediate between the breastbone and shoulder</td>
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<tr>
<td>Proximal</td>
<td>Closer to the origin of the body part or the point of attachment of a limb to the body trunk</td>
<td>The elbow is proximal to the wrist</td>
</tr>
<tr>
<td>Distal</td>
<td>Farther from the origin of a body part or the point of attachment of a limb to the body trunk</td>
<td>The knee is distal to the thigh</td>
</tr>
<tr>
<td>Superficial (external)</td>
<td>Toward or at the body surface</td>
<td>The skin is superficial to the skeletal muscles</td>
</tr>
<tr>
<td>Deep (internal)</td>
<td>Away from the body surface; more internal</td>
<td>The lungs are deep to the skin</td>
</tr>
</tbody>
</table>
Regional Terms

- **Axial** – head, neck, and trunk
- **Appendicular** – appendages or limbs
- Specific regional terminology
Body Planes

- Study of anatomy often involves dissection, in which the body or organs are sectioned (cut) along imaginary lines called **planes**
- **Sagittal and medial** – divides the body into right and left parts
- **Midsagittal** – sagittal plane that lies on the midline
- **Frontal or coronal** – divides the body into anterior and posterior parts
- **Transverse or horizontal** (cross section) – divides the body into superior and inferior parts
- **Oblique** section – cuts made diagonally
Body Planes

- Frontal plane
- Median (midsagittal) plane
- Transverse plane
Body Cavities

- **Dorsal cavity** protects the nervous system, and is divided into two subdivisions
  - **Cranial cavity** is within the skull and encases the brain
  - **Vertebral cavity** runs within the vertebral column and encases the spinal cord

- **Ventral cavity** houses the internal organs (viscera), and is divided into two subdivisions: **thoracic** and **abdominopelvic**
Body Cavities

- Cranial cavity (contains brain)
- Vertebral cavity (contains spinal cord)
- Thoracic cavity (contains heart and lungs)
- Diaphragm
- Abdominal cavity (contains digestive viscera)
- Pelvic cavity (contains bladder, reproductive organs, and rectum)
- Ventral body cavity (thoracic and abdominopelvic cavities)
- Superior mediastinum
- Pleural cavity
- Pericardial cavity within the mediastinum

Key:
- Yellow: Dorsal body cavity
- Red: Ventral body cavity

(a) Lateral view  (b) Anterior view
Body Cavities

- **Thoracic cavity** is subdivided into pleural cavities, the mediastinum, and the pericardial cavity
  - **Pleural cavities** – each houses a lung
  - **Mediastinum** – contains the pericardial cavity, and surrounds the remaining thoracic organs
  - **Pericardial** – encloses the heart
The abdominopelvic cavity is separated from the superior thoracic cavity by the dome-shaped diaphragm.

It is composed of two subdivisions:

- **Abdominal cavity** – contains the stomach, intestines, spleen, liver, and other organs.
- **Pelvic cavity** – lies within the pelvis and contains the bladder, reproductive organs, and rectum.
Serosa is a double-layered membrane that covers walls & organs in ventral cavity

Parietal serosa covering the body walls

Visceral serosa covering the internal organs

Serous fluid separates the serosae
Membrane Types

- **Pleurea** (pleural membrane) – surrounds the lungs, outer layer called parietal pleura, and inner layer called visceral pleura

- **Pericardium** (pericardial membrane) - surrounds the heart, outer layer called parietal pericardium, and inner called visceral pericardium

- **Peritoneum** (peritoneal membrane) – surrounds all the organs w/in abdominopelvic cavity, outer layer called parietal peritoneum, and inner called visceral peritoneum
Other Body Cavities

- Oral and digestive – mouth and cavities of the digestive organs
- Nasal – located within and posterior to the nose
- Orbital – house the eyes
- Middle ear – contain bones (ossicles) that transmit sound vibrations
- Synovial – joint cavities
- Umbilical
- Epigastric
- Hypogastric
- Right and left iliac or inguinal
- Right and left lumbar
- Right and left hypochondriac
Abdominopelvic Regions

Liver
Gallbladder
Ascending colon of large intestine
Small intestine
Cecum
Appendix

Diaphragm
Stomach
Transverse colon of large intestine
Descending colon of large intestine
Initial part of sigmoid colon
Urinary bladder
Abdominopelvic Quadrants

- Right upper
- Left upper
- Right lower
- Left lower