ZOOL 2003 - Human Anatomy and Physiology I

- Course Instructor: Dr. Martin Huss
- Chapter 1: Introduction to Human Anatomy and Physiology.
Overview of Human Anatomy and Physiology

- **Anatomy** – the study of the *structure* of the body and the relationships of the various parts of the body
  - Gross or macroscopic (visible structures)
  - Microscopic (cytology, histology)
  - Developmental – structural changes over time (embryology)

- **Physiology** – the study of the *functions* of the parts of the body, includes specific organ systems and molecular and cellular levels (neurophysiology, cardiovascular physiology, electrophysiology)
Levels of Structural Organization

- Chemical – atoms combine to form molecules
- Cellular – molecules interact to make up cells
- Tissue – cells are grouped into tissue
- Organ – tissues compose organs
- Organ system – organs function together to form organ systems
- Organism (individual) – made up of the organ systems
Levels of Structural Organization

**FIGURE 1.3**
The human body is composed of parts within parts, which vary in complexity.
Basic Structures of the Human Body

- **Tissue** – A group of similar cells that performs a specific function
- **Organ** – A structure consisting of a group of tissues with a specialized function
- **Organ System** – Organs working together to allow the body to perform a function.
Organ Systems

- **Integumentary system**
  - Forms the external body covering
  - Composed of 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
Muscular system

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

- Integrates and coordinates body functions
- 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
Organ Systems of the Body

- **Endocrine System**
  - Integrates and coordinates body functions
  - Includes all glands that secrete chemical messengers, also called hormones
  - Hormones alter the metabolism of target cells
  - Examples of organs of the ES are the pituitary, thyroid, parathyroid, adrenal glands, pancreas, ovaries, testes, pineal gland, and thymus gland
Organ Systems of the Body

- **Cardiovascular system**
  - Composed of the heart and blood vessels
  - The heart pumps blood
  - The blood vessels transport blood 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
Organ Systems of the Body

- **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
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
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
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 I

- **Maintaining boundaries** – the internal environment remains distinct from the external
  - Cellular level – accomplished by plasma membranes
  - Organism 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 food
Necessary Life Functions II

- **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 (fertilization) make possible the formation of a new person
- **Growth** - increase in size of a body part or of the organism
Metabolism

**Metabolism**: A broad term used for all the chemical reactions that occur within cells of the body

- **Catabolism** - breaking down substances into simpler components
- **Anabolism** - synthesizing more complex substances or structures from simpler substances
Homeostasis

- Homeostasis is the ability of the body to maintain a relatively stable internal environment.
- The internal environment of the body is in a dynamic state of equilibrium (internal conditions vary, but within relatively narrow limits).
- A wide variety of chemical, thermal, and neural factors act and interact in complex ways to maintain homeostasis.
Homeostatic Control
Mechanisms

- Variable – the factor or event being regulated
- Receptor monitors the environment 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
In negative feedback systems, the output “turns down” or “shuts off” the original stimulus.

Example: Regulation of blood glucose levels.
In positive feedback systems, the output enhances or “turns up” the original stimulus.

Examples:
Regulation of blood clotting, Uterine contractions during labor.
Anatomical Position

Body erect, feet slightly apart, palms facing forward, thumbs point away from the body
Directional Terms

- **Superior (Cranial) and Inferior (Caudal)** – toward and away from the head or upper part of a structure - above and below-

- **Anterior (Ventral) and Posterior (Dorsal)** – toward the front and back of the body - in front of and behind-

- **Medial, Lateral, and Intermediate** – toward the midline, away from the midline, and between a more medial and lateral structure
## TABLE 1.1 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>

*Whereas the terms ventral and anterior are synonymous in humans, this is not the case in four-legged animals. Ventral specifically refers to the “belly” of a vertebrate animal and thus is the inferior surface of four-legged animals. Likewise, although the dorsal and posterior surfaces are the same in humans the term dorsal specifically refers to an animal’s back. Thus, the dorsal surface of four-legged animals is their superior surface.*
# Directional Terms

## TABLE 1.1: Orientation and Directional Terms

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<thead>
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<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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Directional Terms

- **Proximal and Distal** – closer to and farther from the origin of the body part or the point of attachment of a limb.
- **Superficial (External) and Deep (Internal)** – toward and away from the body surface.
# Directional Terms

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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>
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Regional Terms

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

- Cephalic (head)
  - Otic (ear)
  - Occipital (back of head or base of skull)
  - Acromial (point of shoulder)
  - Vertebral (spinal column)
  - Scapular (shoulder blade)
  - Brachial (arm)
  - Dorsum or dorsal (back)
  - Olecranal (back of elbow)
  - Lumbar (loin)
  - Sacral (between hips)

- Upper extremity

- Manus (hand)

- Lower extremity
  - Gluteal (buttock)
  - Perineal (region between the anus and external genitalia)
  - Femoral (thigh)
  - Popliteal (back of knee)
  - Sural (calf)
  - Calcaneal (heel)
  - Plantar (sole)

(b) Posterior
Body Planes

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

- Transverse Plane
- Frontal or Coronal Plane
- Sagittal 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
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
Body Cavities

- 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.
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
Serosa (serous membrane)- a thin membrane (mesothelium and irregular fibroelastic connective tissue) lining the closed cavities of the body; has two layers with a space between that is filled with serous fluid

Serum – a clear, watery fluid - the fluid portion of the blood obtained after removal of the fibrin clot and blood cells

Serous - relating to, containing, or producing serum - or a substance having a watery consistency
Ventral Body Cavity Membranes

- Parietal serosa covering the body walls
- Visceral serosa covering the internal organs
- Serous fluid separates the serosae
Nomenclature for Serous Membranes

Pleura - the thin serous membrane around the lungs and inner walls of the chest

Peritoneum – the serous membrane lining the abdominal cavity and covering most of the viscera

Endocardium - the membrane that lines the cavities of the heart and forms part of the heart valves

Pericardium - a double-layered serous membrane that surrounds the heart

Visceral Pericardium (epicardium) - the innermost of the two layers of the pericardium

Parietal Pericardium - the tough outermost layer of the pericardium that is attached to the diaphragm and the sternum
Ventral Body Cavity Membranes

Parietal Pleura - pleura lining the inner chest walls and covering the diaphragm

Visceral Pleura - pleura covering the lungs

Peritoneum – the serous membrane lining the abdominal cavity and covering most of the viscera
Abdominopelvic Regions

- Umbilical
- Epigastric
- Hypogastric
- Right and left iliac or inguinal
- Right and left lumbar
- Right and left hypochondriac
Abdominopelvic Quadrants

- Right upper
- Left upper
- Right lower
- Left lower
Aging starts at conception and persists until death of the human body.

1st signs of aging are noticeable in one’s thirties; including decline in fertility.

In 40’s & 50’s, adult-onset disorders may begin

Skin Changes due to loss of elastin, collagen, and subcutaneous fat.

Older people may metabolize certain drugs at different rates than younger people

Cells divide a limited number of times.

Oxygen free-radical damage produces certain pigments. Metabolism slow, and beta amyloid protein may build up in the brain => linked to Alzheimer disease in some.
Examples of Life Span Changes:
Bob Denver - Younger & Older
Examples of Life Span Changes: Russell Johnson – Younger & Older
Examples of Life Span Changes:
Katherine Hepburn – Younger & Older
Examples of Life Span Changes:
Bill Cosby – Younger & Older
Examples of Life Span Changes:
Lauren Bacall – Younger & Older
Examples of Life Span Changes:
Mickey Rooney – Younger & Older
Medical and Applied Sciences

- Cardiology – study of the heart and vascular system
- Dermatology – study of the skin
- Endocrinology - study of hormones, hormone-secreting glands, and associated diseases.
- Epidemiology – study of the factors that contribute to determining the distribution and frequency of health-related conditions.
Medical and Applied Sciences

- **Gastroenterology** – study of the stomach and intestines
- **Geriatrics** – Branch of medicine dealing with older individuals and their medical problems
- **Gynecology** – study of the female reproductive system
- **Hematology** – study of blood and blood diseases.
Medical and Applied Sciences

- Histology – study of the structure and function of tissues (microscopic anatomy)
- Immunology – study of the body’s resistance to disease
- Neonatology – study of newborns and the treatment of their disorders
- Nephrology – study of the structure and function of the kidneys
Medical and Applied Sciences

- **Neurology** – study of the brain and nervous system
- **Obstetrics** – branch of medicine dealing with pregnancy and childbirth
- **Oncology** – study of cancer
- **Ophthalmology** – study of the eye and eye disease
- **Otolaryngology** – study of the ear, throat, larynx, and their diseases
Medical and Applied Sciences

- **Pathology** – study of structural and functional changes within the body associated with disease
- **Pediatrics** – branch of medicine dealing with children and their diseases
- **Pharmacology** – study of drugs and their uses in the treatment of disease
- **Podiatry** – study of the care and treatment of the feet
Medical and Applied Sciences

- Psychiatry – branch of medicine dealing with the mind and its disorders
- Radiology – Study of X rays and radioactive substances
- Toxicology – study of poisonous substances and their effects on physiology
- Urology – branch of medicine dealing with the urinary and male reproductive systems and their diseases