An Introduction to Anatomy & Physiology

PowerPoint® Lecture Presentations prepared by Jason LaPres
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NOTE: Presentations extensively modified for use in MCB 244 & 246 at the University of Illinois by Drs. Kwast & Brown (2013-2014)
Chapter 1 Learning Objectives

- Describe the basic functions of organisms.
- Define anatomy & physiology and the various specialties of each.
- Identify and understand the major levels of organization of our bodies.
- Identify and describe the 11 organ systems of the body.
- Understand and be able to explain the concept of “homeostasis” and describe the roles of negative and positive feedback in regulating body functions.
- Identify the major body cavities using proper anatomical terms.
Anatomy & Physiology: The study of structure-function relationships in biology

- Anatomy
  - Describes the **structures** of the body including
    - What they are made of
    - Where they are located
    - Associated structures

- Physiology
  - Is the study of the function of biological systems including, of course, anatomical structures
    - It includes both individual and cooperative functions

- Anatomy & Physiology: forms the foundation for understanding the body’s parts and functions in concert.
Introduction – A Brief History of Anatomy

- Anatomy (anatome = to cut up): study of “cutting up” of the structural parts
- Oldest medical science; cadaver dissection (dis = apart; secare = to cut)

**Egypt:**
- Anatomical or Edwin Smith Surgical Papyrus (1600 BCE):
  - Contains 48 case histories of medical trauma and their treatment; describes closing wounds with sutures, preventing and curing infection with honey, stopping bleeding with raw meat as well as immobilizing the head and neck to prevent spinal cord injuries during transport.
  - Also contain the first known descriptions of the cranial sutures, meninges, external surface of the brain, cerebrospinal fluid, and intracranial pulsations. Also basic anatomy of major organs and blood vessels as well as use of plants for treating medical conditions.

**Greece:**
- Hippocrates (5th & 4th century BCE) – Greek physician/medical scientist
- Aristotle (4th century BCE) – text based in animal dissections: arteries, veins, organs and organ systems
- Herophilos & Erasistratus (4th century BCE) – extensive cadaver dissections
Greece Cont.: Herophilos & Erasistratus even performed \textit{vivisections} on criminals!

- Claudius Galenus (a.k.a. Galen of Pergamon (Turkey)--2\textsuperscript{nd} century BCE) – compiled previous knowledge and filled in gaps with animal (e.g., monkey & pig) dissections (“Ancient World’s Gray’s Anatomy” [1500 years]) – physician to Roman Emperors

- \textbf{Renaissance} (1500s)— Andreas Vesalius (“\textit{De humani corporis fabrica}” – \textit{On the workings of the human body}) – founder of modern human anatomy

- Gallows (Roman 14\textsuperscript{th} – 16\textsuperscript{th} BCE) & Graves (Michelangelo 17\textsuperscript{th} – 18\textsuperscript{th} century)

- Galileo charged admission for traveling cadaver dissections

- Anatomy Act of 1832 (UK) – finally provided for an adequate legal supply of cadavers for medicine (lead to Gray’s Anatomy) \[\textit{Murder Act of 1752 --stipulated that only the bodies of convicted murderers were allowed for legal dissection}\]

- \textit{What about recent advances? Are there any or has it all been done?} ...
Introduction – Modern Anatomical Projects

The Visible Human Project®

Overview

The Visible Human Project® is an outgrowth of the NLM's 1986 Long-Range Plan. It is the creation of complete, anatomically detailed, three-dimensional representations of the normal male and female human bodies. Acquisition of transverse CT, MR and cryosection images of representative male and female cadavers has been completed. The male was sectioned at one millimeter intervals, the female at one-third of a millimeter intervals.

The long-term goal of the Visible Human Project® is to produce a system of knowledge structures that will transparently link visual knowledge forms to symbolic knowledge formats such as the names of body parts.

Further Information

- General Information
  - A description of The Visible Human Project® image data and how to obtain it (includes license agreement documents).
  - The Visible Human Project® FactSheet.
  - A sampler of images and animations from the Project.
  - The Visible Human Project®: From Data to Knowledge: An update of ongoing National Library of Medicine VHP initiatives.
  - Digitally encoded videos – requires RealPlayer.

- NLM Initiatives
  - Cryosection, MRI and CT image data of the head of a 72 year old male. Cryosections done at 0.174mm intervals and photographed at a resolution of 1055 x 1528 pixels. Work done at Brigham and Women's Hospital, Harvard Medical School, under contract to NLM. Available only to VHP license holders. These images can be found in the directory BW/Univ when logged on to the NLM image server.
  - AnatQuest: a prototype system consisting of an anatomical image database and an online browser developed at the National Library of Medicine.
  - AnatQuest: the overall goal of the AnatQuest project is to explore and implement new visually compelling ways to bring anatomic images from the Visible Human dataset to the general public. Includes 3D renderings and labeled views.
  - Insight Toolkit (ITK): an open-source software toolkit for performing registration and segmentation, developed by six principal organizations under contract to the NLM, three commercial (Kitware, GE Corporate R&D, and Insightful), and three academic (UNC Chapel Hill, University of Utah, and University of Pennsylvania).
  - The Visible Human Project® ATLAS OF FUNCTIONAL HUMAN ANATOMY, VERSION 1.0 'The Head and Neck', developed under contract to the NLM by the University of Colorado Center for Human Simulation.

- Information from the contractors for the Project
  - University of Colorado Health Sciences Center (primary)
  - National Center for Atmospheric Research

- Proceedings from The Visible Human Project Conferences
  - The information presented here is identical to that distributed on CD-ROM to conference attendees. Please refer to section "Disc Info" or "About This CD-ROM", for pertinent information.
  - The Visible Human Project® Conference, 1996
  - The Second Visible Human Project® Conference, 1998
  - The Third Visible Human Project® Conference, 2000
Introduction – Human Anatomy *as Art?*

- Body Worlds™, Bodies™, etc. = traveling exhibitions of preserved human bodies prepared using a technique called plastination (German anatomist Gunther von Hagens - water and fat replaced by acetone then plastics [silicone rubber, polyester & epoxy resins] – up to 12 month process); have done animals as large as horses.

- Controversial: Who are these people and were they willing participants?

- Also debate over Texas inmate used in Visible Human Project

- Finally, there continue to be advances in paleopathology, showing evolution of the human form (not only from distant relatives but of modern humans—height)
Introduction – Human Physiology

- Physiology comes from Ancient Greek: *physis*, "nature, origin"; and -logia, "study of".

- Anatomy & Physiology together is the study of structure-function relationships in biological systems.

- Human Physiology is the study of the mechanical, physical, and biochemical functions of humans, their organs, and the cells of which they are composed.

- Physiology includes: Biochemistry, Biophysics, Cell Biology & Chemistry, Endocrinology, Genetics, Genomics, Immunology, Kinesiology, Neurobiology, Pathology, etc.
Introduction – Brief History of Human Physiology

- Human physiology dates back to the time of Hippocrates — father of modern medicine (5th century BCE)
- Claudius Galenus [a.k.a. Galen of Pergamon] (c. 126-199 A.D.) used experiments to probe body functions; the founder of experimental physiology.
- Middle Ages — the Muslim physician Avicenna (980-1037) introduced experimentation and quantification in *The Canon of Medicine*.
- Ibn al-Nafis (1213–1288) — first physician to correctly describe the anatomy of the heart, the coronary circulation, the structure of the lungs, and the pulmonary circulation
- Renaissance (1500s)— Andreas Vesalius (*De humani corporis fabrica*) — founder of modern human anatomy
- Herman Boerhaave (Leiden 1708) — father of clinical physiology — textbook *Institutiones medicae*
Introduction – Brief History of Human Physiology

• 19th century — Cell theory of Schleiden & Schwann, which “radically” stated that organisms are made up of units called **cells**.

• Claude Bernard's (1813–1878) concept of milieu interieur (internal environment), which would later be taken up and championed as "homeostasis" by American physiologist Walter Cannon (1871–1945)

• 20th century — comparative physiology and ecophysiology (Knut Schmidt-Nielsen and George Bartholomew). Most recently, evolutionary physiology has become a distinct subdiscipline.

• Recent advances are in the Systems Biology subdisciplines, such as physiological genomics (functional genomics)

• In addition, advances in cell physiology/ biology can be expected for decades (centuries?)

• Physiology IS at the center of systems biology and, indeed, personalized medicine.
1-4 Relationships between Anatomy & Physiology

• Anatomy
  • **Gross anatomy**, or macroscopic anatomy, examines large, visible structures
    • *Surface anatomy*: exterior features
    • *Regional anatomy*: body areas
    • *Systemic anatomy*: **organ systems**
    • *Developmental anatomy*: from conception to death
    • *Clinical anatomy*: medical specialties
1-4 Relationships between Anatomy & Physiology

- Anatomy
  - **Microscopic anatomy** examines cells and molecules
    - **Cytology**: study of **cells** and their structures
      - cyt- = cell
    - **Histology**: study
      - hist- = tissue
Physiology Subdisciplines

- **Cell physiology**: processes within and between cells
- **Organ physiology**: functions of specific organs
- **Systemic physiology**: functions of an organ system
- **Pathological physiology**: effects of diseases
1-5 Levels of Organization

- **Chemical (or Molecular)**
  - Chemical, Mechanical and Electrical events that occur within and between cells

- **Cellular**
  - The fundamental compartments of all known living organisms and the molecules and organelles within working together

- **Tissue**
  - Group of cells working together in a concerted manner

- **Organ**
  - A group of tissues working together to perform specific functions

- **Organ System**
  - An organ system is a group of organs working together
  - Humans have 11 organ systems

- **Organism**
  - A human is an organism
Figure 1-1 Levels of Organization

- Tissue Level: Cardiac muscle tissue
- Organ Level: The heart
- Organ system level: The cardiovascular system
- Organism level: Human body

Chemical and Molecular Levels:
- Atoms in combination
- Complex protein molecule
- Protein filaments
- Heart muscle cell
**1-5 Levels of Organization – Organ Systems (11)**

- **Integumentary (Chpt 5)**
  - **Major Organs**
    - Skin
    - Hair
    - Sweat glands
    - Nails
  - **Functions**
    - Protects against environmental hazards
    - Helps regulate body temperature
    - Provides sensory information

- **Skeletal (Chpts 6-9)**
  - **Major Organs**
    - Bones (>270)
    - Cartilages
    - Associated ligaments
    - Bone marrow
  - **Functions**
    - Provides support and protection for other tissues
    - Stores calcium and other minerals
    - Forms blood cells

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1-5 Levels of Organization – Organ Systems (11)

**Muscular (Chpts 10-11)**
- **Major Organs**
  - Skeletal muscles (>650) and associated tendons
- **Functions**
  - Provides movement
  - Provides protection and support for other tissues
  - Generates heat that maintains body temperature

**Nervous (Chpts 12-17)**
- **Major Organs**
  - Brain
  - Spinal cord
  - Peripheral nerves
  - Sense organs
- **Functions**
  - Directs immediate responses to stimuli
  - Coordinates or moderates activities of other organ systems
  - Provides and interprets sensory information about external conditions

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1-5 Levels of Organization – Organ Systems (11)

- **Endocrine (Chpt 18)**
  - **Major Organs**
    - Pituitary gland
    - Pancreas
    - Gonads
    - Adrenal glands
    - Endocrine tissues in other systems
  - **Functions**
    - Directs long-term changes in the activities of other organs
    - Adjusts metabolic activity and energy use by the body
    - Controls structural & functional changes during development

- **Cardiovascular (Chpts 19-21)**
  - **Major Organs**
    - Heart
    - Blood
    - Blood vessels
  - **Functions**
    - Distributes blood cells, water and dissolved materials including nutrients, waste products, oxygen, and carbon dioxide
    - Distributes heat and assists in control of body temperature
1-5 Levels of Organization – Organ Systems (11)

- **Lymphatic** *(Chpt 22)*
  - **Major Organs**
    - Spleen
    - Thymus
    - Lymphatic vessels
    - Lymph nodes
    - Tonsils
  - **Functions**
    - Defends against infection and disease
    - Returns tissue fluids to the bloodstream

- **Respiratory** *(Chpt 23)*
  - **Major Organs**
    - Nasal cavities
    - Sinuses
    - Bronchi
    - Larynx
    - Lungs
    - Trachea
    - Alveoli
  - **Functions**
    - Delivers air to alveoli
    - Provides oxygen to bloodstream
    - Removes carbon dioxide from bloodstream
    - Produces sounds for communication

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1-5 Levels of Organization – Organ Systems (11)

- **Digestive (Chpts 24-25)**
  - **Major Organs**
    - Teeth
    - Tongue
    - Pharynx
    - Esophagus
    - Stomach
    - Small intestine
    - Large intestine
    - Liver
    - Gallbladder
    - Pancreas
  - **Functions**
    - Processes and digests food
    - Absorbs and conserves water
    - Absorbs nutrients
    - Stores energy reserves

- **Urinary (Chpts 26-27)**
  - **Major Organs**
    - Kidneys
    - Ureters
    - Urinary bladder
    - Urethra
  - **Functions**
    - Excretes waste from the blood
    - Controls water balance by regulating volume of urine produced
    - Stores urine prior to voluntary elimination
    - Regulates blood ion concentrations and pH
1-5 Levels of Organization – Organ Systems (11)

- **Male & Female Reproduction (Chpts 28-29)**

  - **Major Organs**
    - Testes
    - Epididymides
    - Ductus deferentia
    - Seminal vesicles
    - Prostate gland
    - Penis and Scrotum
  
  - **Functions**
    - Produces male sex cells (sperm), suspending fluids, and hormones
    - Sexual intercourse

- **Major Organs**
  - Ovaries
  - Uterine tubes
  - Uterus
  - Mammary glands
  - Vagina
  - Labia
  - Clitoris

- **Functions**
  - Produces female sex cells (oocytes) and hormones
  - Supports developing embryo from conception to delivery
  - Provides milk to nourish newborn infant
  - Sexual intercourse
1-6 Homeostasis – Keeping our organ systems in balance

- **Homeostasis**: the ability of an organism to harness mechanisms for the preservation (maintenance) of an almost *constant internal state* in the face of perturbations

- *Homeostasis* first put forth by Claude Bernard and later championed by Walter Cannon
  - Systems respond to external and internal changes to function within a *normal range* (body temperature, fluid balance, etc.)
  - Both passive and active mechanisms involved
1-6 Homeostasis

• Mechanisms of Regulation

• Autoregulation (intrinsic)
  • Automatic response in a cell, tissue, or organ to some environmental change (e.g., cells release chemicals in response to decline in $O_2$ during exercise that increase blood vessel dilation and thus blood flow to active tissues)

• Extrinsic regulation
  • Simultaneous control of several systems by nervous or endocrine input (e.g., nervous system control of heart rate and central and peripheral blood flow to active tissues in low $O_2$)
In response to input from a receptor (a thermometer), a thermostat (the control center) triggers an effector response (either an air conditioner or a heater) that restores normal temperature. In this case, when room temperature rises above the set point, the thermostat turns on the air conditioner, and the temperature returns to normal.
Events in the regulation of body temperature, which are comparable to those shown in Figure 1-2. A control center in the brain (the hypothalamus) functions as a thermostat with a set point of 37°C. If body temperature exceeds 37.2°C, heat loss is increased through enhanced blood flow to the skin and increased sweating.
1-7 Negative and Positive Feedback

• The Role of Negative Feedback
  • The response of the effector negates the stimulus or disturbance (i.e., inverts the signal)
  • Body is brought back into homeostasis
    • Normal range is achieved

• The Role of Positive Feedback
  • The response of the effector increases and amplifies the stimulus or disturbance (i.e., in the same direction as the original signal)
  • Body is moved away from current “set point”
    • Normal range is lost
  • Used to speed up certain processes (e.g., blood clotting, child birth)
Figure 1-4  Positive Feedback: Blood Clotting

Damage to cells in the blood vessel wall releases chemicals that begin the process of blood clotting.

The chemicals start chain reactions in which cells, cell fragments, and soluble proteins in the blood begin to form a clot.

As clotting continues, each step releases chemicals that further accelerate the process.

This escalating process is a positive feedback loop that ends with the formation of a blood clot, which patches the vessel wall and stops the bleeding.

Clotting accelerates

Positive feedback loop
1-7 Negative and Positive Feedback

- Systems Integration
  - Systems work together to maintain homeostasis

- Homeostasis is a state of equilibrium
  - Opposing forces are in balance
  - Dynamic equilibrium — continual adaptation

- Physiological systems work to restore balance
  - Failure results in disease or death
Table 1-1  The Roles of Organ Systems in Homeostatic Regulation

<table>
<thead>
<tr>
<th>Internal Stimulus</th>
<th>Primary Organ Systems Involved</th>
<th>Functions of the Organ Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body temperature</strong></td>
<td>Integumentary system</td>
<td>Heat loss</td>
</tr>
<tr>
<td></td>
<td>Muscular system</td>
<td>Heat production</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular system</td>
<td>Heat distribution</td>
</tr>
<tr>
<td></td>
<td>Nervous system</td>
<td>Coordination of blood flow, heat production, and heat loss</td>
</tr>
<tr>
<td><strong>Body fluid composition</strong></td>
<td><strong>Nutrient concentration</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Digestive system</td>
<td>Nutrient absorption, storage, and release</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular system</td>
<td>Nutrient distribution</td>
</tr>
<tr>
<td></td>
<td>Urinary system</td>
<td>Control of nutrient loss in the urine</td>
</tr>
<tr>
<td></td>
<td>Skeletal system</td>
<td>Mineral storage and release</td>
</tr>
<tr>
<td></td>
<td>Respiratory system</td>
<td>Absorption of oxygen, elimination of carbon dioxide</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular system</td>
<td>Internal transport of oxygen and carbon dioxide</td>
</tr>
<tr>
<td></td>
<td>Lymphatic system</td>
<td>Removal, destruction, or inactivation of toxins and pathogens</td>
</tr>
<tr>
<td><strong>Body fluid volume</strong></td>
<td>Urinary system</td>
<td>Elimination or conservation of water from the blood</td>
</tr>
<tr>
<td></td>
<td>Digestive system</td>
<td>Absorption of water; loss of water in feces</td>
</tr>
<tr>
<td></td>
<td>Integumentary system</td>
<td>Loss of water through perspiration</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular system and lymphatic system</td>
<td>Distribution of water throughout body tissues</td>
</tr>
<tr>
<td><strong>Waste product concentration</strong></td>
<td>Urinary system</td>
<td>Elimination of waste products from the blood</td>
</tr>
<tr>
<td></td>
<td>Digestive system</td>
<td>Elimination of waste products by the liver in feces</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular system</td>
<td>Transport of waste products to sites of excretion</td>
</tr>
<tr>
<td><strong>Blood pressure</strong></td>
<td>Cardiovascular system</td>
<td>Pressure generated by the heart moves blood through blood vessels</td>
</tr>
<tr>
<td></td>
<td>Nervous system and endocrine system</td>
<td>Adjustments in heart rate and blood vessel diameter can raise or lower blood pressure</td>
</tr>
</tbody>
</table>

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1-8 Anatomical Terminology

• Although we will often examine the integration of various organ systems in the maintenance of whole-body homeostasis, it is easier for introductory students to learn the anatomy and physiology of each organ system one at a time (Chapters 5 – 29).

• Thus, your text book begins with some basic anatomical terminology in Chapter 1 that we will now examine as it will be used throughout the two semesters.
1-8 Anatomical Terminology

- **Anatomical position**: hands and arms extended at sides, palms forward, legs straight, feet together

  **Supine**: lying down, face up

  **Prone**: lying down, face down

- **Superficial Anatomy** – structures on or near the body surface

- **Anatomical Landmarks**
  - References to palpable (those that can be felt or touched) structures

- **Anatomical Regions**
  - 4 Abdominopelvic quadrants – often used by clinicians
  - 9 Abdominopelvic regions – often used by anatomists

- **Anatomical Directions**
  - Reference terms based on subject
Figure 1-5a: Anatomical Landmarks

- Cephalic or head
- Frontal or forehead
- Cranial or skull
- Facial or face
- Oral or mouth
- Mental or chin
- Axillary or armpit
- Brachial or arm
- Antecubital or front of elbow
- Nasal or nose
- Ocular, orbital or eye
- Otic or ear
- Buccal or cheek
- Cervical or neck
- Thoracic or thorax, chest
- Mammary or breast
- Abdominal (abdomen)
- Umbilical or navel

Anterior view
Figure 1-5a  Anatomical Landmarks

- Antebrachial or forearm
- Carpal or wrist
- Palmar or palm
- Pollex or thumb
- Digits (phalanges) or fingers (digital or phalangeal)
- Patellar or kneecap
- Crural or leg
- Tarsal or ankle
- Digits (phalanges) or toes (digital or phalangeal)
- Hallux or great toe

- Pelvic (pelvis)
- Manual or hand
- Inguinal or groin
- Pubic (pubis)
- Femoral or thigh
- Pedal or foot

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Figure 1-5b  Anatomical Landmarks

Acromial or shoulder
Dorsal or back
Olecranal or back of elbow

Cephalic or head
Cervical or neck
Upper limb

b Posterior view
Figure 1-5b  Anatomical Landmarks

Lumbar or loin

Gluteal or buttock

Popliteal or back of knee

Sural or calf

Calcaneal or heel of foot

Plantar or sole of foot

Upper limb

Lower limb

Posterior view
Abdominopelvic quadrants. The four abdominopelvic quadrants are formed by two perpendicular lines that intersect at the navel. The terms for these quadrants, or their abbreviations, are most often used in clinical discussions.
Abdominopelvic regions. The nine abdominopelvic regions provide more precise regional descriptions.
Anatomical relationships. The relationship between the abdominopelvic quadrants and regions and the locations of the internal organs are shown here.
A lateral view. Arrows indicate important directional terms used in this text; definitions and descriptions are given in Table 1-2.
<table>
<thead>
<tr>
<th>Term</th>
<th>Region or Reference</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>The front surface</td>
<td>The navel is on the anterior surface of the trunk.</td>
</tr>
<tr>
<td>Ventral</td>
<td>The belly side (equivalent to anterior when referring to human body)</td>
<td>The navel is on the ventral surface of the trunk.</td>
</tr>
<tr>
<td>Posterior or dorsal</td>
<td>The back surface</td>
<td>The shoulder blade is located posterior to the rib cage.</td>
</tr>
<tr>
<td>Cranial or cephalic</td>
<td>The head</td>
<td>The cranial, or cephalic, border of the pelvis is on the side toward the head rather than toward the thigh.</td>
</tr>
<tr>
<td>Superior</td>
<td>Above; at a higher level (in the human body, toward the head)</td>
<td>In humans, the cranial border of the pelvis is superior to the thigh.</td>
</tr>
<tr>
<td>Caudal</td>
<td>The tail (coccyx in humans)</td>
<td>The hips are caudal to the waist.</td>
</tr>
<tr>
<td>Inferior</td>
<td>Below; at a lower level</td>
<td>The knees are inferior to the hips.</td>
</tr>
<tr>
<td>Medial</td>
<td>Toward the body’s longitudinal axis; toward the midsagittal plane</td>
<td>The medial surfaces of the thighs may be in contact; moving medially from the arm across the chest surface brings you to the sternum.</td>
</tr>
<tr>
<td>Lateral</td>
<td>Away from the body’s longitudinal axis; away from the midsagittal plane</td>
<td>The thigh articulates with the lateral surface of the pelvis; moving laterally from the nose brings you to the cheeks.</td>
</tr>
<tr>
<td>Proximal</td>
<td>Toward an attached base</td>
<td>The thigh is proximal to the foot; moving proximally from the wrist brings you to the elbow.</td>
</tr>
<tr>
<td>Distal</td>
<td>Away from an attached base</td>
<td>The fingers are distal to the wrist; moving distally from the elbow brings you to the wrist.</td>
</tr>
<tr>
<td>Superficial</td>
<td>At, near, or relatively close to the body surface</td>
<td>The skin is superficial to underlying structures.</td>
</tr>
<tr>
<td>Deep</td>
<td>Farther from the body surface</td>
<td>The bone of the thigh is deep to the surrounding skeletal muscles.</td>
</tr>
</tbody>
</table>
Figure 1-8  Sectional Planes

- **Plane**: a three-dimensional axis
- **Section**: a slice parallel to a plane
- Important in radiological techniques (e.g., MRI, PET, CT)
### Table 1-3 Terms That Indicate Sectional Planes

<table>
<thead>
<tr>
<th>Plane</th>
<th>Orientation of Plane</th>
<th>Directional Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse or horizontal</td>
<td>Perpendicular to long axis</td>
<td>Transversely or horizontally</td>
<td>A transverse, or horizontal, section separates superior and inferior portions of the body. A cut in this plane is called a cross section.</td>
</tr>
<tr>
<td>Sagittal</td>
<td>Parallel to long axis</td>
<td>Sagittally</td>
<td>A sagittal section separates right and left portions. You examine a sagittal section, but you section sagittally.</td>
</tr>
<tr>
<td>Midsagittal</td>
<td></td>
<td></td>
<td>In a midsagittal section or median section, the plane passes through the midline, dividing the body into right and left sides.</td>
</tr>
<tr>
<td>Parasagittal</td>
<td></td>
<td></td>
<td>A parasagittal section, which is a cut parallel to the midsagittal plane, separates the body into right and left portions of unequal size.</td>
</tr>
<tr>
<td>Frontal or coronal</td>
<td></td>
<td>Frontally or coronally</td>
<td>A frontal, or coronal, section separates anterior and posterior portions of the body; coronal usually refers to sections passing through the skull.</td>
</tr>
</tbody>
</table>
1-9 Body Cavities

• Essential Functions of Body Cavities
  1. Protect organs from accidental shocks
  2. Permit changes in size and shape of internal organs

• Ventral body cavity (coelom)
  • Divided by the diaphragm
    • Thoracic cavity
    • Abdominopelvic cavity
Figure 1-9 Relationships among the Subdivisions of the Ventral Body Cavity

Ventral Body Cavity
- Provides protection
- Allows organ movement
- Linings prevent friction

Subdivides during development into

Thoracic Cavity
- Surrounded by chest wall and diaphragm
  - Right Pleural Cavity
    - Surrounds right lung
  - Mediastinum
    - Contains the trachea, esophagus, and major vessels
    - Pericardial Cavity
      - Surrounds heart
  - Left Pleural Cavity
    - Surrounds left lung

Abdominopelvic Cavity
- Peritoneal Cavity
  - Extends throughout abdominal cavity and into superior portion of pelvic cavity
- Abdominal Cavity
  - Contains many digestive glands and organs
- Pelvic Cavity
  - Contains urinary bladder, reproductive organs, last portion of digestive tract

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1-9 Body Cavities

- **Serous Membranes**
  - Line body cavities and cover organs
  - Consist of *parietal layer* and *visceral layer*
    - Parietal layer — lines cavity
    - Visceral layer — covers organs
      - For example within the Abdominopelvic Cavity:
        - Peritoneal cavity — chamber within abdominopelvic cavity
        - *Parietal peritoneum* lines the internal body wall
        - *Visceral peritoneum* covers the organs
Figure 1-10a The Ventral Body Cavity and Its Subdivisions

- **POSTERIOR**
  - Pleural cavity
  - Pericardial cavity
  - Peritoneal cavity
  - Abdominal cavity
  - Pelvic cavity
  - Abdominopelvic cavity

- **ANTERIOR**
  - Thoracic cavity
  - Heart
  - Visceral pericardium
  - Pericardial cavity
  - Parietal pericardium

- **Air space**
  - Balloon

- **(Top Right)**
  - Right lung
  - Left lung

- **(Bottom Right)**
  - Mediastinum
  - Spinal cord

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1-9 Body Cavities – Abdominopelvic Cavity

- **Abdominal cavity** — superior portion
  - Diaphragm to top of pelvic bones
  - Contains digestive organs
  - *Retroperitoneal* space
    - Area posterior to *peritoneum* and anterior to muscular body wall
    - Contains pancreas, kidneys, ureters, and parts of the digestive tract

- **Pelvic cavity** — inferior portion
  - Within pelvic bones
  - Contains reproductive organs, rectum and bladder

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Chapter 1 Objective Summary Review

• Be able to name the various specialties of anatomy and physiology.

• Be able to name the major levels of organization in organisms, from molecular to organisms.

• Be familiar with the 11 organ systems of the body and their major components. (MURDERS LINC)

• Be able to explain the concept of homeostasis, including both positive and negative feedback.

• Be able to identify the major body cavities using proper anatomical terms.