Introduction

- Anatomy and physiology affect your life everyday
  - Anatomy is the oldest medical science
    - 1600 B.C.
  - Physiology is the study of function
    - Biochemistry
    - Biology
    - Chemistry
    - Genetics
Introduction

- Study strategies crucial for success
  - Attend all lectures, labs, and study sessions
  - Read your lecture and laboratory assignments before going to class or lab
  - Devote a block of time each day to your A&P course
  - Set up a study schedule and stick to it
  - Do not procrastinate!
  - Approach the information in different ways
  - Develop the skill of memorization, and practice it regularly
  - As soon as you experience difficulty with the course, seek assistance
Introduction

- Important features of the textbook
  - Learning Outcomes
  - Illustrations and Photos
  - Pronunciation Guides
  - Checkpoint Questions
  - The A&P Top 100
  - Tips & Tricks
  - Clinical Notes
  - Chain Link Icons
  - End-of-Chapter Study and Review Materials
  - Systems Overview Section
  - System in Perspective Summaries
  - Colored Tabs
  - End-of-Book Reference Sections
Introduction

- Supplements
  - The InterActive Physiology® (IP) CD
  - MyA&P™
  - Martini’s Atlas of the Human Body
  - Get Ready for A&P!
  - A&P Applications Manual
  - Study Guide
- Full descriptions in preface of textbook
Structure and Function

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

- **Physiology**
  - Is the study of
    - Functions of anatomical structures
    - Individual and cooperative functions
Anatomy and Physiology Integrated

- Anatomy
  - **Gross anatomy**, or macroscopic anatomy, examines large, visible structures
    - *Surface anatomy*: exterior features
    - *Regional anatomy*: body areas
    - *Systemic anatomy*: groups of organs working together
    - *Developmental anatomy*: from conception to death
    - *Clinical anatomy*: medical specialties
Anatomy and Physiology Integrated

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

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

- The Chemical (or Molecular) Level
  - Atoms are the smallest chemical units
  - Molecules are a group of atoms working together

- The Cellular Level
  - Cells are a group of atoms, molecules, and organelles working together

- The Tissue Level
  - Tissues are a group of similar cells working together

- The Organ Level
  - An organ is a group of different tissues working together
Levels of Organization

- **The Organ System Level**
  - Organ systems are a group of organs working together
  - Humans have 11 organ systems

- **The Organism Level**
  - A human is an organism
Levels of Organization

FIGURE 1–1 Levels of Organization.
Levels of Organization

THE INTEGUMENTARY SYSTEM

Major Organs:
- Skin
- Hair
- Sweat glands
- Nails

Functions:
- Protects against environmental hazards
- Helps regulate body temperature
- Provides sensory information
Levels of Organization

THE SKELETAL SYSTEM

Major Organs:
- Bones
- Cartilages
- Associated ligaments
- Bone marrow

Functions:
- Provides support and protection for other tissues
- Stores calcium and other minerals
- Forms blood cells
Levels of Organization

THE MUSCULAR SYSTEM

Major Organs:
- Skeletal muscles and associated tendons

Functions:
- Provides movement
- Provides protection and support for other tissues
- Generates heat that maintains body temperature
Levels of Organization

THE NERVOUS SYSTEM

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
Levels of Organization

THE ENDOCRINE SYSTEM

Major Organs:
- Pituitary gland
- Thyroid gland
- Pancreas
- Suprarenal glands
- Gonads (testes and ovaries)
- Endocrine tissues in other systems

Functions:
- Directs long-term changes in the activities of other organ systems
- Adjusts metabolic activity and energy use by the body
- Controls many structural and functional changes during development
Levels of Organization

THE CARDIOVASCULAR SYSTEM

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
Levels of Organization

THE LYMPHOID SYSTEM

Major Organs:
- Spleen
- Thymus
- Lymphatic vessels
- Lymph nodes
- Tonsils

Functions:
- Defends against infection and disease
- Returns tissue fluids to the bloodstream
Levels of Organization

THE RESPIRATORY SYSTEM

Major Organs:
- Nasal cavities
- Sinuses
- Larynx
- Trachea
- Bronchi
- Lungs
- Alveoli

Functions:
- Delivers air to alveoli (sites in lungs where gas exchange occurs)
- Provides oxygen to bloodstream
- Removes carbon dioxide from bloodstream
- Produces sounds for communication
Levels of Organization

THE DIGESTIVE SYSTEM

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 (ions, water, and the breakdown products of dietary sugars, proteins, and fats)
- Stores energy reserves
Levels of Organization

THE URINARY SYSTEM

Major Organs:
- Kidneys
- Ureters
- Urinary bladder
- Urethra

Functions:
- Excretes waste products from the blood
- Controls water balance by regulating volume of urine produced
- Stores urine prior to voluntary elimination
- Regulates blood ion concentrations and pH
Levels of Organization

THE MALE REPRODUCTIVE SYSTEM

Major Organs:
- Testes
- Epididymides
- Ductus deferens
- Seminal vesicles
- Prostate gland
- Penis
- Scrotum

Functions:
- Produces male sex cells (sperm), suspending fluids, and hormones
- Sexual intercourse
Levels of Organization

THE FEMALE REPRODUCTIVE SYSTEM

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

Functions:
- Produces female sex cells (oocytes) and hormones
- Supports developing embryo from conception to delivery
- Provides milk to nourish newborn infant
- Sexual intercourse
Homeostasis:

- **Homeostasis**: all body systems working together to maintain a stable internal environment
  - Systems respond to external and internal changes to function within a **normal range** (body temperature, fluid balance)
Mechanisms of Regulation

- Autoregulation (intrinsic)
  - Automatic response in a cell, tissue, or organ to some environmental change

- Extrinsic regulation
  - Responses controlled by nervous and endocrine systems
Homeostasis

- **Receptor**
  - Receives the stimulus
- **Control center**
  - Processes the signal and sends instructions
- **Effector**
  - Carries out instructions
Homeostasis

FIGURE 1–3 The Control of Room Temperature.
Negative and Positive Feedback

- The Role of Negative Feedback
  - The response of the effector negates the stimulus
  - Body is brought back into homeostasis
    - Normal range is achieved
Negative and Positive Feedback

Figure 1–4 Negative Feedback in the Control of Body Temperature.
Negative and Positive Feedback

- The Role of Positive Feedback
  - The response of the *effector* increases change of the *stimulus*
  - Body is moved away from homeostasis
    - *Normal range* is lost
  - Used to speed up processes
FIGURE 1–5 Positive Feedback: Blood Clotting.
Systems Integration

- Systems integration
  - Systems work together to maintain homeostasis
- Homeostasis is a state of equilibrium
  - Opposing forces are in balance
- Physiological systems work to restore balance
  - Failure results in disease or death
# Systems Integration

## TABLE 1-1  The Roles of Organ Systems in Homeostatic Regulation

<table>
<thead>
<tr>
<th>Internal Characteristic</th>
<th>Primary Organ Systems Involved</th>
<th>Functions of the Organ Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body temperature</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>Body fluid composition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrient concentration</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>Oxygen, carbon dioxide levels</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>Body fluid volume</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</td>
<td>Distribution of water</td>
</tr>
<tr>
<td>Waste product concentration</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>Blood pressure</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>
Anatomical Terminology

- **Superficial Anatomy**
  
  - **Anatomical position**: hands at sides, palms forward
  
  - **Supine**: lying down, face up
  
  - **Prone**: lying down, face down
Anatomical Terminology

- Superficial Anatomy
  - Anatomical Landmarks
    - References to palpable structures
  - Anatomical Regions
    - Body regions
    - Abdominopelvic quadrants
    - Abdominopelvic regions
- Anatomical Directions
  - Reference terms based on subject
Anatomical Terminology

FIGURE 1–6 Anatomical Landmarks. Anterior
FIGURE 1–6 Anatomical Landmarks. Anterior

- Antebrachium or forearm (antebrachial)
- Carpus or wrist (carpal)
- Palma or palm (palmar)
- Pollex or thumb
- Digits or phalanges or fingers (digital or phalangeal)
- Patella or kneecap (patellar)
- Crus or leg (crural)
- Tarsus or ankle (tarsal)
- Digits or phalanges or toes (digital or phalangeal)
- Hallux or great toe
- Pelvis (pelvic)
- Manus or hand (manual)
- Inguen or groin (inguinal)
- Pubis (pubic)
- Femur or thigh (femoral)
- Pes or foot (pedal)
Anatomical Terminology

FIGURE 1–6 Anatomical Landmarks. Posterior

- Cephalon or head (cephalic)
- Cervicis or neck (cervical)
- Upper limb
- Acromion (acromial)
- Dorsum or back (dorsal)
- Olecranon or back of elbow (olecranal)
FIGURE 1–6 Anatomical Landmarks. Posterior
## TABLE 1–2  Regions of the Human Body (see Figure 1–6)

<table>
<thead>
<tr>
<th>Structure</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cephalon (head)</td>
<td>Cephalic region</td>
</tr>
<tr>
<td>Cervicis (neck)</td>
<td>Cervical region</td>
</tr>
<tr>
<td>Thoracis (thorax or chest)</td>
<td>Thoracic region</td>
</tr>
<tr>
<td>Brachium (arm)</td>
<td>Brachial region</td>
</tr>
<tr>
<td>Antebrachium (forearm)</td>
<td>Antebrachial region</td>
</tr>
<tr>
<td>Carpus (wrist)</td>
<td>Carpal region</td>
</tr>
<tr>
<td>Manus (hand)</td>
<td>Manual region</td>
</tr>
<tr>
<td>Abdomen</td>
<td>Abdominal region</td>
</tr>
<tr>
<td>Lumbus (loin)</td>
<td>Lumbar region</td>
</tr>
</tbody>
</table>
# Anatomical Terminology

## TABLE 1–2 Regions of the Human Body (see Figure 1–6)

<table>
<thead>
<tr>
<th>Structure</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gluteus (buttock)</td>
<td>Gluteal region</td>
</tr>
<tr>
<td>Pelvis</td>
<td>Pelvic region</td>
</tr>
<tr>
<td>Pubis (anterior pelvis)</td>
<td>Pubic region</td>
</tr>
<tr>
<td>Inguen (groin)</td>
<td>Inguinal region</td>
</tr>
<tr>
<td>Femur (thigh)</td>
<td>Femoral region</td>
</tr>
<tr>
<td>Crus (anterior leg)</td>
<td>Crural region</td>
</tr>
<tr>
<td>Sura (calf)</td>
<td>Sural region</td>
</tr>
<tr>
<td>Tarsus (ankle)</td>
<td>Tarsal region</td>
</tr>
<tr>
<td>Pes (foot)</td>
<td>Pedal region</td>
</tr>
<tr>
<td>Planta (sole)</td>
<td>Plantar region</td>
</tr>
</tbody>
</table>
FIGURE 1–7 Abdominopelvic Quadrants.
Anatomical Terminology

FIGURE 1–7 Abdominopelvic Regions.
FIGURE 1–7 Abdominopelvic Relationships.
Anatomical Terminology

FIGURE 1–8 Directional References. A Lateral View.
FIGURE 1-8 Directional References. An Anterior View.
## Table 1–3: Directional Terms (see Figure 1–8)

<table>
<thead>
<tr>
<th>Term</th>
<th>Region or Reference</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>The front; before</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; behind</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 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>
Anatomical Terminology

- **Sectional Anatomy**
  - **Planes and sections**
    - **Plane**: a three-dimensional axis
    - **Section**: a slice parallel to a plane
    - Used to visualize internal organization and structure
    - Important in radiological techniques
      - MRI
      - PET
      - CT
FIGURE 1–9 Sectional Planes.
### TABLE 1-4  Terms That Indicate Sectional Planes (see Figure 1-9)

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

- Body cavities have two essential functions
  - Protect organs from accidental shocks
  - Permit changes in size and shape of internal organs

- Ventral body cavity (*coelom*)
  - Divided by the **diaphragm**:
    - Thoracic cavity
    - Abdominopelvic cavity
FIGURE 1–10 Relationships Among the Subdivisions of the Ventral Body Cavity.
Body Cavities

- Serous membranes
  - Line body cavities and cover organs
  - Consist of *parietal layer* and *visceral layer*
    - Parietal layer — lines cavity
    - Visceral layer — covers organ
Body Cavities

- **The Thoracic Cavity**
  - Separated into regions
    - Right and left *pleural* cavities
      - contain right and left lungs
  - **Mediastinum**
    - upper portion filled with blood vessels, trachea, esophagus, and thymus
    - lower portion contains *pericardial cavity*
      » the *heart* is located within the pericardial cavity
Body Cavities

FIGURE 1–11 The Ventral Body Cavity and Its Subdivisions.
FIGURE 1–11 The Ventral Body Cavity and Its Subdivisions.
Body Cavities

FIGURE 1–11 The Ventral Body Cavity and Its Subdivisions.
Body Cavities

- The Abdominopelvic Cavity
  - Peritoneal cavity — chamber within abdominopelvic cavity
    - *Parietal peritoneum* lines the internal body wall
    - *Visceral peritoneum* covers the organs
Body Cavities

- The 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
Body Cavities

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