Introduction to Human Anatomy and Physiology

Chapter One

SAP 1

- **Students will analyze anatomical structures in relationship to their physiological functions.**
  - a. Apply correct terminology when explaining the orientation of body parts and regions.
  - b. Investigate the interdependence of the various body systems to each other and to the body as a whole.
  - c. Explain the role of homeostasis and its mechanisms as these relate to the body as a whole and predict the consequences of the failure to maintain homeostasis.

Learning Targets

- Understand anatomy and physiology and their relationship with one another
- Know the structural levels of organization
- Know the 8 functions of life
- Know the survival needs
- Be able to compare and contrast the 11 body systems
- Understand the concept of homeostasis and its importance
- Know the anatomical position and directional terms

Overview of Anatomy & Physiology

- Anatomy – the study of the structure of body parts
  - Gross or macroscopic (structures we can see)
  - Microscopic (structures we cannot see)
    - Cystology- study of cells
    - Histology- study of tissues
  - Developmental (structural changes over time)
- Physiology – the study of the function of the body parts

Gross Anatomy

- Regional – all structures in one part of the body (such as the abdomen or leg)
- Systemic – gross anatomy of the body studied by system
- Surface – study of internal structures as they relate to the overlying skin

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

Physiology

- Understanding physiology also requires a knowledge of physics, which explains electrical currents, blood pressure, and the way muscle uses bone for movement

Principle of Complementarity

- Structure determines what functions can take place.
  - Ex) The heart is a muscular chamber and is able to pump the blood
  - The lungs cannot pump blood because the walls of its air sacs are very thin
- But the exchange of gases and the bodies oxygen supply occur in the lungs

Levels of Structural Organization

- Chemical – atoms combined to form molecules
- Cellular – cells are made of molecules
- Tissue – consists of similar types of cells
- Organ – made up of different types of tissues
- Organ system – consists of different organs that work closely together
- Organismal – made up of the organ systems

Levels of Structural Organization

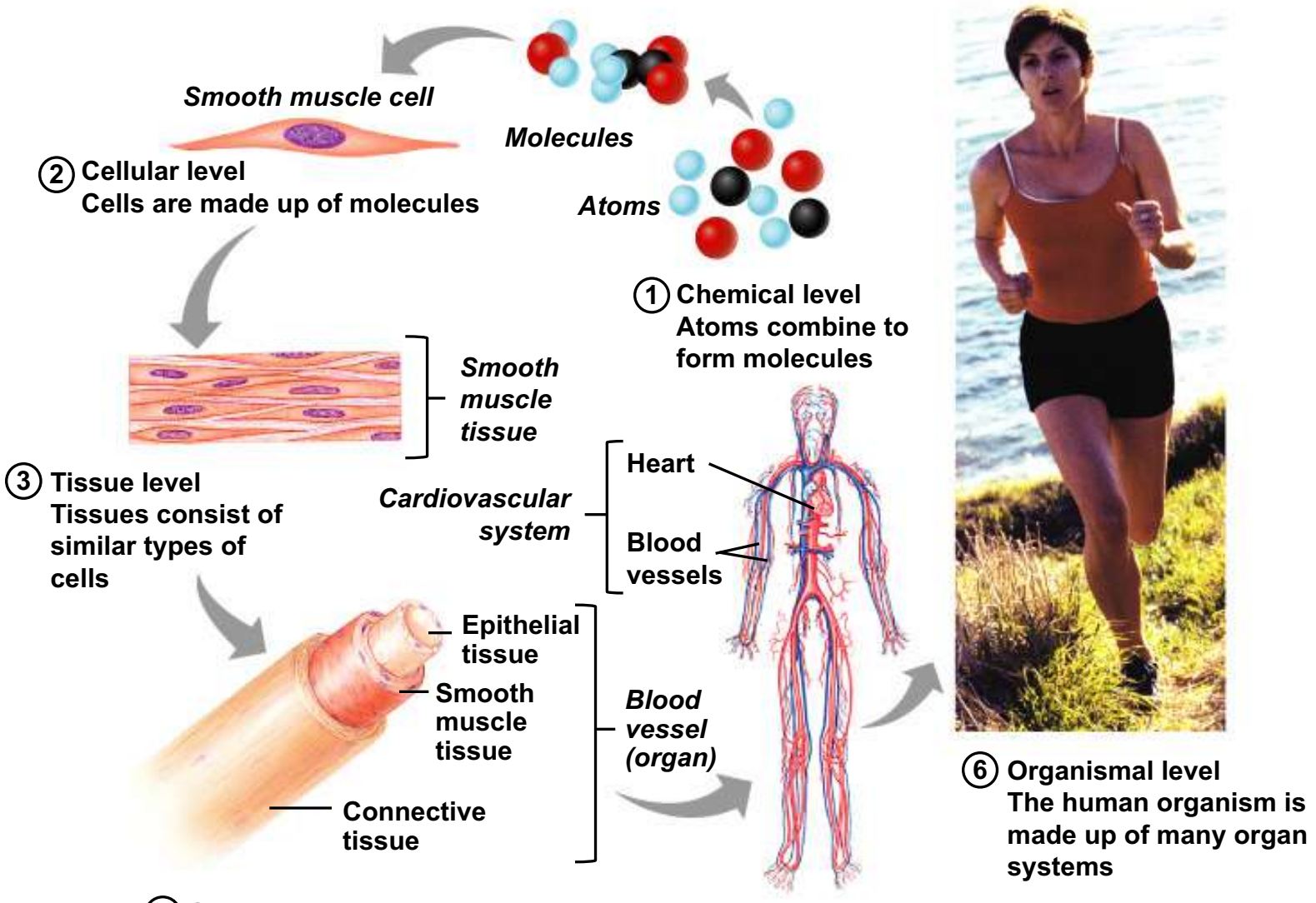


Figure 1.1

Organ Systems of the Body

- 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 [*with the joints they make up*]
  - Protects and supports body organs
  - Provides the framework for muscles
  - Site of blood cell formation (hematopoiesis)
  - 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
  - Have only one function
    - Contract or shorten

Organ Systems of the Body

- 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

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
  - White blood cells and chemicals in the blood protect the body from foreign substances: Bacteria, Toxins, Tumor Cells

Organ Systems of the Body

- Lymphatic system
  - Composed of red bone marrow, thymus, spleen, lymph nodes, tonsils, 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
  - Allows gas exchange between lungs and blood.

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 food 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

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

Necessary Life Functions

- Maintaining Boundaries
- Movement
- Responsiveness
- Digestion
- Metabolism
- Excretion
- Reproduction
- Growth

Maintaining Boundaries

- Must keep the “inside” and “outside” separate
- Membrane
  - Allows needed substances in while preventing harmful substances entry
  - Contains internal contents
  - Integumentary system
    - Prevents internal organs from drying out, bacteria, damaging heat, sunlight, and chemicals.

Movement

- Done by the muscular system
  - Walking, swimming, etc.
- Skeletal system provides the framework for the muscular system.
- Movement occurs when blood, food materials, and urine are propelled through the organs of the cardiovascular, digestive, and urinary system.

Responsiveness (Irritability)

- Ability to sense changes in the environment and react to them.
- Ex.) Carbon dioxide levels rise in your blood, breathing rate increases to blow off excess carbon dioxide.
- Nervous system bears majority of the responsibility for responsiveness.
- Body cells are irritable to some extent.

Digestion

- Break down ingested food so it can be absorbed into the blood
- Nutrient rich blood is distributed to the body cells by the cardiovascular system

Metabolism

- All chemical reactions that occur within the body cells
- Breaking down complex substances into simpler building blocks (Catabolism)
- Making larger structures from smaller ones (Anabolism)
- Nutrients and oxygen to produce molecules of ATP (ATP powers cellular activity)
  - Cellular Respiration
- Regulated by the endocrine system

Excretion

- Process of removing waste from the body
- Digestive system rids the body of indigestible food residues in feces
- Urinary system disposes of nitrogenous waste in urine

Reproduction

- Production of offspring
- Cellular reproduction (mitosis) produces 2 identical daughter cells for body growth or repair
- Organismal reproduction=sexual reproduction
- Organs produce sperm and egg
- Regulated by the endocrine system

Growth

- Increase in size accompanied by an increase in cell number
  - For growth to occur:
    - Cell-constructing activities must occur at a faster rate than cell-destroying activities

Survival Needs

- Nutrients (Food)
- Oxygen (20% air we breath O_2)
- Water (60-80% of body weight)
- Temperature (37°C or 98.6°F)
- Atmospheric Pressure- For gas exchange

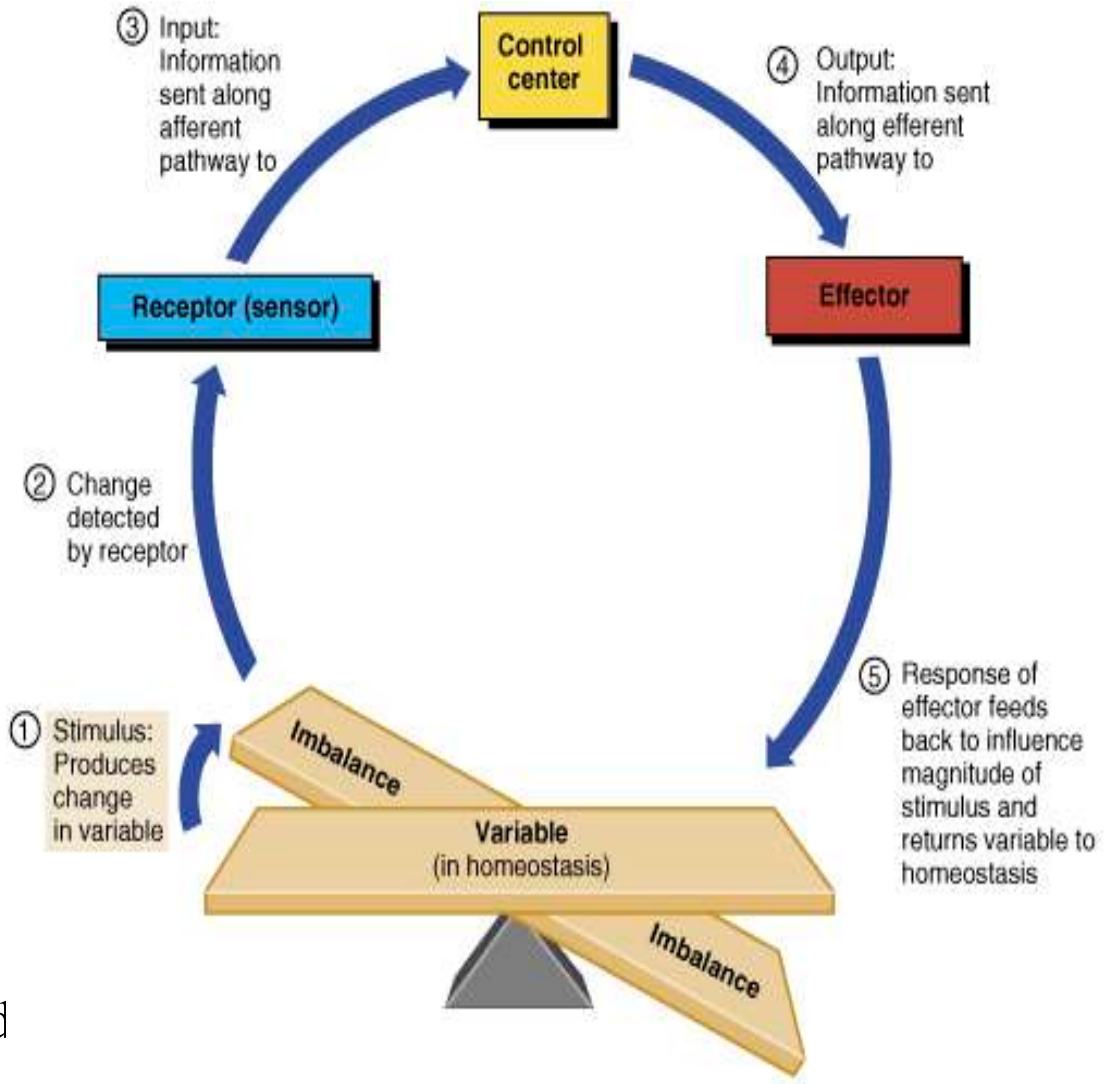
Homeostasis

- Describes the body's ability to maintain relatively stable internal conditions.
- As we age our body organs become less efficient causing a less stable internal condition leading to homeostatic imbalance.

Homeostatic Systems

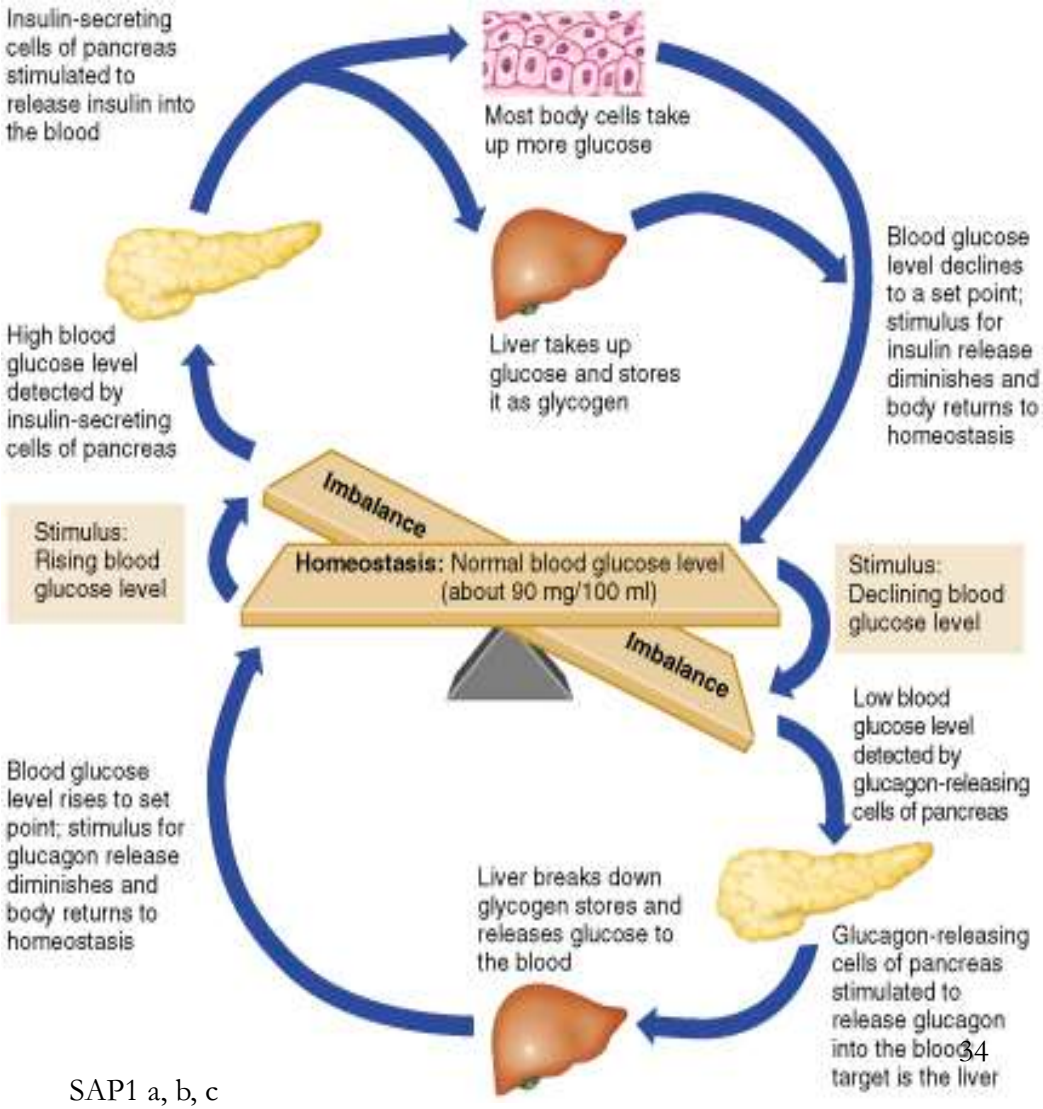
Three Basic Components:

1. **Receptor**
   - detects change in environment (stimulus/stress)
   - sends input (information) to a control center
2. **Control Center**
   - Determines level to maintain and appropriate action; sends output to effector(s)
3. **Effector**
   - causes a response, i.e., an "effect" which is triggered by output



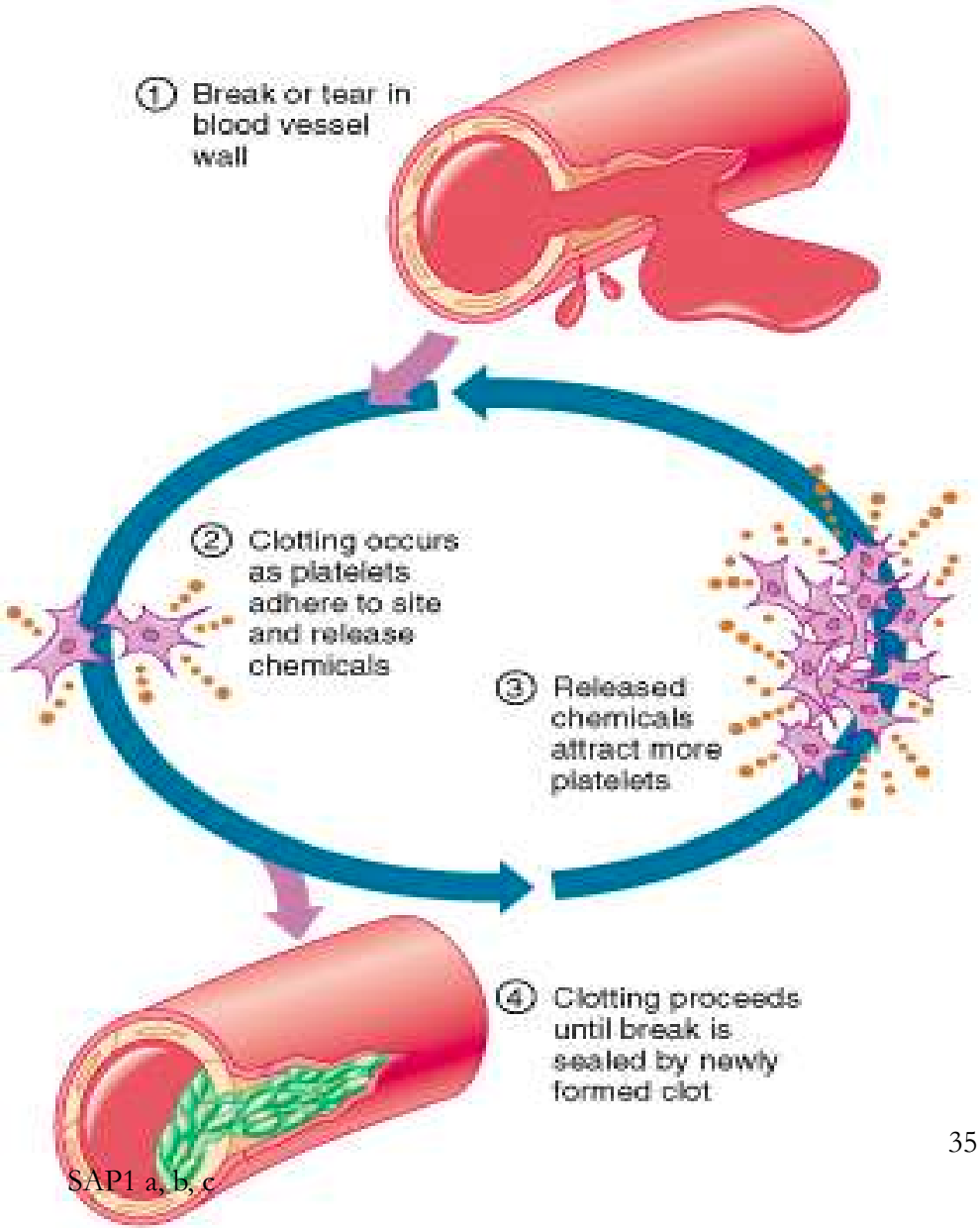
Negative Feedback

- Response to stimulus is to shut off original stimulus
- Works like the thermostat in house
- Ex) Regulation of body temperature, blood glucose, etc.



Positive Feedback

- Rare in the body because it increases the stimulus
- Ex) blood clotting and the birth of a baby
  - Oxytocin continuously produced until baby is outside birth canal



Anatomical Position

- Body erect
- Feet on the floor and slightly apart
- Head and palms forward
  - Supine-refers to the body lying face upward
  - Prone-refers to the body lying face downward

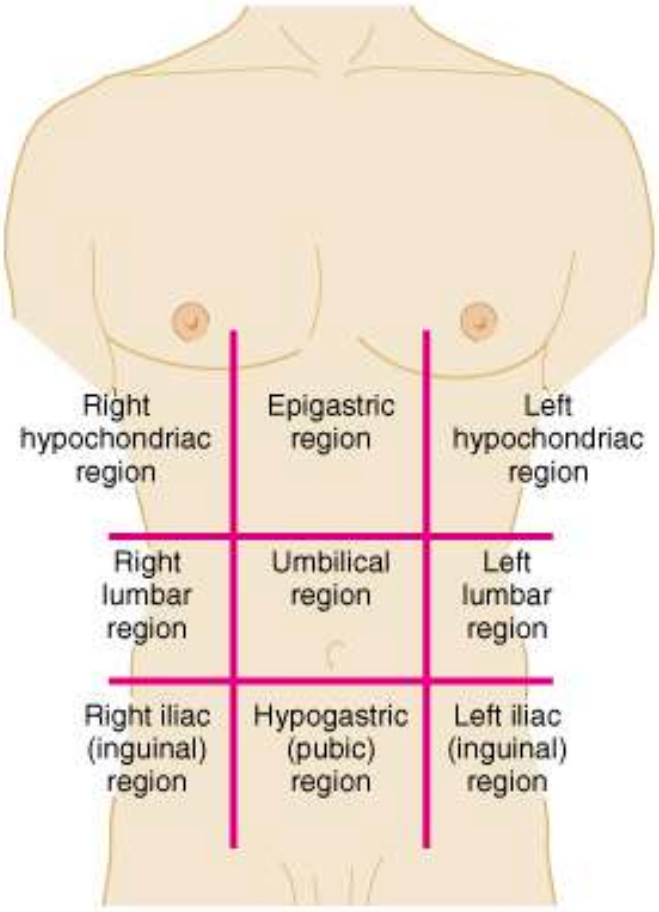
Directional Terminology

- Anterior (ventral): front side of body
- Posterior (dorsal): back side of body
- Superior (cranial): toward the head
- Inferior (caudal): away from the head
- Medial: toward the midline (inner side)
- Lateral: away from the midline (outer side)
- Proximal: closer to the point of attachment
- Distal: farther from the point of attachment
- Superficial (external): located close to or on the body surface
- Deep (internal): located beneath the body surface

Body Regional Terminology

- Head (cephalic) and neck (cervical)
- Extremities
- Trunk
  - Chest (thoracic)
  - Abdomen (celiac)
    - Epigastric-upper middle portion
    - Umbilical-central portion
    - Hypogastric-lower middle portion
    - Hypochondriac-either side of epigastric
    - Lumbar-either side of umbilical
    - Iliac-either side of hypogastric

Abdominopelvic Cavity



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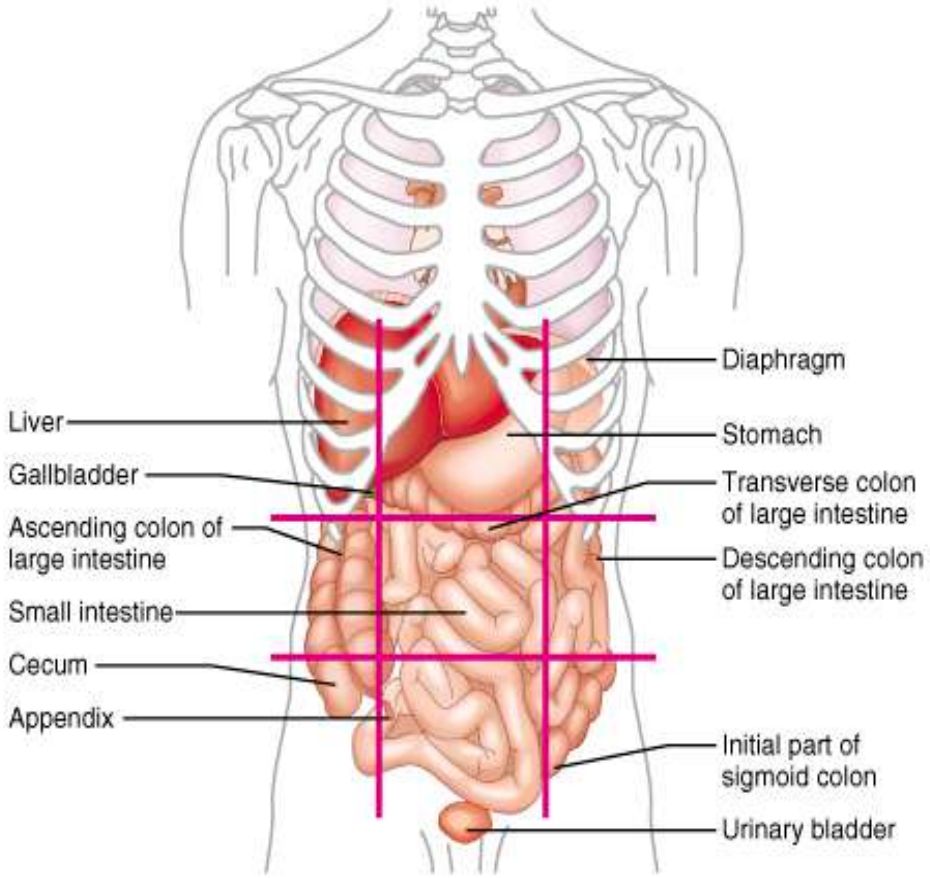

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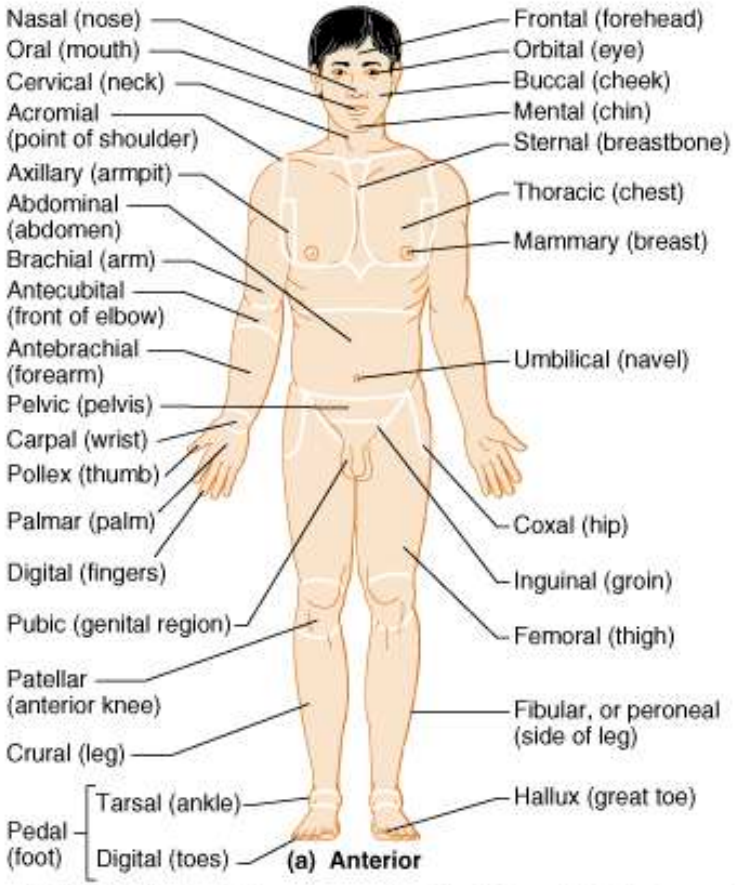
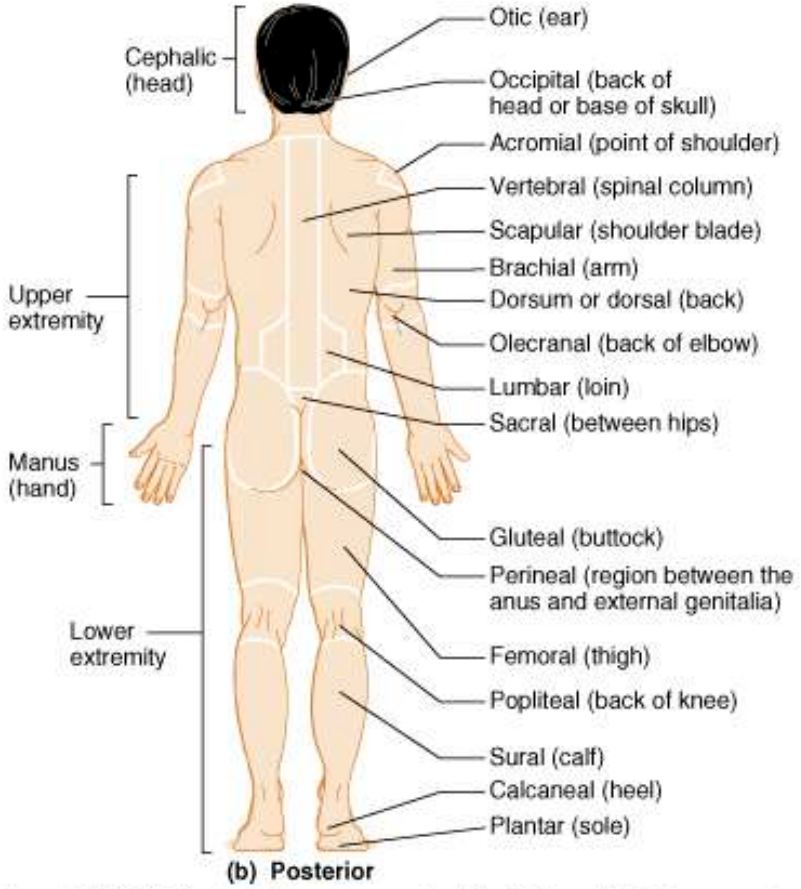
Body Regional Terminology cont.

- Back
  - Dorsum-upper back (b/t & just below shoulder blades)
  - Lumbar-lower back or groin
- Axillary-armpits
- Gluteal-buttocks
- Pubic-genital area where the hair grows
- Inguinal-groin
- Perineum-region b/t the anus and reproductive organs

Body Regional Terminology cont.





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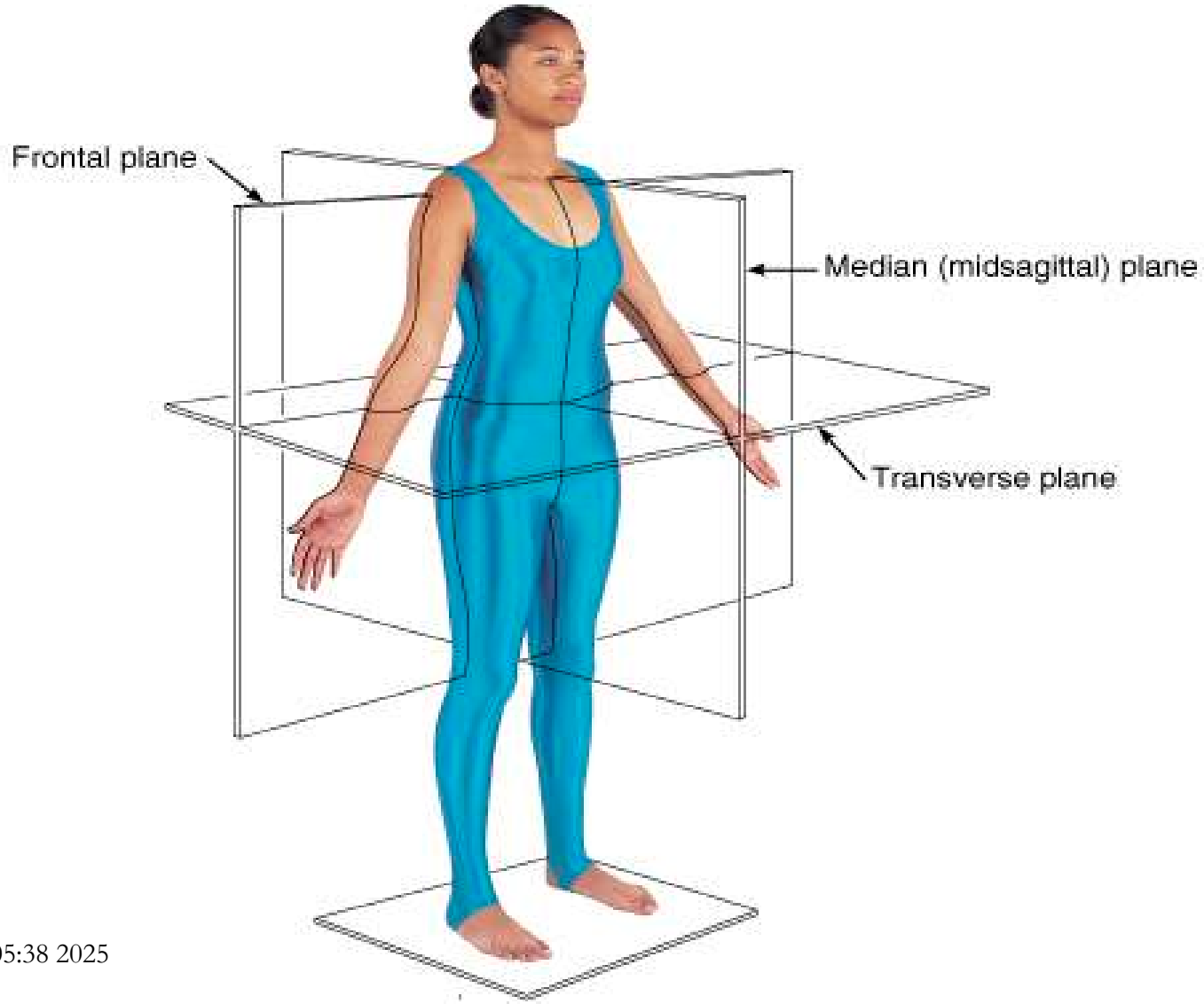
Body Planes

- Saggital: divides the body into right and left portions
  - Median or midsagittal: directly down the middle of the body
  - Parasagittal: divides anywhere except the middle, divides into unequal parts
- Frontal (coronal): divides the body into anterior and posterior portions
- Transverse: divides the body into superior (top) and inferior (bottom) portions

Body Planes cont.



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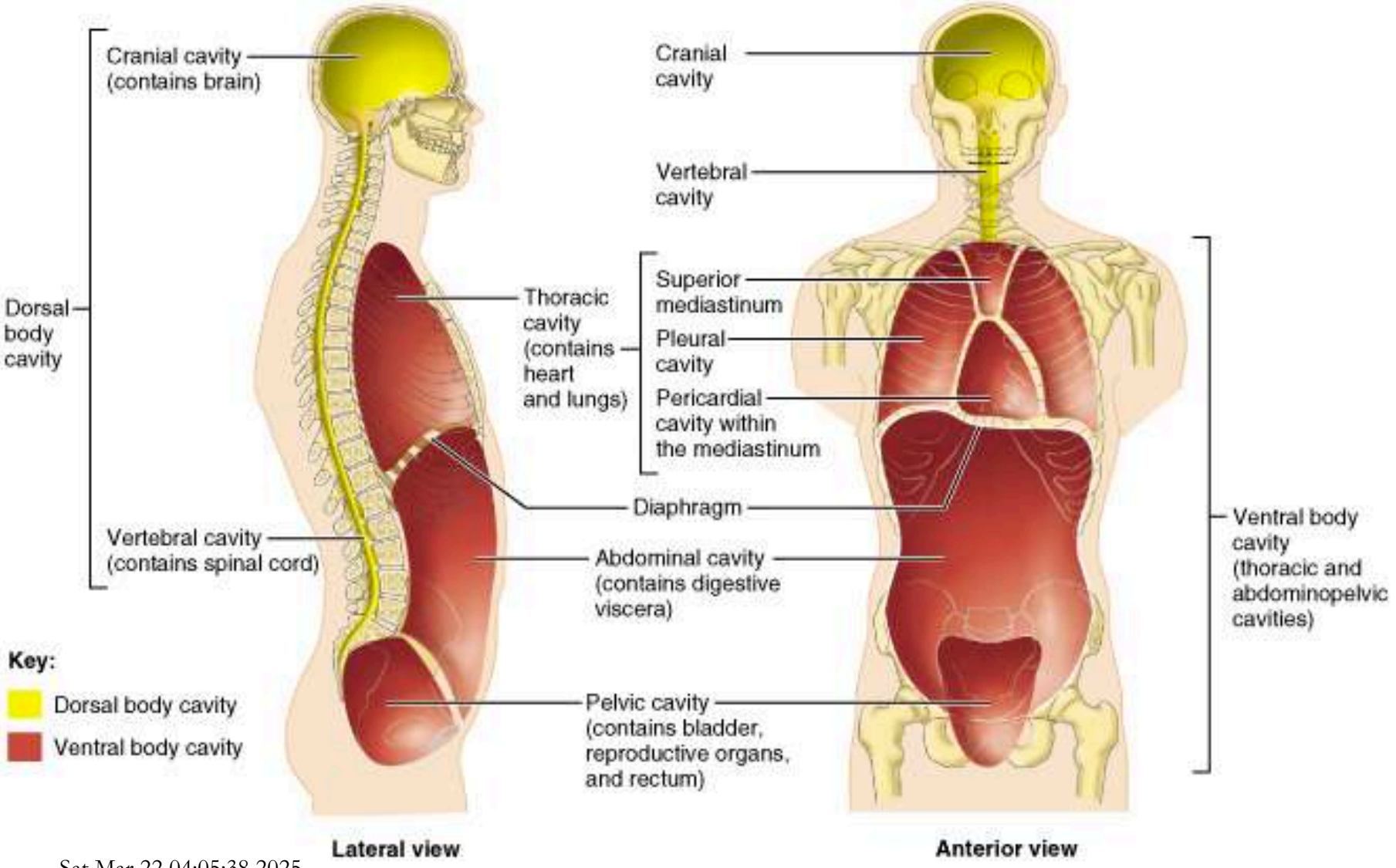
Body Cavities

- Dorsal body cavity
  - Cranial (brain)
  - Vertebral or spinal (spinal cord)
- Ventral body cavity
  - Thoracic
    - Pleural (lungs)
    - Pericardial (heart)
  - Abdominopelvic
    - Abdominal (stomach, spleen, liver, gallbladder, pancreas, small and large intestines)
    - Pelvic (lower part of the digestive system (rectum), the urinary bladder, and the internal reproductive organs of the female)

Body Cavities cont.



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