LAU School of Arts and Sciences

General Biology II

BIO 202

GENERAL CONCEPTS AND A QUICK REVISION OF BODY TISSUES

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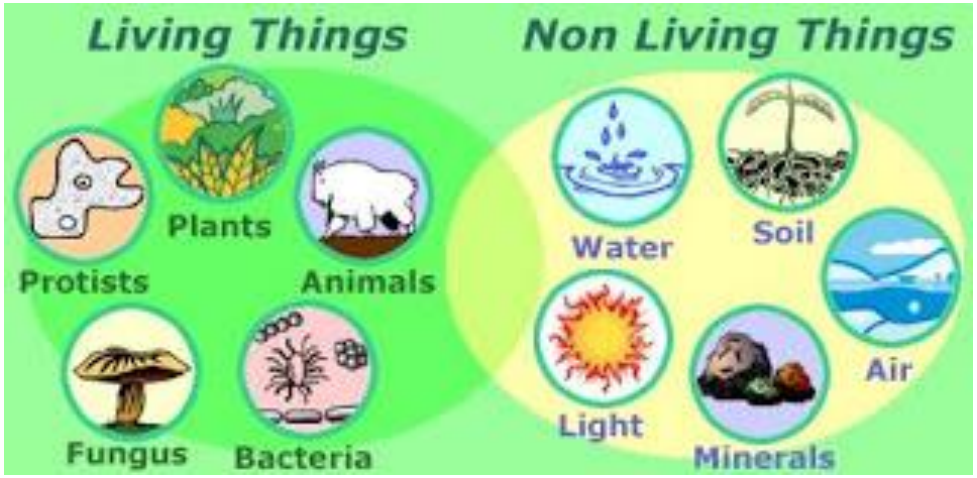
The Characteristics of Living Things

- **All living things share organization, responsiveness, growth and differentiation, reproduction, movement, metabolism, and excretion**

Organization

- **Every organism has:**
- **A characteristic pattern of organization which differs from that of inanimate objects**
- **Discrete boundaries from the environment (skin)**
- **Life only continues as long as the organism can fight to maintain organization**



Responsiveness

- **Irritability: ability to be irritated by external surroundings (e.g. a light that is too bright)**
- **Adaptability: in order to survive, a living thing needs to adapt to its environment**
  - **Even bacteria react and respond**

Growth and Differentiation

- Increasing in number or size of cells
- In multicellular organisms the individual cells become specialized to perform particular functions
- Ex. Human adult and infant

Reproduction

- **Creating subsequent generations of similar organisms**

Movement

- **Internal: movement of materials inside the body (e.g. blood, food, oxygen, etc.)**
- **External: moving positions**

Metabolism and Excretion

- Organisms rely on complex chemical reactions to provide energy and to synthesize proteins
- Metabolism – all chemical operations in the body
- Nutrients are used for growth
- Respiration – the absorption
- Excretion – potentially harmful wastes of metabolic operations that must be removed from body fluids

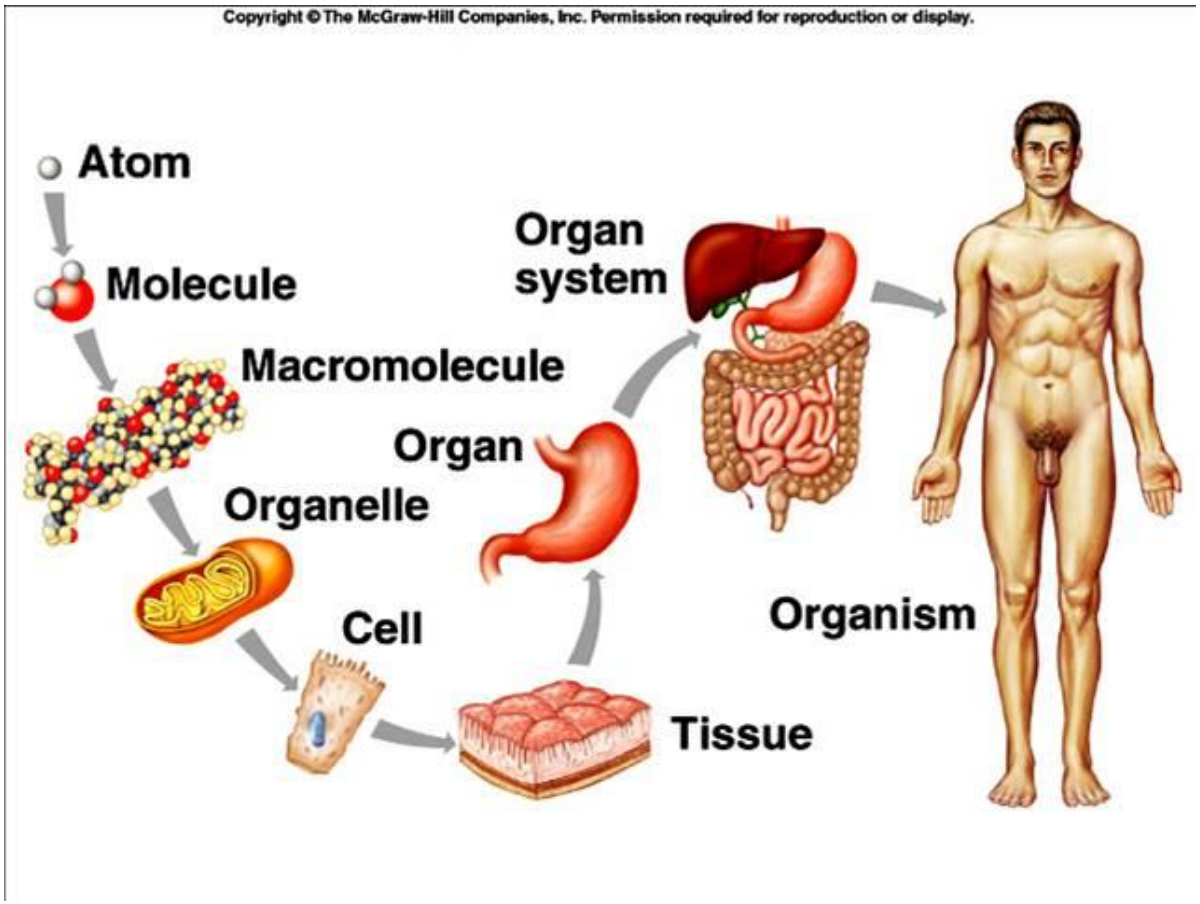
Anatomy and Physiology

- **Anatomy – study of internal and external structures of the body and the physical relationships among body parts**
- **Physiology – study of how organisms perform their vital functions**
- **All specific functions are performed by specific structures**

Anatomy

- Anatomy can be divided into microscopic and macroscopic anatomy:
- Macroscopic or gross anatomy is the examination of relatively large structures with the unaided eye
- Microscopic anatomy deals with the structures that cannot be seen without magnification
- Examples???

Levels of Organization



Levels of Organization

- **Chemical or molecular level:**

Include atoms – the smallest most stable units of matter, which can combine to form molecules

Levels of Organization

- **The cellular level:**

Molecules interact to form organelles (the cells structural and functional components) with specific functions

Levels of Organization

- **The tissue level:**

A tissue is a group of cells working together to perform one or more specific functions.

Heart cells form cardiac tissue

Levels of Organization

- **The organ level:**

Consists of two or more tissues working in combination to perform several functions

Levels of Organization

- **The organ system level:**

Organs interact in organ system

We have in total 11 organ systems

Levels of Organization

- **The organism level:**

All organ systems of the body work together to maintain life and health

Levels of Structural Organization

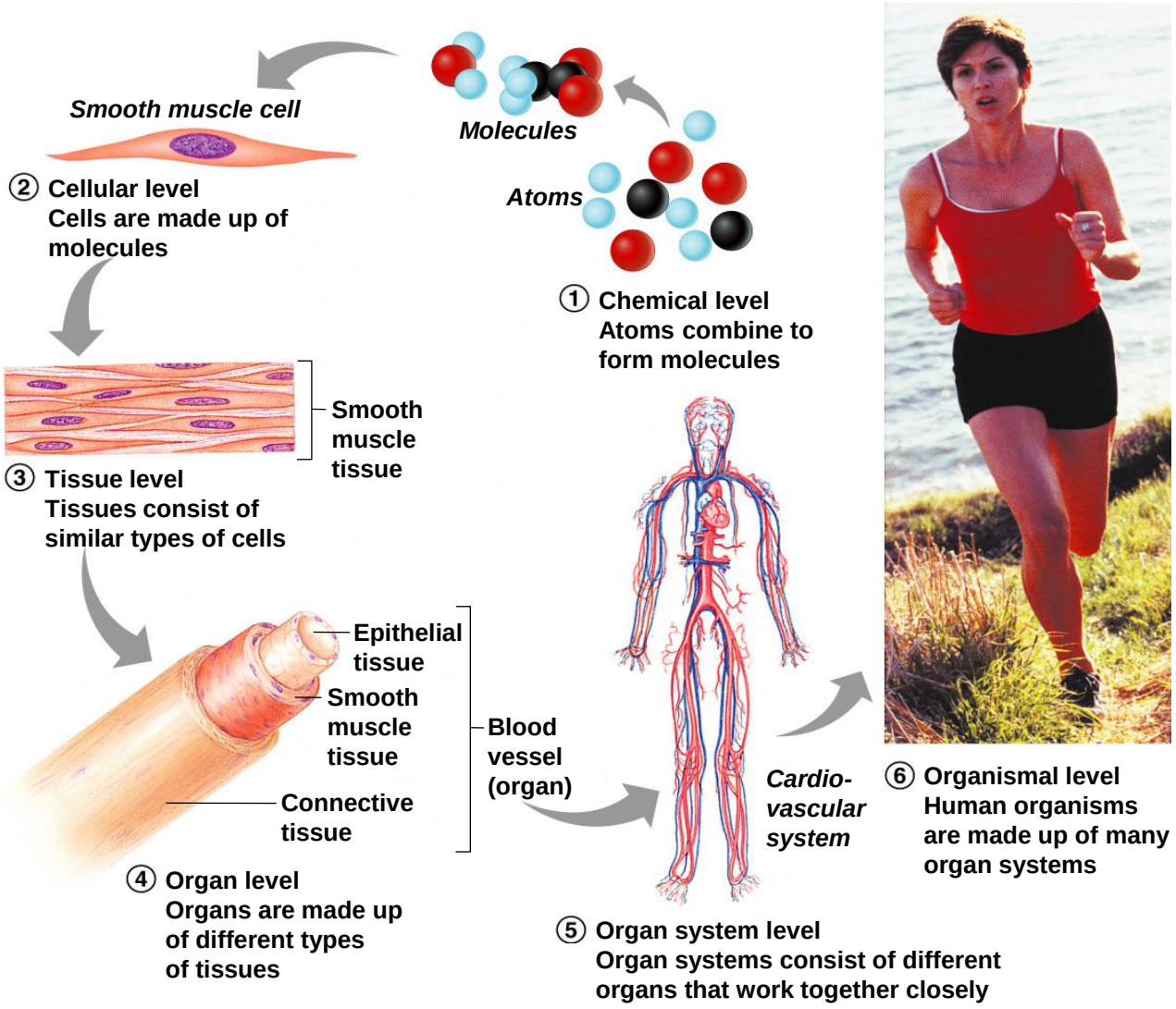
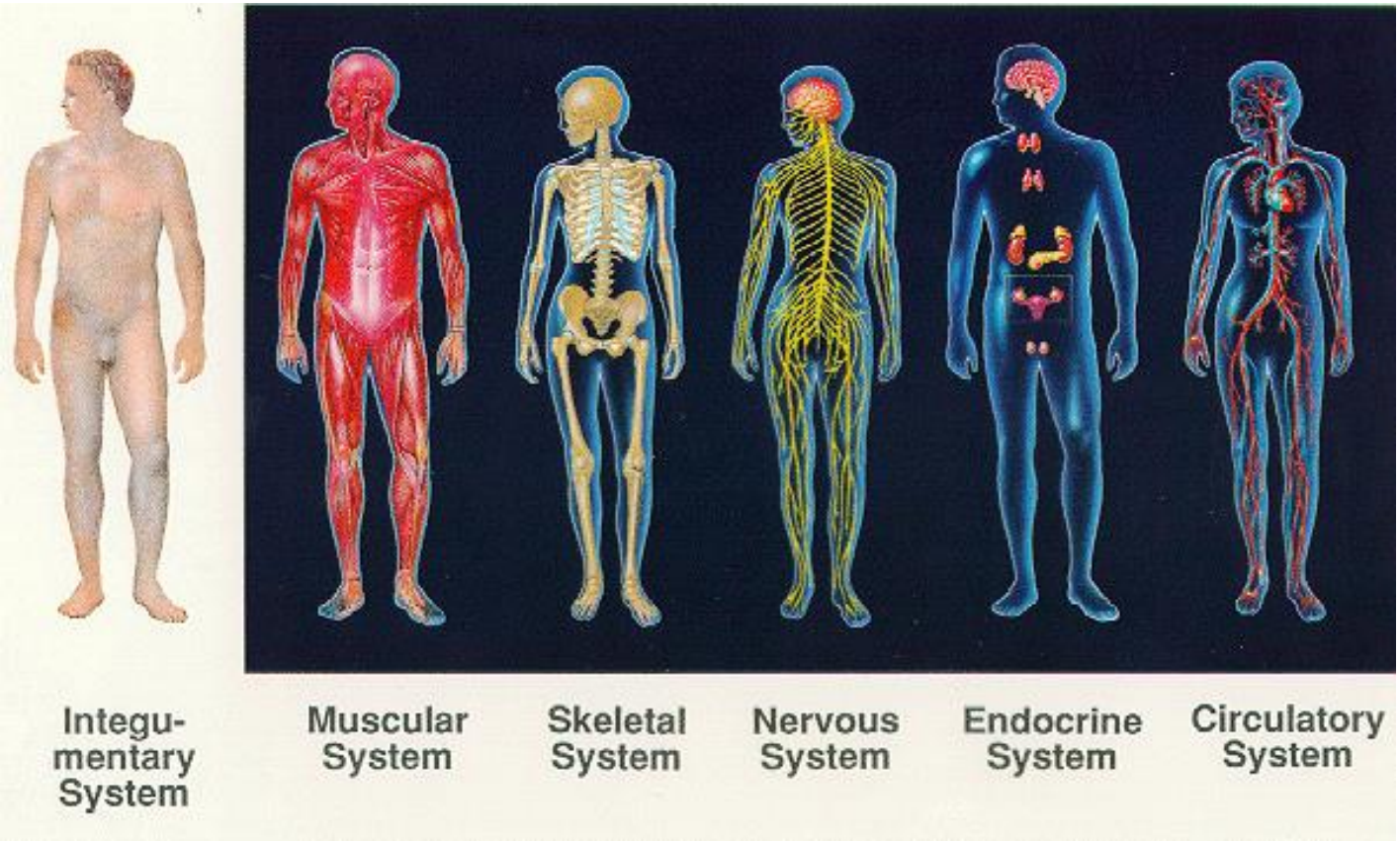


Figure 1.1

Levels of Organization

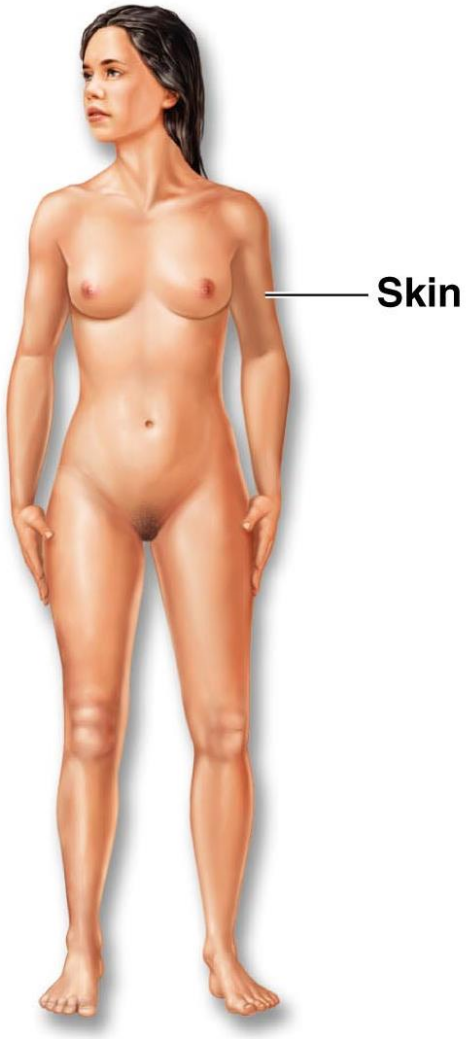


An Introduction to the Organ Systems

- Integumentary system
- Nervous system
- Skeletal system
- Endocrine system
- Muscular system
- Cardiovascular system

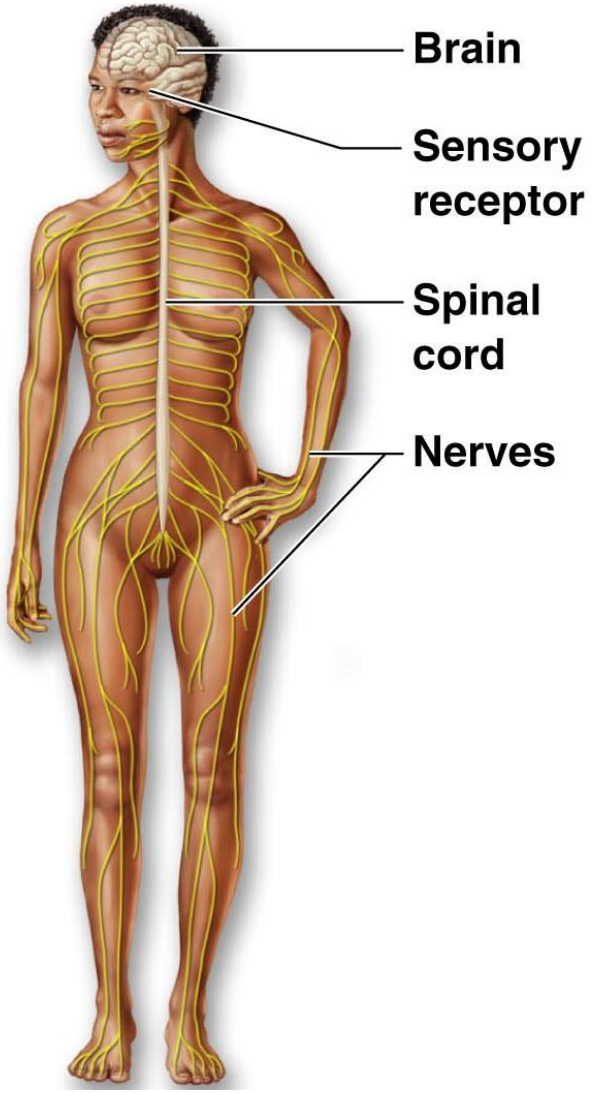
The Integumentary System

- Integumentary
  - Major organs:
    - Skin
    - Hair
    - Sweat glands
    - Nails
  - Functions:
    - Protects again environmental hazards
    - Helps regulate body temperature
    - Provides sensory information



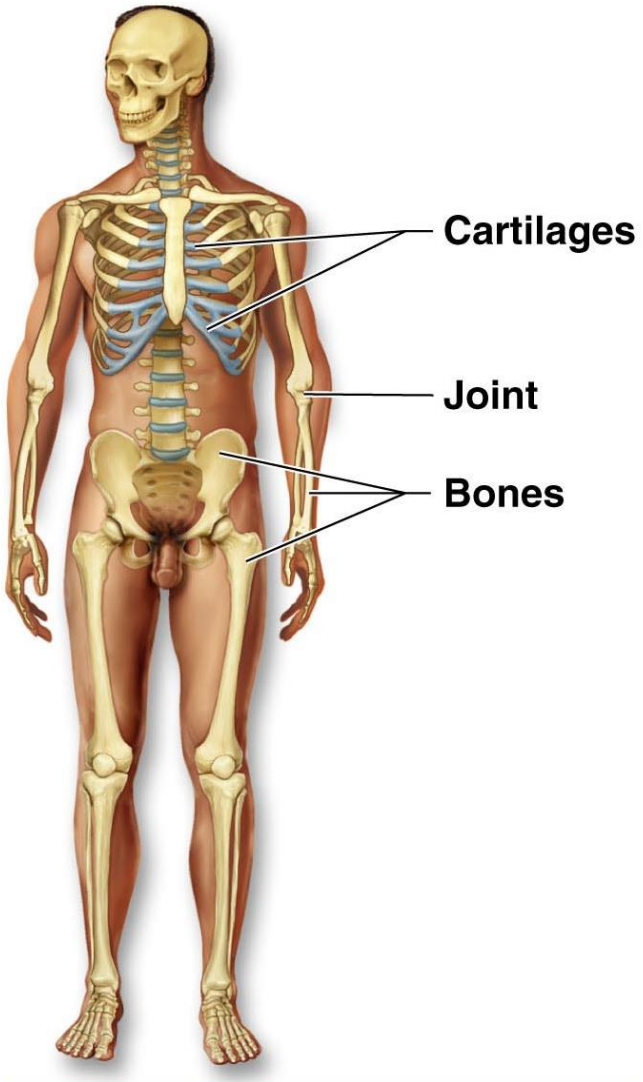
The Nervous System

- Nervous
  - 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



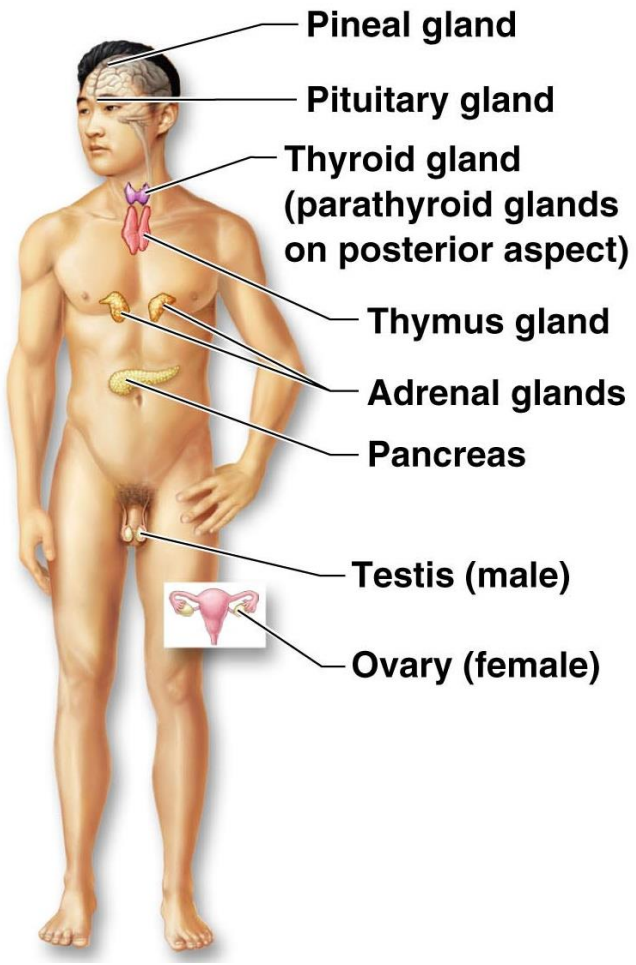
The Skeletal System

- Skeletal
  - Major Organs:
    - Bones
    - Cartilages
    - Associated ligaments
    - Bone marrow
  - Functions:
    - Provides support and protection for other tissues
    - Stores calcium and other minerals
    - Forms blood cells



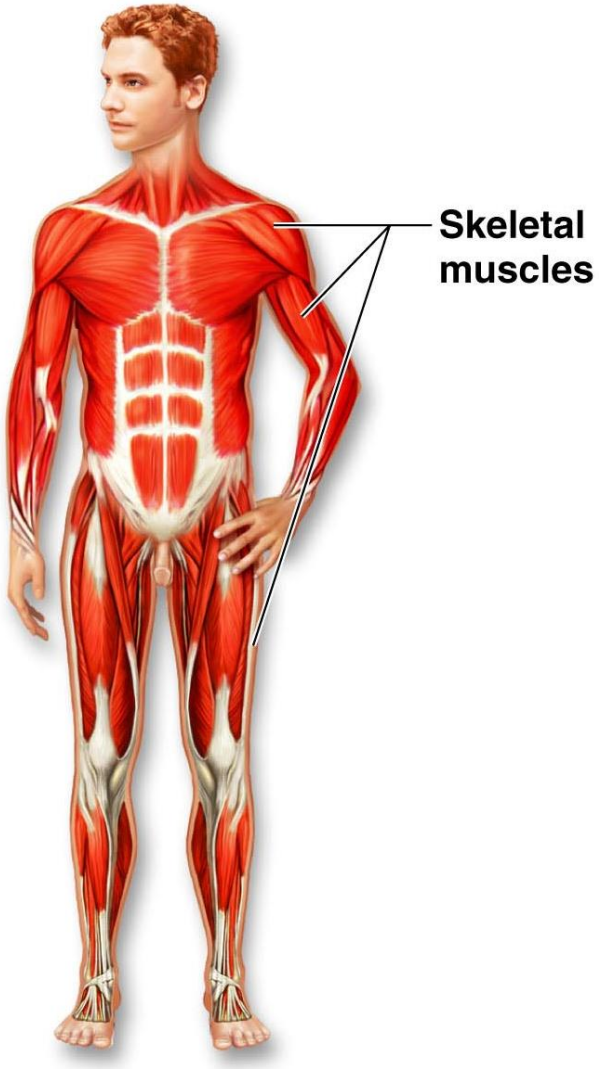
The Endocrine System

- Endocrine
  - Major Organs:
    - Pituitary gland
    - Thyroid gland
    - Pancreas
    - Adrenal glands
    - Gonads (testes or 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



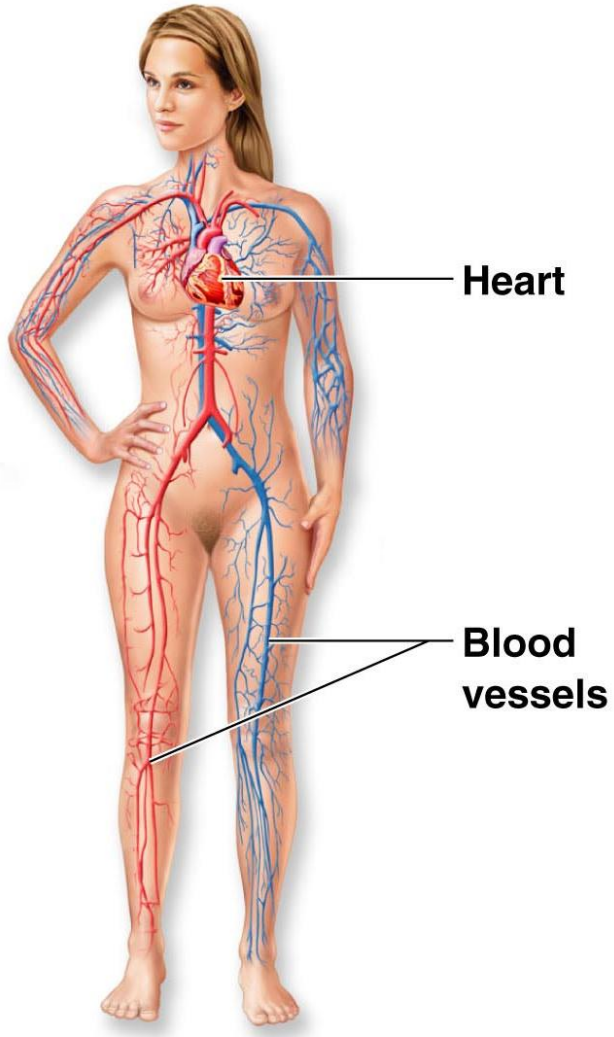
The Muscular System

- Muscular
  - Major Organs:
    - Skeletal muscles and associated tendons and aponeuroses (tendinous sheets)
  - Functions:
    - Provides movement
    - Provides protection and support for other tissues
    - Generates heat that maintains body temperature (shivering, exercising)



The Cardiovascular System

- Cardiovascular
  - Major Organs:
    - Heart
    - Blood
    - Blood vessels
  - Functions:
    - Distributes blood cells, water, and dissolved materials, including nutrients, oxygen, and carbon dioxide
    - Distributes heat and assists in control of body temperature

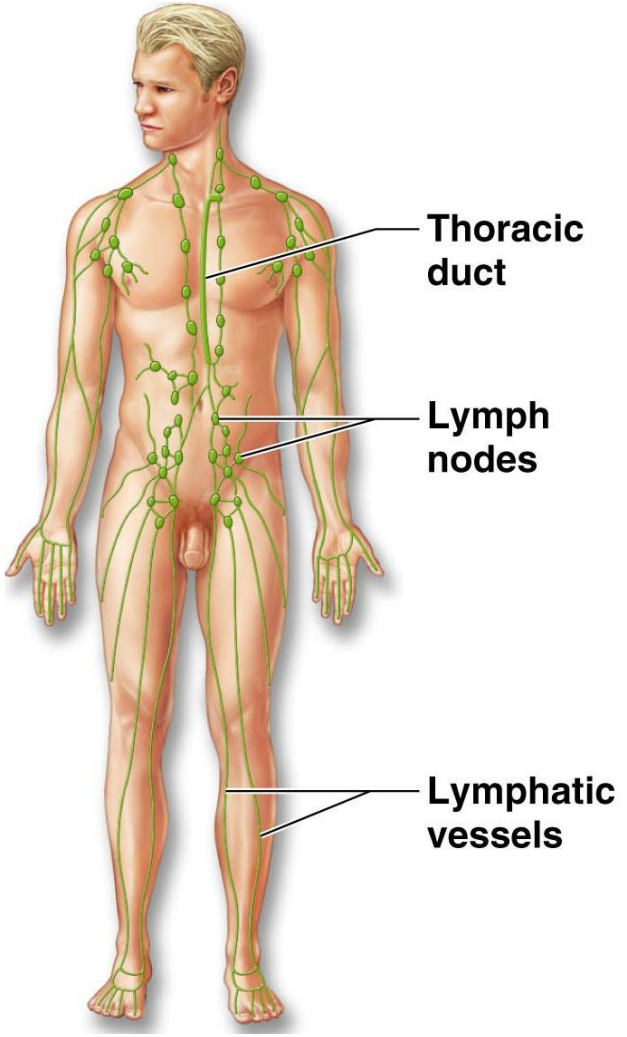


Introduction to the Organ Systems

- Lymphatic system
- Urinary system
- Respiratory system
- Digestive system
- Reproductive system

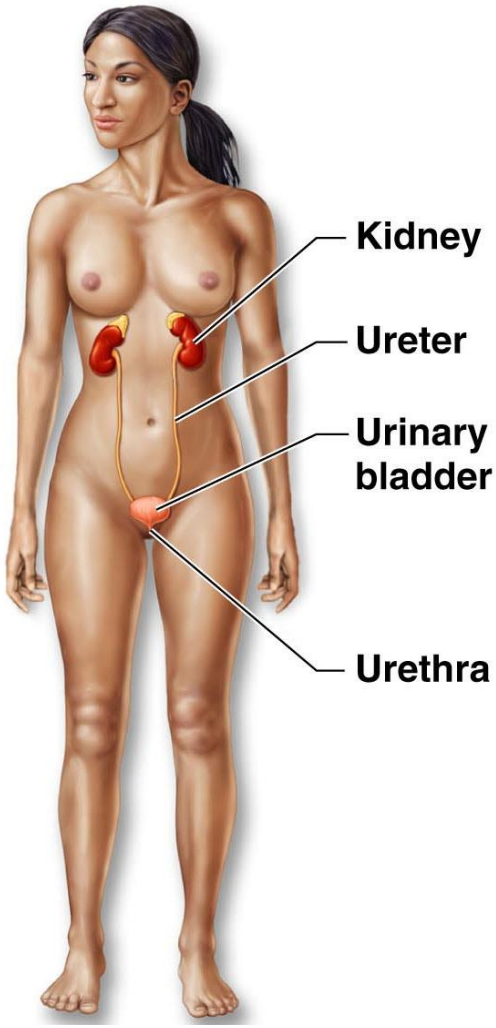
The Lymphatic System

- Lymphatic
  - Major Organs:
    - Spleen
    - Thymus
    - Lymphatic vessels
    - Lymph nodes
    - Tonsils
  - Functions:
    - Defends against infection and disease
    - Returns fluids to the bloodstream



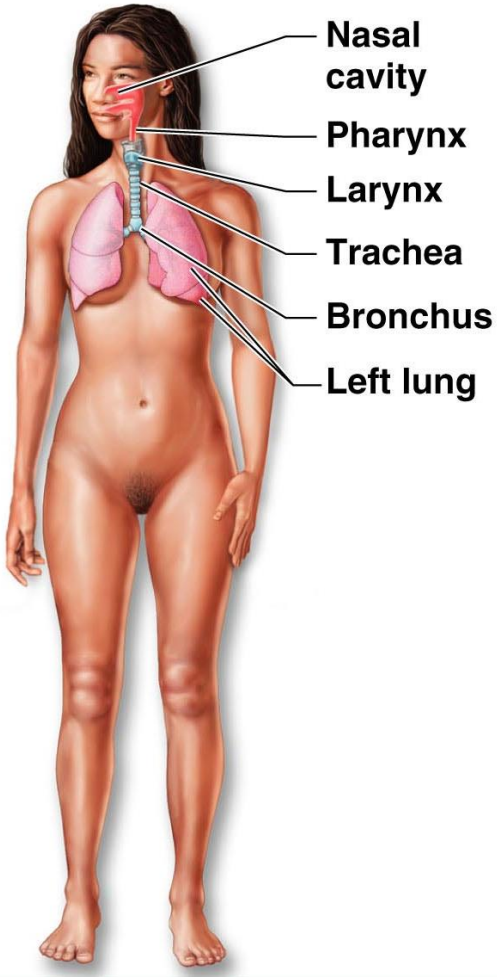
The Urinary System

- Urinary
  - 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



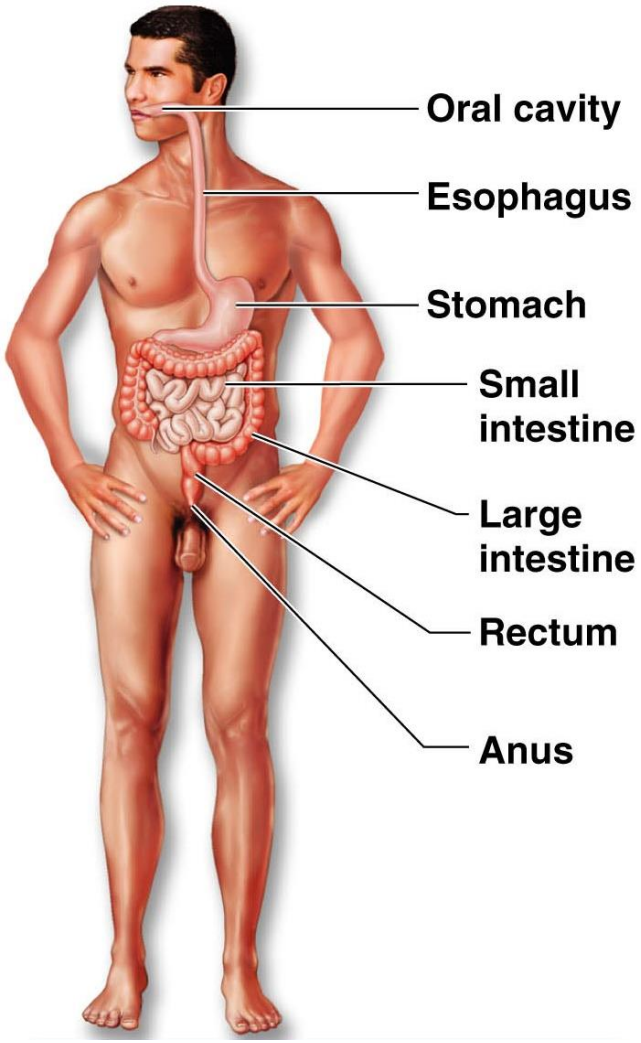
The Respiratory System

- Respiratory
  - 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



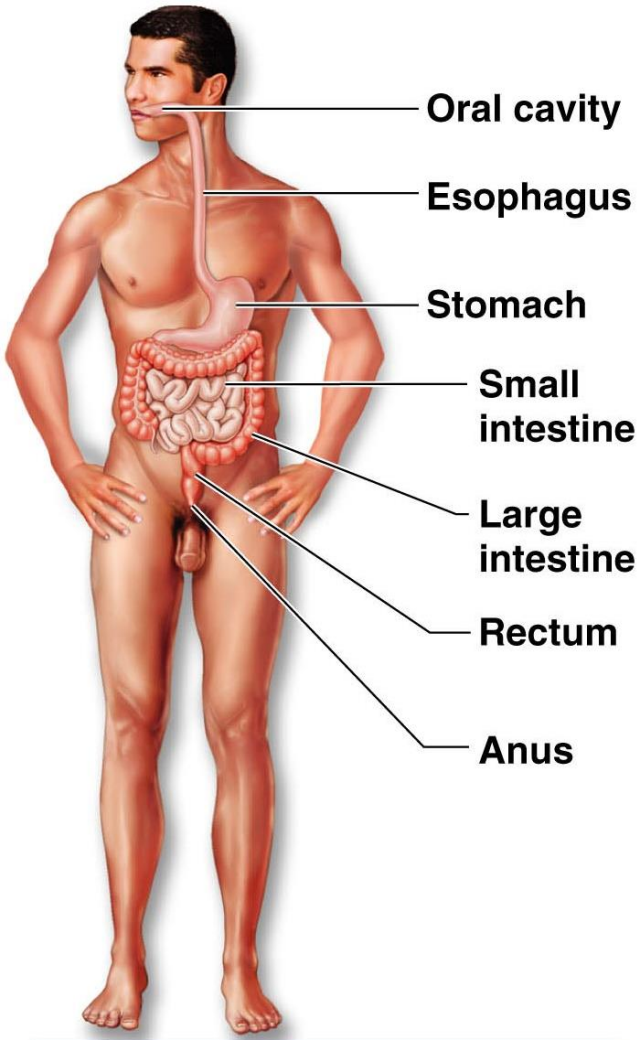
The Digestive System

- Digestive
  - Major Organs:
    - Teeth
    - Tongue
    - Pharynx
    - Esophagus
    - Stomach
    - Small intestine
    - Large intestine
    - Liver
    - Gallbladder
    - Pancreas



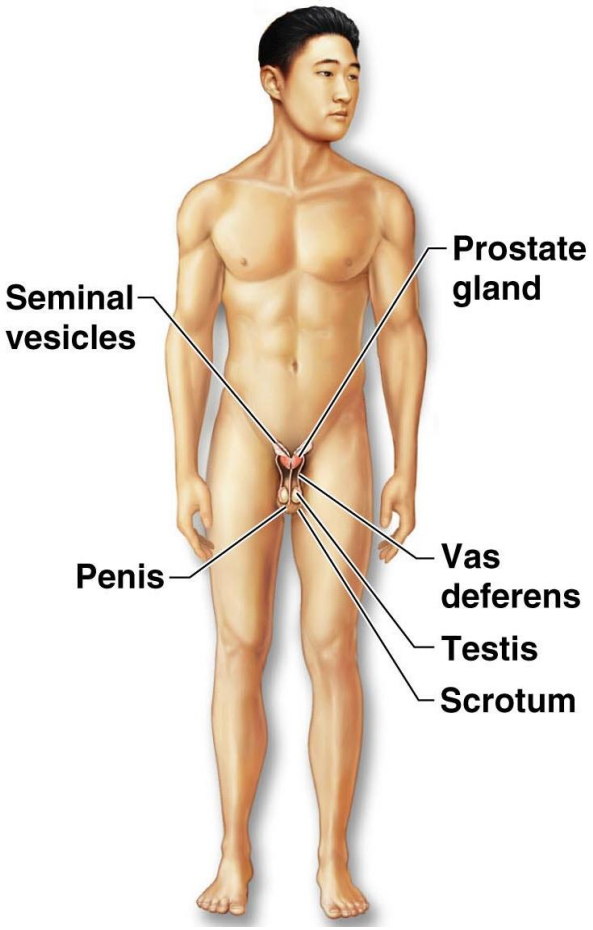
The Digestive System

- Digestive
  - 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



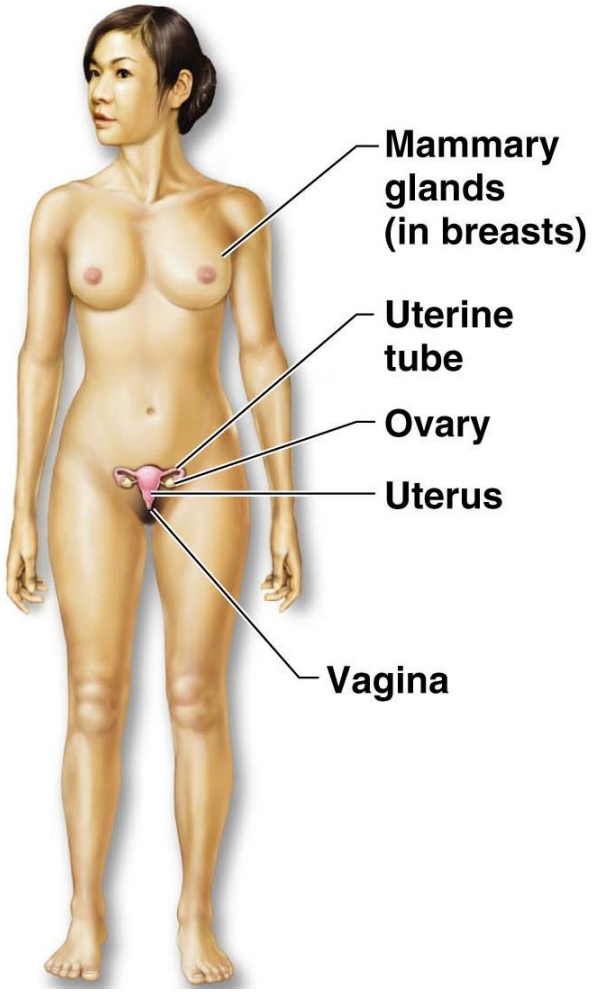
The Male Reproductive System

- Reproductive - Male
  - Major Organs:
    - Testes
    - Epididymis
    - Ductus deferens
    - Seminal vesicles
    - Prostate gland
    - Penis
    - Scrotum
  - Functions:
    - Produces male sex cells (sperm) and hormones



The Female Reproductive System

- Reproductive - Female
  - 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



Homeostasis

- The central unifying concept in physiology
- Maintaining equilibrium
- Homeostasis works by feedback loops

Homeostasis

- **Homeostatic regulation is the adjustment of physiological systems to preserve homeostasis**
- **Autoregulation (intrinsic): occurs when the activities of a cell, tissue, or organ adjust automatically in response to an environmental change**
- **Extrinsic regulation: results from activities of nervous system or endocrine system**
- **Examples: nervous system, endocrine system**

Homeostasis

- The regulatory mechanism of homeostasis consists of three parts:
  - Receptor: sensitive to environmental change or stimulus
  - Control center: receives and processes information from the receptor
  - Effector: cell or organ that responds

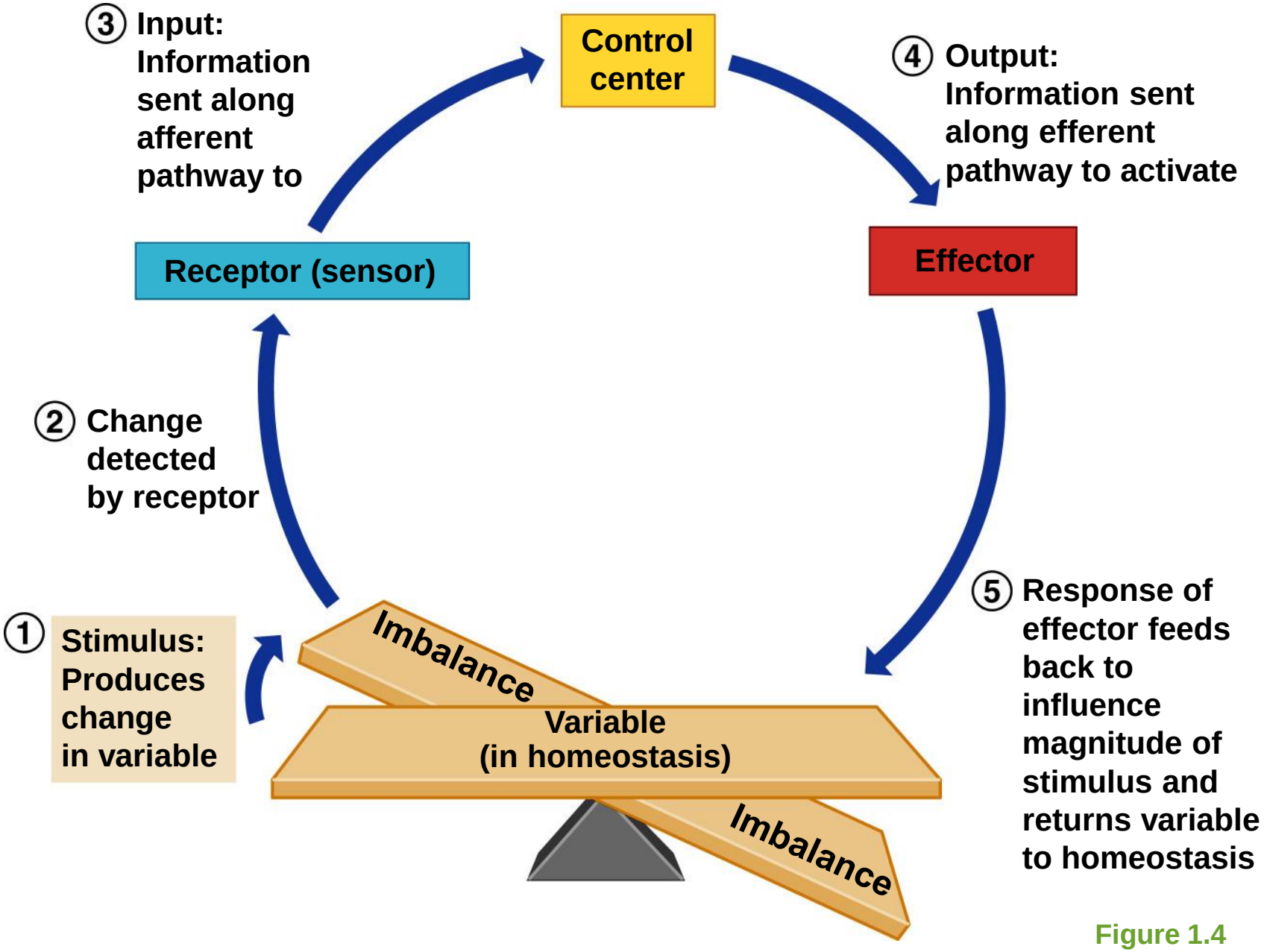


Figure 1.4

Negative Feedback

- Method of homeostatic regulation
- The effector activated by the control center opposes the stimulus
- Negative feedback minimizes change
- Example: thermoregulation

Negative Feedback: Regulation of Blood Pressure

- External or internal stimulus increases BP
  - Baroreceptors (pressure sensitive receptors)
    - Detect higher BP
    - Send nerve impulses to brain for interpretation
    - Response sent via nerve impulse to heart and blood vessels
    - BP drops and homeostasis is restored
    - Drop in BP negates the original stimulus: *"negative feedback"*

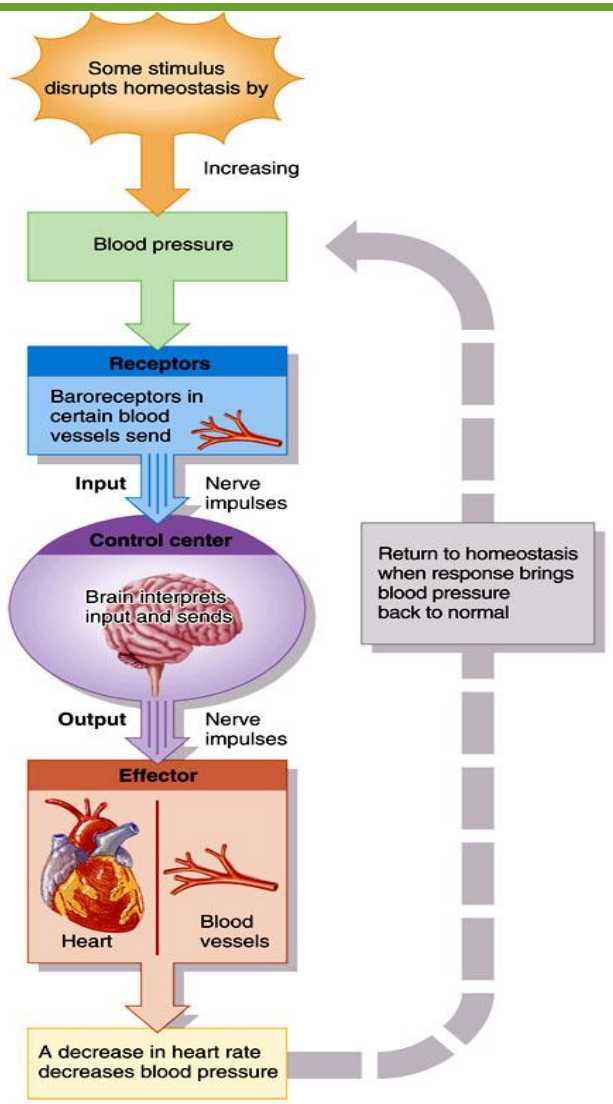


Figure 01.03 Tortora - PAP 12/e

Positive Feedback

- **An initial stimulus produces a response that exaggerates the change in the original conditions rather than opposing it**

Positive Feedback: Childbirth

- Uterine contractions cause vagina to open
- Stretch-sensitive receptors in cervix send impulse to brain
- Oxytocin is released into the blood which increases contractions
- Contractions push baby farther down the uterus
- Cycle continues to the birth of the baby (no more stretching)

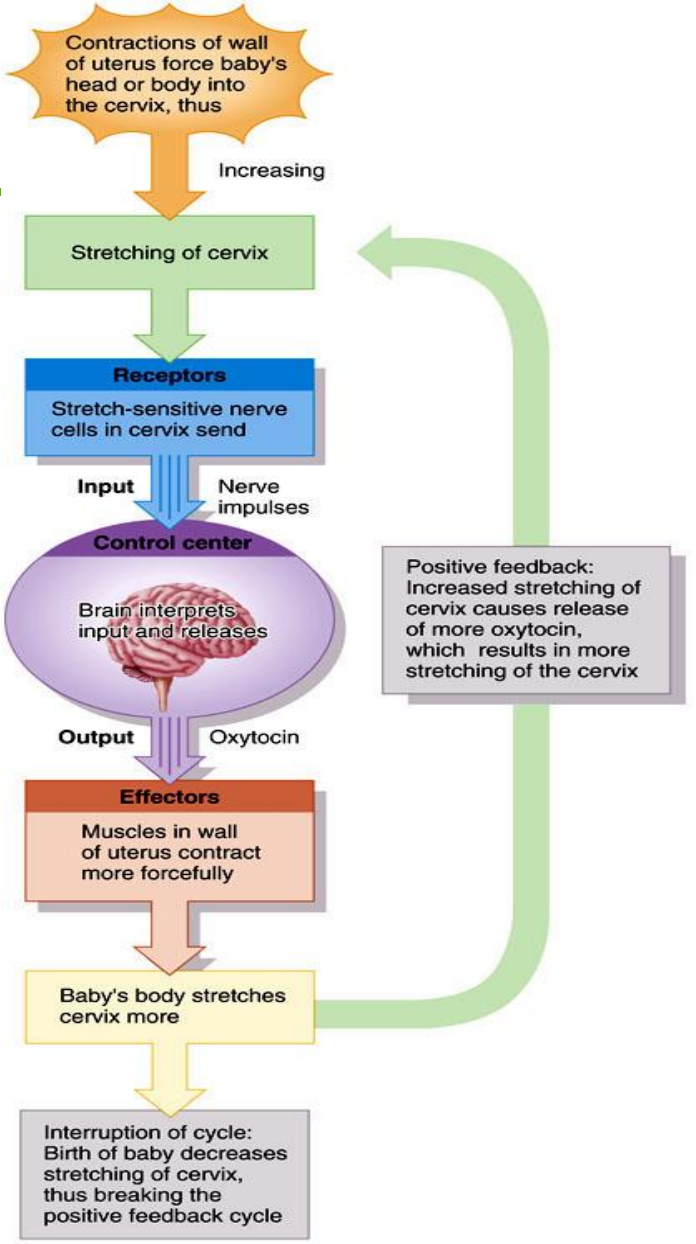
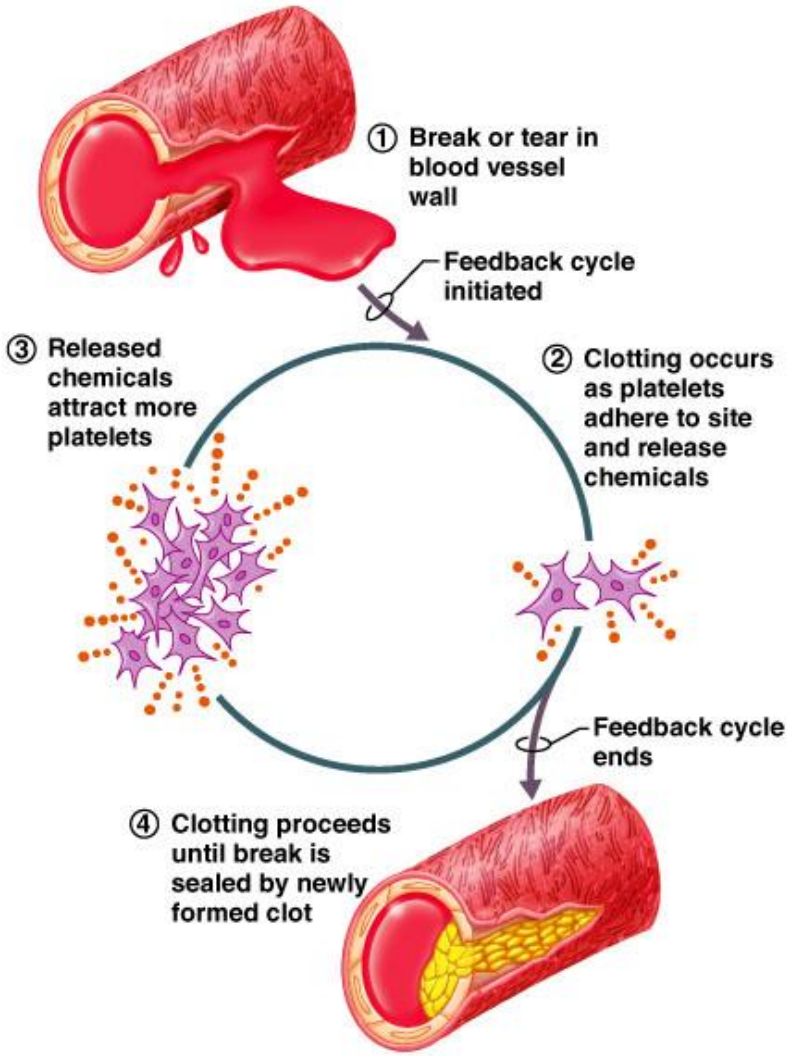


Figure 01.04 Tortora - PAP 12/e

Positive Feedback: Blood clotting



A Pathway That Alters Homeostasis?

- **When the cells in the body malfunction, the homeostatic balance becomes disrupted. This leads to disease or cell malfunction**
- **Nutrition:** If your diet is lacking in a specific vitamin or mineral your cells will function poorly, possibly resulting in a disease condition. For example, a menstruating woman with inadequate dietary intake of iron will become anemic. Lack of hemoglobin, a molecule that requires iron, will result in reduced oxygen-carrying capacity. In mild cases symptoms may be vague (e.g. fatigue), but if the anemia is severe the body will try to compensate by increasing cardiac output, leading to palpitations and sweatiness, and possibly to heart failure.
- **Toxins:** Any substance that interferes with cellular function, causing cellular malfunction (chemical, plant, insecticides, and/or bites). A commonly seen example of this is drug overdoses. When a person takes too much of a drug their vital signs begin to waver; either increasing or decreasing, these vital signs can cause problems including coma, brain damage and even death.

Subspecialties of Anatomy and Physiology

TABLE 1.1

Selected Subspecialties of Anatomy and Physiology

SUBSPECIALTIES OF ANATOMY	STUDY OF
Embryology (em′-brē-OL-ō-jē; *embry-* = embryo; *-logy* = study of)	The first eight weeks of development following fertilization of an egg (in humans).
Developmental biology	The complete development of an individual from fertilization of an egg to death.
Cell biology	Cellular structure and functions.
Histology (his′-TOL-ō -jē; *hist-* = tissue)	Microscopic structure of tissues.
Surface anatomy	Surface markings of the body to understand internal anatomy through visualization and palpation (gentle touch).
Gross anatomy	Structures that can be examined without using a microscope.
Systemic anatomy	Structure of specific systems of the body such as the nervous or respiratory systems.
Regional anatomy	Specific regions of the body such as the head or chest.
Radiographic anatomy (rā-dē-ō-GRAF-ik; *radio-* = ray; *-graphic* = to write)	Body structures that can be visualized with x-rays.
Pathological anatomy (path′-ō-LOJ-i-kal; *path-* = disease)	Structural changes (from gross to microscopic) associated with disease.

SUBSPECIALTIES OF PHYSIOLOGY	STUDY OF
Neurophysiology (NOOR-ō-fiz-ē-olǥ-ō-jē; *neuro-* = nerve)	Functional properties of nerve cells.
Endocrinology (en′-dō-kri-NOL-ō-jē; *endo-* = within; *-crin* = secretion)	Hormones (chemical regulators in the blood) and how they control body functions.
Cardiovascular physiology (kar-dē-ō-VAS-kū-lar; *cardi-* = heart; -vascular = blood vessels)	Functions of the heart and blood vessels.
Immunology (im′-ū-NOL-ō-jē; *immun-* = not susceptible)	How the body defends itself against disease-causing agents.
Respiratory physiology (RES-pir-a-to′-rē; respira- = to breathe)	Functions of the air passageways and lungs.
Renal physiology (RĒ-nal; *ren-* = kidney)	Functions of the kidneys.
Exercise physiology	Changes in cell and organ functions as a result of muscular activity.
Pathophysiology (PATH-ō-fiz-ē-ol′-ō-jē)	Functional changes associated with disease and aging.

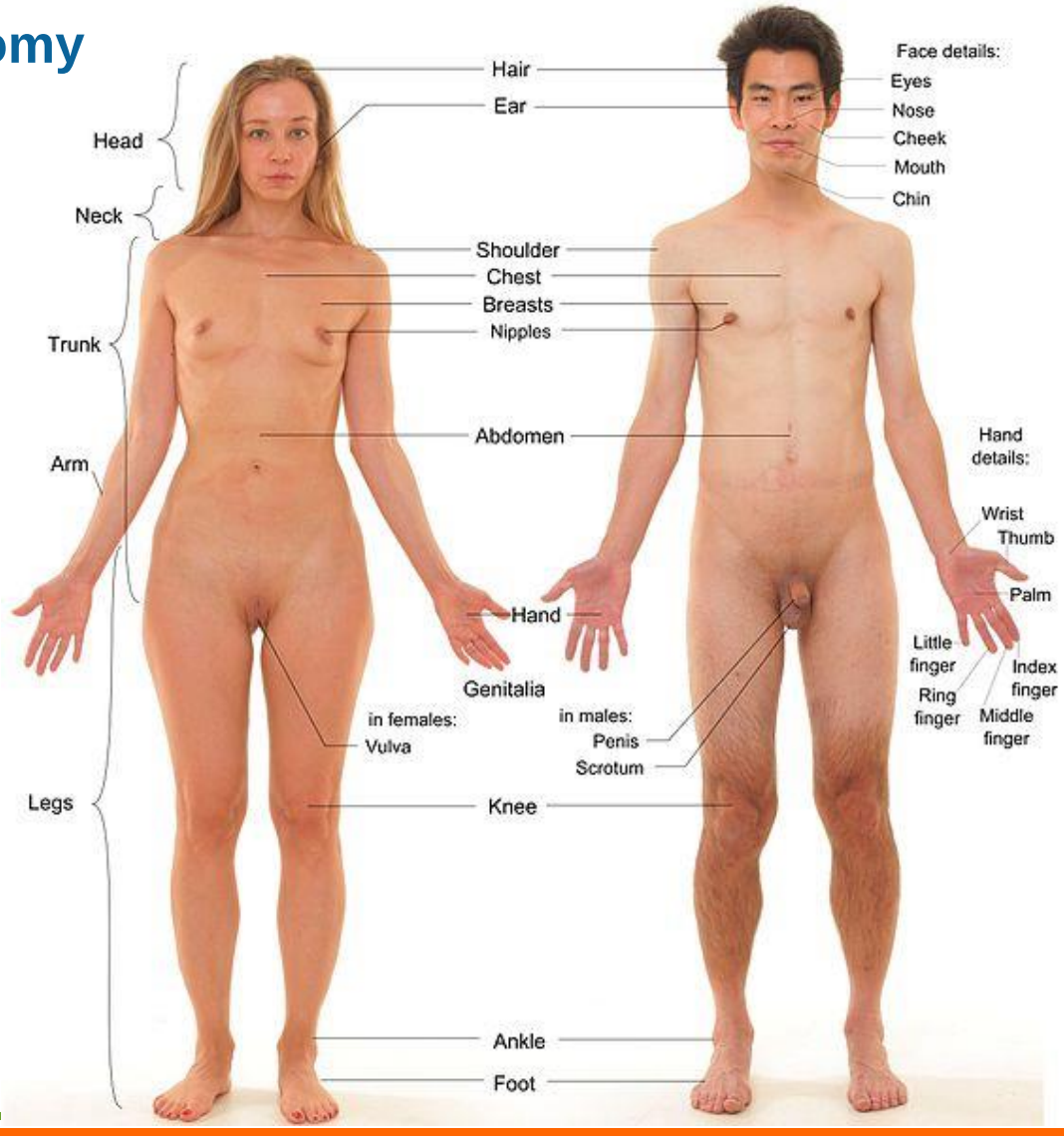
Table 01.01 Tortora - PAP 12/e

A Frame of References for Anatomical Studies

- **Superficial Anatomy**
  - **Anatomical Position**
    - **Prone and Supine**

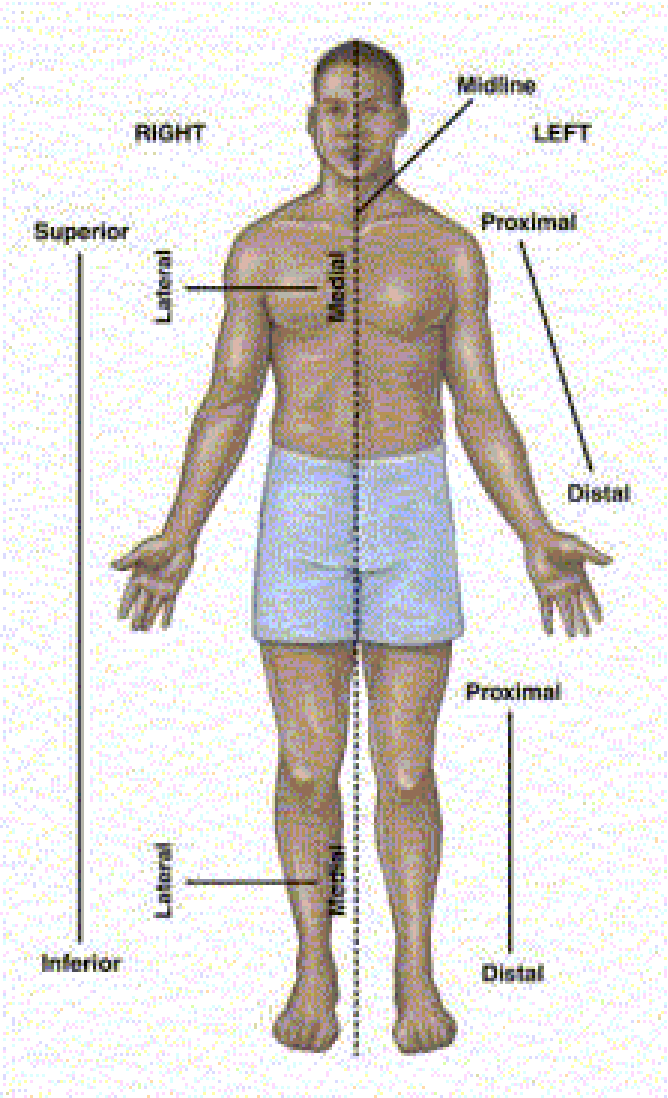
Superficial Anatomy

- **Surface Anatomy**



Anatomical position

- Body upright
  - Standing erect facing the observer
  - Head and eyes facing forward
  - Feet are flat on the floor and forward
  - Upper limbs to the sides
  - Palms turned forward
- Terms for a reclining body
  - Prone position - Body is lying face down
  - Supine position - Body is lying face up



Abdominopelvic Quadrants

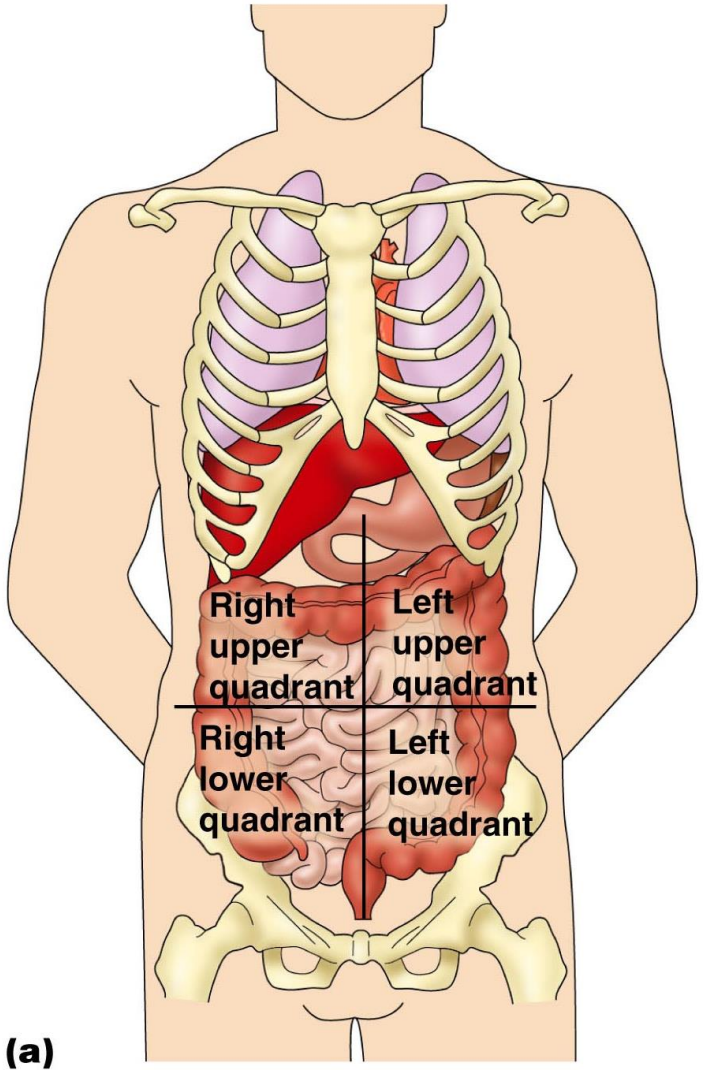


Figure 1.8a

Abdominopelvic Regions

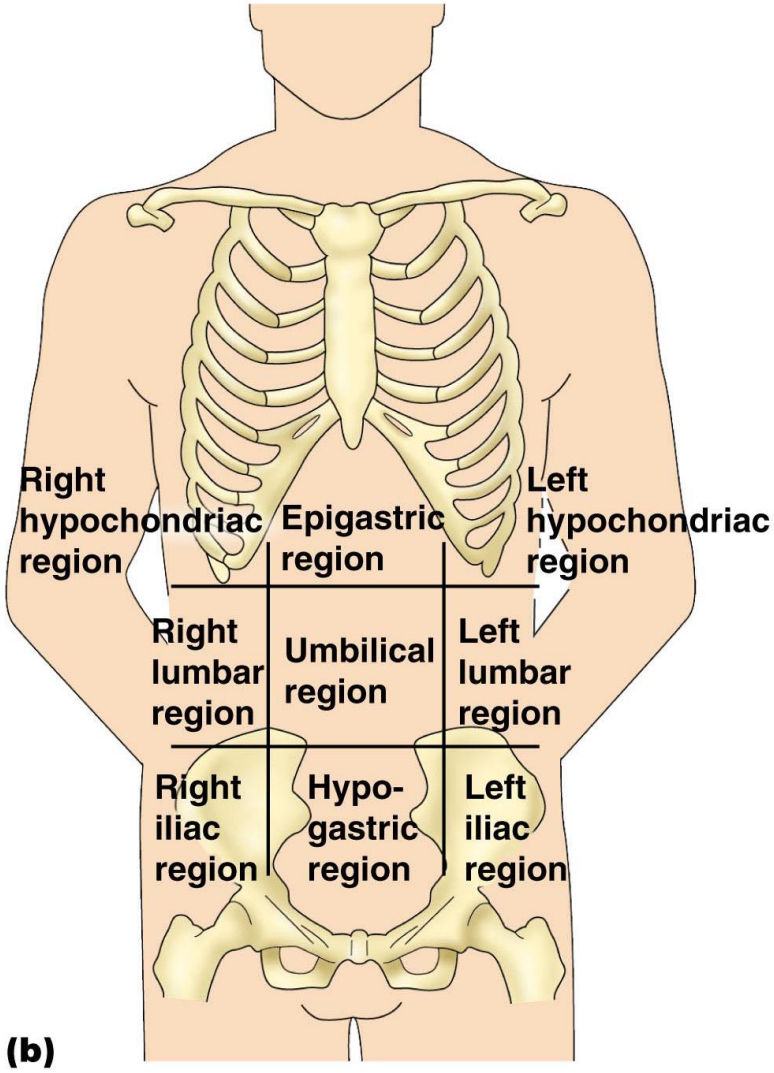
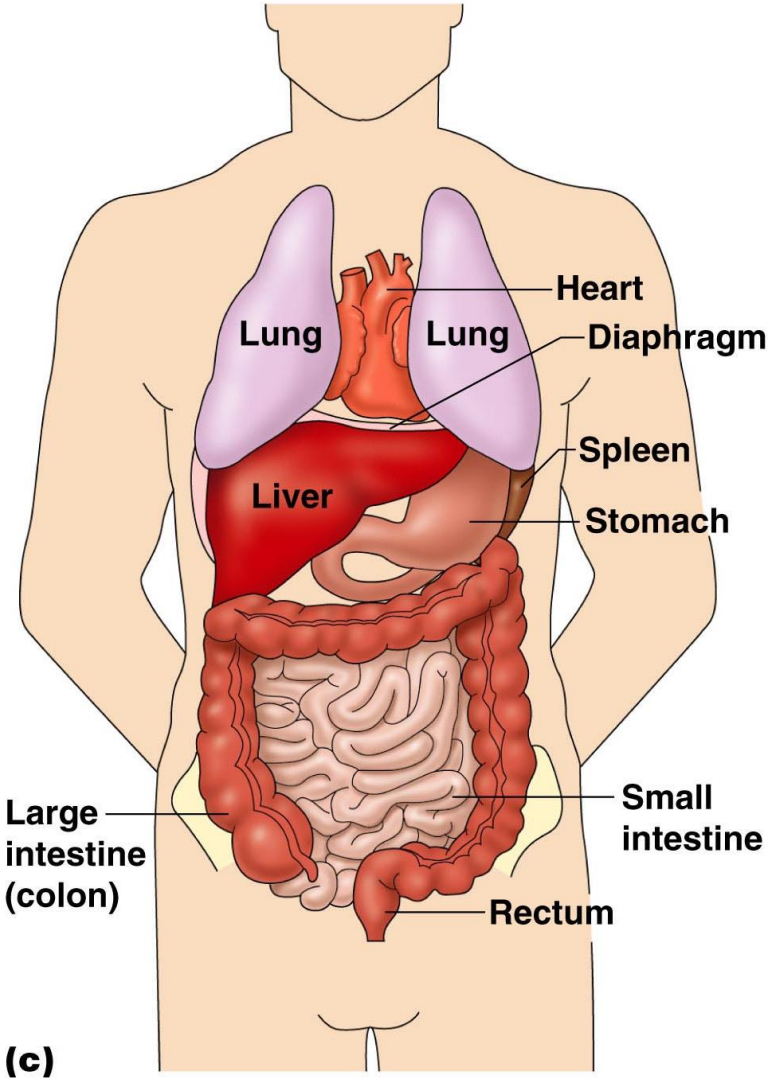


Figure 1.8b

Abdominopelvic Major Organs

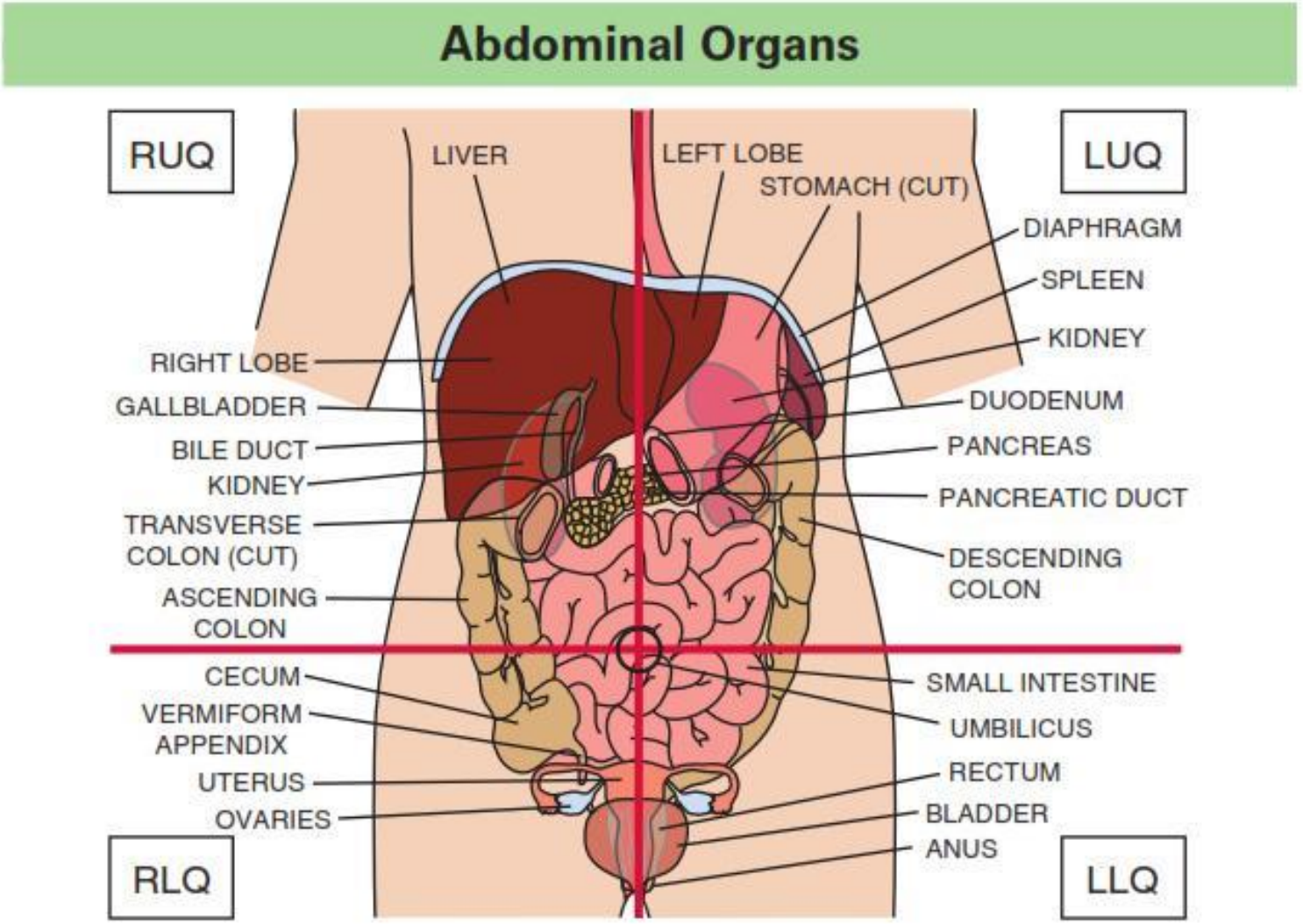


Question: If one was a victim of a very severe car accident, what organs are most vulnerable to traumatic injury and why?

Answer: The most vulnerable organs are those found in the abdominal cavity because they are only protected by trunk muscles and are not reinforced by bones like the thoracic, cranial and pelvic cavities are.

Figure 1.8c

Abdominal Organs

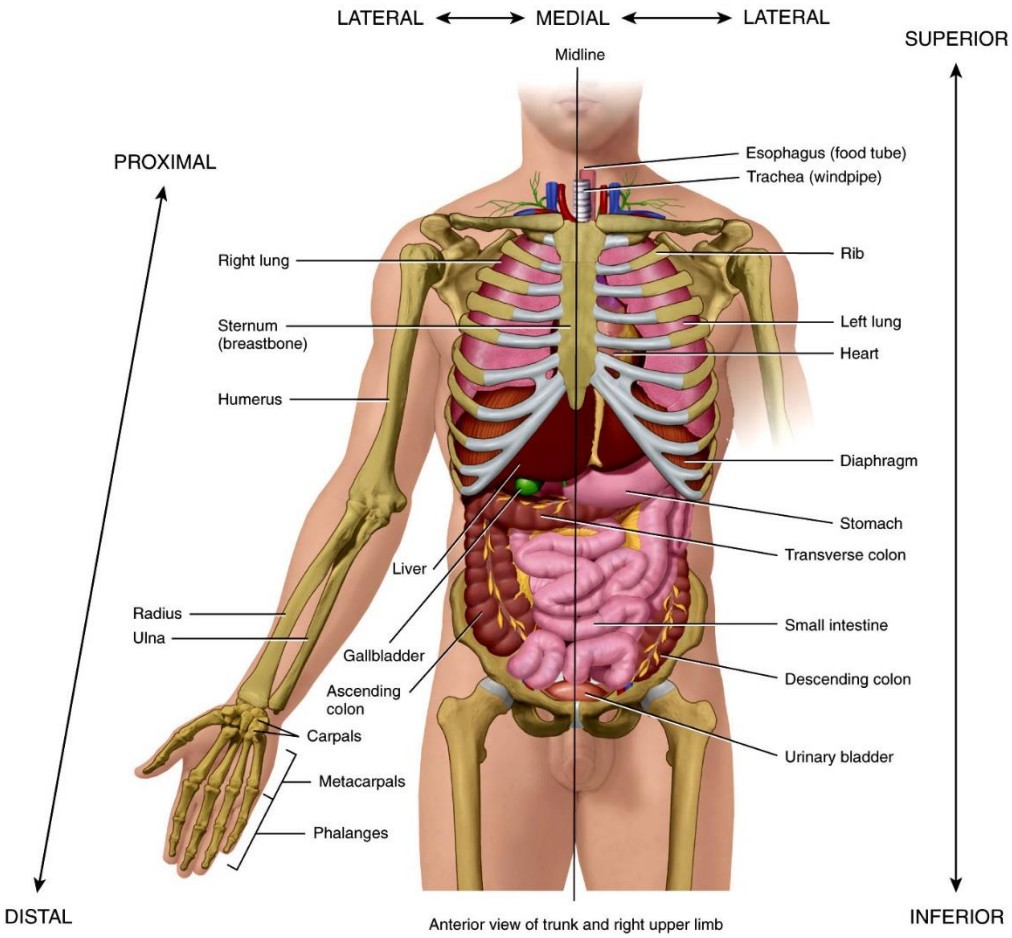


A Frame of Reference for Anatomical Studies

- **The location can help the physician determine the possible cause:**
  - **For example: tenderness in the right lower quadrant??**
  - **Tenderness in the right upper quadrant??**

Directional References

- Anterior or ventral
  - Nearer to the front of the body
- Posterior or dorsal
  - Nearer to the back of the body
- Superior or cranial
  - Toward the head
- Inferior or caudal
  - Away from the head

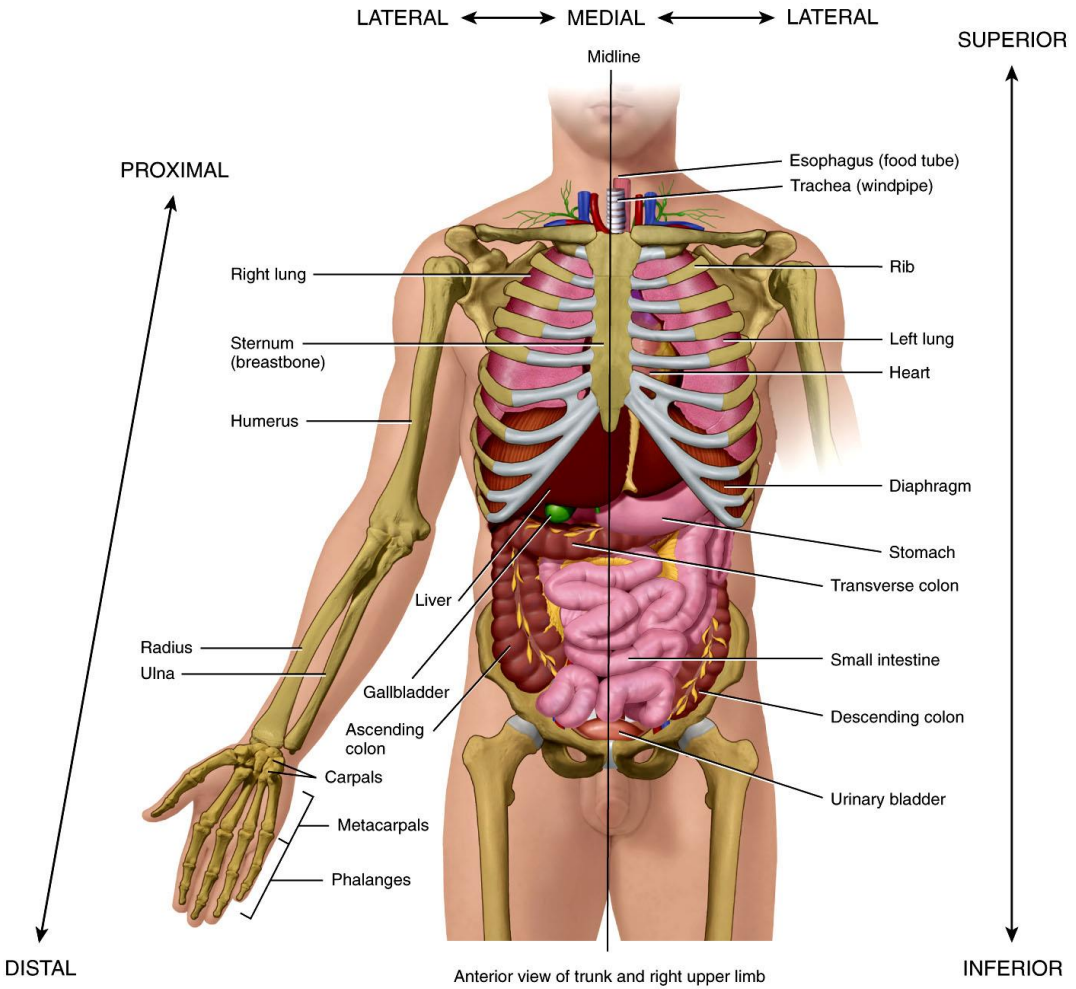


Anterior view of trunk and right upper limb

Figure 01.06 Tortora - PAP 12/e

Directional References

- **Proximal**
  - Nearer to the attachment of a limb to the trunk
- **Distal**
  - Farther from the attachment of a limb to the trunk
- **Lateral**
  - Farther from the midline
- **Medial**
  - Nearer to the midline

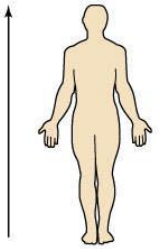
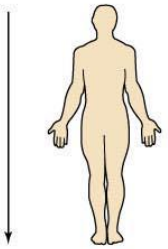
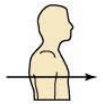


Anterior view of trunk and right upper limb

Figure 01.06 Tortora - PAP 12/e

Directional References

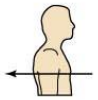
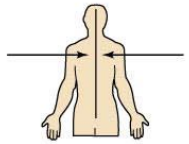
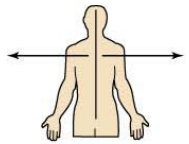
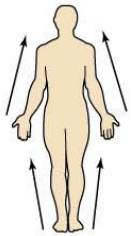
TABLE 1.1 Orientation and Directional Terms

Term	Definition	Illustration	Example
Superior (cranial or cephalad)	Toward the head end or upper part of a structure or the body; above		The forehead is superior to the nose.
Inferior (caudal)*	Away from the head end or toward the lower part of a structure or the body; below		The navel is inferior to the breastbone.
Ventral (anterior)†	Toward or at the front of the body; in front of		The breastbone is anterior to the spine.

*The term *caudal*, literally "toward the tail," is synonymous with *inferior* only to the inferior end of the spine.
†*Ventral* and *anterior* are synonymous in humans; this is not the case in four-legged animals. *Ventral* refers to the "belly" of an 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* refers to an animal's back. Thus, the dorsal surface of four-legged animals is their superior surface.

Directional References

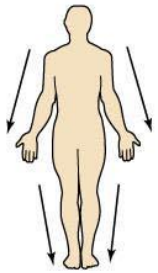
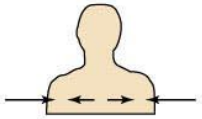
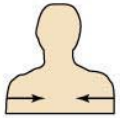
TABLE 1.1 Orientation and Directional Terms *(continued)*

Term	Definition	Illustration	Example
Dorsal (posterior)†	Toward or at the backside of the body; behind		The heart is posterior to the breastbone.
Medial	Toward or at the midline of the body; on the inner side of		The heart is medial to the arm.
Lateral	Away from the midline of the body; on the outer side of		The arms are lateral to the chest.
Proximal	Close to the origin of the body part or the point of attachment of a limb to the body trunk		The elbow is proximal to the wrist (meaning that the elbow is closer to the shoulder or attachment point of the arm than the wrist is).

*The term *caudal*, literally "toward the tail," is synonymous with *inferior* only to the inferior end of the spine.
†*Ventral* and *anterior* are synonymous in humans; this is not the case in four-legged animals. *Ventral* refers to the "belly" of an 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* refers to an animal's back. Thus, the dorsal surface of four-legged animals is their superior surface.

Directional References

TABLE 1.1 Orientation and Directional Terms *(continued)*

Term	Definition	Illustration	Example
Distal	Farther from the origin of a body part or the point of attachment of a limb to the body trunk		The knee is distal to the thigh.
Superficial (external)	Toward or at the body surface		The skin is superficial to the skeleton.
Deep (internal)	Away from the body surface; more internal		The lungs are deep to the rib cage.

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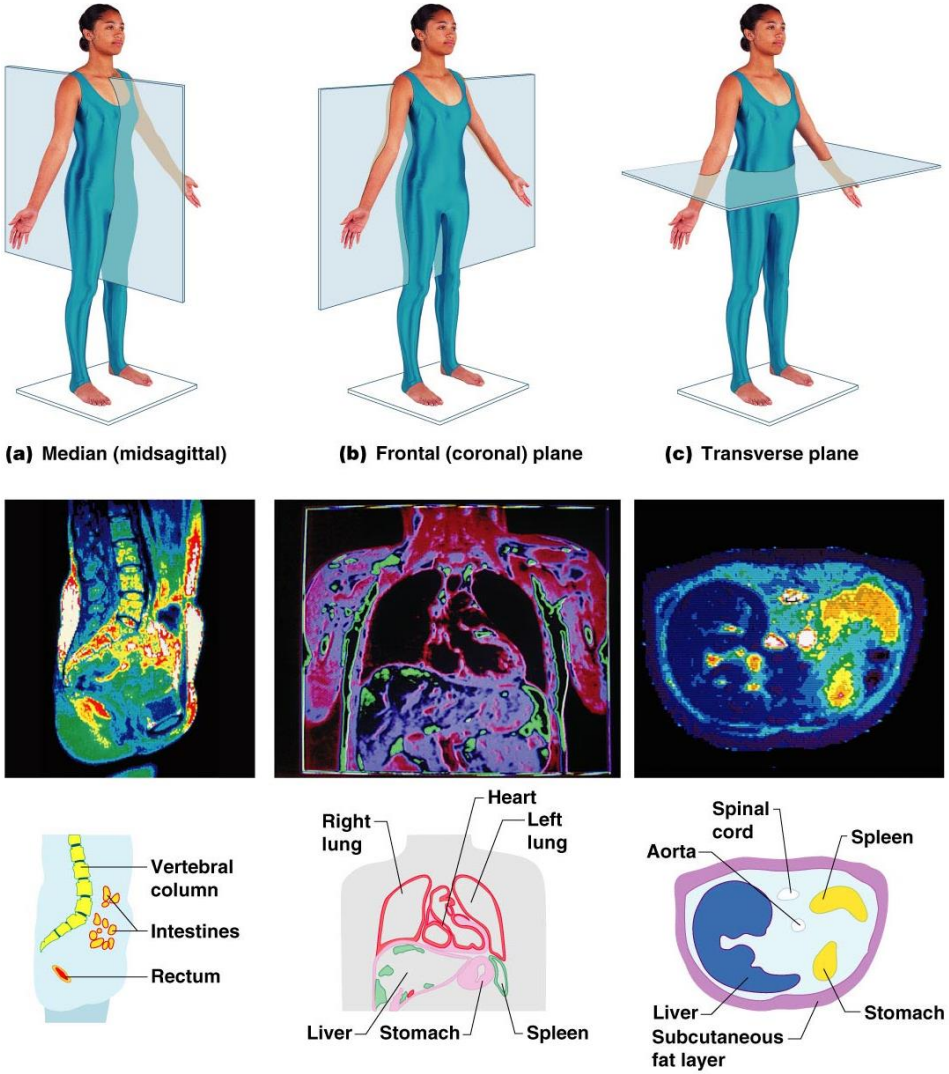
†*Ventral* and *anterior* are synonymous in humans; this is not the case in four-legged animals. *Ventral* refers to the "belly" of an animal and thus is the inferior surface of four-legged animals. Likewise, although the dorsal and posterior surfaces are the same in humans, the term *dorsal* refers to an animal's back. Thus, the dorsal surface of four-legged animals is their superior surface.

Planes and Sections are important in visualizing Structure

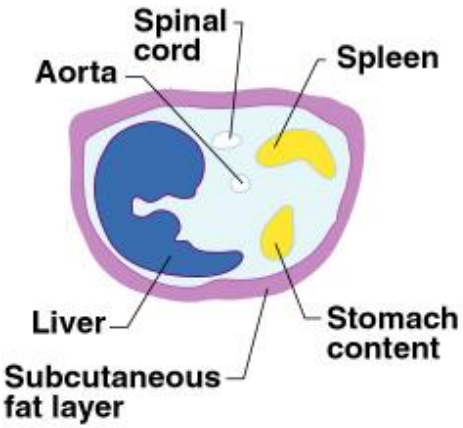
- Transverse or cross-sectional plane divides the body into superior and inferior
- Frontal (coronal) plane divides the body into anterior and posterior
- Sagittal plane divides the body into left and right
  - Midsagittal or median divides the body exactly down the middle (equal parts)

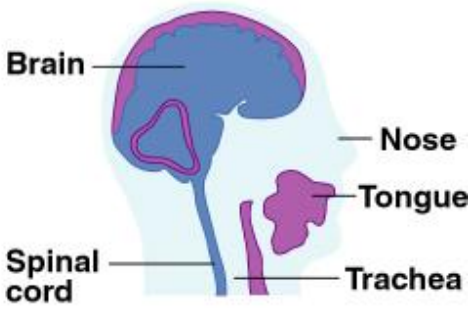
Body Planes and Sections



Body Planes and Sections

---------- Section ---------- Section ---------- Section





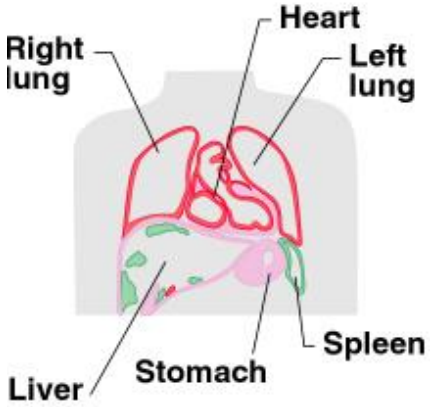
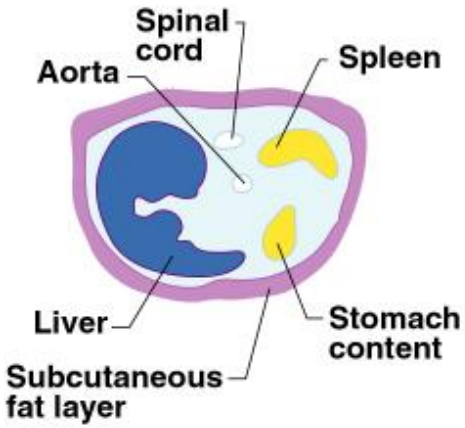


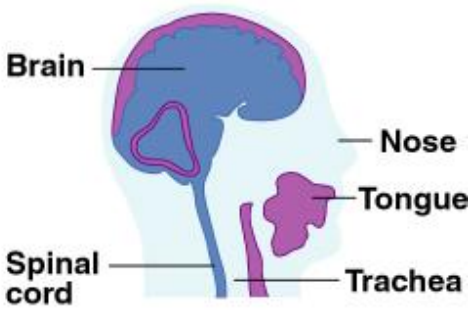
Figure 1.6

Body Planes and Sections

Cross Section



Sagittal Section



Coronal Section

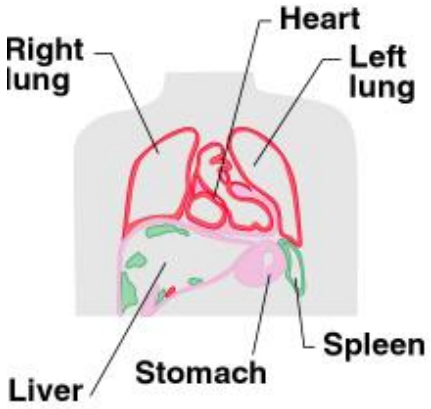


Figure 1.6

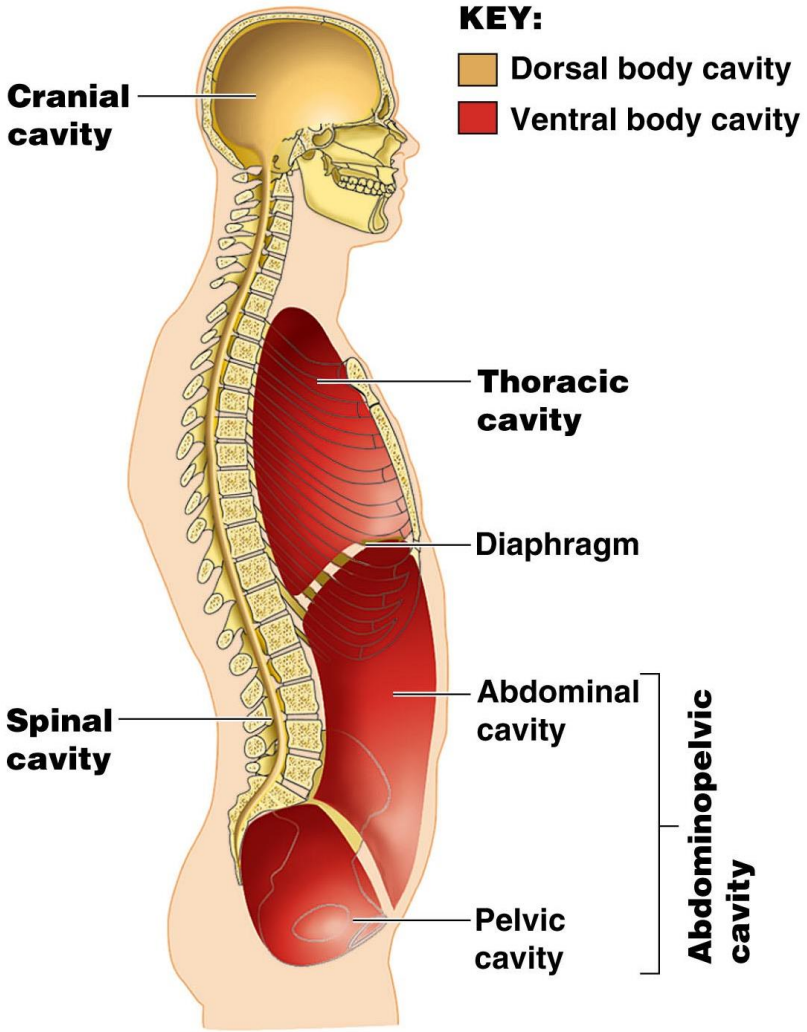
Body Cavities

- Body cavities are internal chambers holding vital organs
  - Cavities protect vital organs
  - Cavities allow organs to change in shape and size
- Two body cavities
  - Dorsal body cavity includes the cranial cavity and the spinal cavity
  - Ventral body cavity includes the thoracic cavity and the abdominopelvic cavity

Body Cavities

- Dorsal body cavity
  - Cranial cavity houses the brain
  - Spinal cavity houses the spinal cord
- Ventral body cavity
  - Thoracic cavity houses heart, lungs and others
  - Abdominopelvic cavity houses digestive system and most urinary system organs
    - Pelvic cavity contains urinary bladder, part of large intestine and internal organs of reproduction

Body Cavities



Other cavities include:

- Oral cavity
  - tongue and teeth
- Nasal cavity
  - Houses nose
- Orbital cavities
  - Houses eyeballs
- Middle ear cavities
  - Small bones of the middle ear
- Synovial cavities
  - Joints

Physiological Variation

- **Reference man: a healthy male, 22 years old, weighing 70 Kg, living at a mean ambient temperature of 20° C, engaging in light physical activity, and consuming 2 800 Kcal per day**

- **Reference woman: the same except for a weight of 58 Kg and an intake of 2 000 Kcal/day**