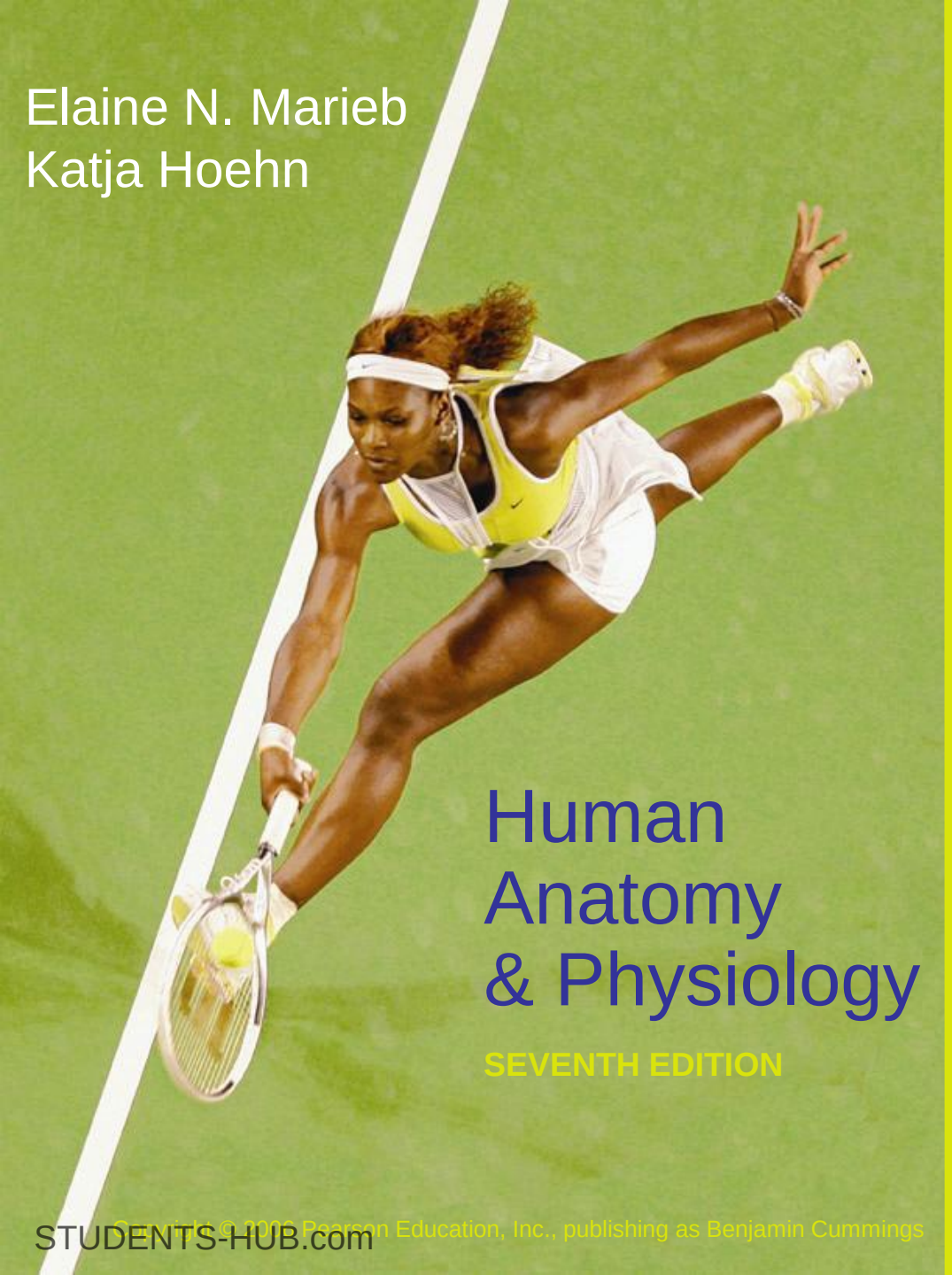
Elaine N. Marieb
Katja Hoehn



Human Anatomy & Physiology

SEVENTH EDITION

PowerPoint® Lecture Slides
prepared by Vince Austin,
Bluegrass Technical
and Community College

CHAPTER 1 PART A

The Human Body: An Orientation

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

Physiology

- Considers the operation of specific organ systems (talks about the function of the organs)
  - 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
  - the way muscle uses bone for movement

Principle of Complementarity

- Function always reflects structure
- What a structure can do depends on its specific form
- Physiology and anatomy are related to each other and they are inseparable.

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

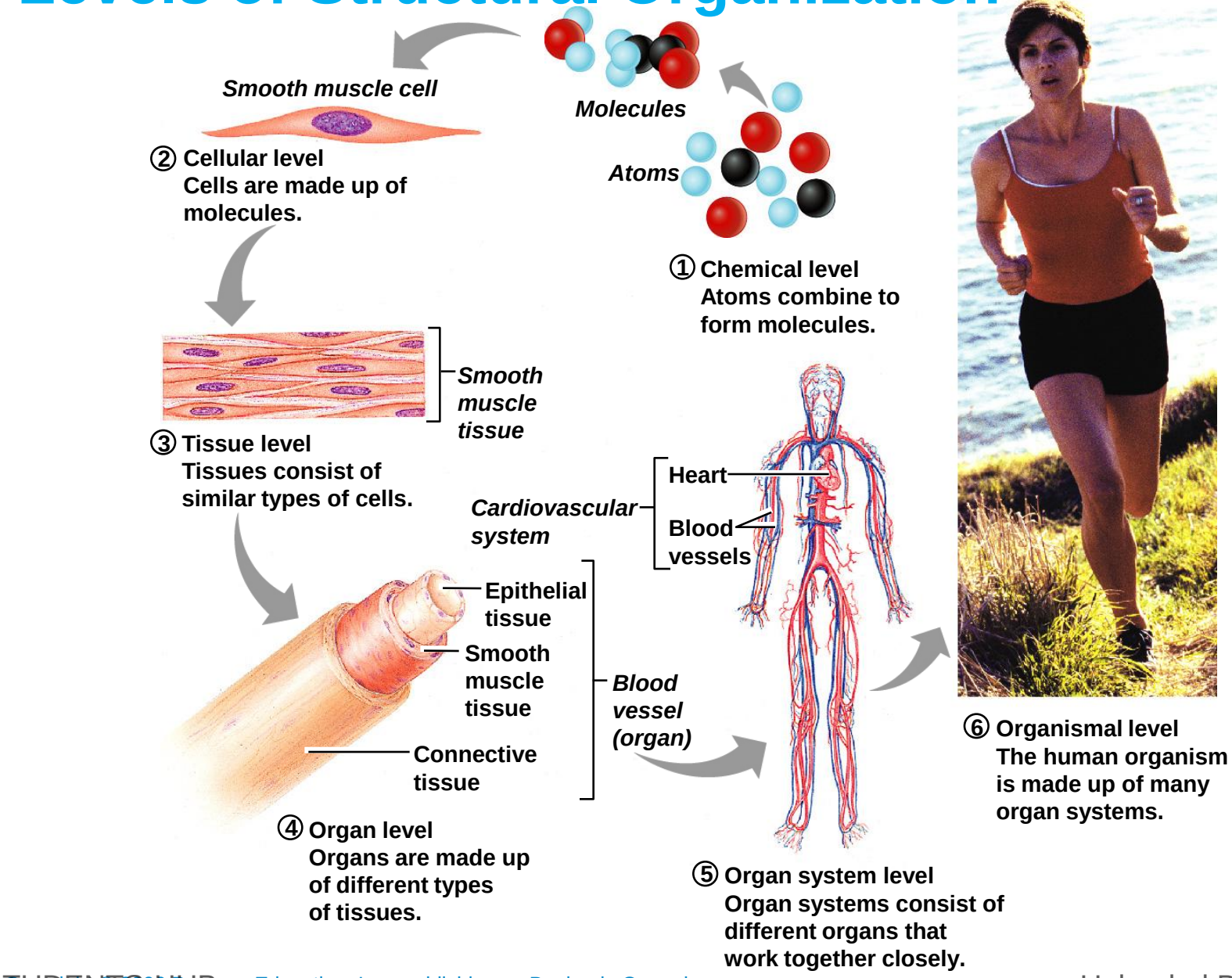
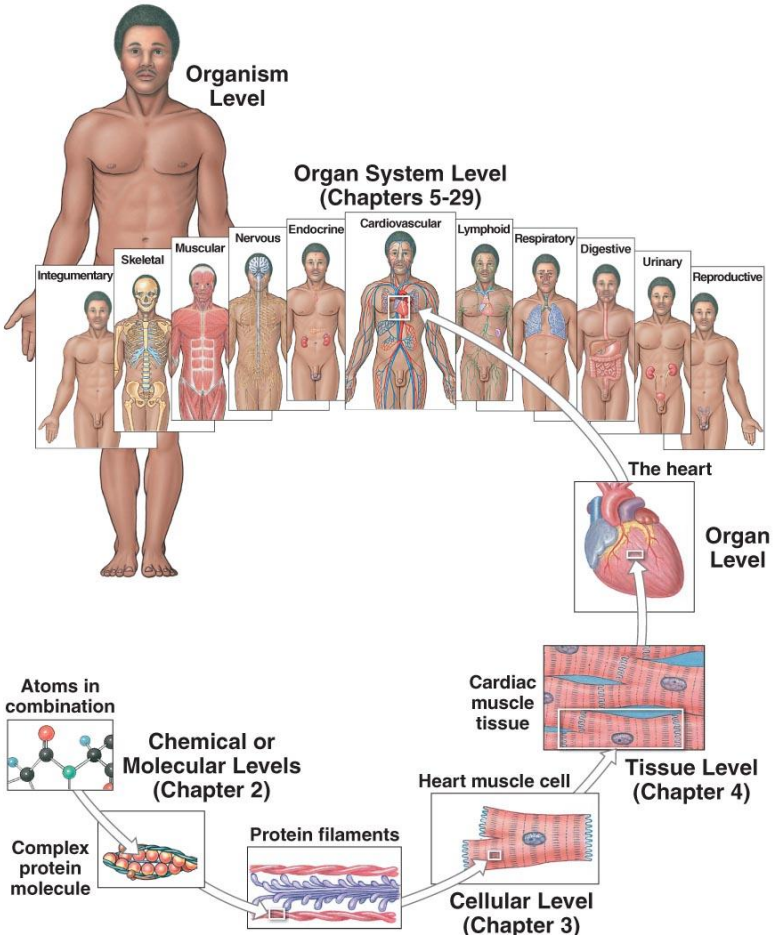


Figure 1.1

Levels of Organization



Organ Systems Interrelationships

- The integumentary system protects the body from the external environment
- Digestive and respiratory systems, in contact with the external environment, take in nutrients and oxygen

Organ Systems Interrelationships

- Nutrients and oxygen are distributed by the blood
- Metabolic wastes are eliminated by the urinary and respiratory systems

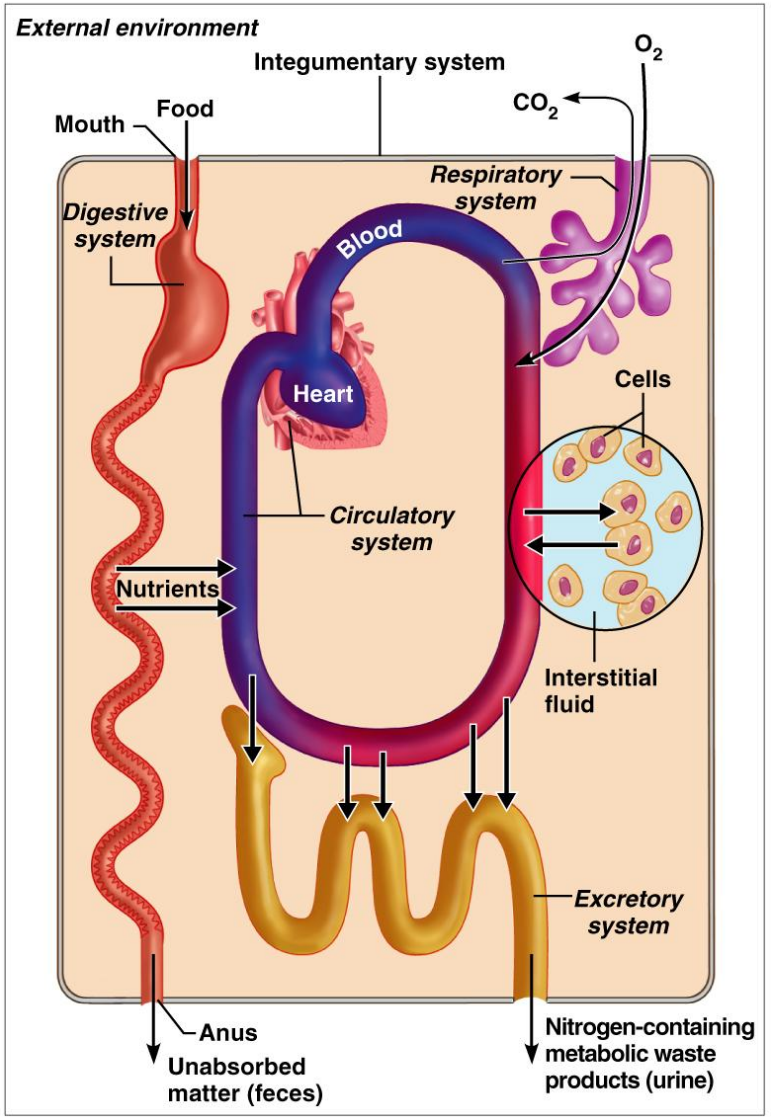


Figure 1.2

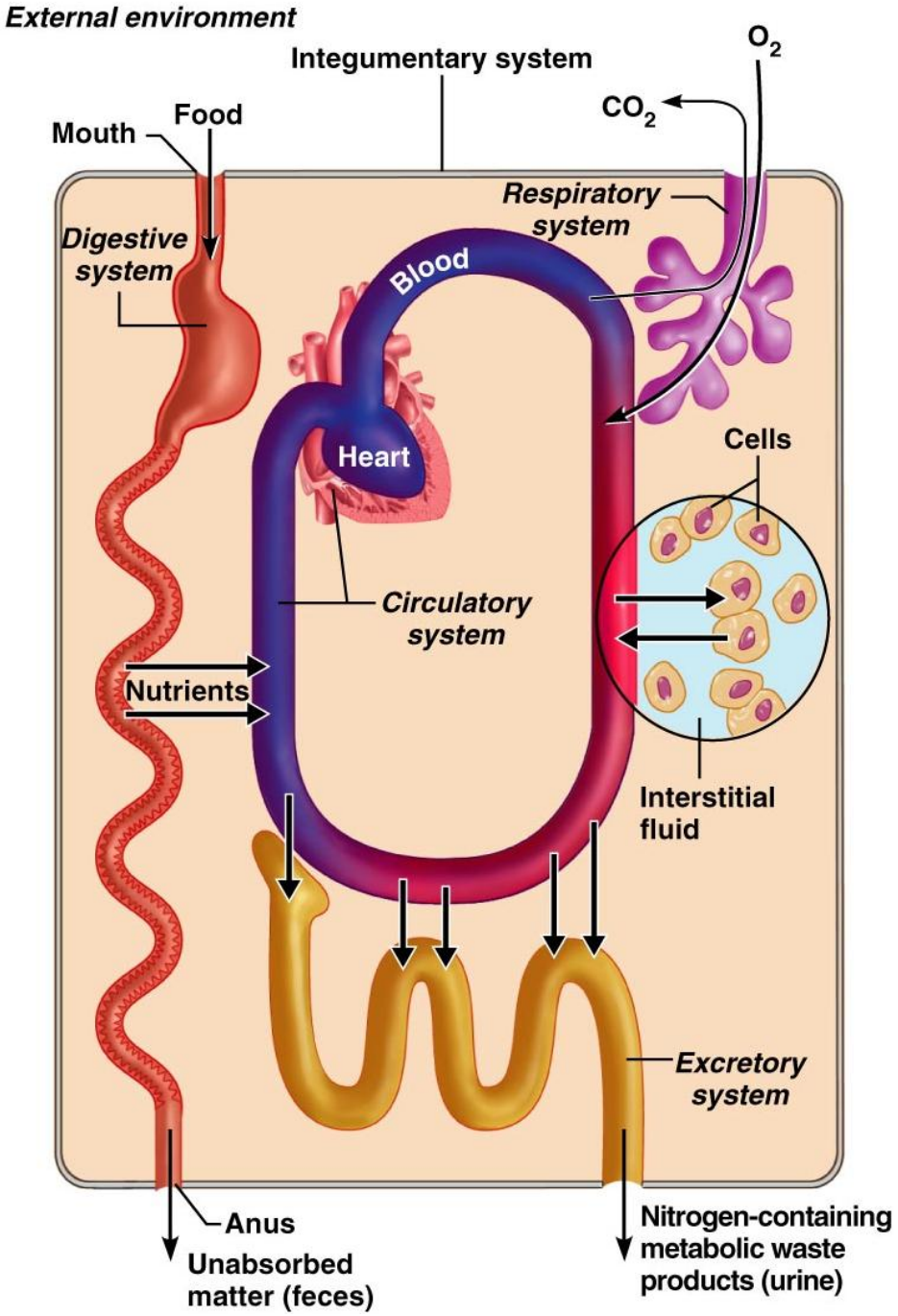


Figure 1.2

Necessary Life Functions

- Maintaining boundaries – the internal environment remains distinct from the external environment
  - **Cellular level** – accomplished by plasma membranes
  - **Organismal level** – accomplished by the skin
- Movement – locomotion, propulsion (peristalsis), and contractility

Necessary Life Functions

- Responsiveness – ability to sense changes in the environment and respond to them
- Digestion – breakdown of ingested foodstuffs
- Metabolism – all the chemical reactions that occur in the body
- Excretion – removal of wastes from the body

Necessary Life Functions

- Reproduction – cellular and organismal levels
  - Cellular – an original cell divides and produces two identical daughter cells
  - Organismal – sperm and egg unite to make a whole new person
- Growth – increase in size of a body part or of the organism

Homeostasis

- Homeostasis – ability to maintain a relatively stable internal environment in an ever-changing outside world
- The internal environment of the body is in a dynamic state of equilibrium
- Chemical, thermal, and neural factors interact to maintain homeostasis

Homeostasis

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**

Homeostatic Control Mechanisms

- Variables produce a change in the body
- The three interdependent components of control mechanisms:
  - Receptor – monitors the environments and responds to changes (stimuli)
  - Control center – determines the set point at which the variable is maintained
  - Effector – provides the means to respond to stimuli

Homeostatic Control Mechanisms

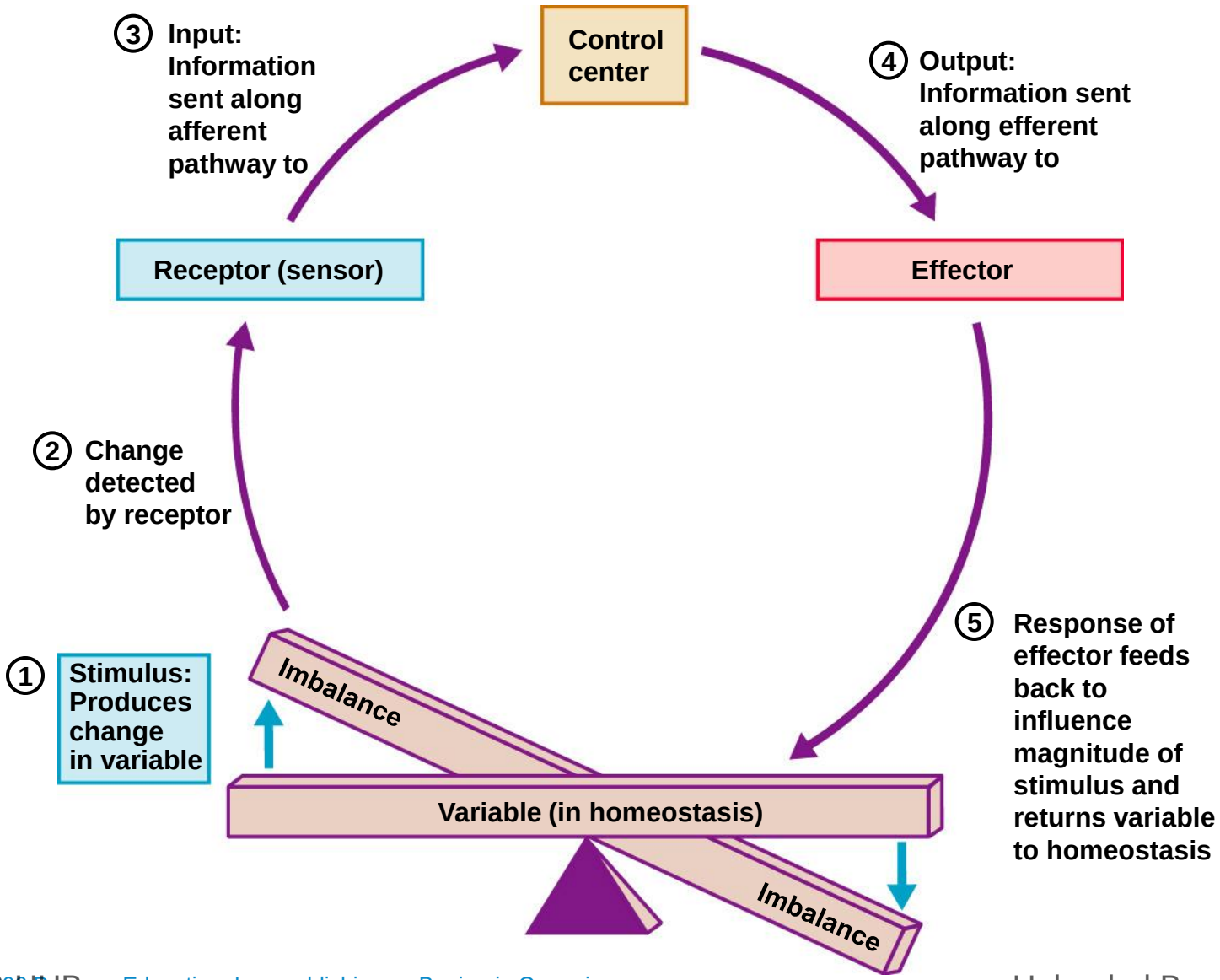


Figure 1.4

Negative Feedback

- In negative feedback systems, the output shuts off the original stimulus
- Example: Regulation of room temperature

Negative and Positive Feedback

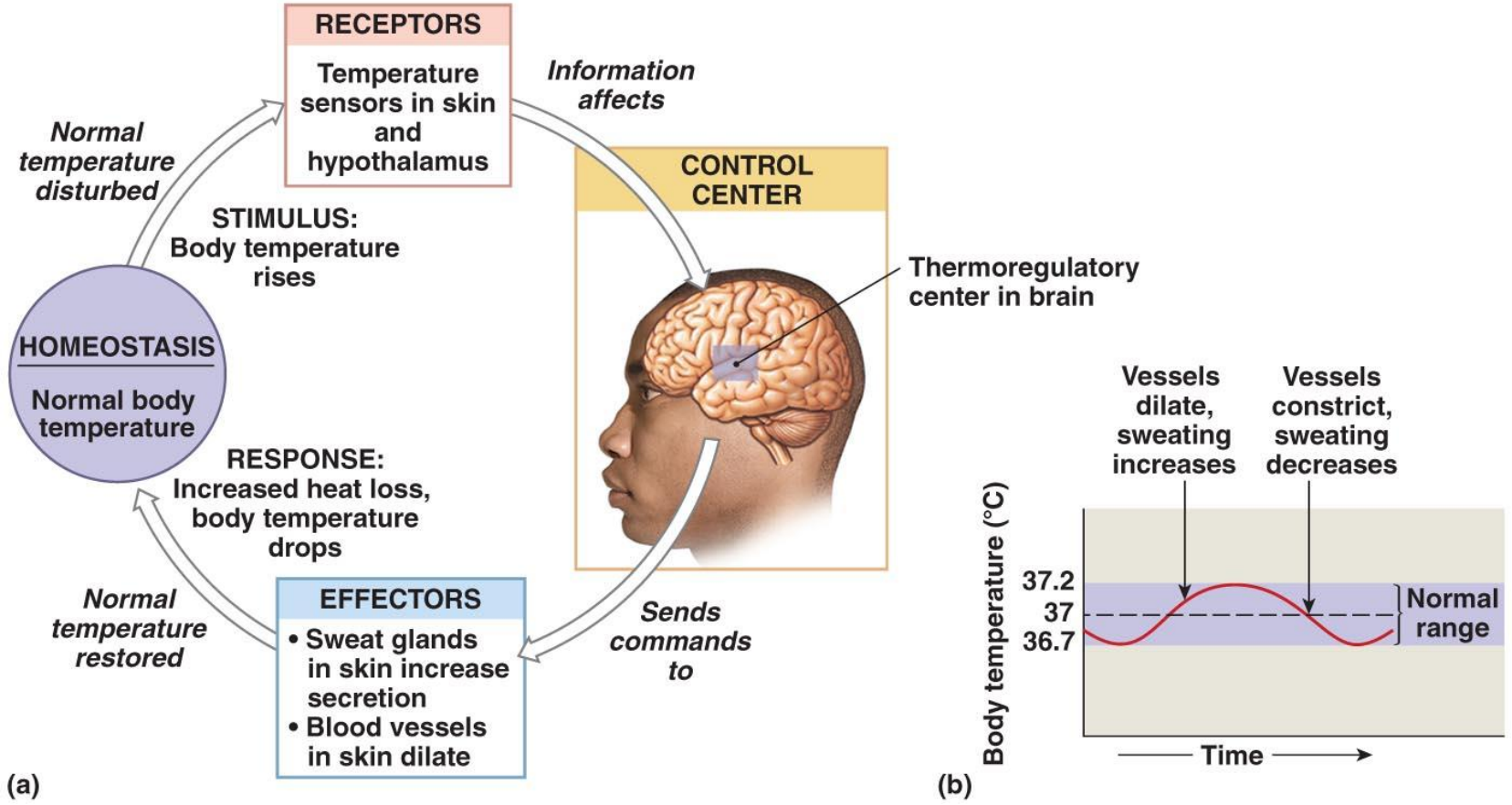


FIGURE 1–4 Negative Feedback in the Control of Body Temperature.

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

Positive Feedback

- In positive feedback systems, the output enhances or exaggerates the original stimulus
- Example: Regulation of blood clotting

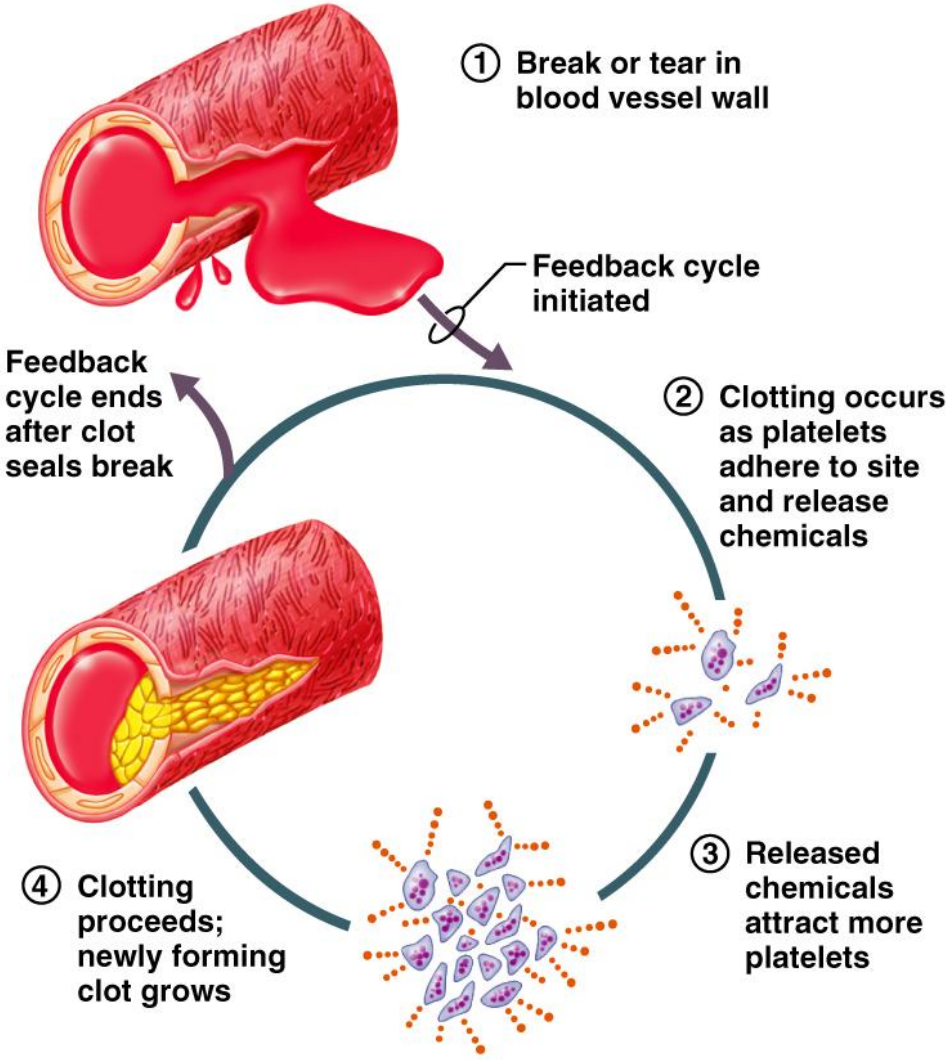


Figure 1.6

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

Internal Characteristic	Primary Organ Systems Involved	Functions of the Organ Systems
Body temperature	Integumentary system	Heat loss
	Muscular system	Heat production
	Cardiovascular system	Heat distribution
	Nervous system	Coordination of blood flow, heat production, and heat loss
Body fluid composition		
Nutrient concentration	Digestive system	Nutrient absorption, storage, and release
	Cardiovascular system	Nutrient distribution
	Urinary system	Control of nutrient loss in the urine
Oxygen, carbon dioxide levels	Respiratory system	Absorption of oxygen, elimination of carbon dioxide
	Cardiovascular system	Internal transport of oxygen and carbon dioxide
Body fluid volume	Urinary system	Elimination or conservation of water from the blood
	Digestive system	Absorption of water; loss of water in feces
	Integumentary system	Loss of water through perspiration
	Cardiovascular system	Distribution of water
Waste product concentration	Urinary system	Elimination of waste products from the blood
	Digestive system	Elimination of waste products by the liver in feces
	Cardiovascular system	Transport of waste products to sites of excretion
Blood pressure	Cardiovascular system	Pressure generated by the heart moves blood through blood vessels
	Nervous system and endocrine system	Adjustments in heart rate and blood vessel diameter can raise or lower blood pressure

Anatomical Terminology

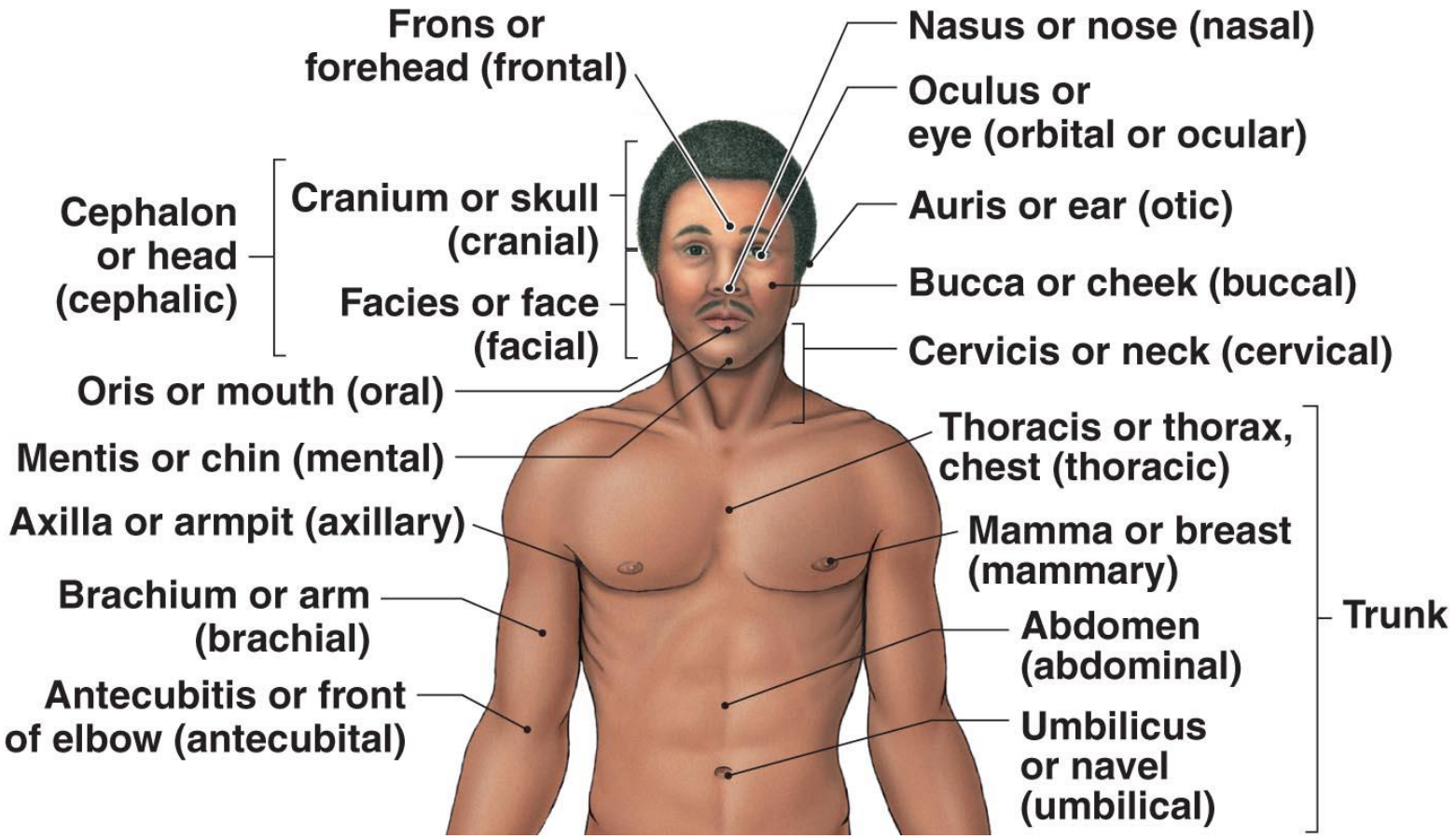


FIGURE 1–6 Anatomical Landmarks. Anterior

Anatomical Terminology

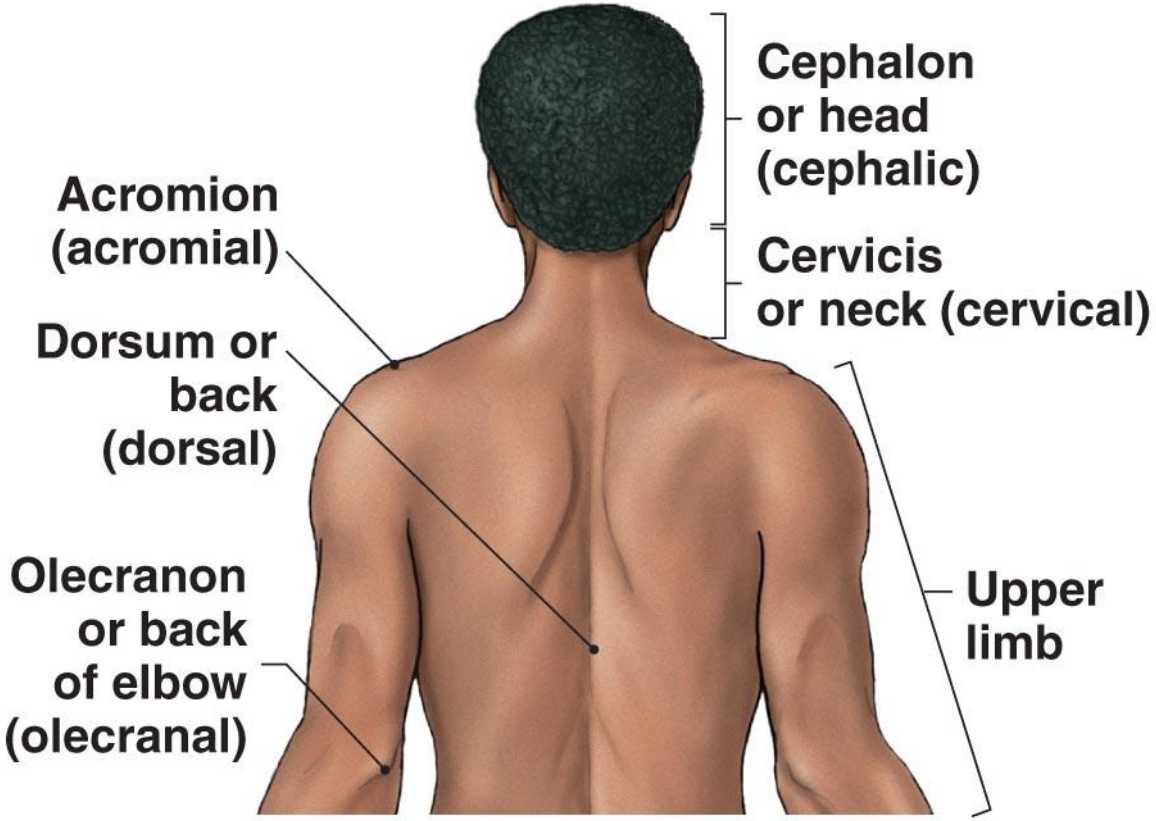


FIGURE 1–6 Anatomical Landmarks. Posterior

Anatomical Position

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

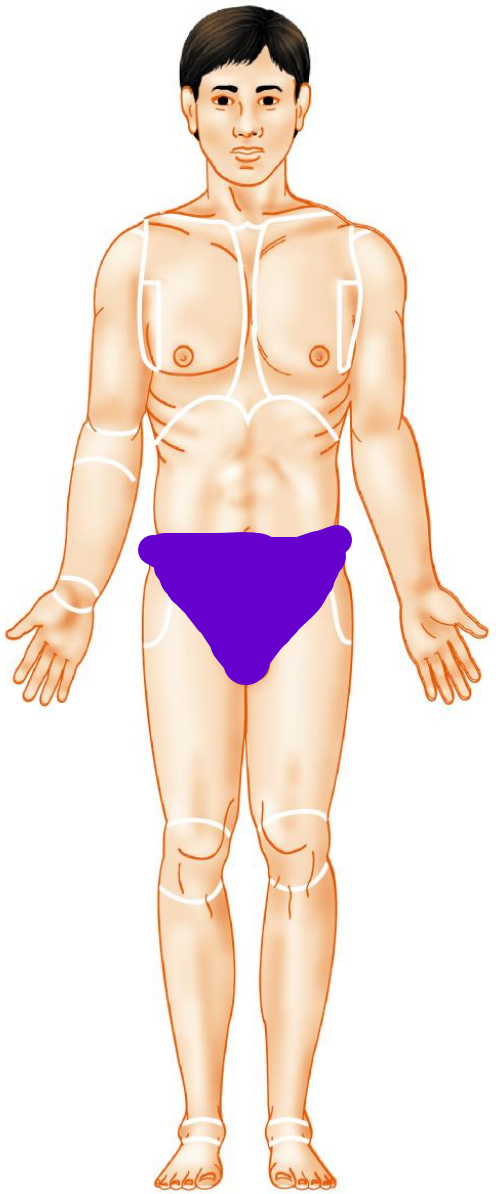


Figure 1.7a

Directional Terms

Superior and inferior – toward and away from the head, respectively

Anterior and posterior – toward the front and back of the body

Medial, lateral, and intermediate – toward the midline, away from the midline, and between a more medial and lateral structure

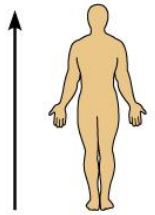
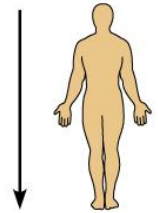
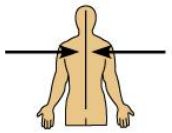
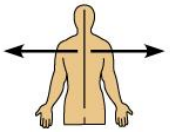
Directional Terms

Proximal and distal – closer to and farther from the origin of the body part

Superficial and deep – toward and away from the body surface

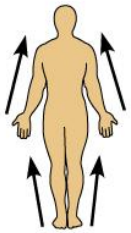
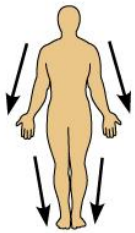
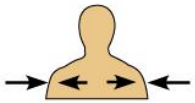
Directional Terms

TABLE 1.1 Orientation and Directional Terms

TERM	DEFINITION	EXAMPLE	
Superior (cranial)	Toward the head end or upper part of a structure or the body; above		The head is superior to the abdomen
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 chin
Ventral (anterior)*	Toward or at the front of the body; in front of		The breastbone is anterior to the spine
Dorsal (posterior)*	Toward or at the back 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
Intermediate	Between a more medial and a more lateral structure		The collarbone is intermediate between the breastbone and shoulder

Directional Terms

TABLE 1.1 Orientation and Directional Terms

TERM	DEFINITION	EXAMPLE	
Proximal	Closer 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
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 skeletal muscles
Deep (internal)	Away from the body surface; more internal		The lungs are deep to the skin

*The terms *ventral* and *anterior* are synonymous in humans, but this is not the case in four-legged animals. Whereas *anterior* refers to the leading portion of the body (abdominal surface in humans, head in a cat), *ventral* specifically refers to the "belly" of a vertebrate animal and thus is the inferior surface of four-legged animals. Likewise, although the dorsal and posterior surfaces are the same in humans, the term *dorsal* specifically refers to an animal's back. Thus, the dorsal surface of four-legged animals is their superior surface.

Body Planes

Sagittal – divides the body into right and left parts

Midsagittal or medial – sagittal plane that lies on the midline

Frontal or coronal – divides the body into anterior and posterior parts

Transverse or horizontal (cross section) – divides the body into superior and inferior parts

Oblique section – cuts made diagonally

Body Planes

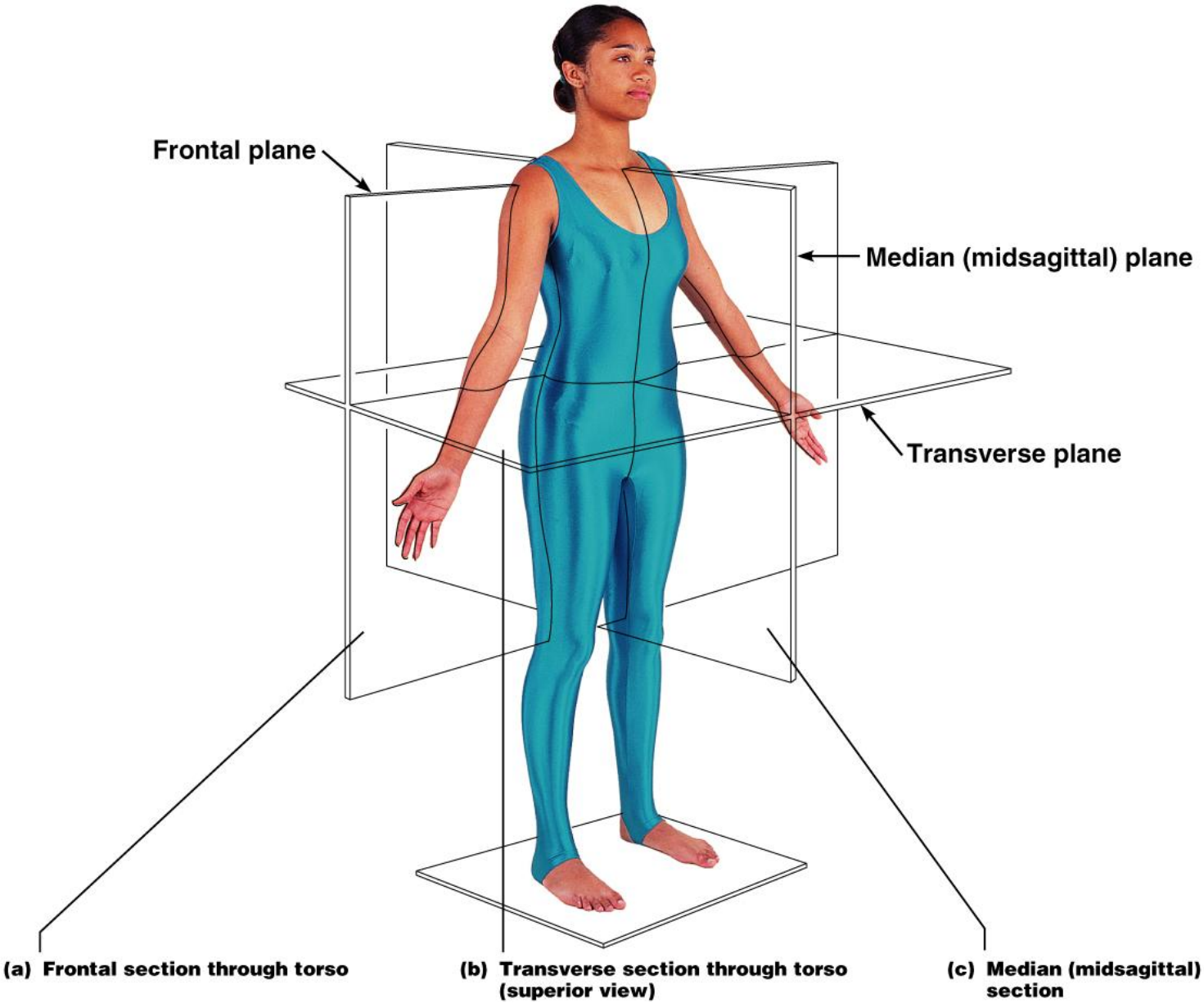


Figure 1.8

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

Serous Membrane Relationship

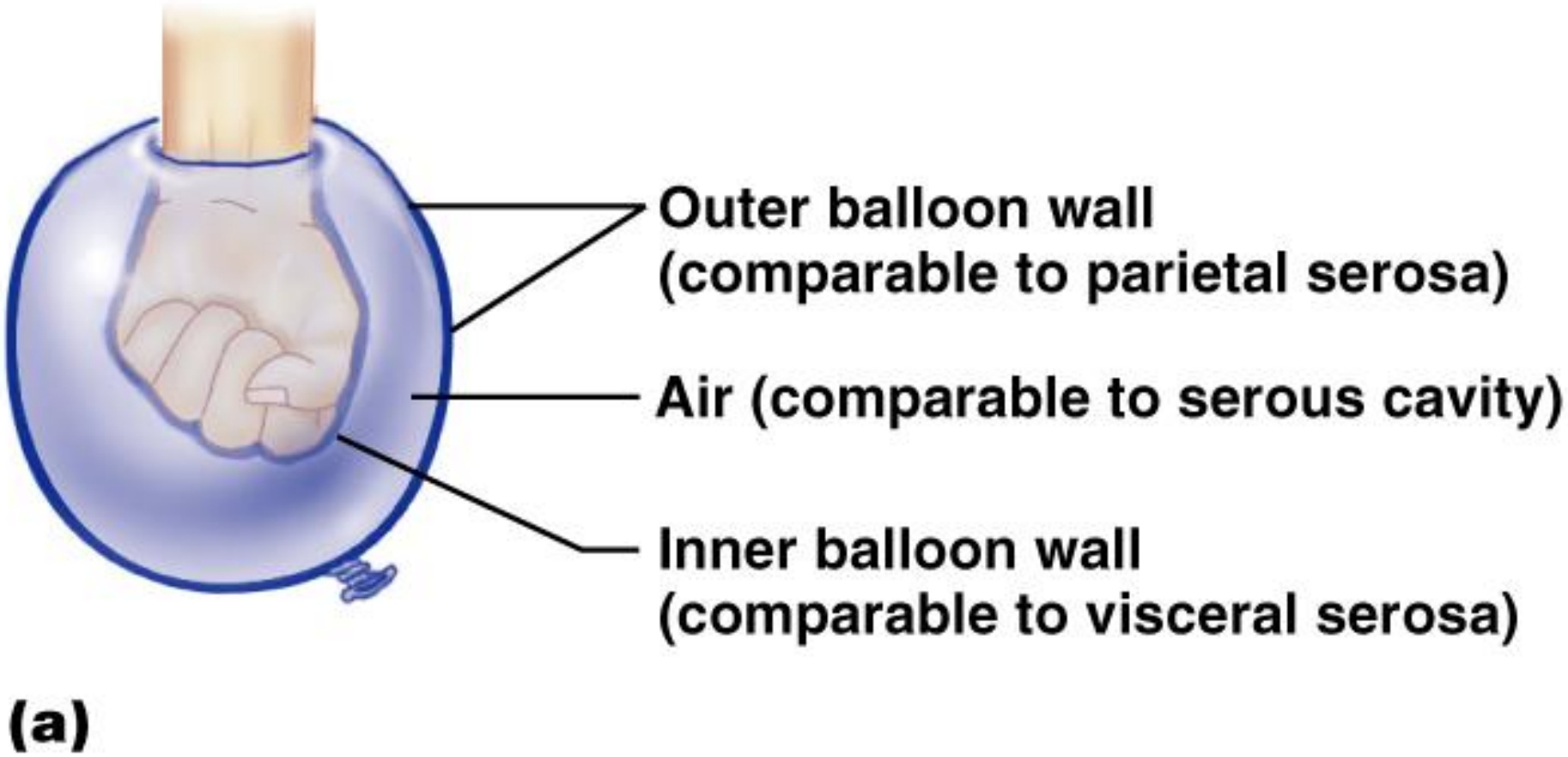
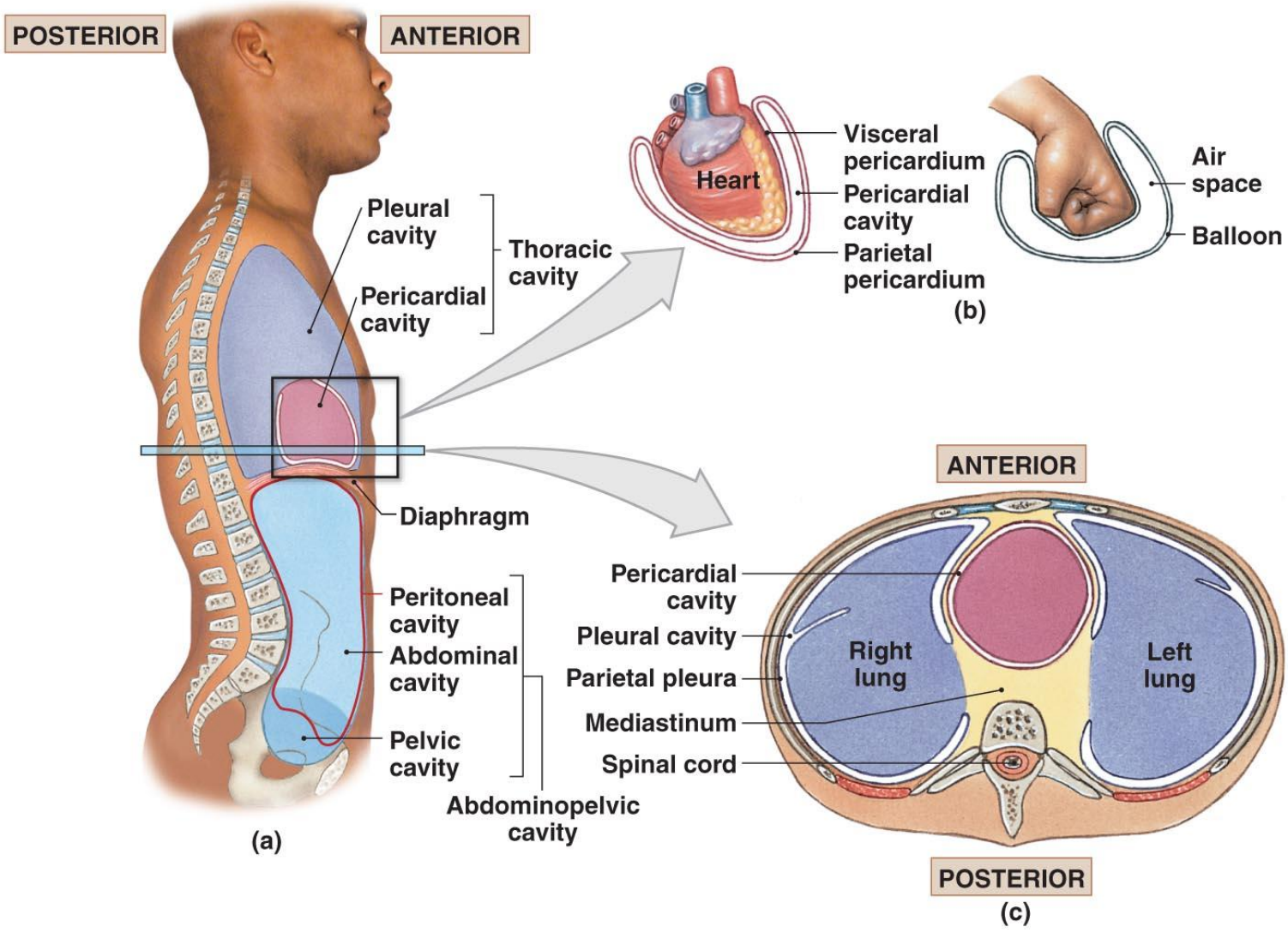


Figure 1.10a

Body Cavities



Body Cavities

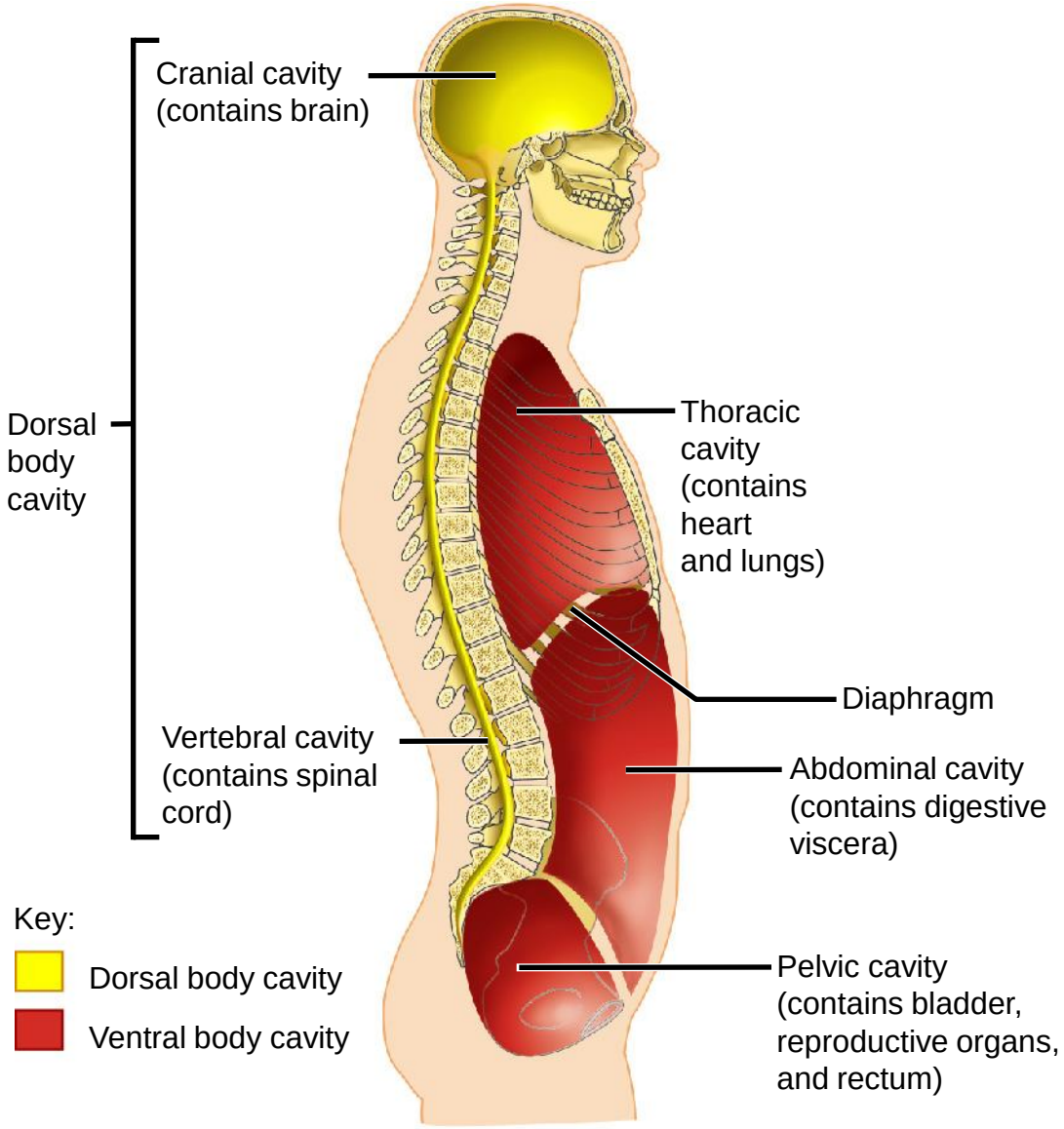
Dorsal cavity protects the nervous system, and is divided into two subdivisions

- Cranial cavity – within the skull; encases the brain
- Vertebral cavity – runs within the vertebral column; encases the spinal cord

Ventral cavity houses the internal organs (viscera), and is divided into two subdivisions

- Thoracic
- Abdominopelvic

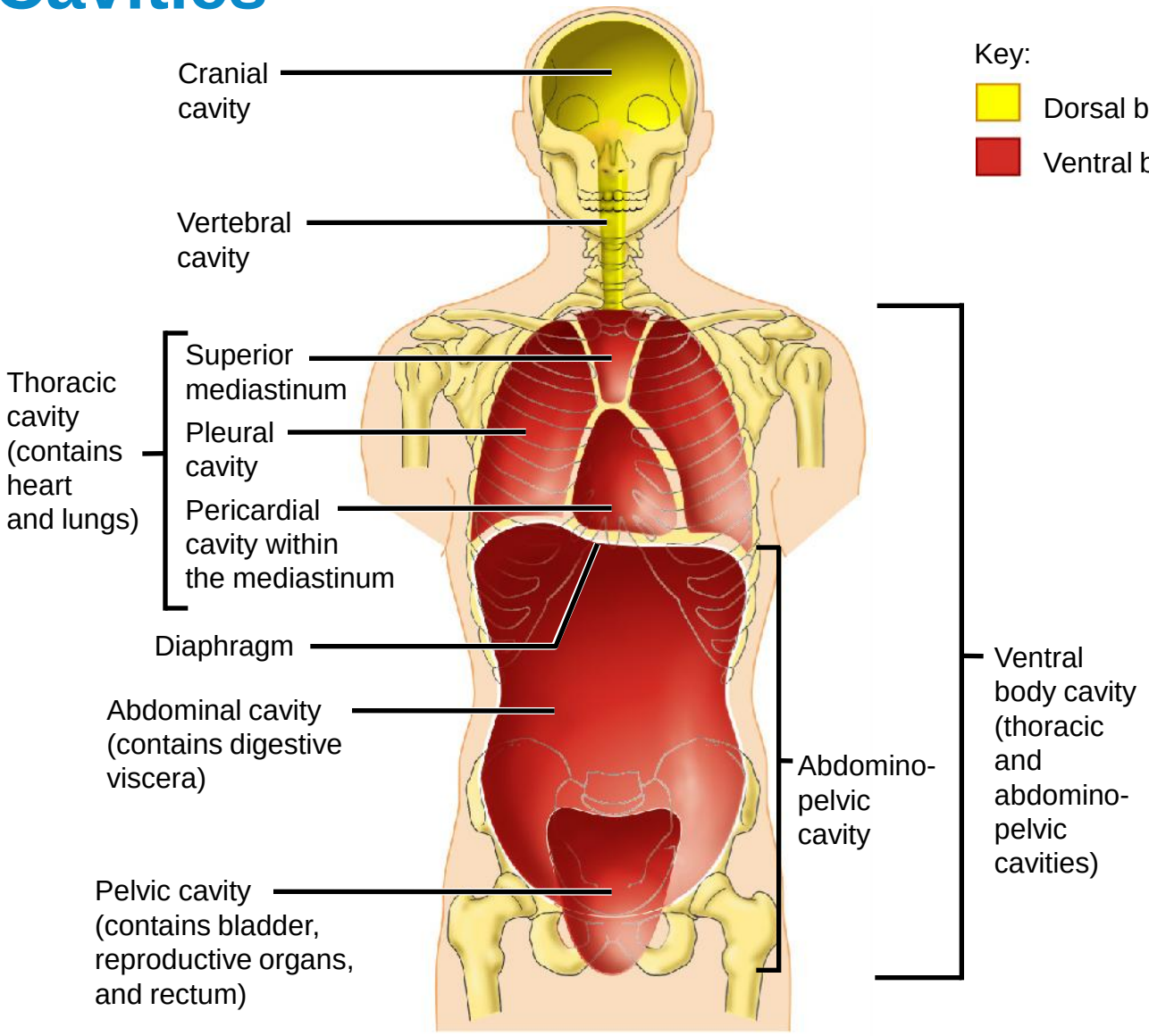
Body Cavities



(a) Lateral view

Figure 1.9a

Body Cavities



(b) Anterior view

Figure 1.9b

Body Cavities

Thoracic cavity is subdivided into two pleural cavities, the mediastinum, and the pericardial cavity

Pleural cavities – each houses a lung

Mediastinum – contains the pericardial cavity; surrounds the remaining thoracic organs

Pericardial cavity – encloses the heart

Body Cavities

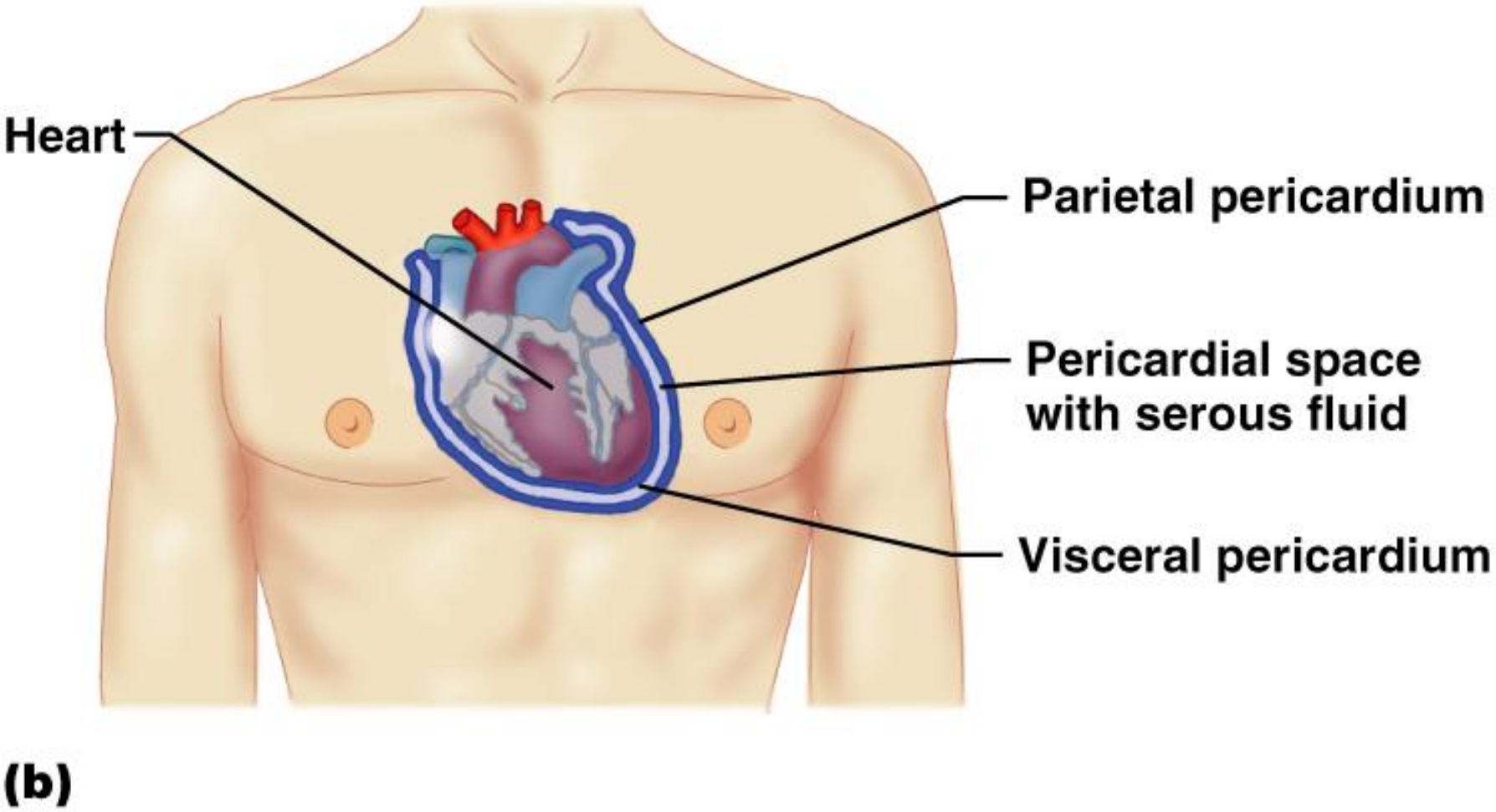
The abdominopelvic cavity is separated from the superior thoracic cavity by the dome-shaped diaphragm

It is composed of two subdivisions

Abdominal cavity – contains the stomach, intestines, spleen, liver, and other organs

Pelvic cavity – lies within the pelvis and contains the bladder, reproductive organs, and rectum

Heart Serosae



Other Body Cavities

Oral and digestive – mouth and cavities of the digestive organs

Nasal –located within and posterior to the nose

Orbital – house the eyes

Middle ear – contains bones (ossicles) that transmit sound vibrations

Synovial – joint cavities

Other Body Cavities

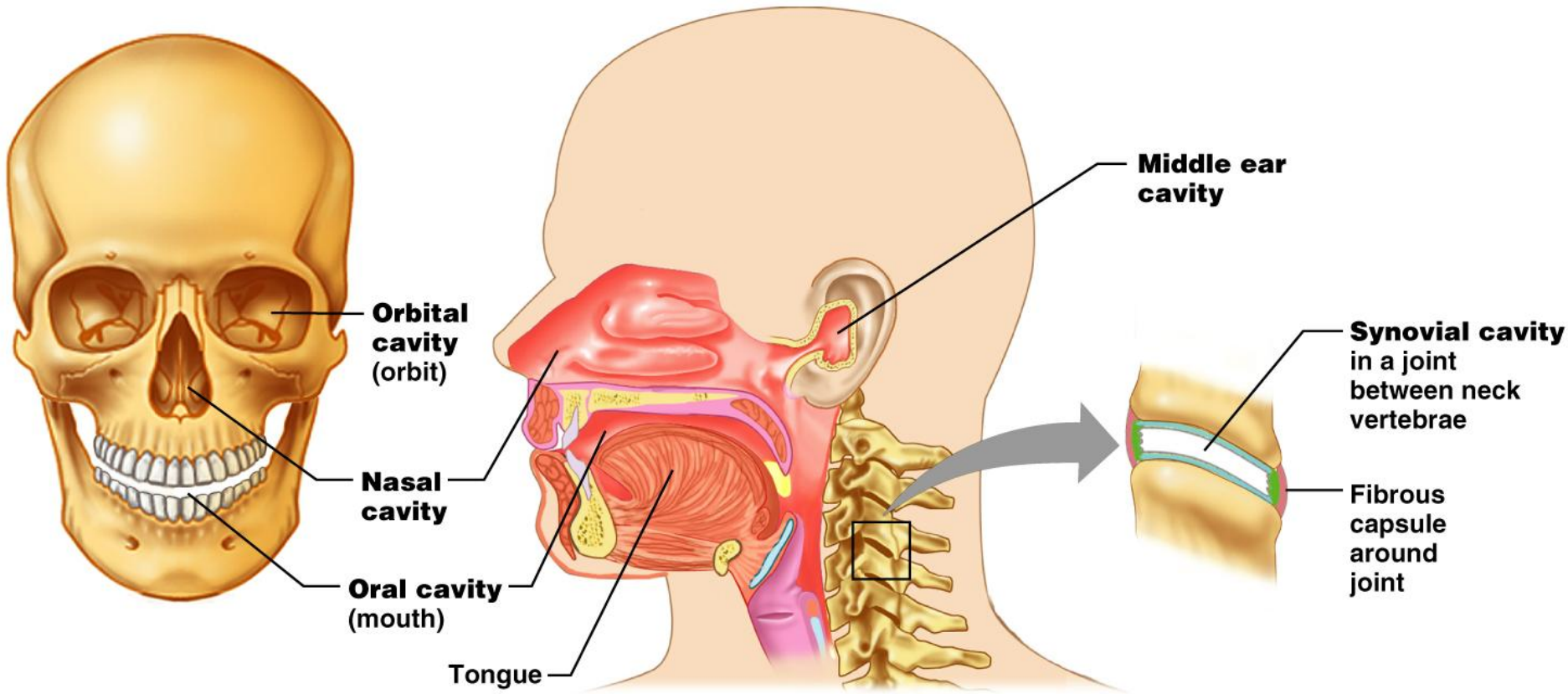


Figure 1.13