

Chapter 31 - Animal Organization and Homeostasis

Friday, March 9th 2012

Outline

- Tissue Types
 - Epithelial
 - Connective
 - Muscular
 - Nervous
- Organs
- Organ Systems
- Homeostasis
 - Negative Feedback
 - Positive Feedback

Levels of Organization

- Tissue - Group of similar cells performing a similar function
- Organ - Group of tissues performing a specialized function
- Organ System - Collection of several organs functioning together
- Organism - A collection of organ systems

Tissues and Tissue Types

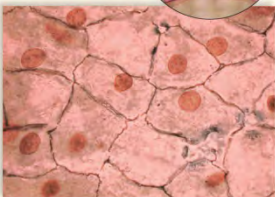
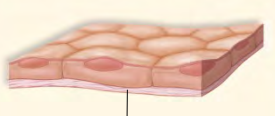
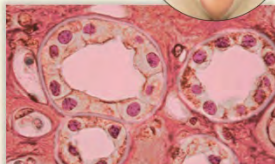
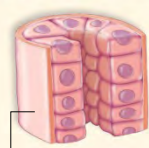

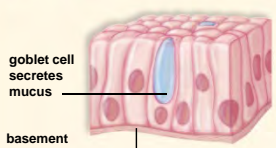

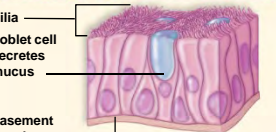
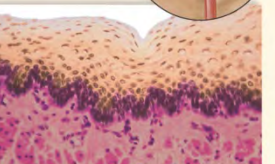
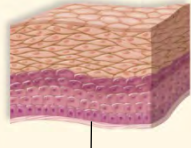
- Tissues are:
 - Collections of specialized cells and cell products organized to perform a limited number of functions
 - Histology = study of tissues
- The four tissue types are:
 - Epithelial
 - Connective
 - Muscular
 - Nervous

Epithelial Tissue

- Includes glands and epithelium
 - Glands are secretory
 - Exocrine glands - Secrete products into ducts or cavities
 - Endocrine glands - Secrete products directly into the bloodstream
- Is avascular
- Forms a protective barrier that regulates permeability
- Cells may show polarity

Types of Epithelial Tissues in the Vertebrates

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<p>Simple squamous</p> <ul style="list-style-type: none"> • lining of lungs, blood vessels • protects   <p>basement membrane</p>	<p>Simple cuboidal</p> <ul style="list-style-type: none"> • lining of kidney tubules, various glands • absorbs molecules   <p>basement membrane</p>	<p>Simple columnar</p> <ul style="list-style-type: none"> • lining of small intestine, oviducts • absorbs nutrients   <p>goblet cell secretes mucus</p> <p>basement membrane</p>	<p>Pseudostratified, ciliated columnar</p> <ul style="list-style-type: none"> • lining of trachea • sweeps impurities toward throat   <p>cilia</p> <p>goblet cell secretes mucus</p> <p>basement membrane</p>	<p>Stratified squamous</p> <ul style="list-style-type: none"> • lining of nose, mouth, esophagus, anal canal, vagina • protects   <p>basement membrane</p>
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(All). © Ed Reschke

Epithelial Tissue

- Epithelial tissue:
 - Forms a continuous layer over body surfaces
 - Lines inner cavities
 - Covers abdominal organs
- Functions of epithelial tissue
 - Physical protection
 - Control permeability
 - Provide sensation
 - Produce specialized secretions

Classification of Epithelial Tissue

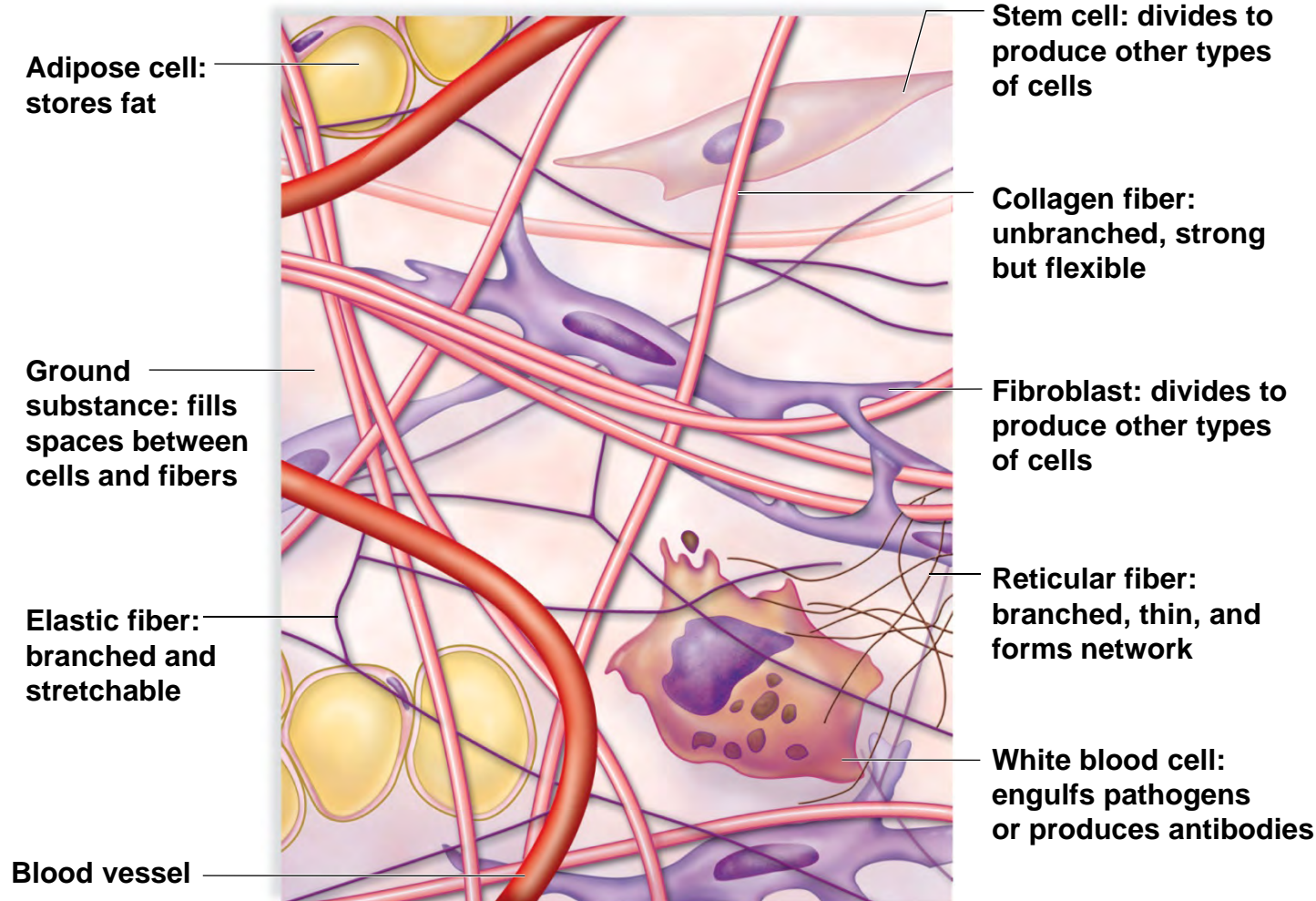
- Number of cell layers
 - Simple
 - Stratified
- Shape of apical surface cells
 - Squamous
 - Cuboidal
 - Columnar

Connective Tissue

- Connective tissues consist of:
 - Fibroblast cells
 - A matrix containing collagen and elastic fibers
- Loose fibrous connective tissue
 - Allows organs to expand
- Dense fibrous connective tissue
 - Strong connective tissue
 - Tendons
 - Ligaments

Diagram of Fibrous Connective Tissue

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Connective Tissue

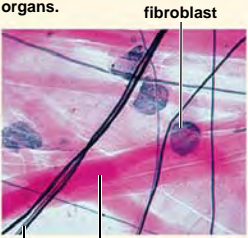
- Adipose Tissue
 - Insulates the body and provides padding
- Cartilage
 - Classified according to type of collagen and elastic fibers found in the matrix
 - Cartilage cells (chondrocytes), lie in small chambers (lacunae) in the matrix

Connective Tissue Examples

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Loose fibrous connective tissue

- has space between components.
- occurs beneath skin and most epithelial layers.
- functions in support and binds organs.



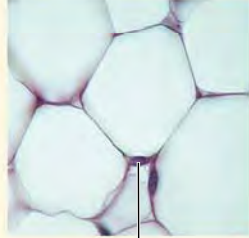
fibroblast

elastic fiber collagen fiber 50 μm

a.

Adipose tissue

- cells are filled with fat.
- occurs beneath skin, around heart and other organs.
- functions in insulation, stores fat.

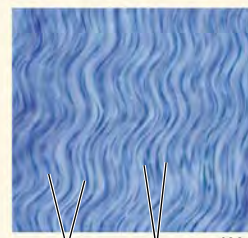


nucleus 50 μm

b.

Dense fibrous connective tissue

- has collagenous fibers closely packed.
- in dermis of skin, tendons, ligaments.
- functions in support.

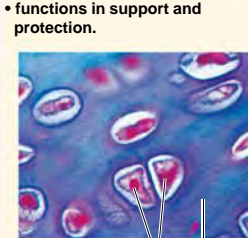


collagen fibers nuclei of fibroblasts 400x

c.

Hyaline cartilage

- has cells in lacunae.
- occurs in nose and walls of respiratory passages; at ends of bones, including ribs.
- functions in support and protection.

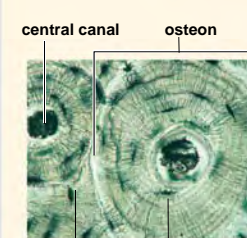


chondrocyte within lacunae matrix 50 μm

d.

Compact bone

- has cells in concentric rings.
- occurs in bones of skeleton.
- functions in support and protection.



central canal osteon osteocyte within a lacuna canaliculi 320x

e.

a, b: © Ed Reschke; c: © McGraw-Hill Higher Education, Dennis Strete, photographer; d, e: © Ed Reschke

Connective Tissue

- Compact Bone
 - Matrix is inorganic salts deposited around protein fibers
 - Bone cells (osteocytes) are located in lacunae
 - Lacunae arranged in concentric circles within osteons around tiny tubes (central canals)

Animation

McGraw Hill Osteoporosis



Baby's bone



Play



Pause



Audio



Text

Bone is living tissue. Bone building is far from complete when a baby is born. During growth from infancy to adulthood, bone is increased in size, strength and hardness.

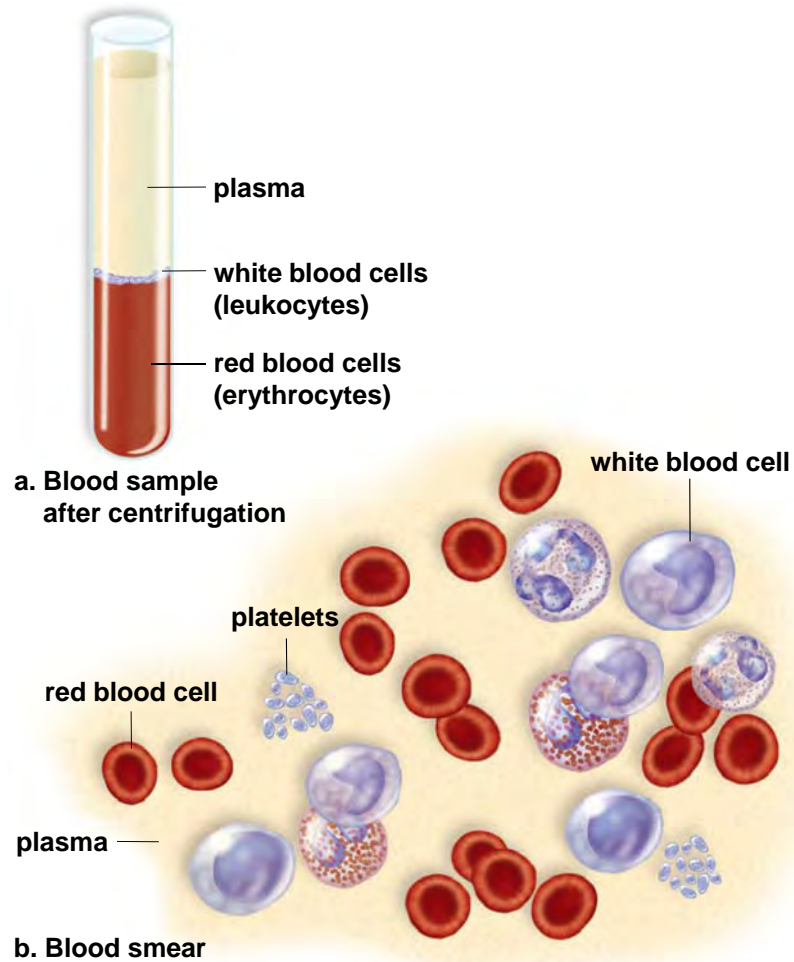
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Blood

- Actually a connective tissue in which cells are embedded in a liquid matrix (plasma)
 - Red blood cells - erythrocytes
 - White blood cells - leukocytes
- Transports nutrients and oxygen to cells
- Removes carbon dioxide and other wastes

Blood, a Liquid Tissue

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Function of Connective Tissue

- Establishing a structural framework
- Transporting fluids and dissolved materials
- Protecting delicate organs
- Supporting, surrounding and interconnecting tissues
- Storing energy reserves
- Defending the body from microorganisms

Muscular Tissue

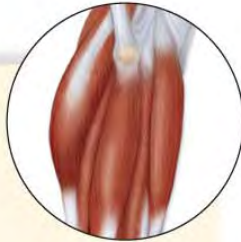
- Contractile cells containing actin and myosin filaments
- Cells are called muscle fibers
- Three types of muscle tissue:
 - Skeletal Muscle
 - Voluntary - Long, striated fibers, multinucleated
 - Smooth Muscle
 - Involuntary - No striations
 - Cardiac Muscle
 - Striated, but mostly involuntary
 - Bound by intercalated disks
 - Relies on pacemaker cells for regular contraction

Muscular Tissue

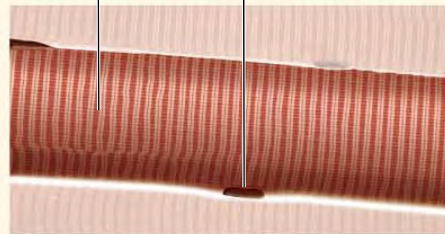
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Skeletal muscle

- has striated cells with multiple nuclei.
- occurs in muscles attached to skeleton.
- functions in voluntary movement of body.



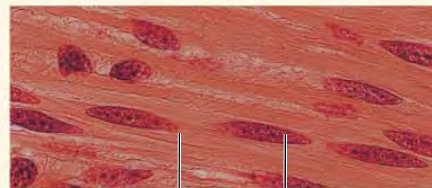
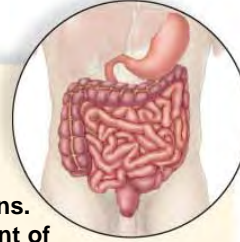
striation nucleus



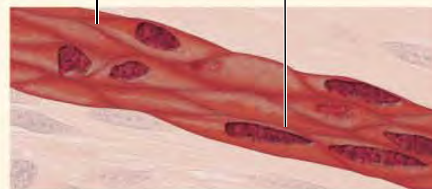
a.

Smooth muscle

- has spindle-shaped cells, each with a single nucleus.
- cells have no striations.
- functions in movement of substances in lumens of body.
- is involuntary.
- is found in blood vessel walls and walls of the digestive tract.



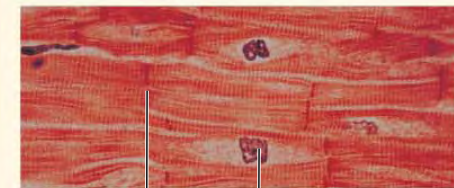
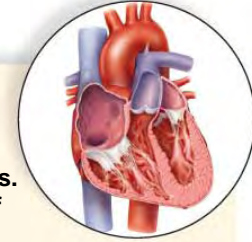
smooth muscle cell nucleus 400X



b.

Cardiac muscle

- has branching, striated cells, each with a single nucleus.
- occurs in the wall of the heart.
- functions in the pumping of blood.
- is involuntary.



intercalated disk nucleus 250X



c.

a, c: © Ed Reschke; b: © McGraw-Hill Higher Education, Dennis Strete, photographer

Nervous Tissue

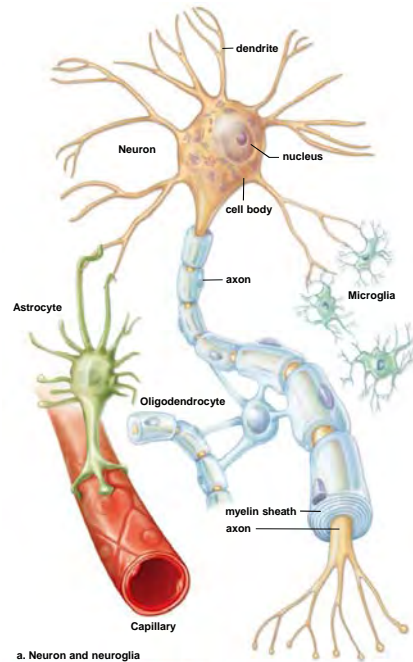
- Conducts electrical impulses
- Conveys information from one area to another
- Nerve tissue contains:
 - Neurons
 - Transmit information
 - Consist of dendrites, a cell body and an axon
 - Neuroglia
 - Support and nourish neurons

Nervous Tissue

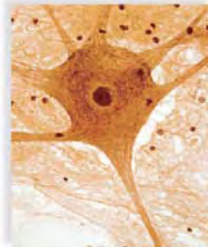
- Nervous system has three functions
 - Sensory input
 - Sensory receptors detect changes
 - Transmit info to the spinal cord
 - Data integration
 - Spinal cord and brain integrate
 - Decision is made regarding appropriate response
 - Motor output
 - Response is transmitted to effector (gland or muscle)
 - Effector initiates actual response

Neurons and Neuroglia

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a. Neuron and neuroglia



b. Micrograph of a neuron 200x

Nerve Regeneration

- In humans, axons outside the brain and spinal cord can regenerate, but not those inside these organs.
- Injury in CNS degenerate
 - Permanent loss of nervous function.
- In cold-water fishes and amphibians axon regeneration in the CNS does occur.
 - Several proteins play role in axon regeneration

Researchers at Work

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a.



b.

(Woman): © Vol. 154/Corbis; (Man): © Vol. 12/Corbis

Treatment Today for Spinal Cord Injuries

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a.



b.

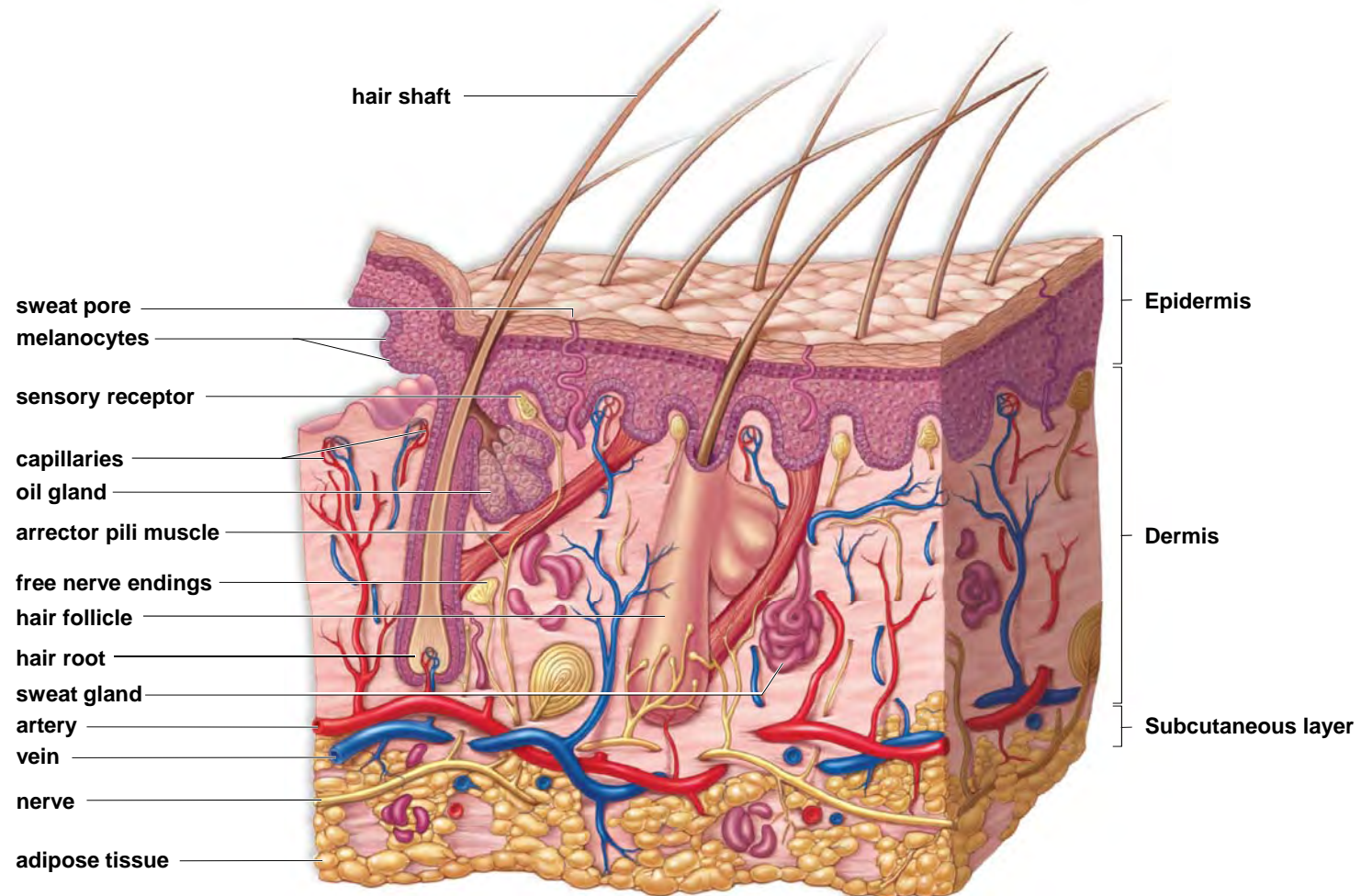
a: © AP Photo/Elliot D. Novak; b: © Diana De Rosa/Press Link

Functions & Regions of Skin

- Functions of skin
 - Covers and protects underlying body regions
 - Regulate body temperature, and
 - Contains sensory receptor
- Epidermis - Outer, thinner region
 - Stratified squamous epithelium
 - New cells are pushed outward, become keratinized, and are sloughed off
 - Melanocytes produce melanin (pigment)
 - Nails grow from specialized epidermal cells

Human Skin Anatomy

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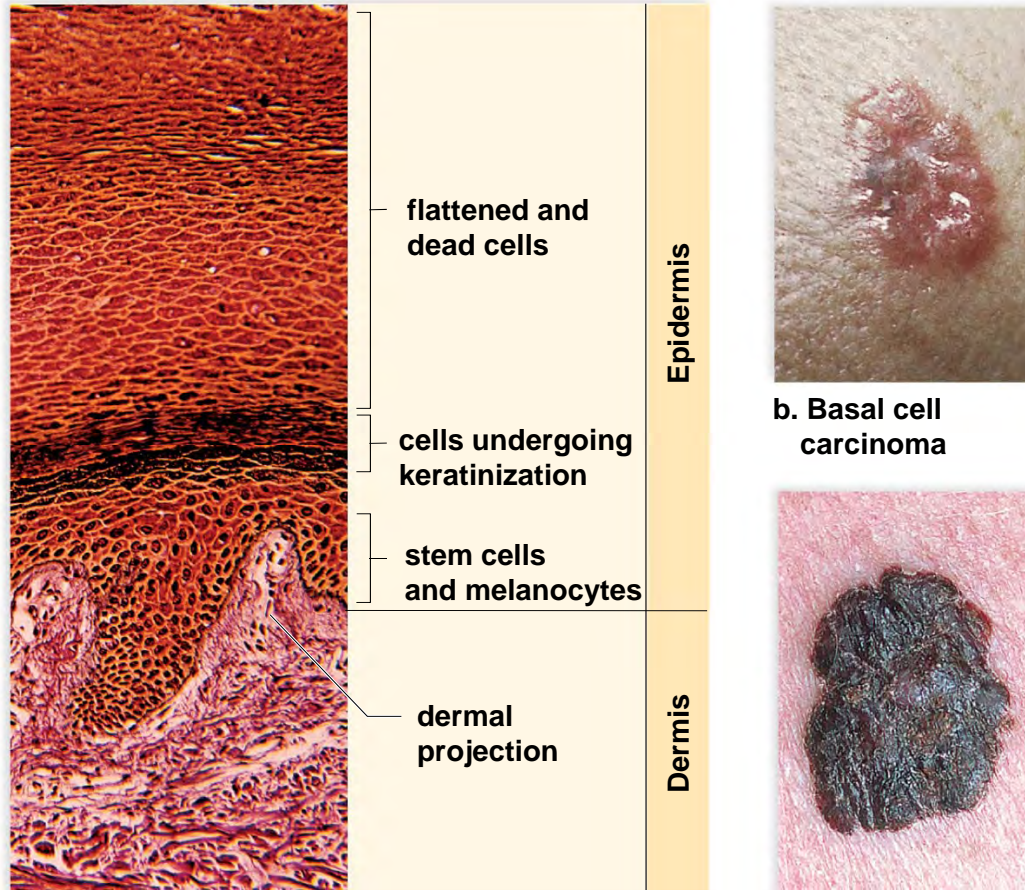


Regions of Skin

- Dermis - Deeper and thicker than epidermis
 - Fibrous connective tissue containing elastic and collagen fibers contains:
 - Hair follicles
 - Sebaceous glands
 - Receptors
 - Nerve fibers
 - Blood vessels
- Subcutaneous Layer - Loose, connective tissue located below dermis

The Epidermis

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a. Photomicrograph of skin

c. Melanoma

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Organ Systems

- **Body Cavities**

- **Dorsal cavity (toward the back)**

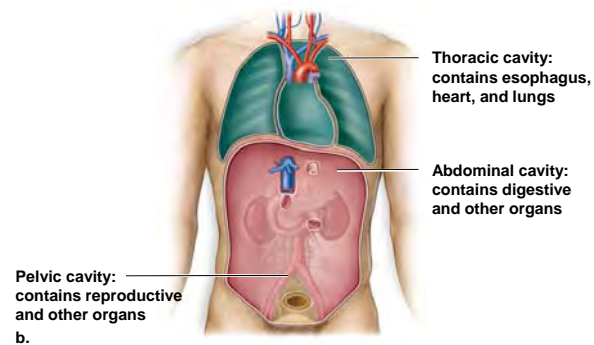
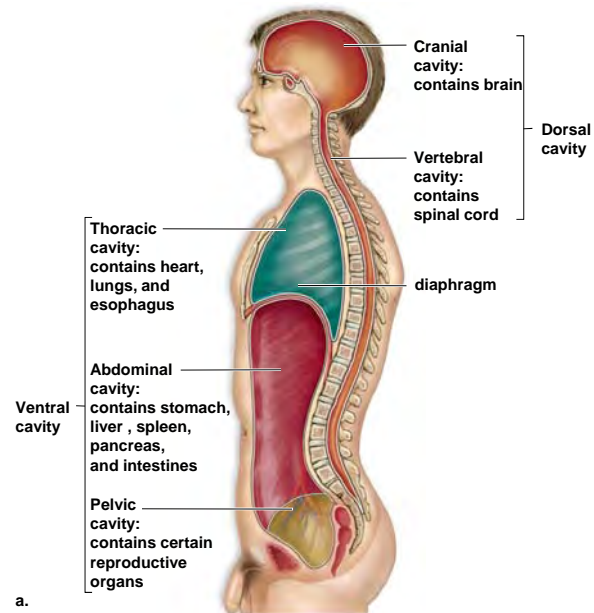
- Contains the cranial cavity and the vertebral canal
- The brain is in the cranial cavity, and
- The spinal cord is in the vertebral canal

- **Ventral cavity (toward the front) is divided by the diaphragm into**

- The thoracic cavity (includes heart and lungs) and
- The abdominal cavity (most other internal organs)
- The pelvic cavity

Mammalian Body Cavities

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Homeostasis

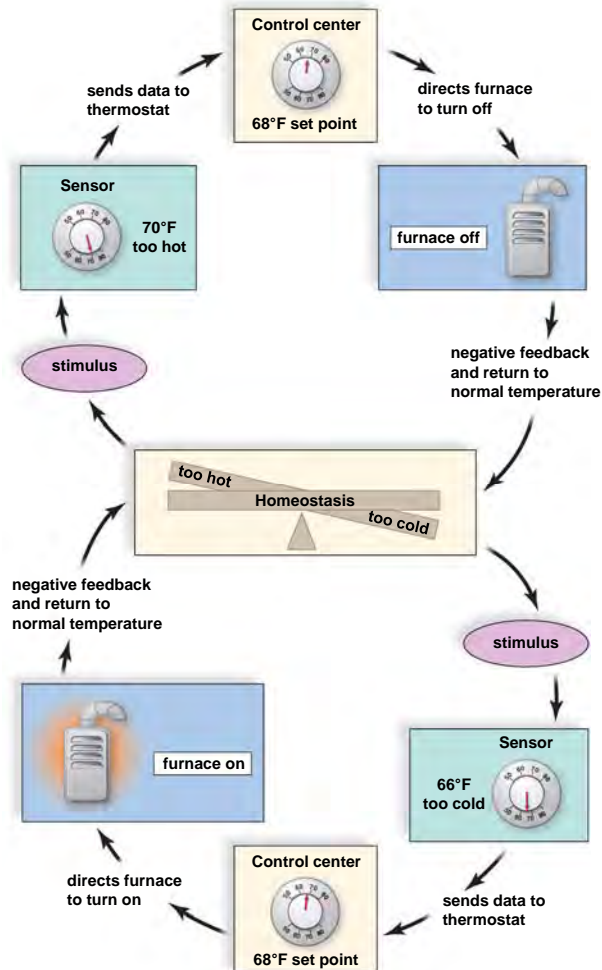
- The organ systems of the human body contribute to homeostasis
 - The digestive system
 - Takes in and digests food
 - Provides nutrient molecules that replace used nutrients
 - The respiratory system
 - Adds oxygen to the blood
 - Removes carbon dioxide
 - The liver and the kidneys
 - Store excess glucose as glycogen
 - Later, glycogen is broken down to replace the glucose used
 - The hormone insulin regulates glycogen storage
 - The kidneys
 - Under hormonal control as they excrete wastes and salts

Negative Feedback

- Homeostatic Control
 - Partially controlled by hormones
 - Ultimately controlled by the nervous system
- Negative Feedback is the primary homeostatic mechanism that keeps a variable close to a set value
 - Sensor detects change in environment
 - Regulatory Center activates an effector
 - Effector reverses the changes

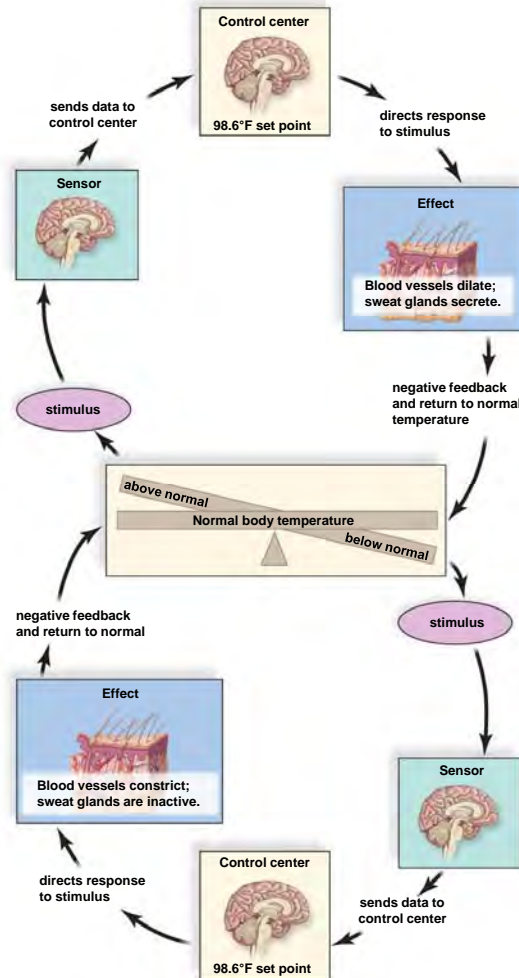
Regulation of Room Temperature

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Regulation of Body Temperature

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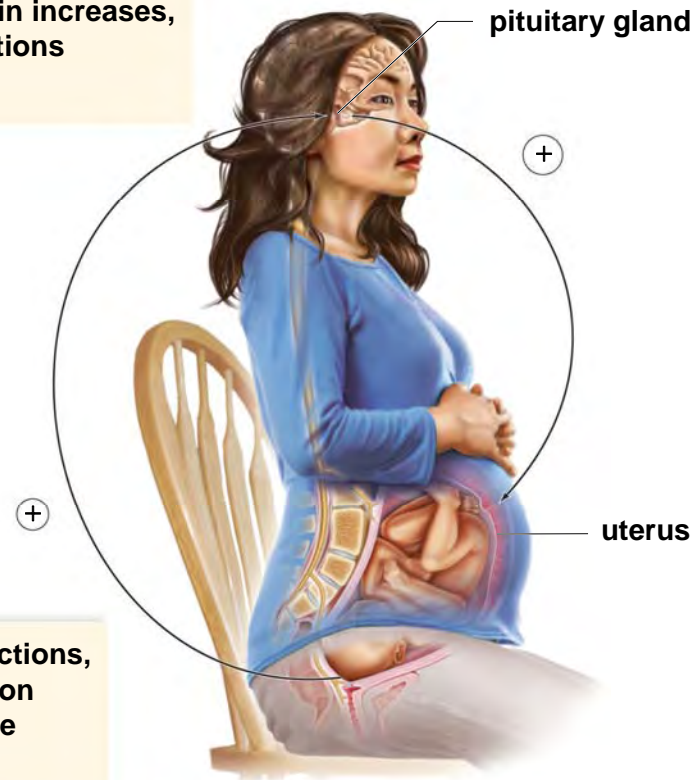
Positive Feedback

- During positive feedback, an event increases the likelihood of another event
 - Childbirth process
 - Urge to urinate
- Positive Feedback
 - Does not result in equilibrium
 - Does not occur as often as negative feedback

Positive Feedback

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2. Signals cause pituitary gland to release the hormone oxytocin. As the level of oxytocin increases, so do uterine contractions until birth occurs.



1. Due to uterine contractions, baby's head presses on cervix, and signals are sent to brain.

Review

- Tissue Types
 - Epithelial
 - Connective
 - Muscular
 - Nervous
- Organs
- Organ Systems
- Homeostasis
 - Negative Feedback
 - Positive Feedback