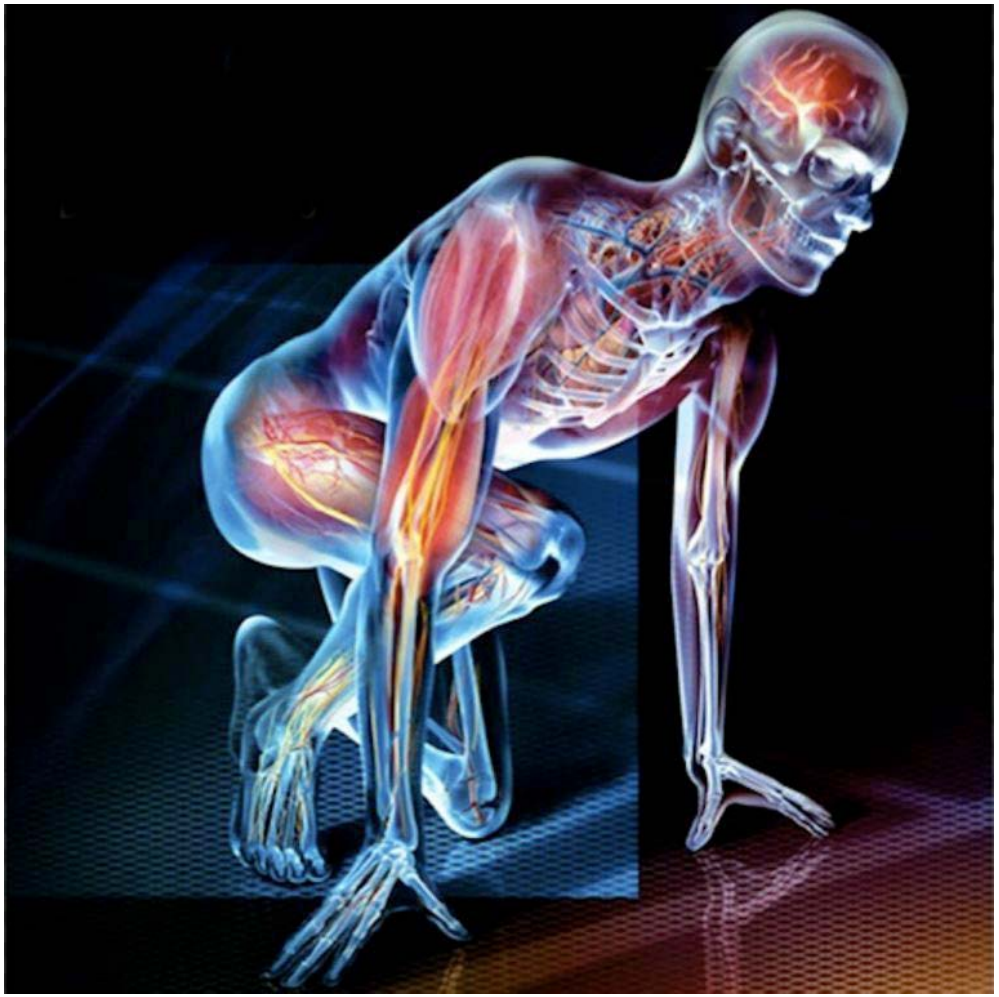
Physiology



Introduction to Physiology
&
Homeostasis

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Outline

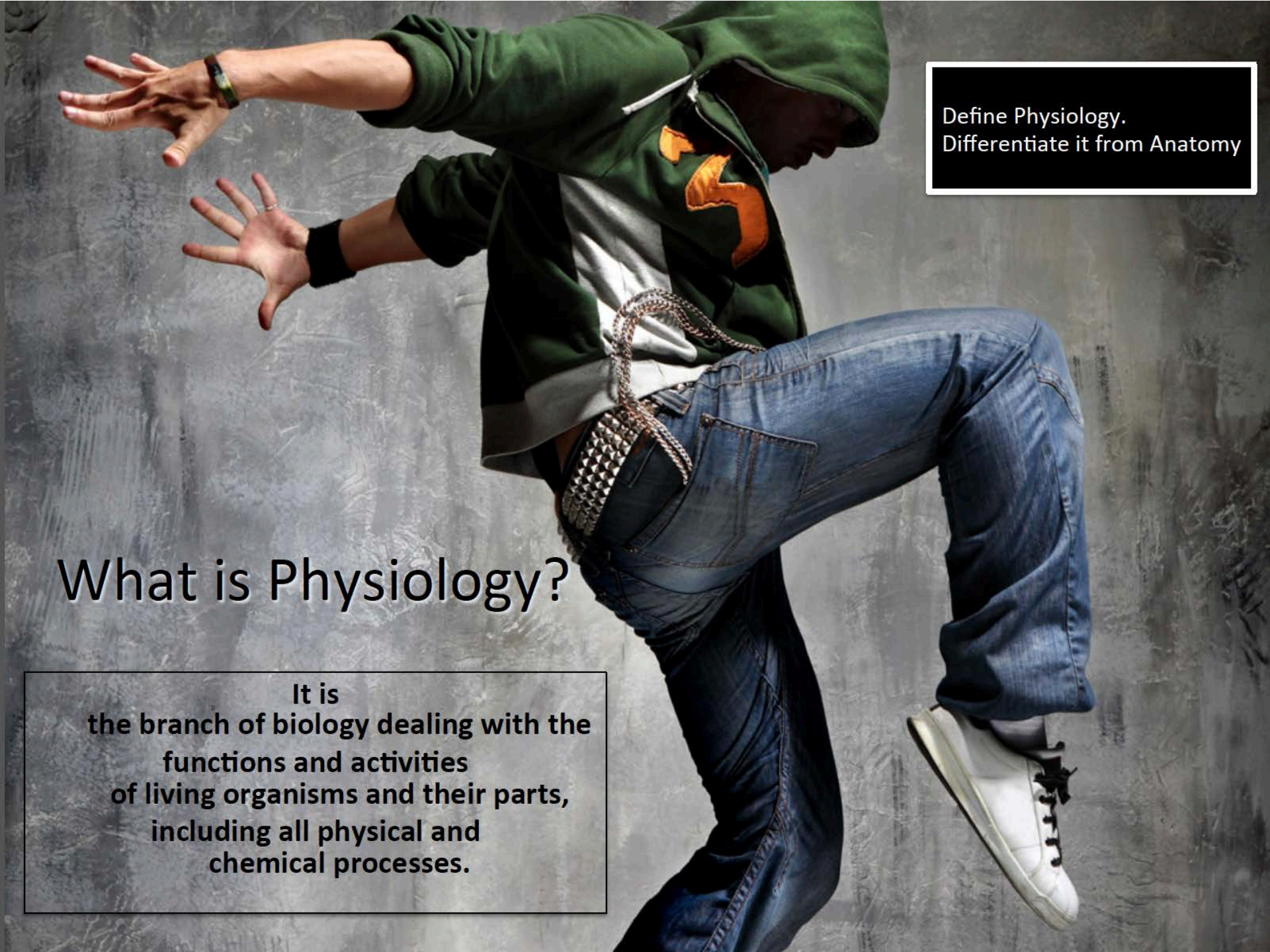
① Introduction to Physiology

② Homeostasis

http://docs.neu.edu.tr/staff/deniz.balci/

Reading Assignment

Guyton And Hall Textbook Of Medical Physiology, 13 Edition, Chapter 1, pg; 3-10



Define Physiology.
Differentiate it from Anatomy

What is Physiology?

It is
the branch of biology dealing with the functions and activities of living organisms and their parts, including all physical and chemical processes.

Distinguish between Process & Function

Process

- How do we breathe?
- How does blood flow?
- How do RBCs transport O2?

Function

- Why do we breathe?
- Why does blood flow?
- Why do RBC transport O2?

Integrate both for complete picture!

Organization of the Body

Is the basic functional unit of all organisms.

Cells

↓

Cells that are similar or function similarly are grouped together to form

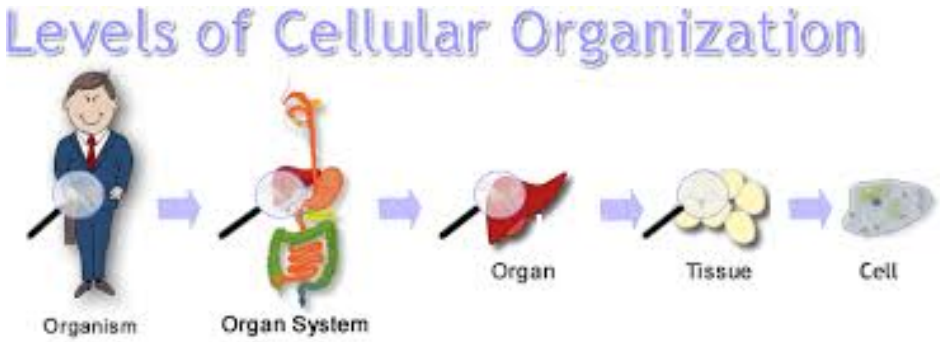
Tissues

↓

Tissues are grouped together to form

Organs

Organs grouped together to form the **Organ system.**

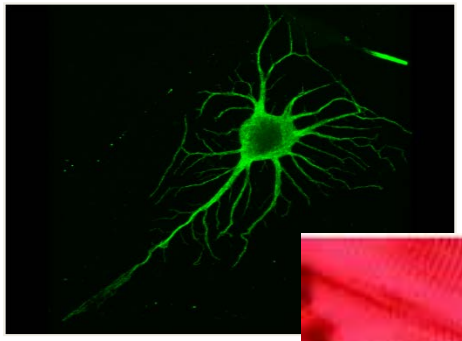


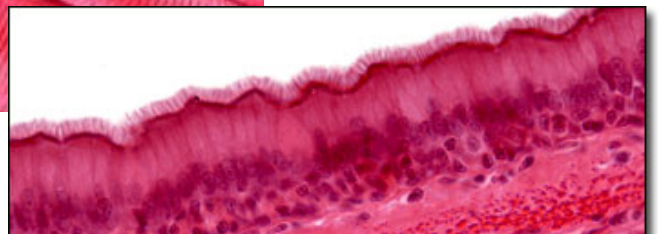
Organization of the Body

- Body has over **200** different cell types,

  100 Trillion cells

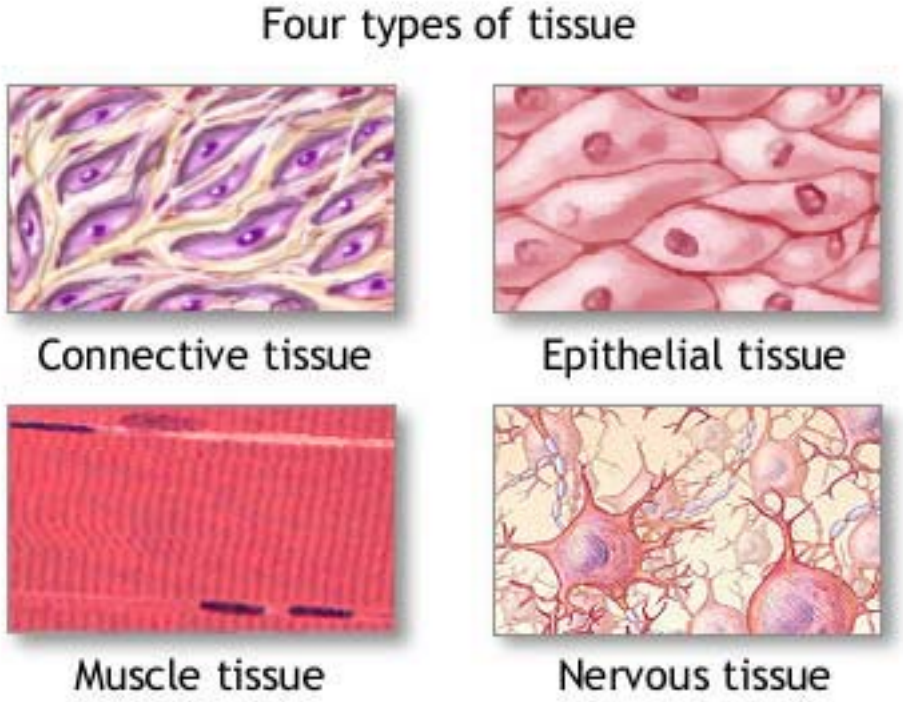
- Cells can be put into four groups according to their cell function.
  - Neurons
  - Muscle cells
  - Epithelial cells
  - Connective tissue cells



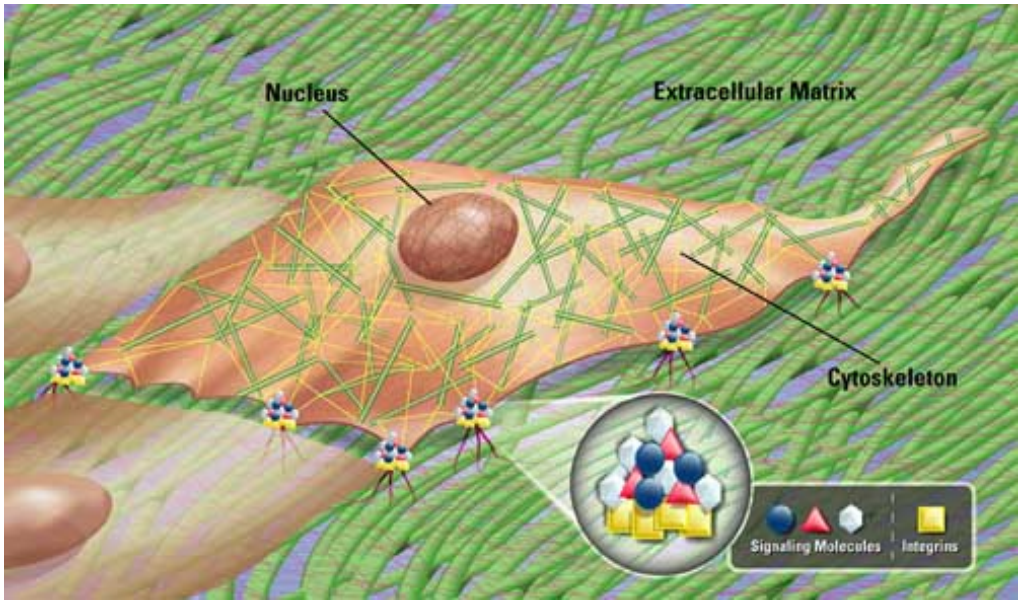


Major Tissue Types

- Based primarily on cell function
- Correspond to four major cell types



Terminology

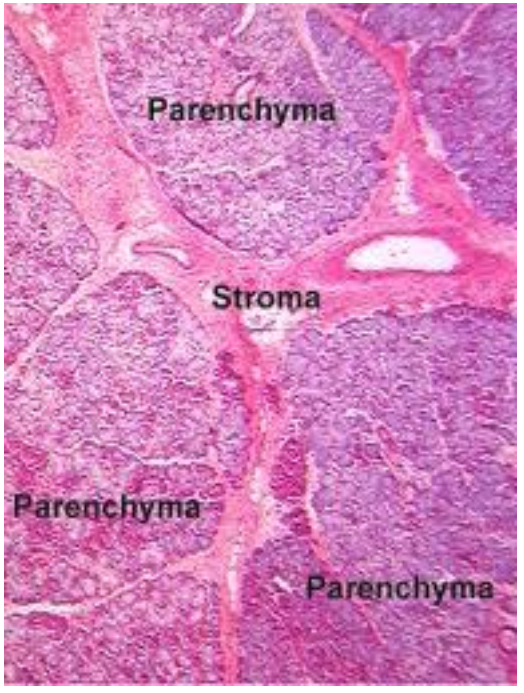


Tissues are composed of:

- Cells
- Extracellular matrix

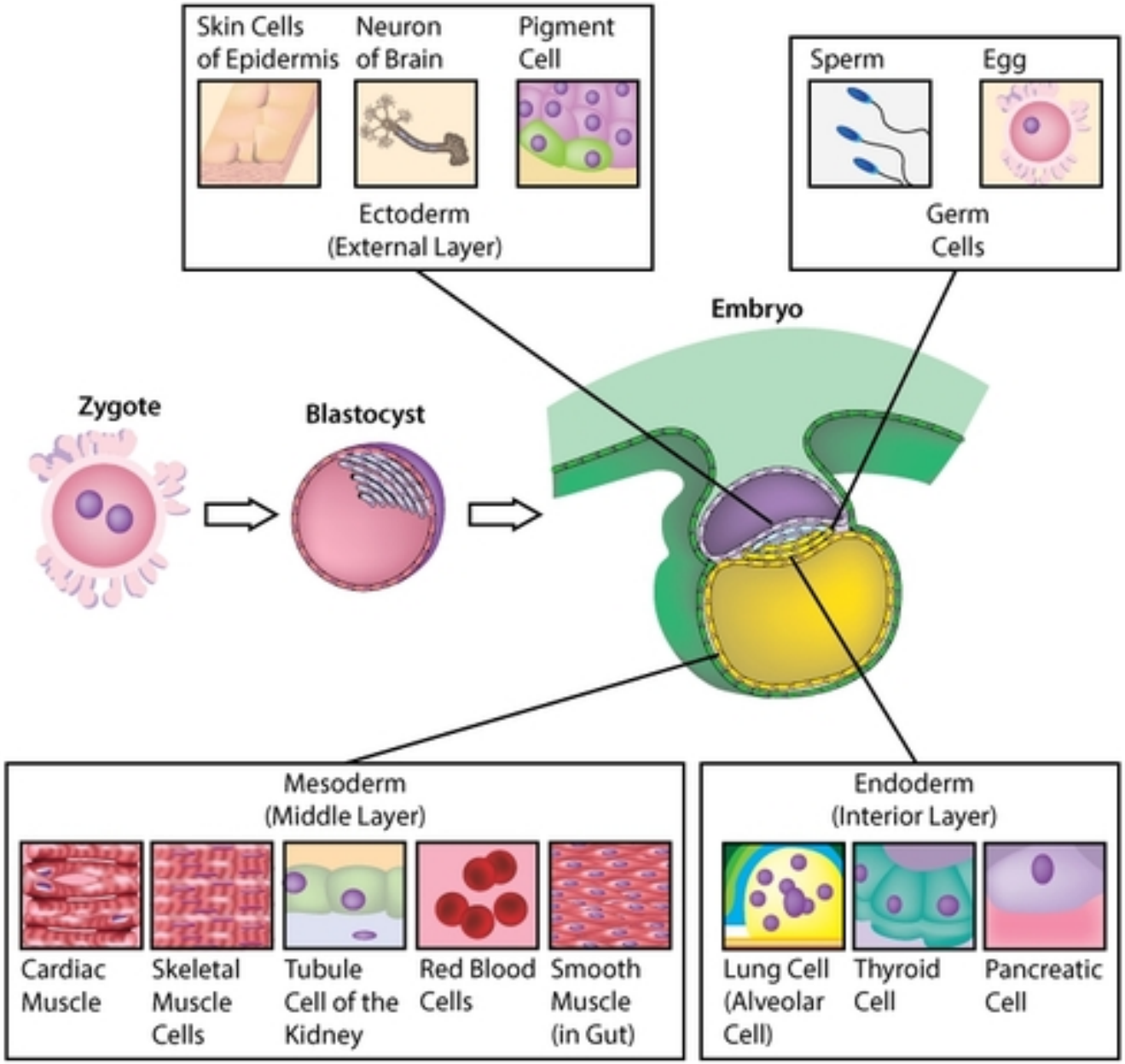
Organs are composed of:

- Parenchyma (cells that perform main function of organ)
- Stroma (supporting tissue)

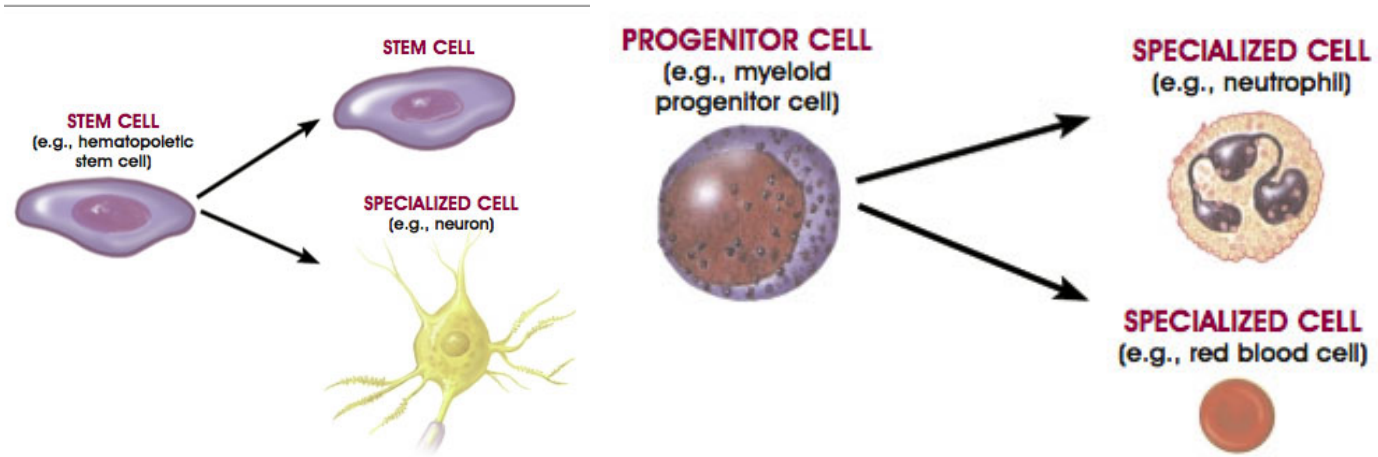


Cellular Differentitation

Human organism includes 200 different cell types all derived from zygote



- Cells arise in the body from **progenitor** or **stem cells** and become specialized for one or more distinct functions such as
  - contraction, nerve conduction, secretion, absorbtion, protection
- This process of cell specialization is known as cell **differentiation.**
- Structural (become very efficient for specialized function) or morphological (change in shape) modifications during differentiation are accompanied by **biochemical changes** (Ex; formation of red blood cells requires the differentiating cells to make specialized proteins for oxygen transport).

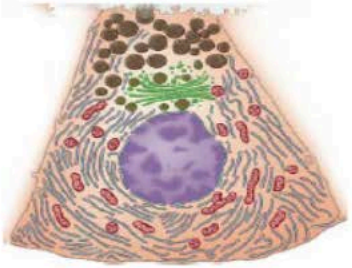


Vary in their shape and size

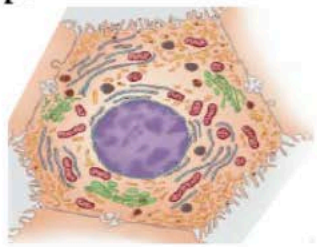
Various cell types; shape, size, intracellular organizations, polarization – Functions

These three cells all belong to "Intestinal Epithelial Cell" groups

Small Intestine (Absorptions)

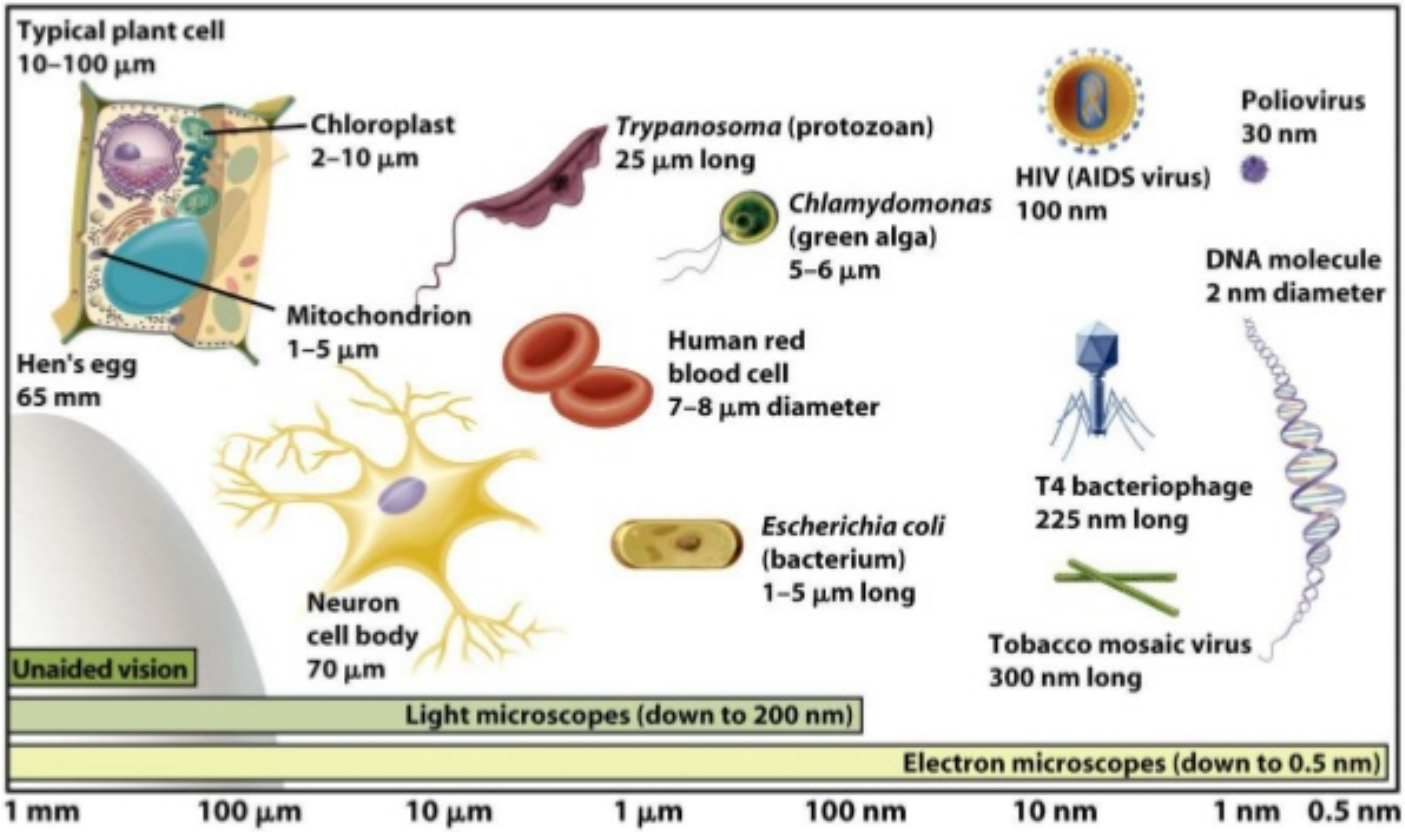


Pancreatic Acinar cell (Digestive enzyme production)



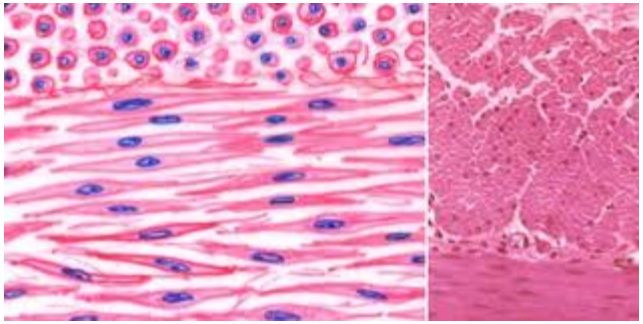
Liver Hepatocyte (Metabolism, protein production Bile secretion etc)

200 micron (oocyte)
150 micron (neuron body)
4-5 micron (eritrocytes)

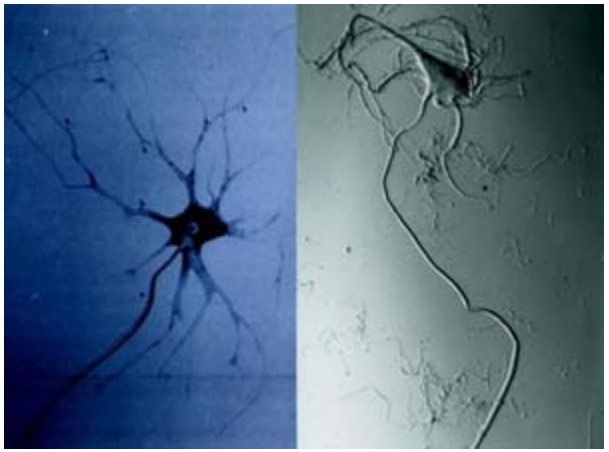


Cell structure closely relates function

- **Muscle cells** contain numerous organelles providing energy required for muscle contraction.



- **Nerve cells** are long and thin to carry impulses over distance.



Pictures adapted from www.imgarce.com

Why cells are different from each other??

- Different shapes and sizes.
- Different functions?
- Different specialized proteins

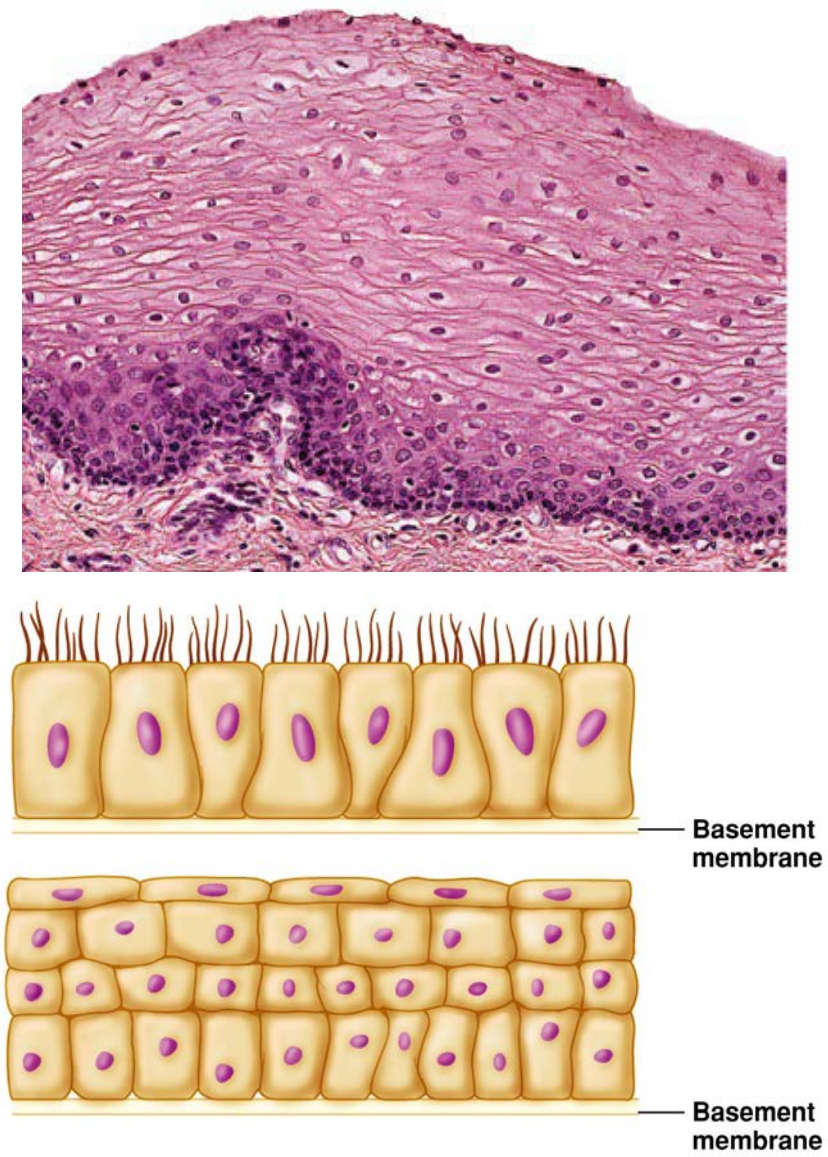
  – As well as these 'specialised' proteins, almost all your cells share a common set of 'housekeeping' proteins.

Epithelial Cells and Epithelium

Sheet-like layer of cells,

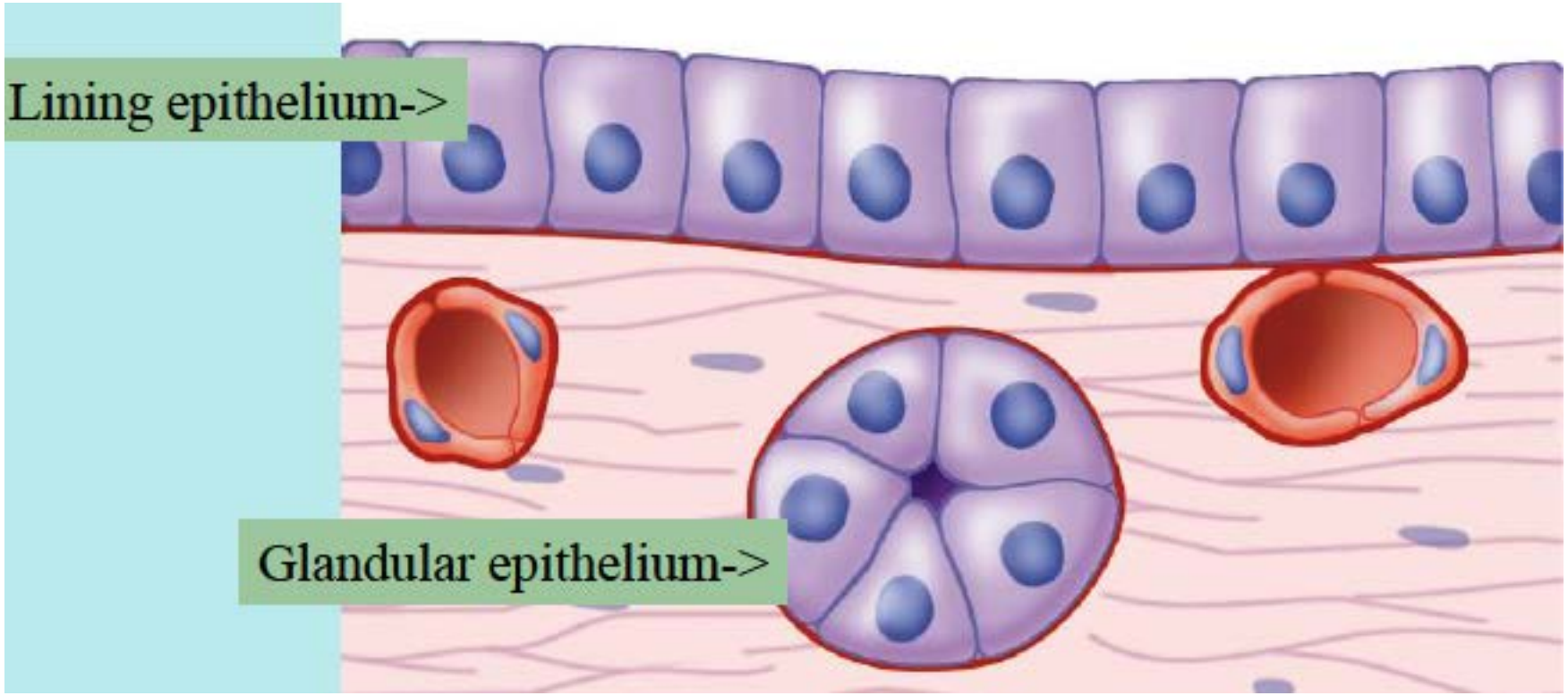
Functions of Epithelium

- Covering of external surfaces
- Lining of internal surfaces
- Protection
- Absorption
- Sensation
- Secretion



(c) Epithelial cells

Two Main Kinds of Epithelium

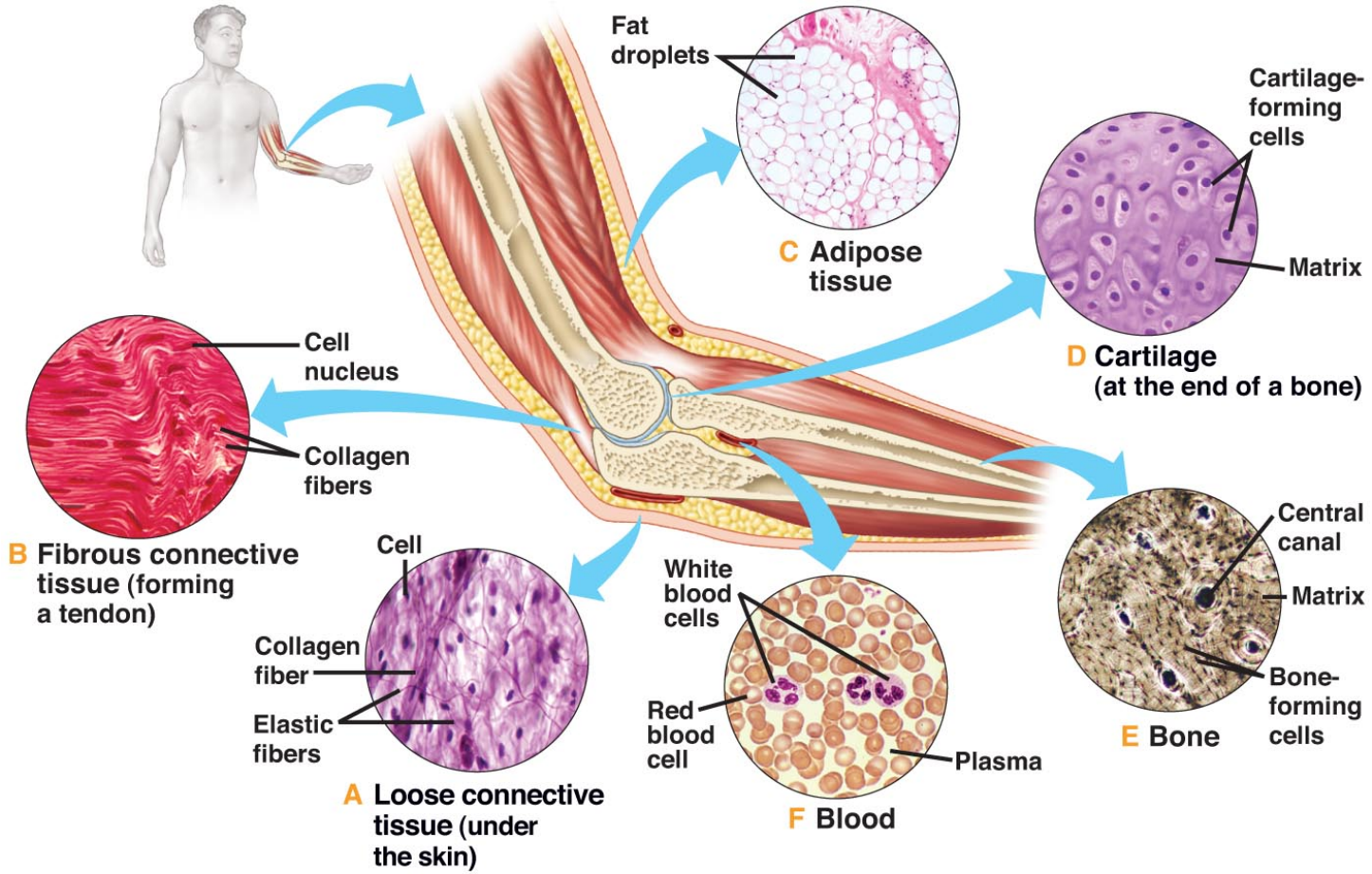


Covering and lining epithelium
Covers outer surfaces of body and lines internal body passages

Glandular epithelium
Contains cells specialized for secretion

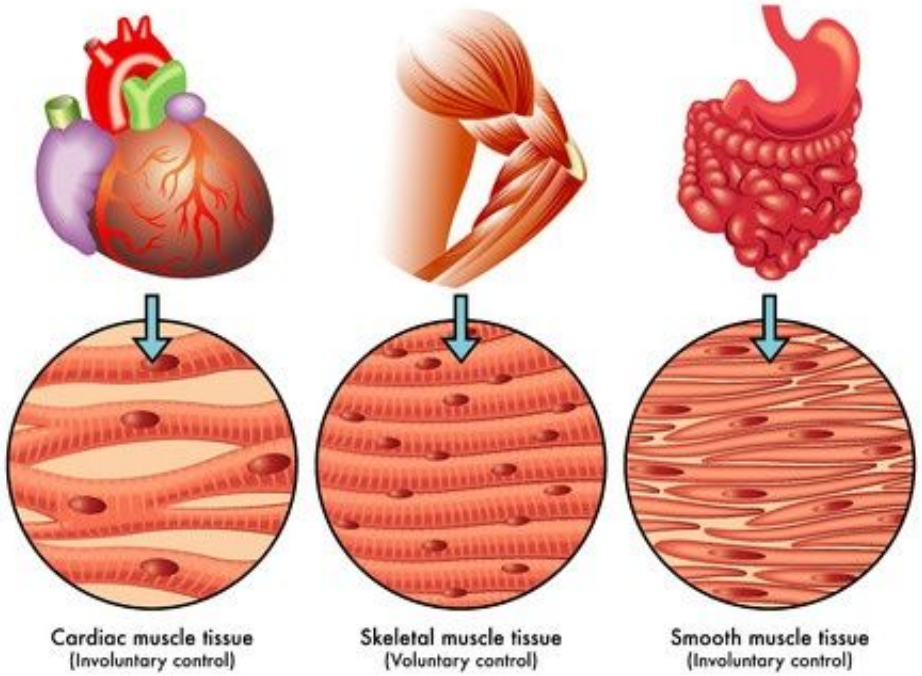
Connective Tissue

- Anchors and links structures of body
- Characterized by extracellular matrix
- Most diverse of the four Tissues



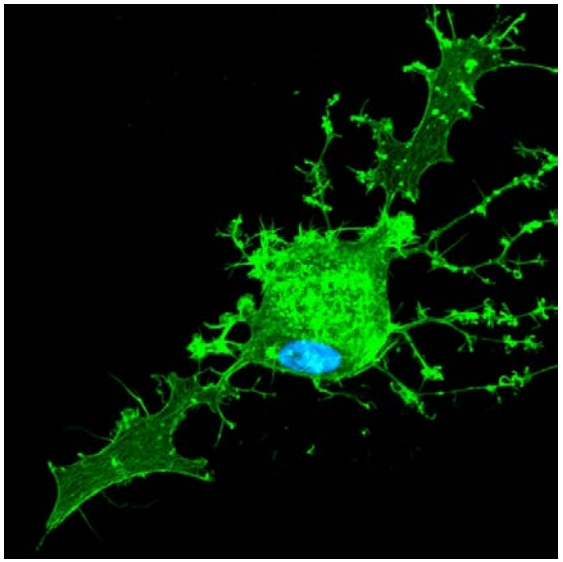
Muscle cells and Muscle Tissue

- Specialized to contract
- Can be voluntary or involuntary
- Examples of contraction
  - Flexing of forearm
  - Pumping of blood
  - Mixing of food in the stomach



Neurons and Nervous Tissue

- Transmit signals for communication



- Have branches to receive or transmit
  - Receive information from receptors
  - Transmit information to muscles or glands

- Some neurons process information
- Neurons and glial cells (support)

Organ System

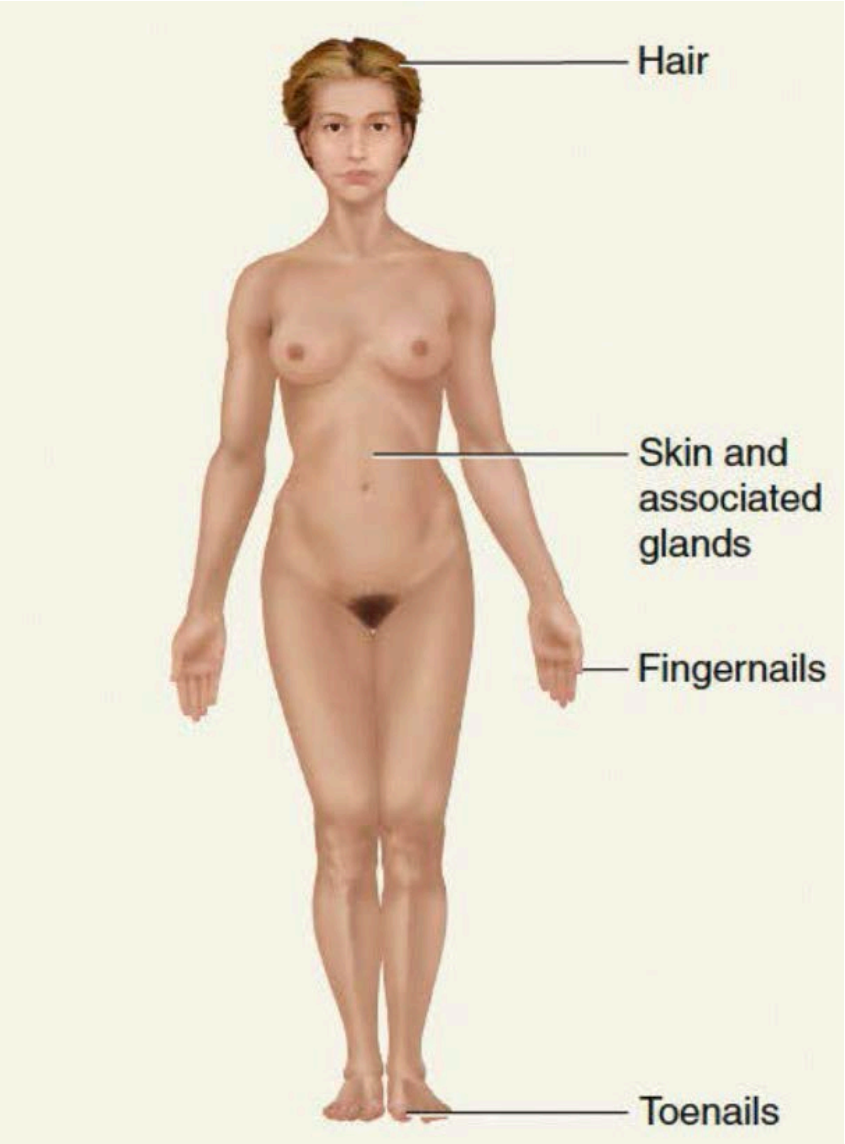
- **Tissues** contain similar functional cells

- **Organs**
- Composed of at least two tissue types
- Perform specific functions

- **Organ System**
- Collection of organs
- Perform particular task

Body-Covering System

Integumentary System



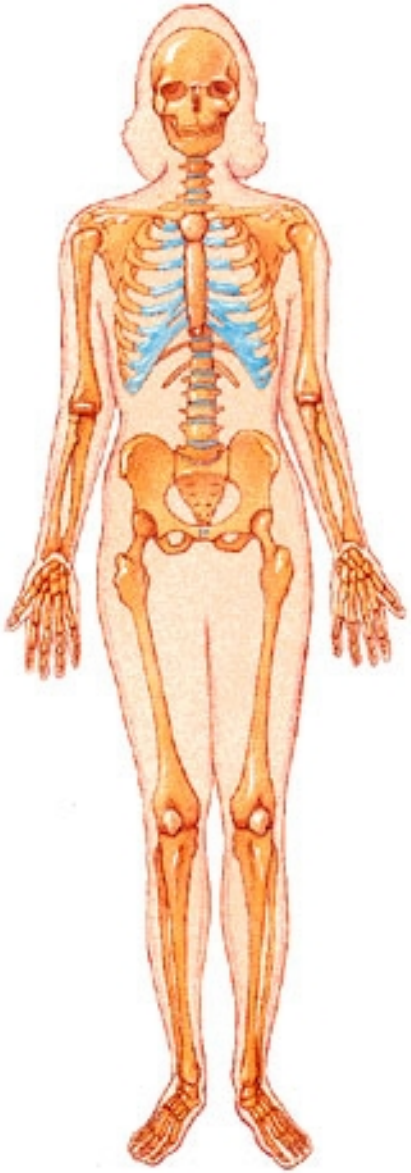
COMPONENTS

- The integument (skin)
- structures derived from it (hair, nails, oil sweat glands).

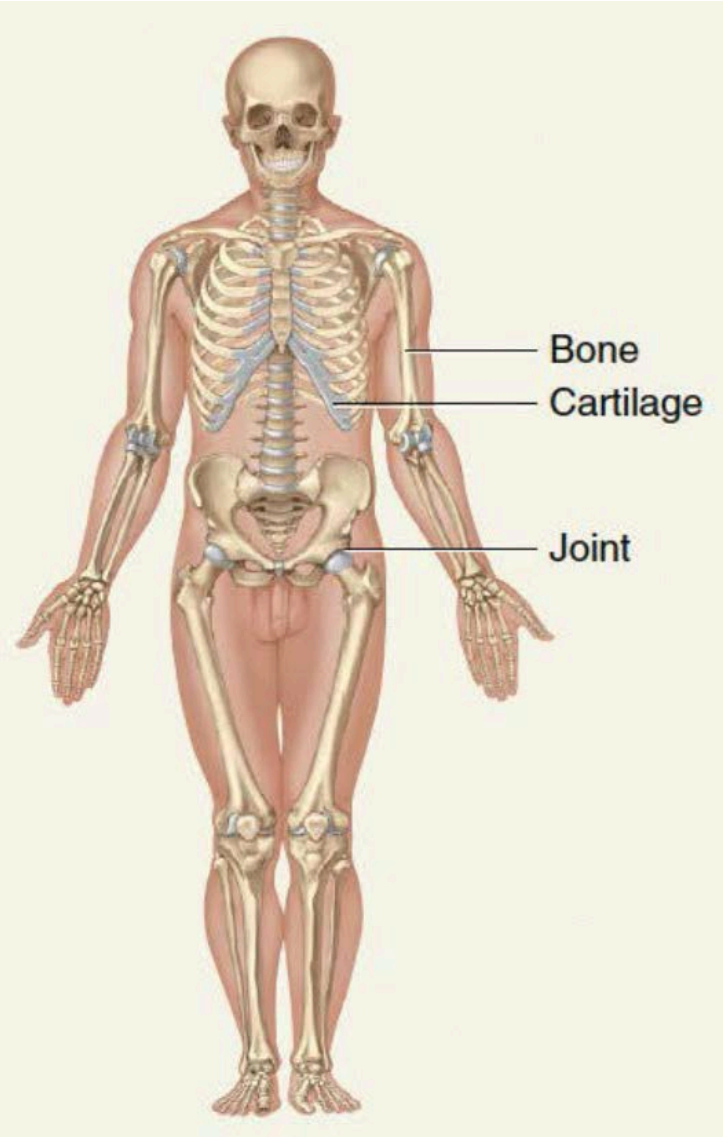
FUNCTIONS

- Protects the body
- regulates body temperature
- eliminates wastes
- receives certain stimuli (touch, temperature, pain).

Support and Movement Systems



Skeletal System



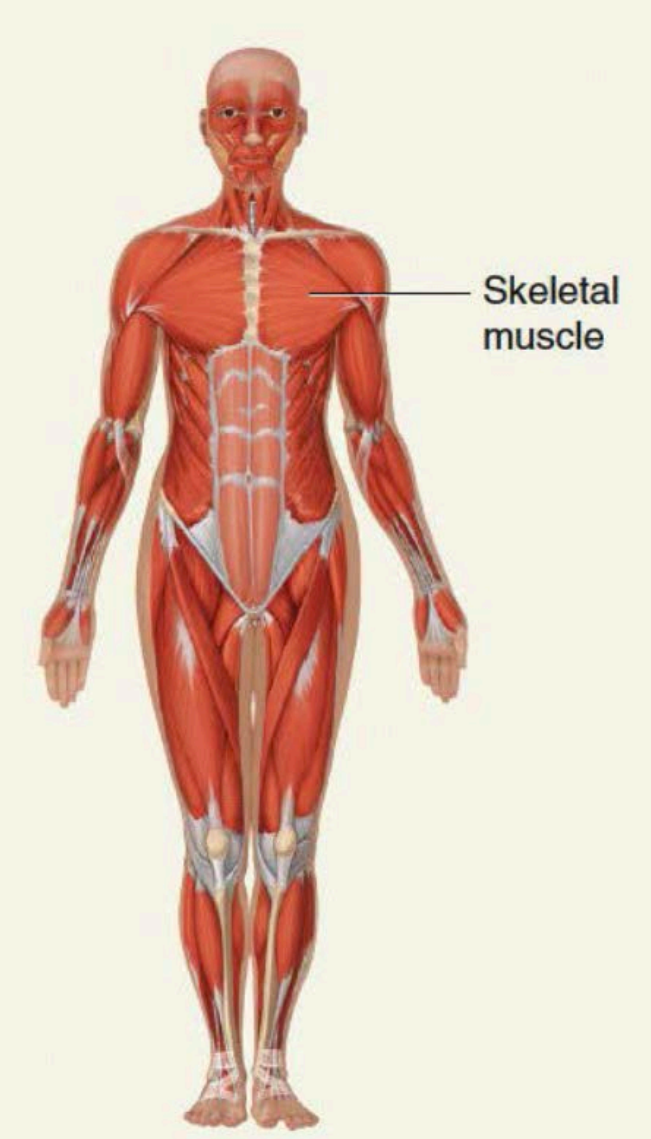
COMPONENTS

- Bones
- Cartilage
- Ligaments (which steady the bones at the joints).

FUNCTIONS

- support & protect the body
- Assist with body movement
- Provides areas for muscle attachment
- Produces blood cells (hematopoiesis),
- stores minerals & lipids.

Muscular System



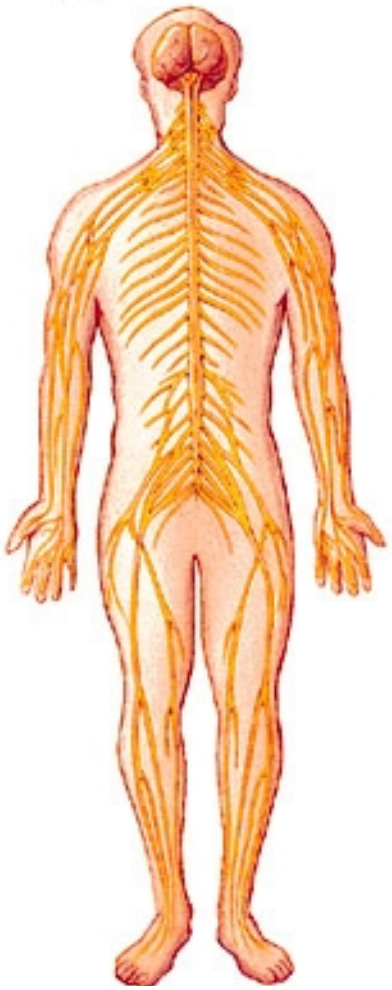
COMPONENTS

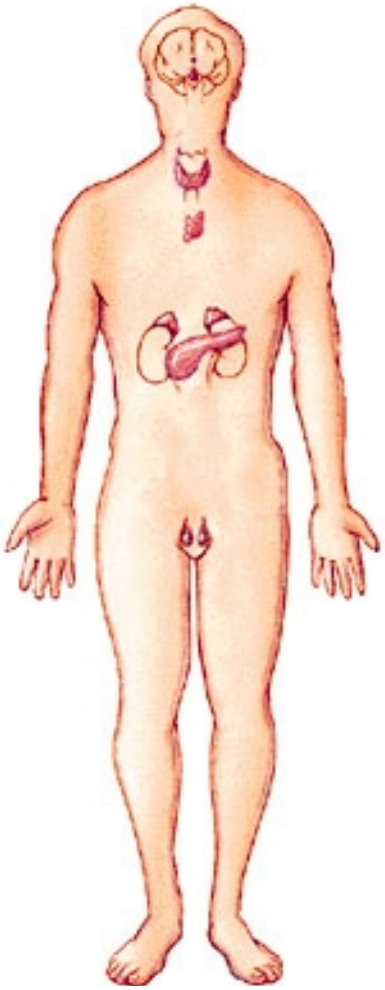
- Skeletal muscles of the body and their tendinous attachments.
- Smooth & Cardiac

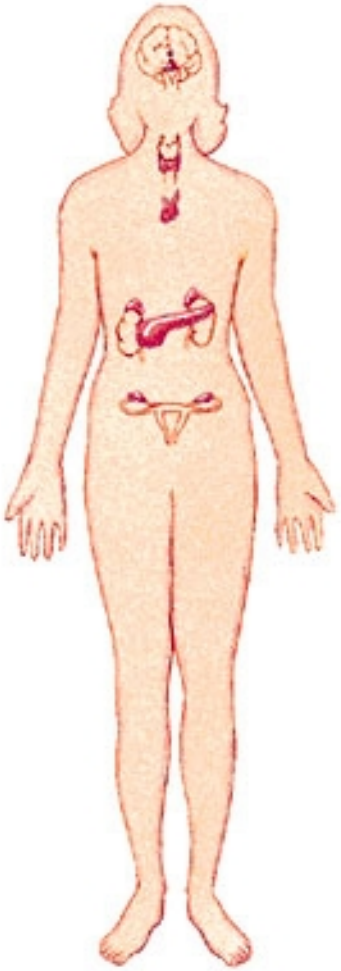
FUNCTIONS

- Effects body movements
- Maintains posture
- produces body heat.

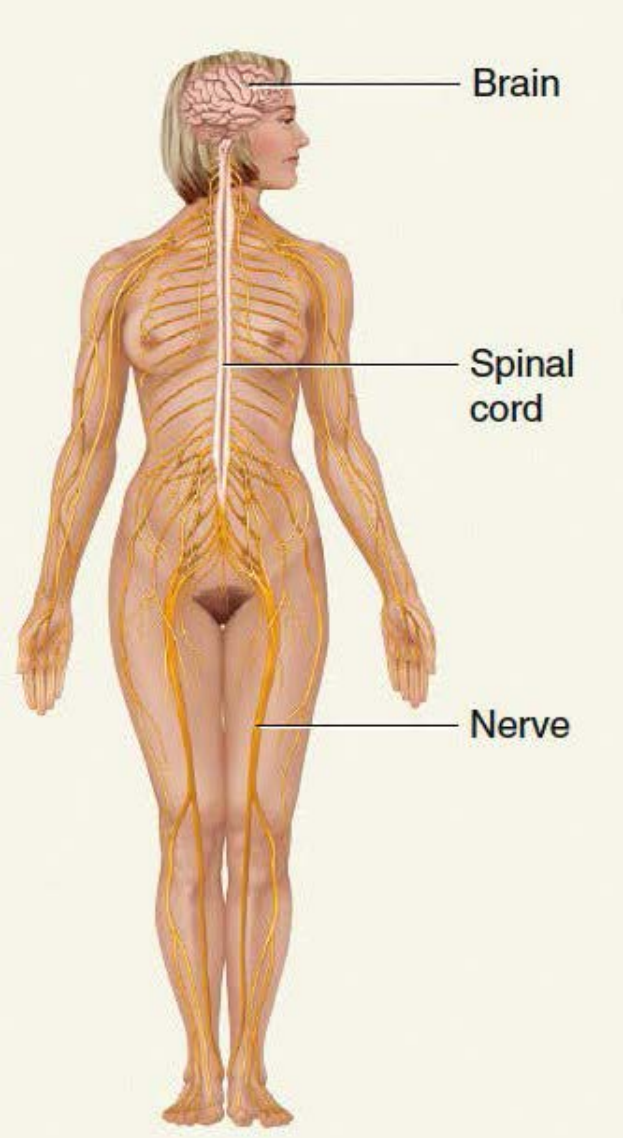
Integration and Coordination Systems







Nervous System



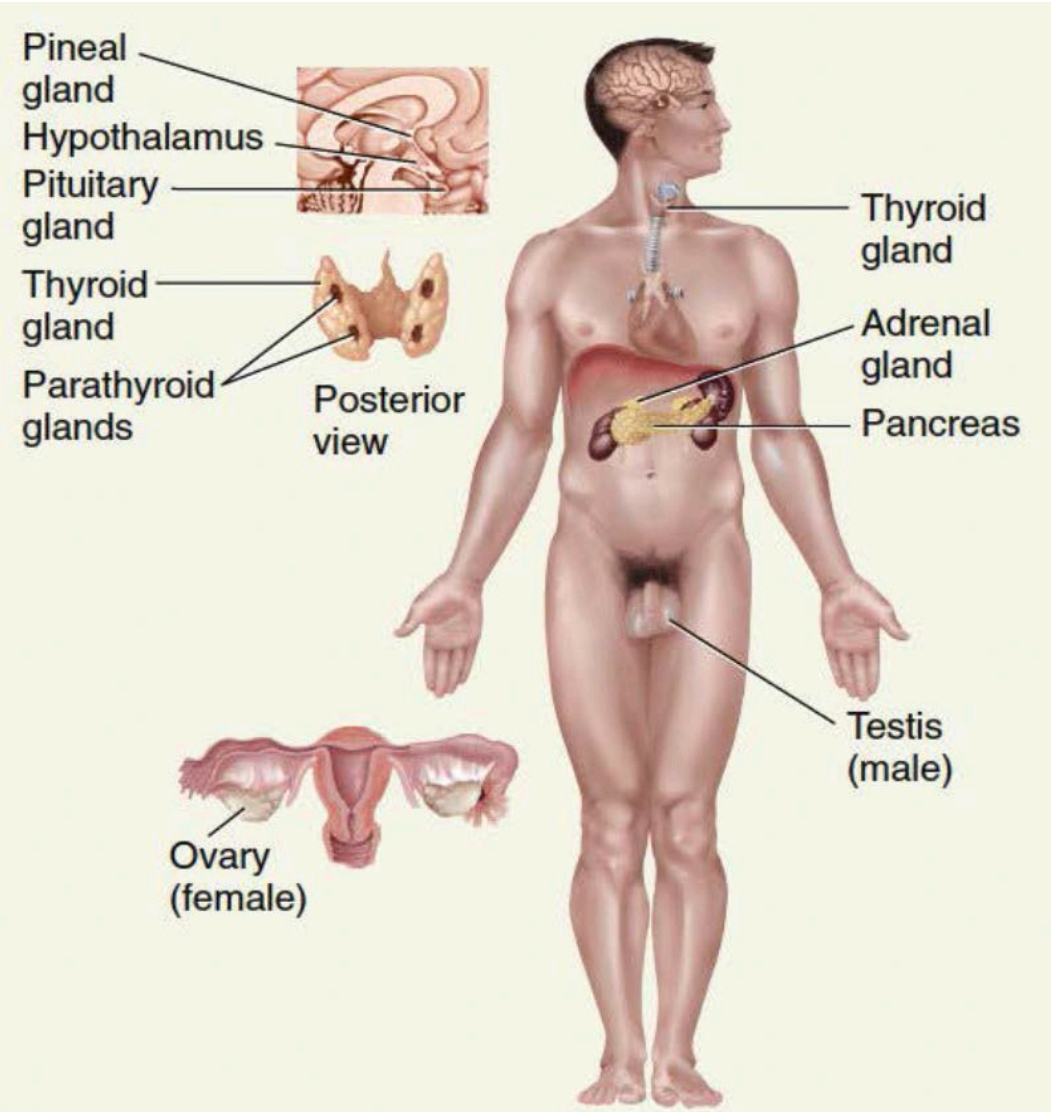
COMPONENTS

- Brain
- spinal cord
- nerves
- sensory organs such as the eye and the ear

FUNCTIONS

- Detects and responds to changes in internal & external environments
- enables reasoning & memory
- regulates body activities.

Endocrine System



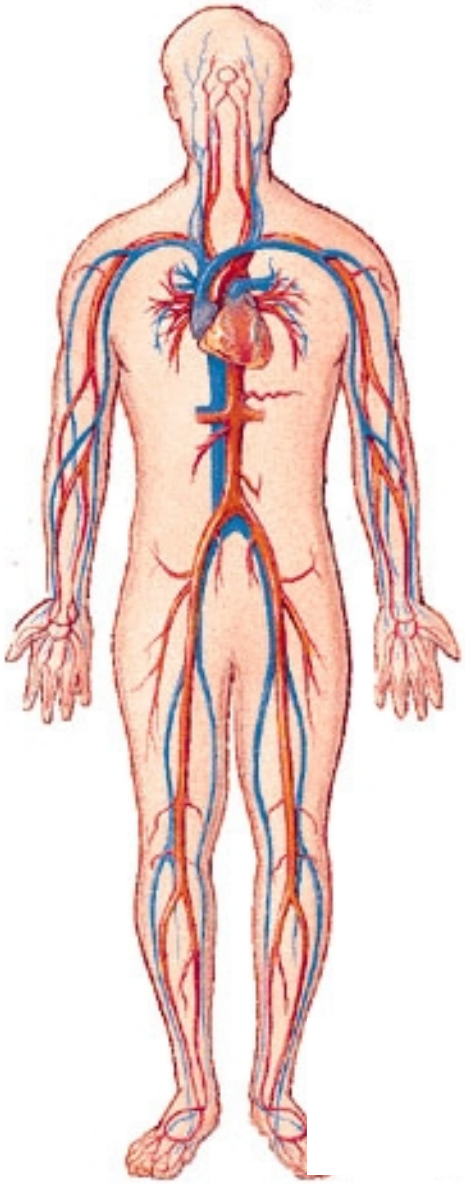
COMPONENTS

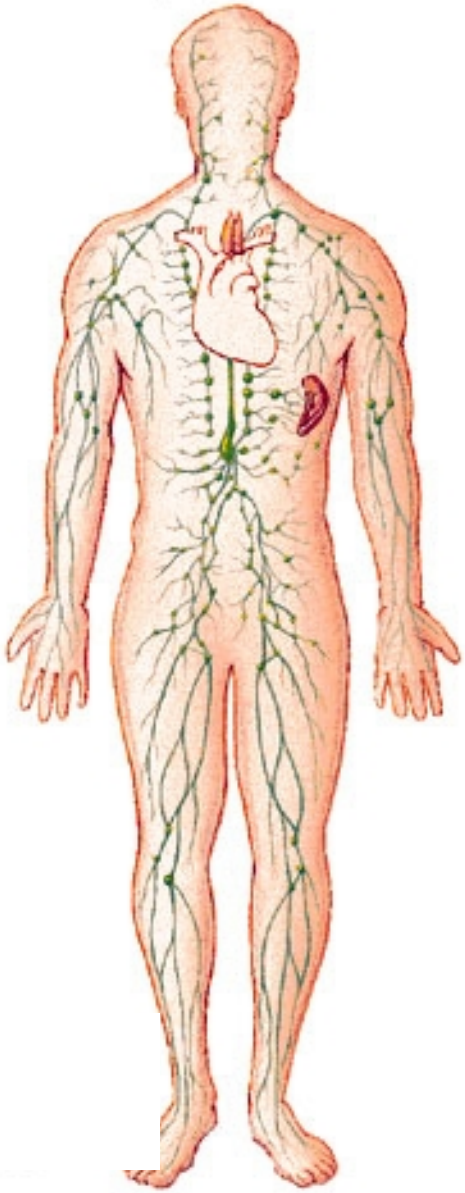
- The hormone producing Glands & tissues.

FUNCTIONS

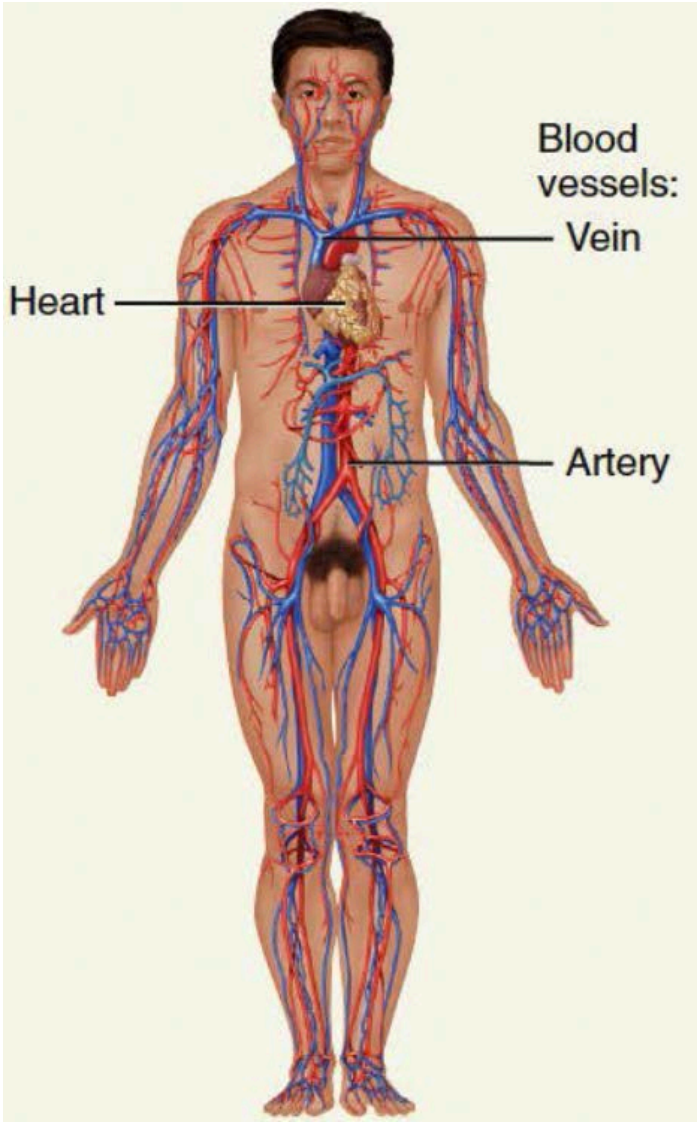
- Controls and integrates body functions via hormones secreted into the bloodstream.

Transport Systems





Cardiovascular System



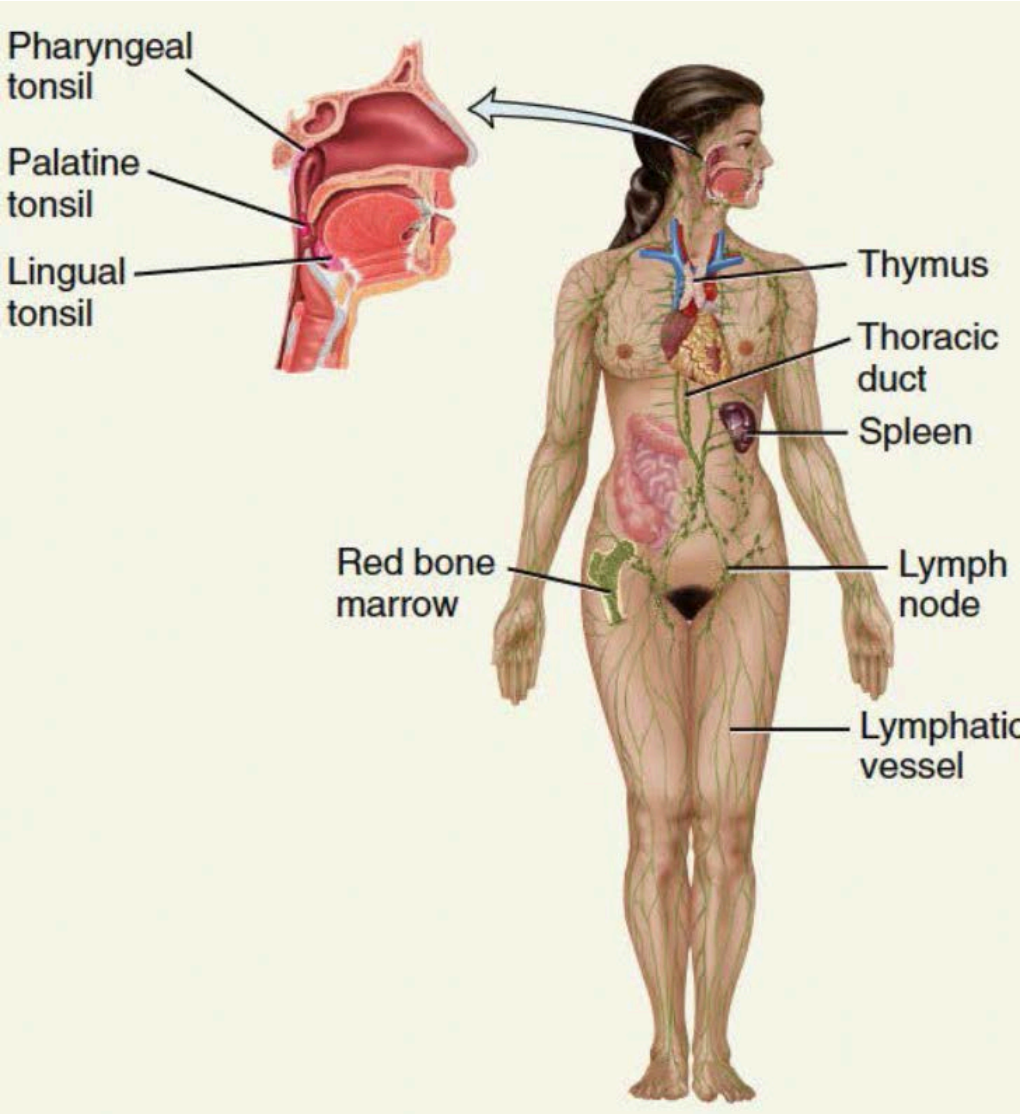
COMPONENTS

- Blood
- Heart
- Blood vessels

FUNCTIONS

- Transports respiratory gases, nutrients, wastes, and hormones;
- helps regulate body temperature
- acid–base balance
- protects against disease & fluid loss

Lymphatic System & Immunity



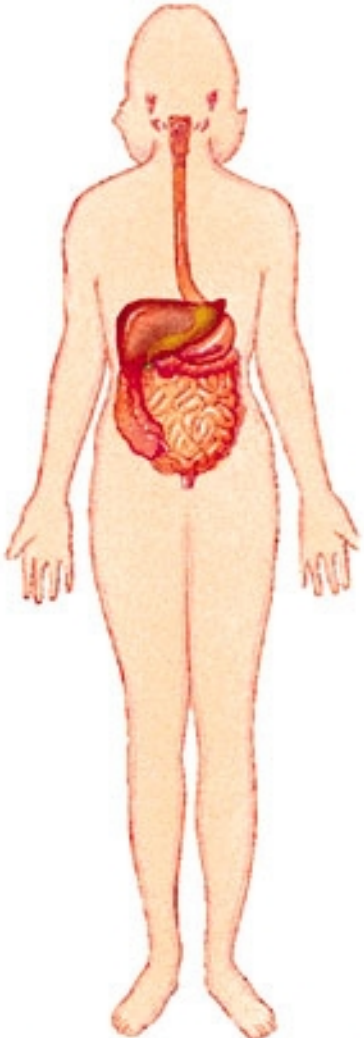
COMPONENTS

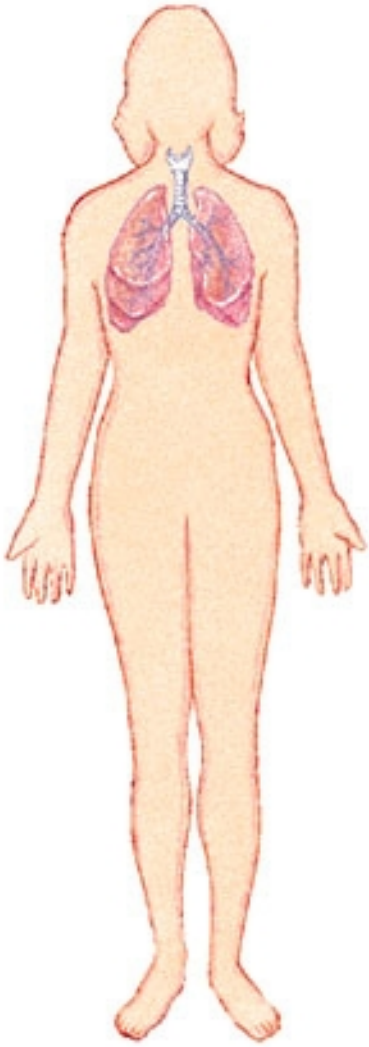
- lymphatic vessels
- Lymph
- lymph nodes
- other lymphatic organs (spleen, thymus, tonsils)
- Immune cells (T,B,WBC)

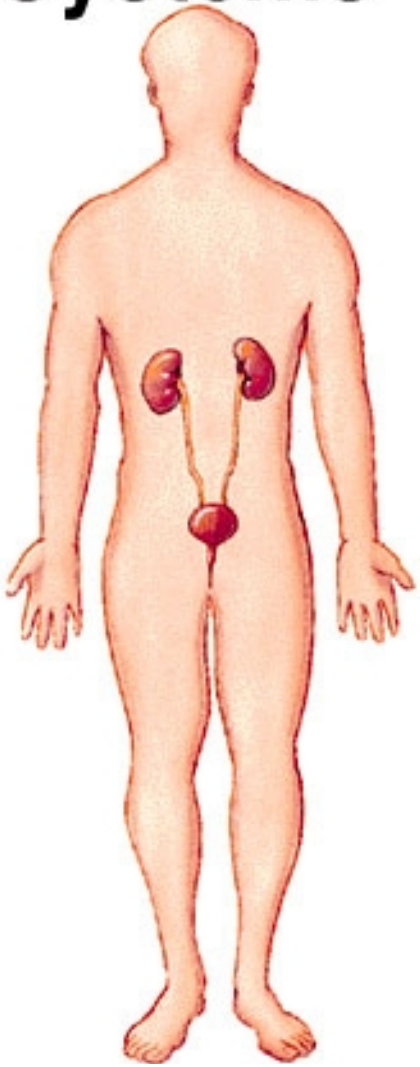
FUNCTIONS

- Removes foreign substances from the blood and lymph
- combats disease
- maintains tissue fluid balance
- absorbs dietary fats from the digestive tract.

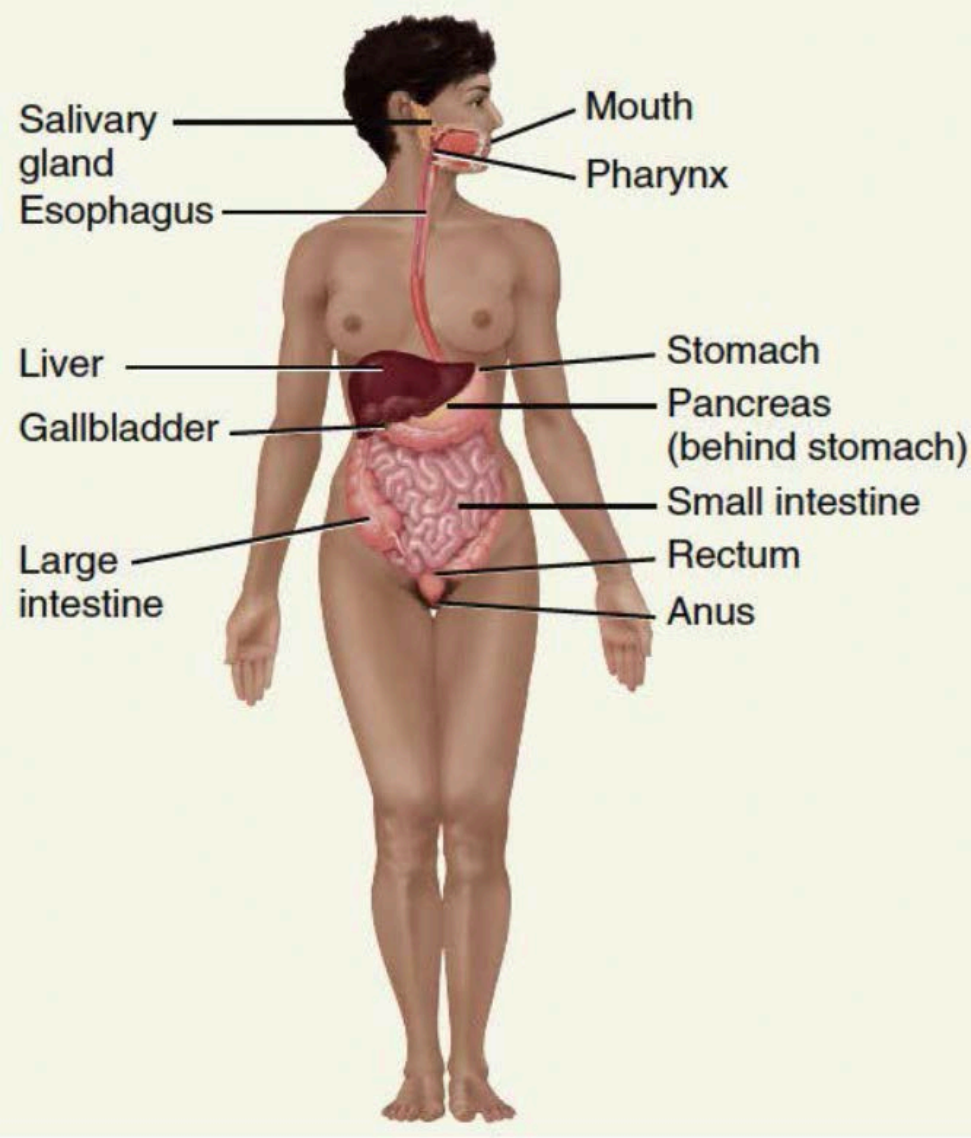
Absorption and Excretion Systems







Digestive System



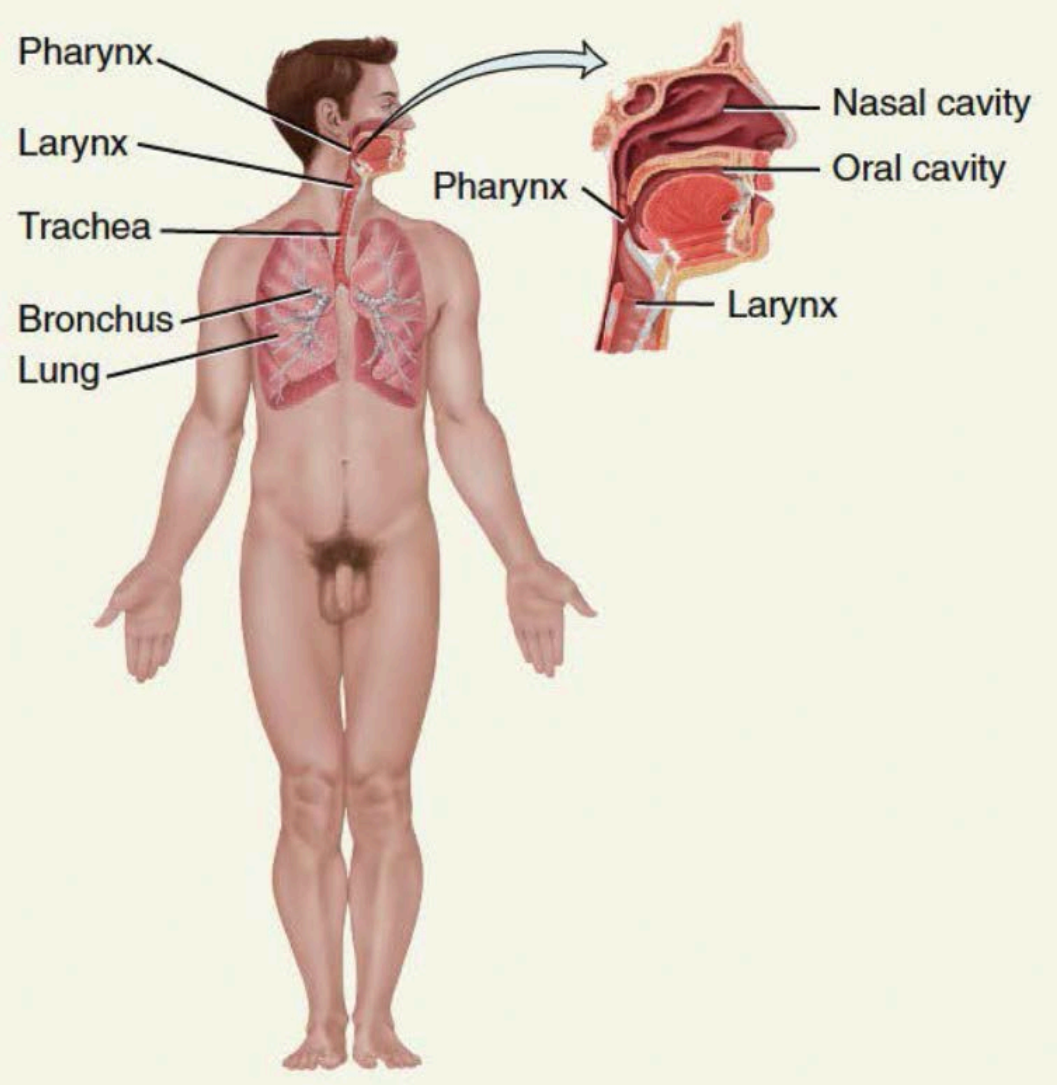
COMPONENTS

- The body organs that render ingested foods absorbable.

FUNCTIONS

- Mechanically and chemically breaks down foods for cellular use
- eliminates undigested wastes.

Respiratory System



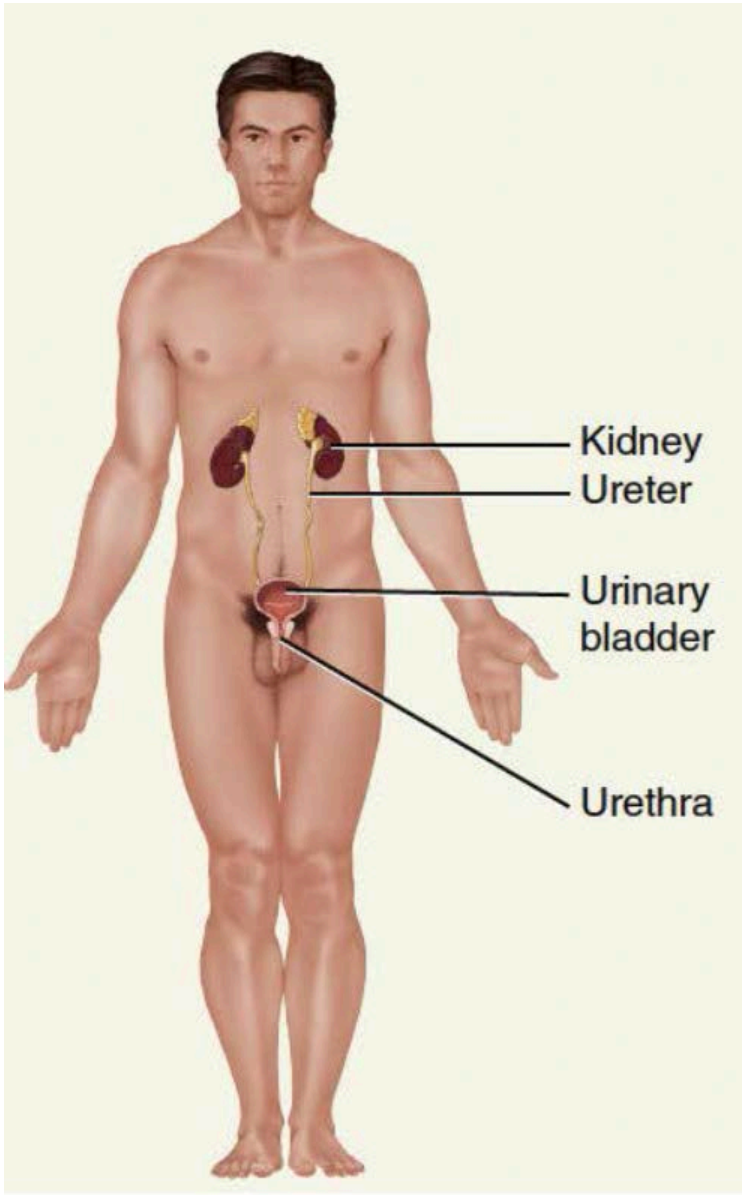
COMPONENTS

- The body organs concerned with movement of respiratory gases (O2 and CO2) to and from the pulmonary blood (the blood within the lungs).

FUNCTIONS

- Supplies oxygen to the blood
- eliminates carbon dioxide
- also helps to regulate acid–base balance.

Urinary System



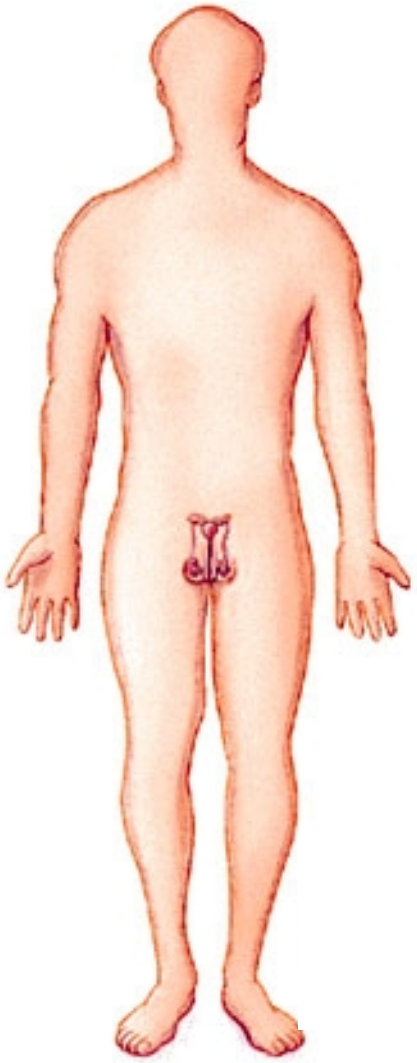
COMPONENTS

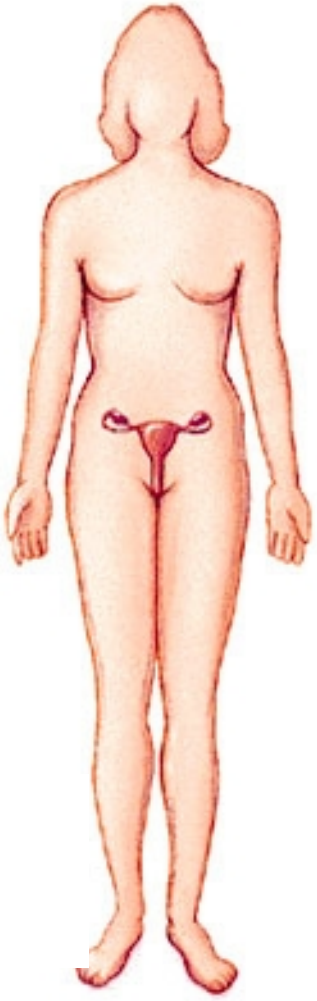
- The organs that operate to remove wastes from the blood and to eliminate urine from the body.

FUNCTIONS

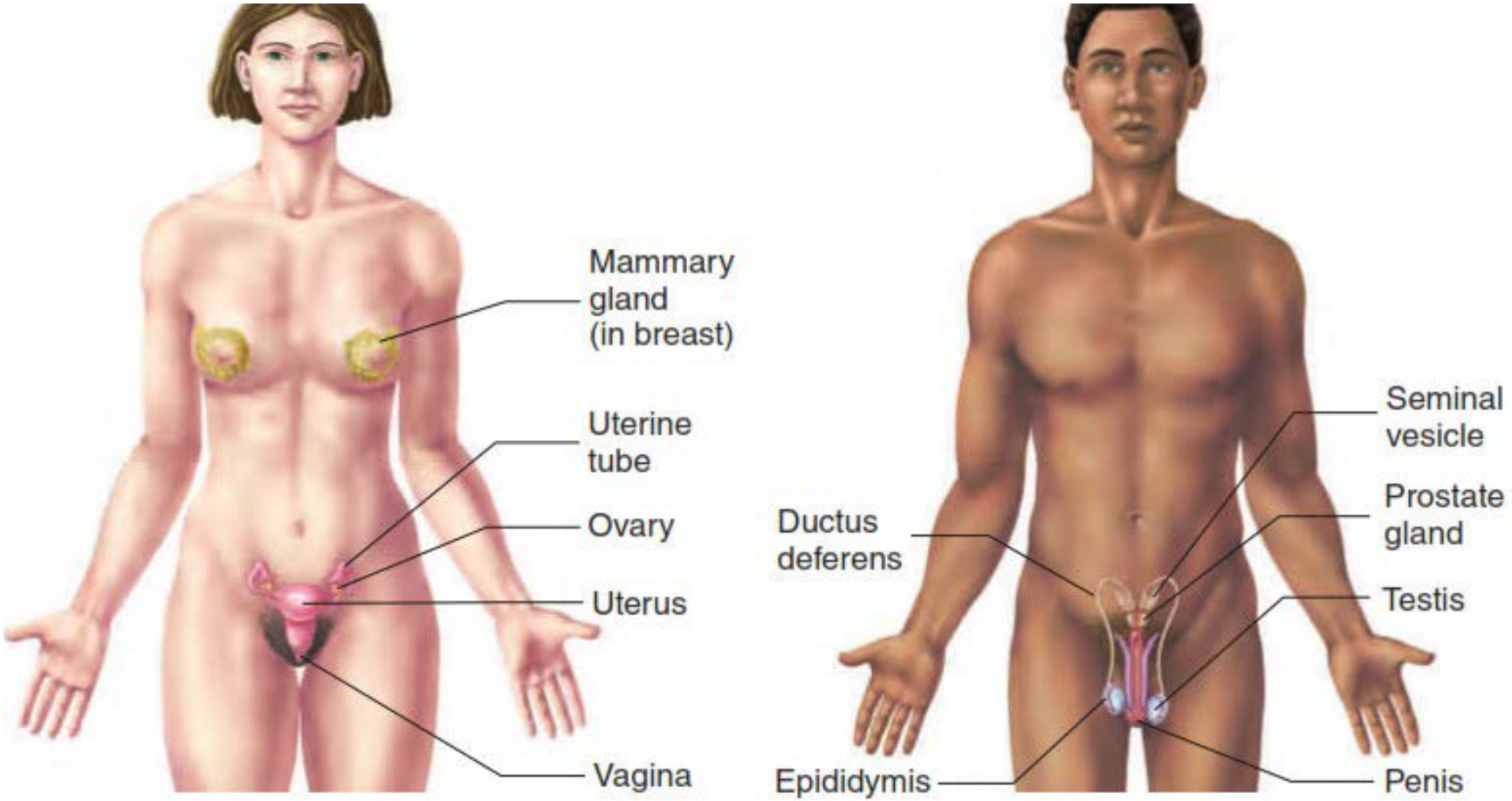
- Removes various wastes from the blood
- regulates the chemical composition, volume, and electrolyte balance of the blood;
- helps maintain the acid–base balance of the body.

Reproductive System





Reproduction System



COMPONENTS; The body organs that produce, store, and transport reproductive cells (gametes, or sperm and ova).

FUNCTIONS; Reproduce the organism, produce sex hormones.

Organ Systems

- Protection, Support, and Movement
  - Integumentary System
  - Skeletal System
  - Muscular System
- Internal Communications & Integration
  - Nervous System
  - Endocrine System
- Fluid Transport
  - Circulatory System
  - Lymphatic System
- Defense
  - Immune (Lymphatic System)
- Input and Output
  - Respiratory System
  - Urinary System
  - Digestive System
- Reproduction
  - Reproductive System

HOMEOSTASIS

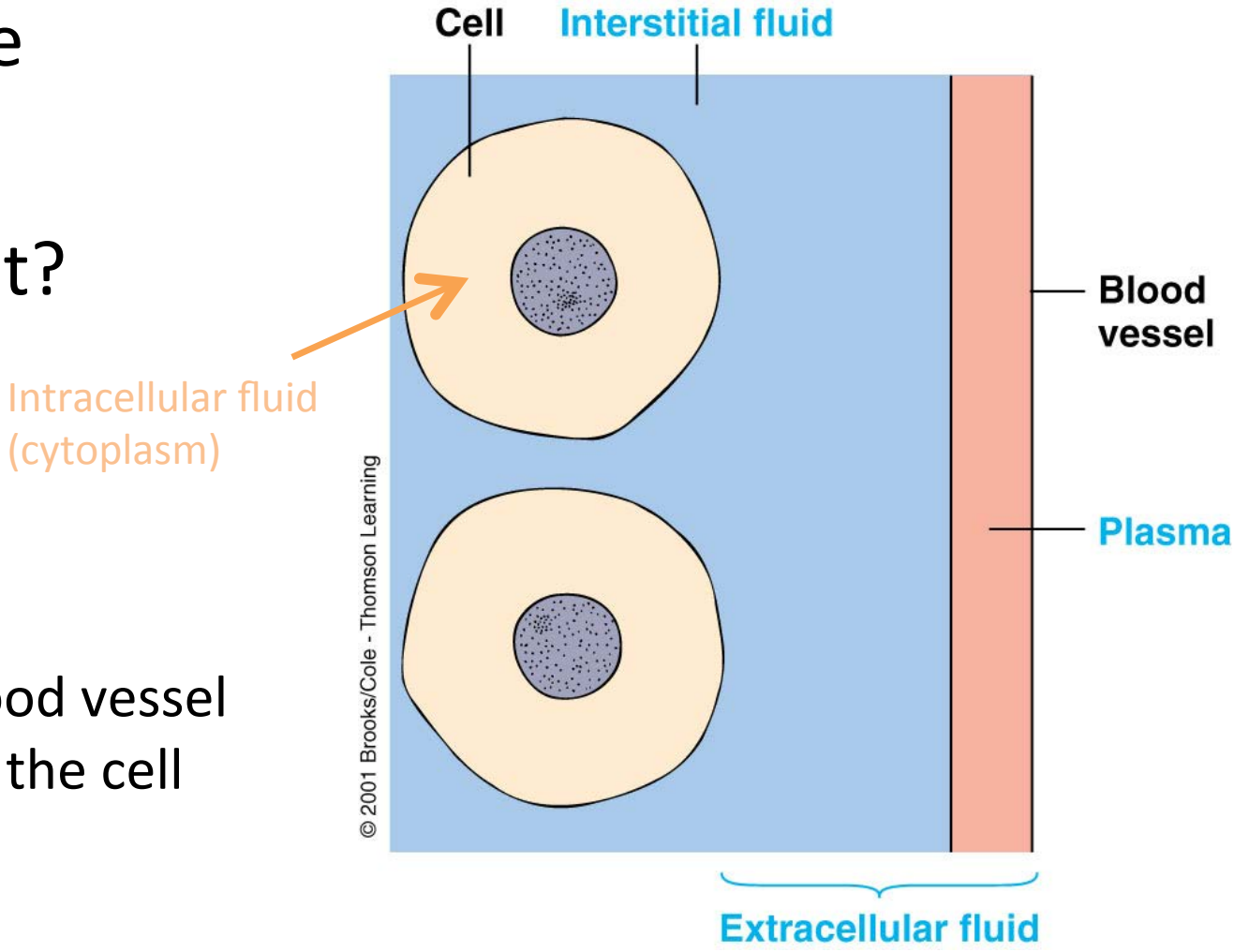
"…it is all about a balancing act…"

What is Homeostasis?

The maintenance of a constant environment in the body is called

Homeostasis is the maintenance of a relatively stable internal environment

What is the 'internal' environment?

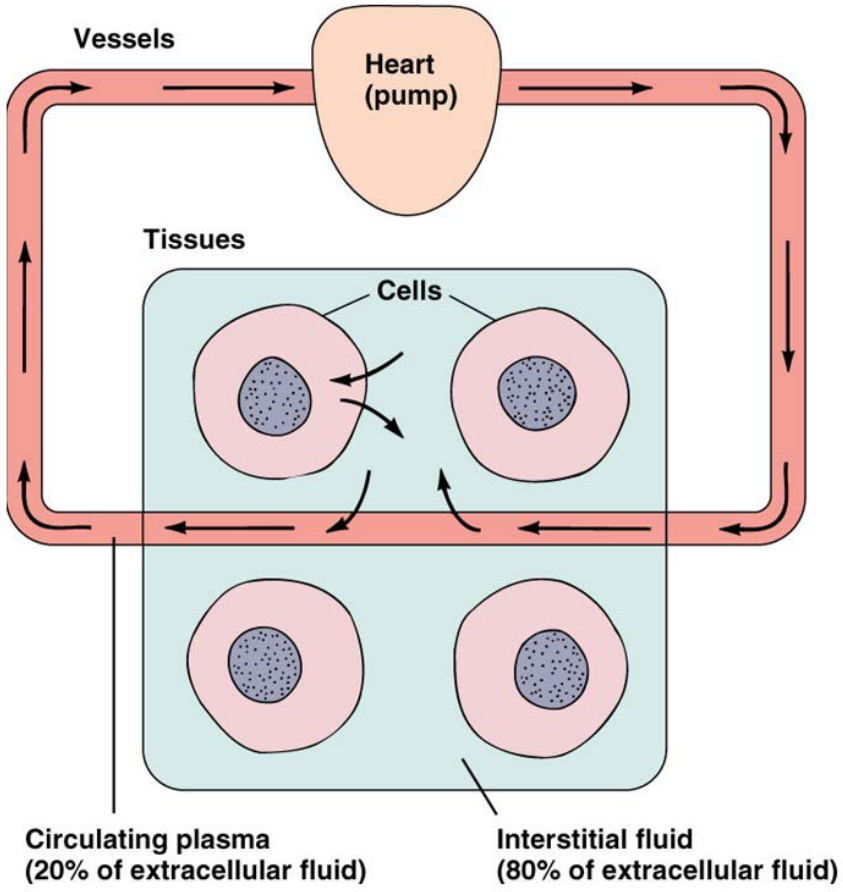


ICF=within the cell
ECF=outside the cell
1) Plasma = in the blood vessel
2) Interstial = around the cell (in tissue)

Examples of Physiological conditions requiring homeostasis:

Body cells work best if they have the correct:

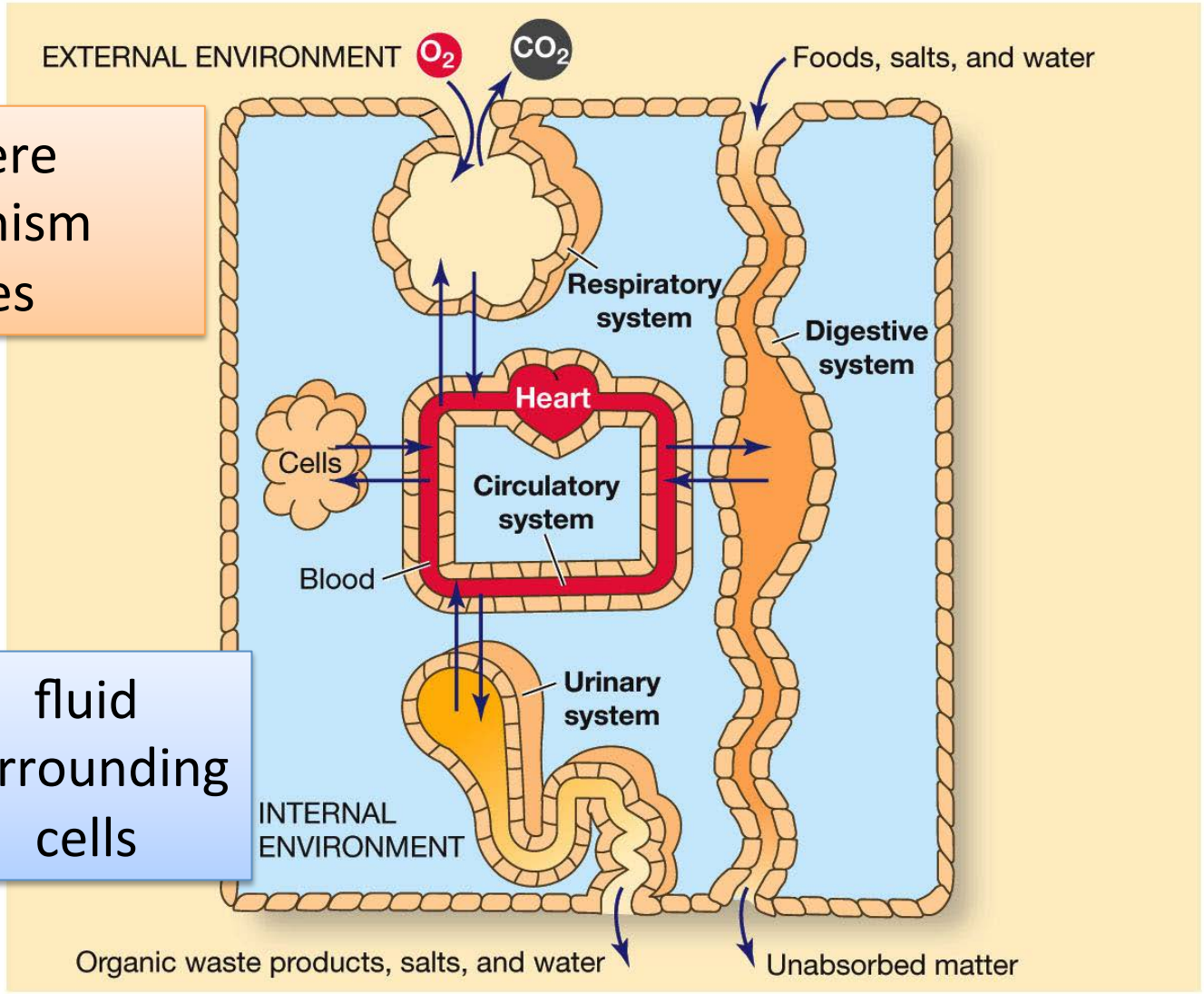
- O_2 and CO_2 levels in the body
- energy requirement
- glucose level in blood
- water / ion balance
- pH
- temperature



Homeostasis is made up of many other systems.

where organism lives

fluid surrounding cells

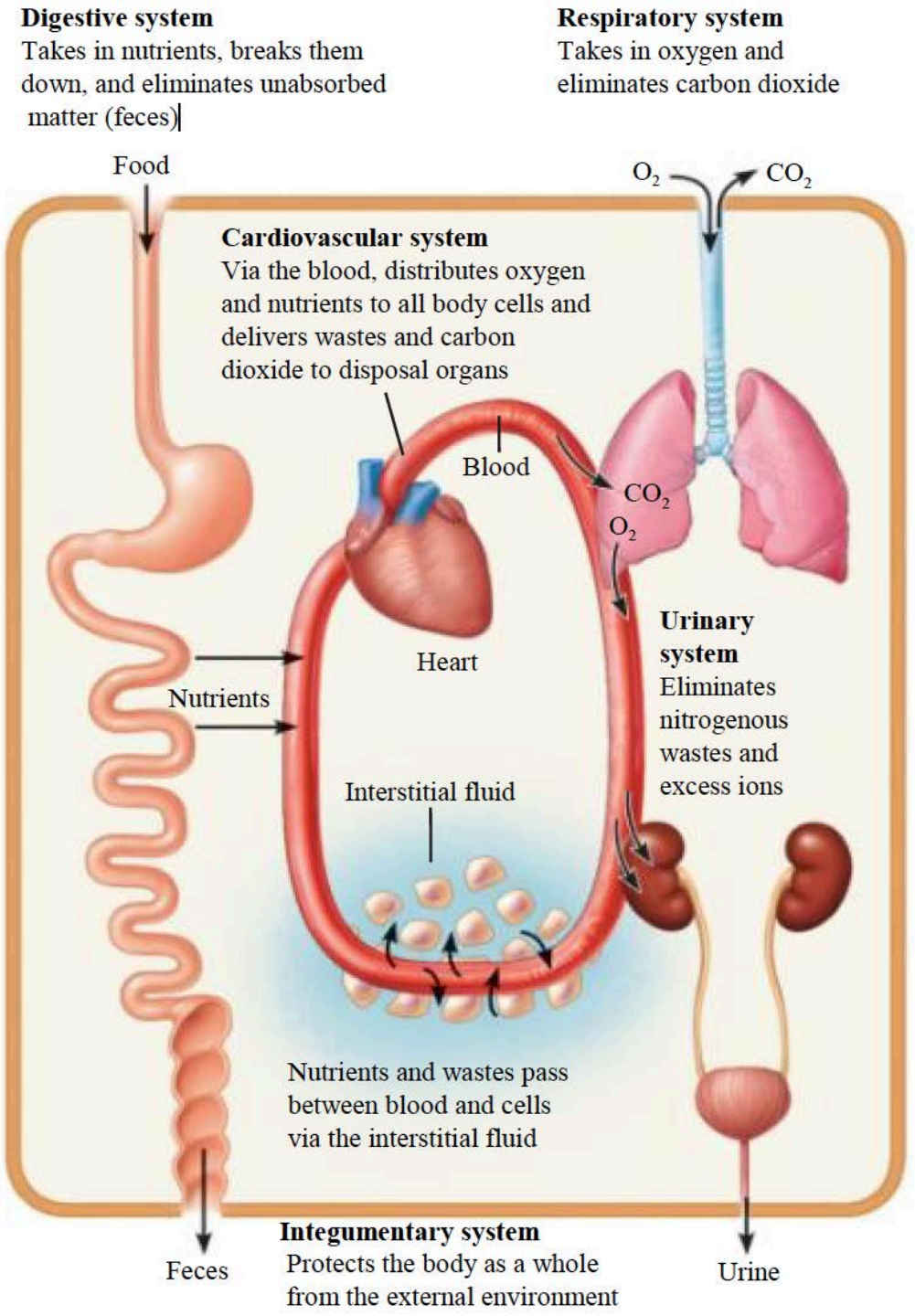


LIFE 8e, Figure 40.1

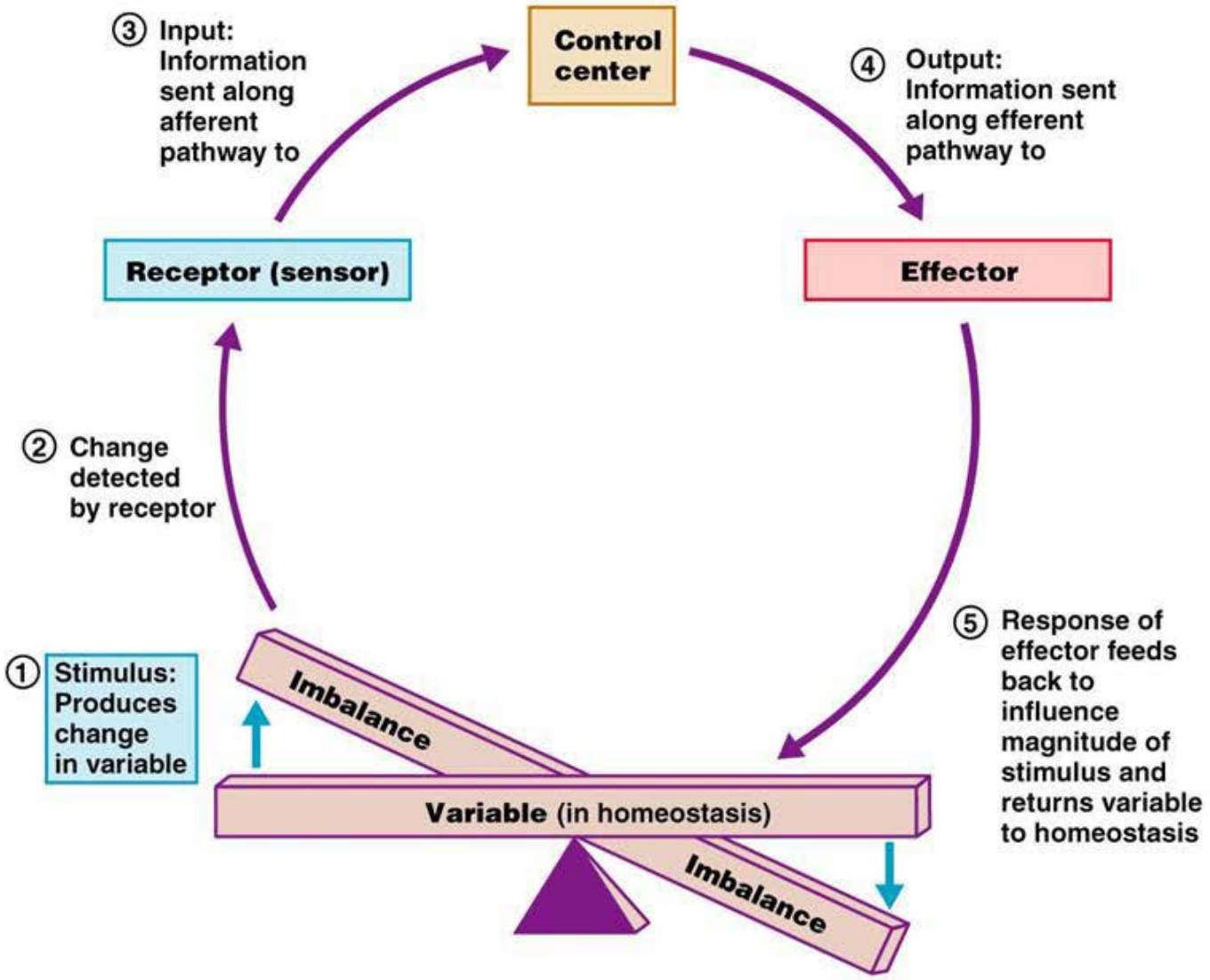
work together to keep the body in a stable internal environment

Organ Systems Interrelation ships

- All cells depend on organ systems to meet their survival needs.
- Organ systems work cooperatively to perform necessary life functions



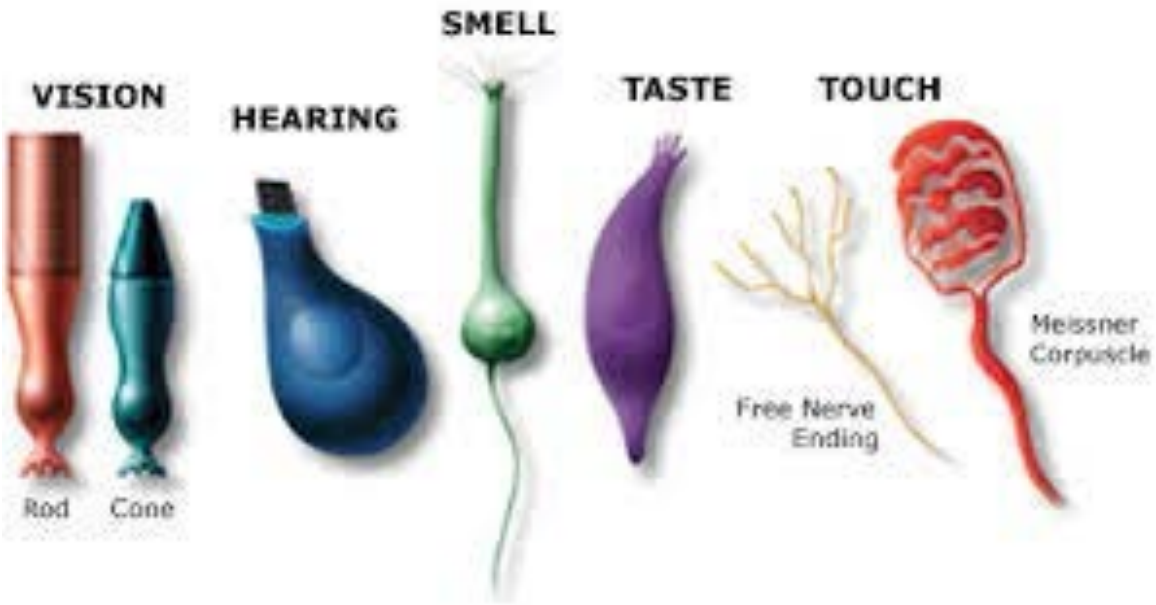
Homeostasis: Components



Homeostasis: Components
Receptors

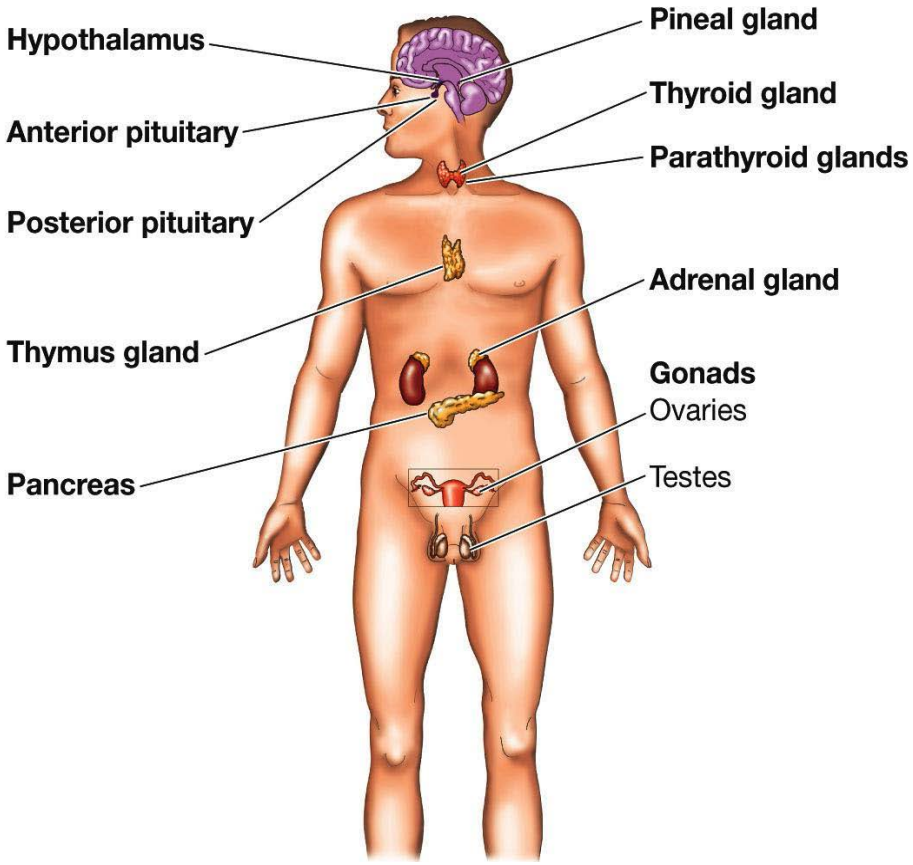
- They are sensors which detect stimuli
- Receptors include

✓Thermoreceptors
✓Chemoreceptors
✓Baroreceptors



Integrating Centre
Control Center

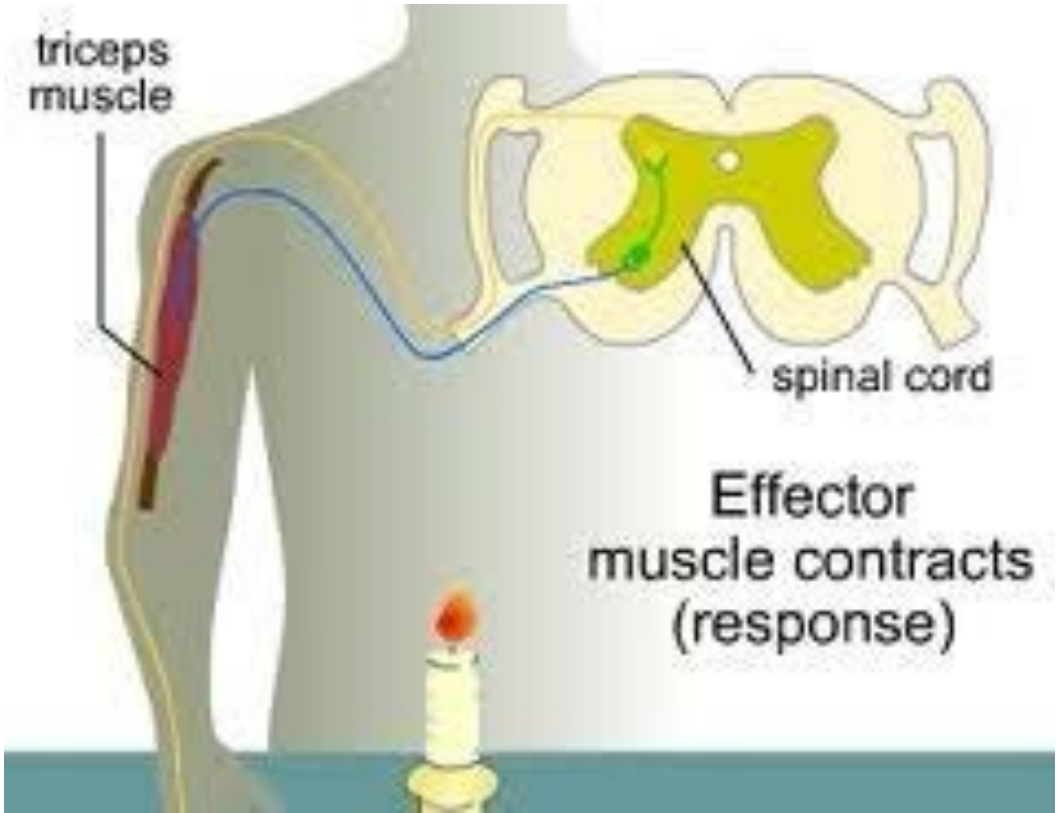
An endocrine gland



Brain or spinal cord

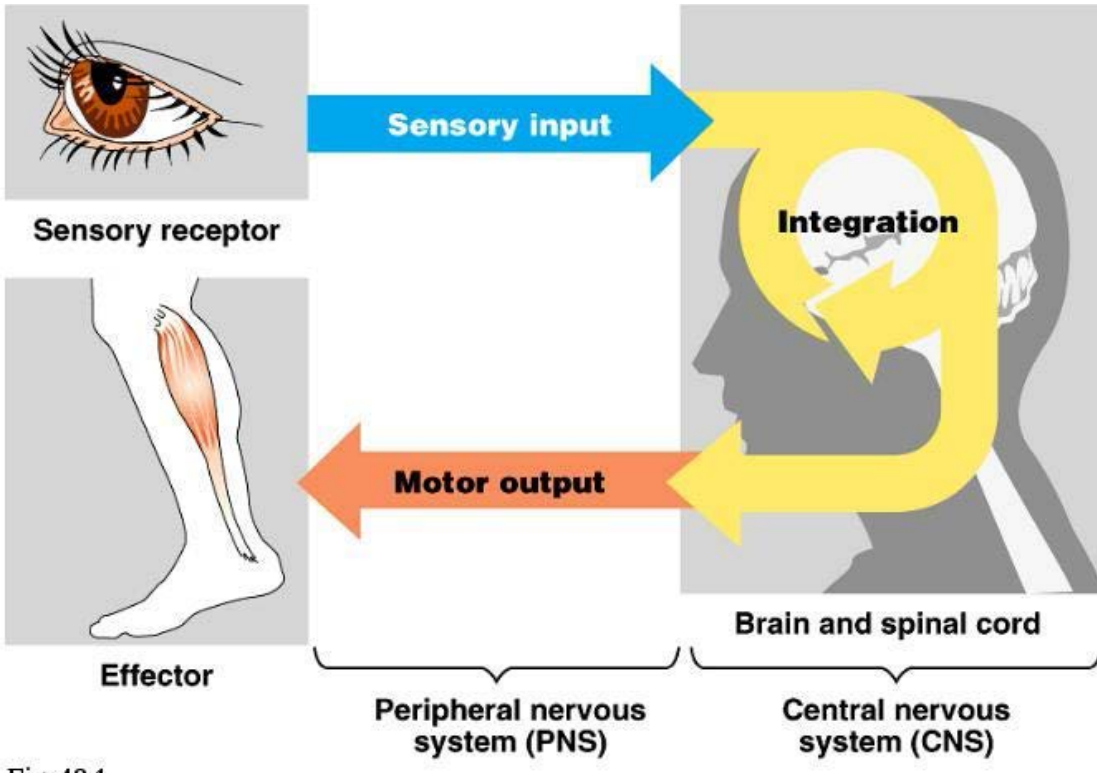
Effectors

- Responsible for body responses
- • Muscles (smooth, striated, and cardiac)
- • Glands



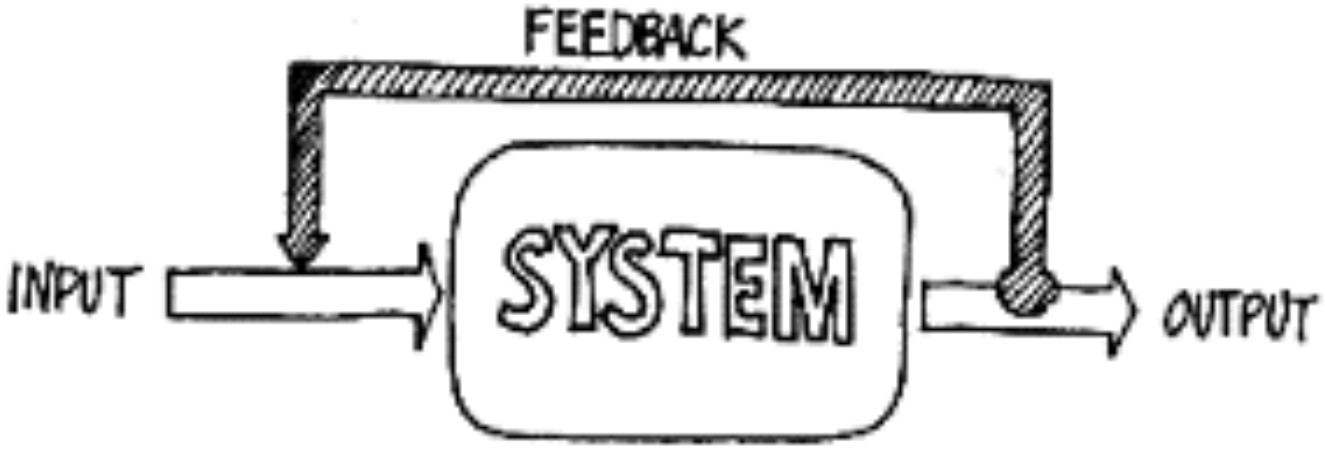
Signals

- **Input signal**- from a receptor to an integrating center (afferent)
- Output signal- from an integrating center to an effector (efferent)
- Signals are chemicals or neuronal



What is Feedback?

- Feedback refers to responses made after a change has been detected

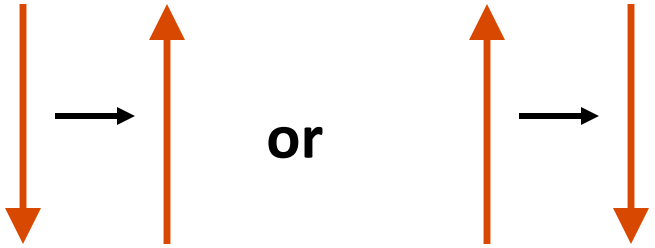


The signal sent by the effector is called feedback

F E E D B A C K S Y S T E M S

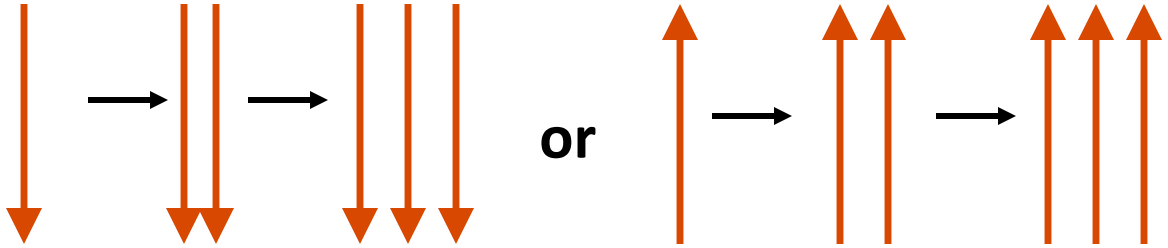
1- **Negative feedback mechanisms**:

Causes the variable to change in a direction **opposite** to that of the initial change.



2- Positive feedback mechanisms:

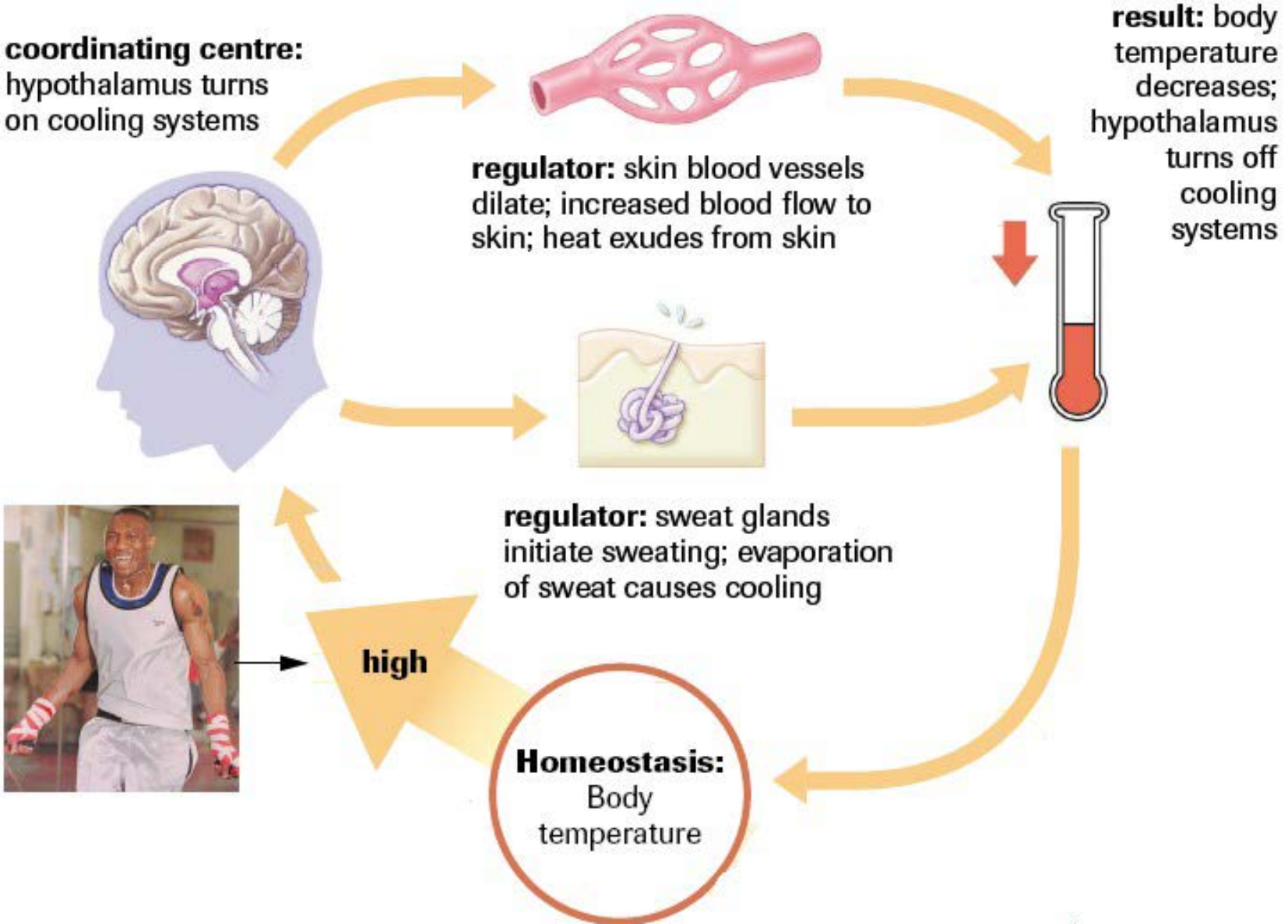
Causes the variable to accelerate the change in the **same direction** that the initial disturbance.



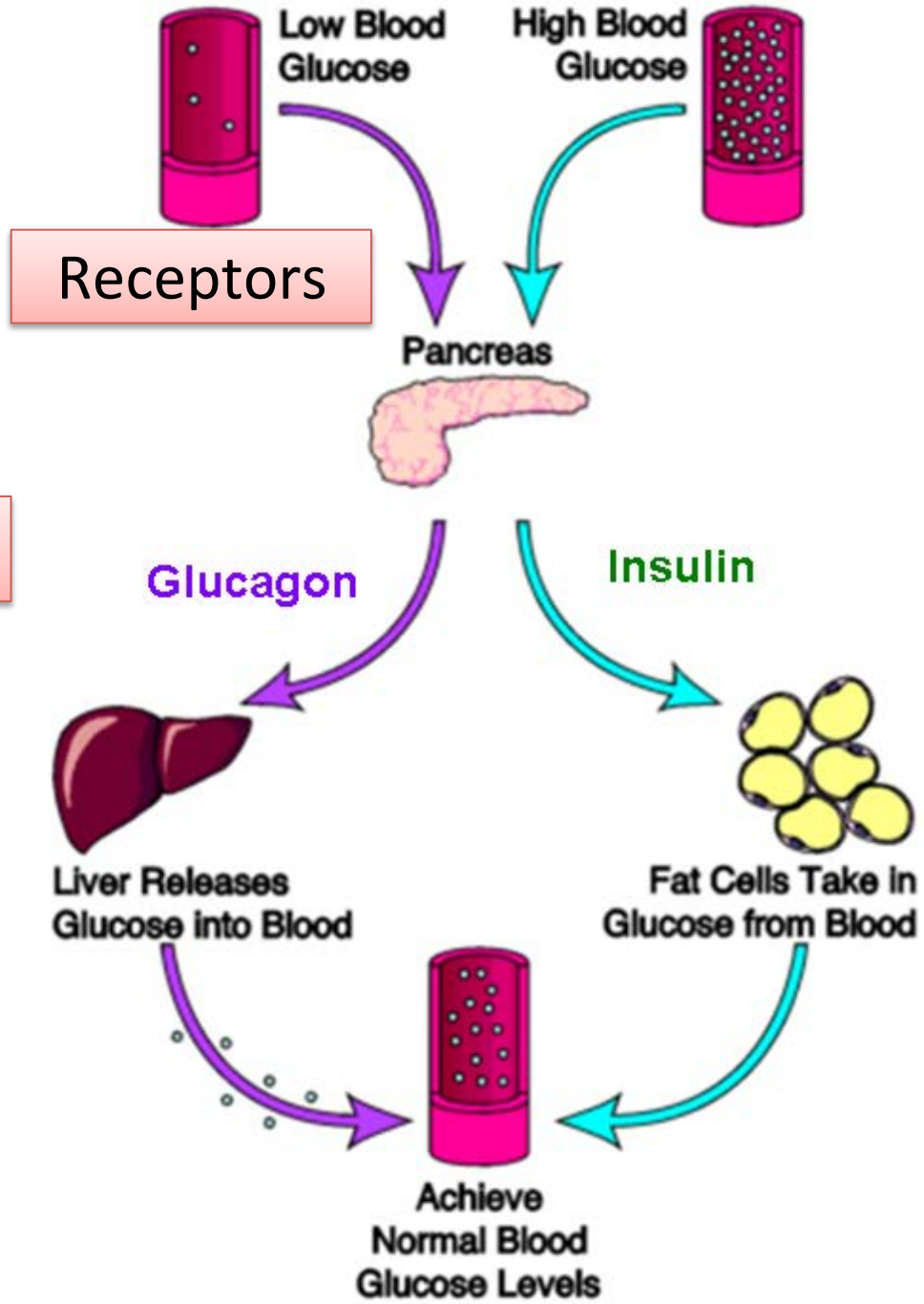
Examples of Negative Feedback Control:

- O_2 and CO_2 levels in the body
- hormone levels, e.g. thyroxine
- sex hormones
- **metabolic levels e.g. glucose**
- water balance
- the regulation of pH
- **body temperature**

Temp Regulation: Negative feedback

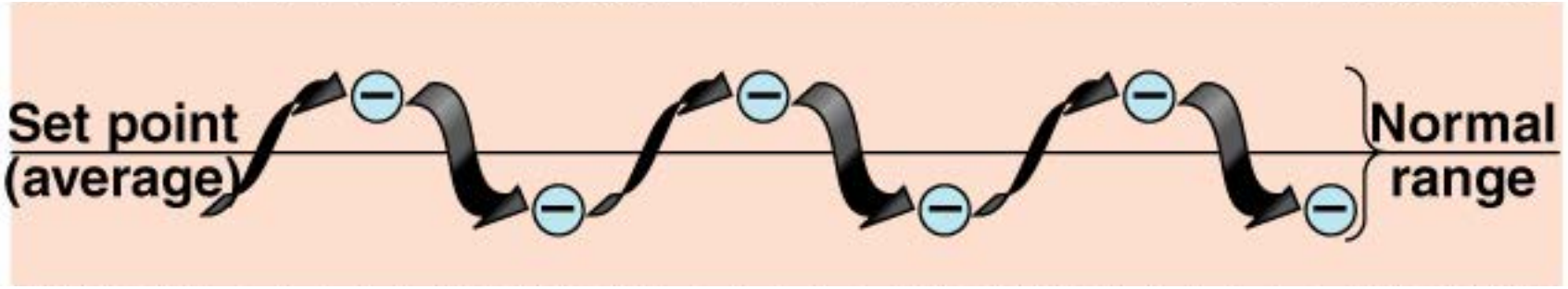


Blood sugar regulation: Negative feedback



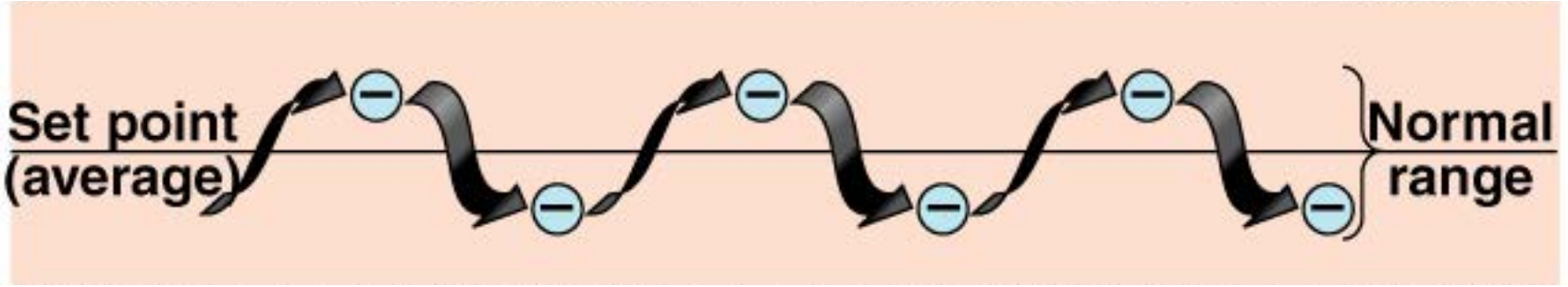
In negative feedback (feedback inhibition)

- the initial stimulus provokes a response which tends to reduce the magnitude of the Stimulus
- as conditions return to their optimum, the corrective processes can be switched off



Why is negative feedback very common in the body?

increases the stability of systems



Positive feedback:

- a disturbance leads to events which increase the disturbance even further
- rare in biological systems

WHY rare?

lead to:

- ✓ **an unstable situation**
- ✓ **extreme states**

Examples of Positive Feedback Control:

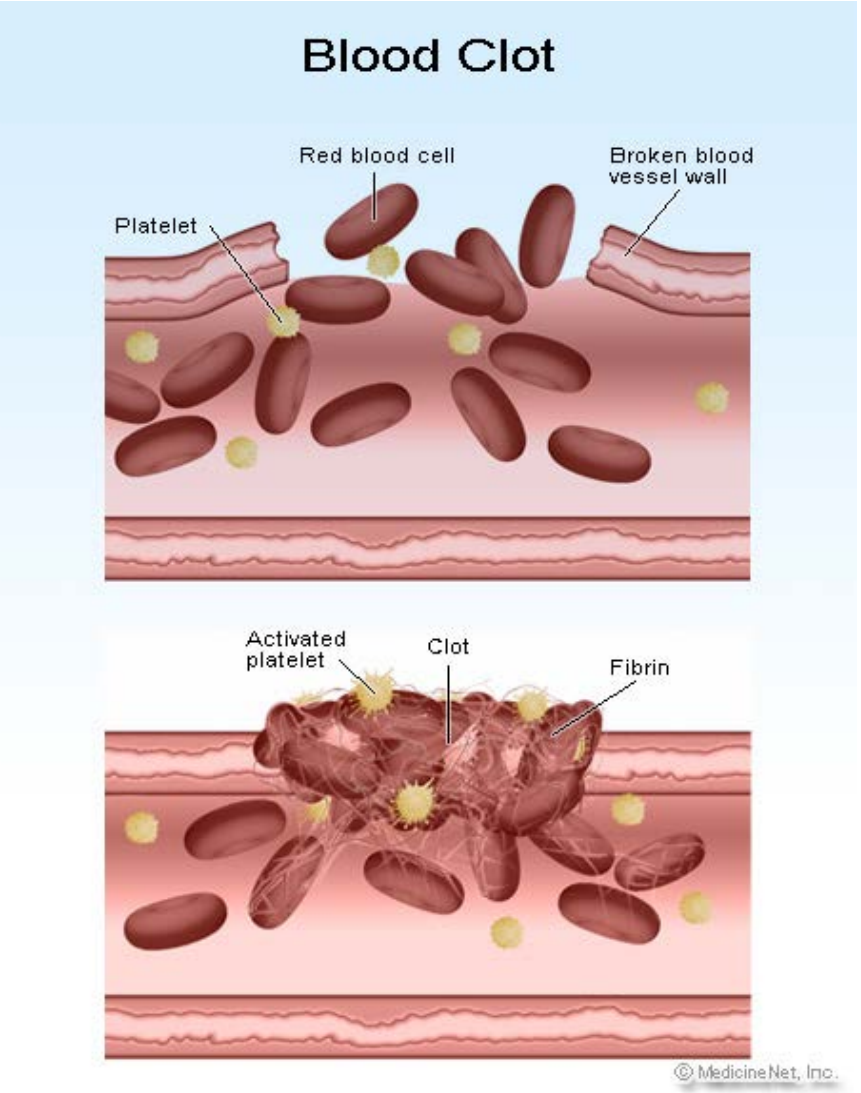
1. Blood clotting

Activated platelet

releases chemicals

More platelets are activated

A blood clot forms

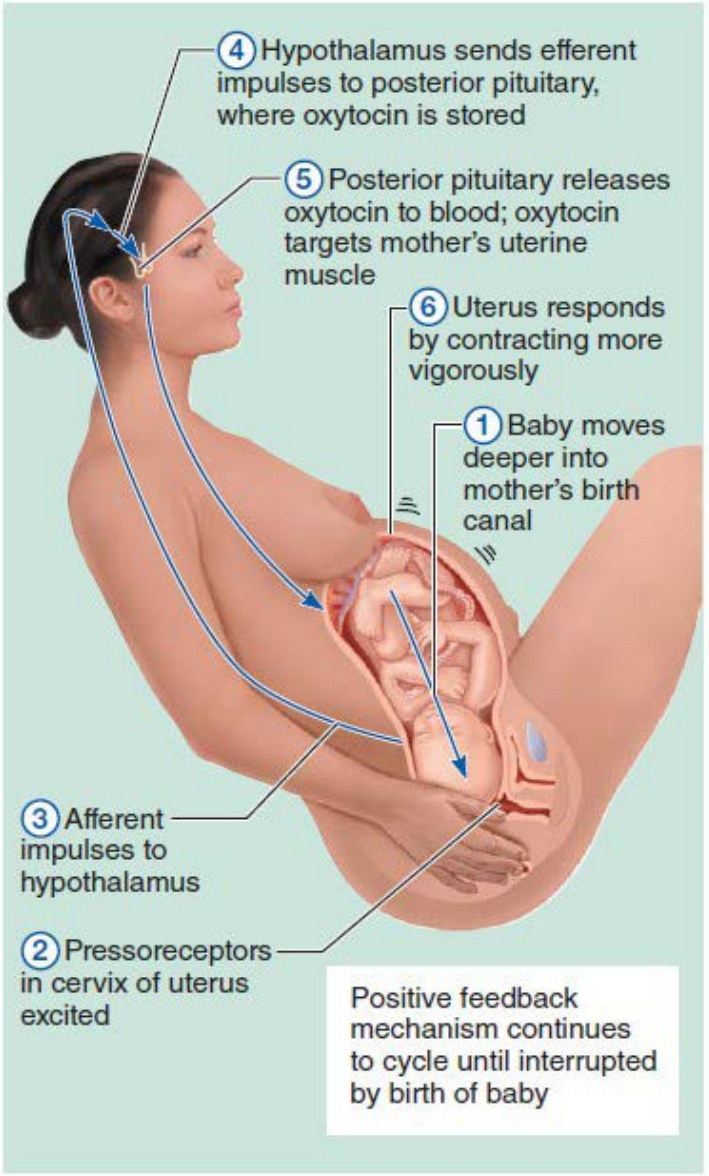


Examples of Positive Feedback Control

2. Child birth

Oxytocin stimulates muscular contractions of the uterus

More oxytocin is released




Keep your
balance!!