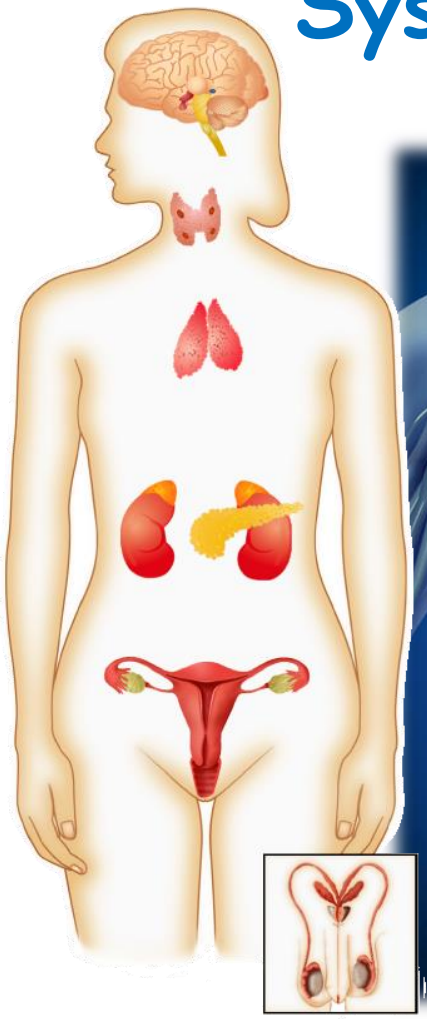
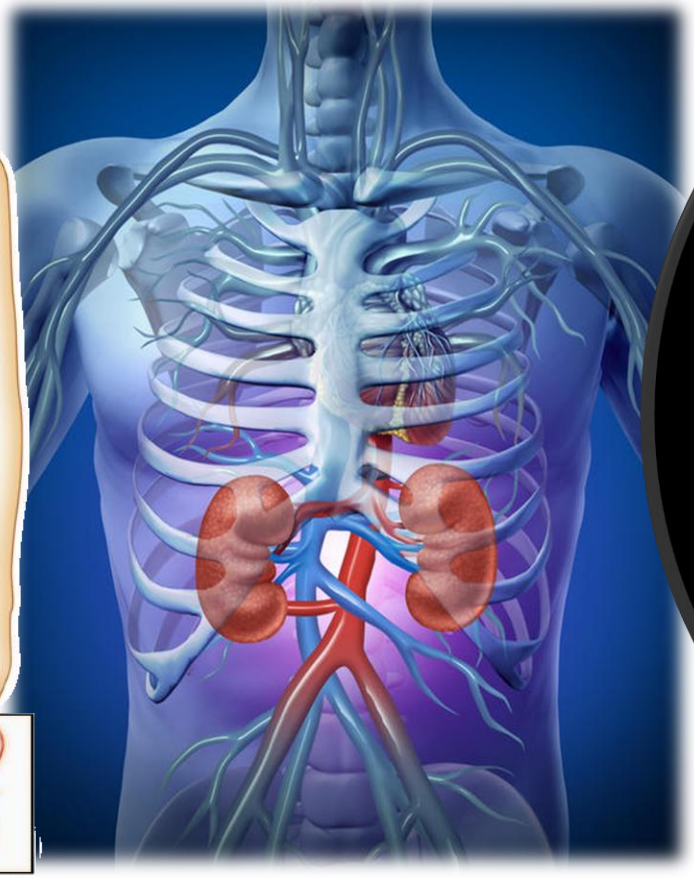
Go to the "Slide Show" shade above

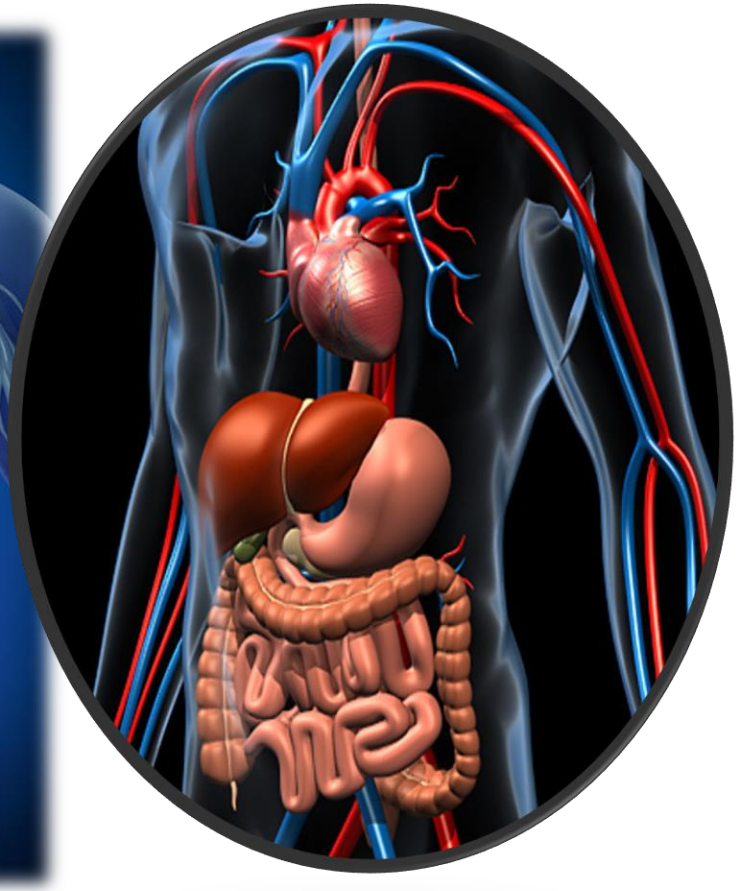
Click on "Play from Beginning"

Human Anatomy & Physiology

Endocrine, Immune, Digestive, Excretory Systems Chapter 31, 33







WARM-UP

Match the following:

System	Description
Digestive	Made up of glands that release their products into the bloodstream.
Endocrine	The body's main defense against pathogens.
Excretory	Mechanical and Chemical in nature so nutrients can be absorbed.
Immune	Rid the body of cellular waste.

WARM-UP

Human Anatomy & Physiology

System	Description
Digestive	Mechanical and Chemical in nature so nutrients can be absorbed.
Endocrine	**Made up of glands that release their products into the bloodstream.**
Excretory	Rid the body of cellular waste.
Immune	The body's main defense against pathogens.

Lesson Objectives

By the end of this lesson, you should be able to:

- Recognize, identify, & define the anatomy and function of the human Endocrine system.
  - Types of glands (exocrine versus endocrine).
  - Positive / Negative feedback mechanism.
- Recognize, identify, & define the anatomy and function of the human Immune system.
  - Types of White Blood Cells; two general categories (innate vs. adaptive); Lines of defense.
  - Acquired immunity (active vs. passive); Primary vs. Secondary response; Immune diseases.
- Recognize, identify, & define the anatomy and function of the human Digestive system.
  - Nutrients; Four stages of food processing; Two methods of digestion.
  - Alimentary Canal (stomach to anus) with digestive accessory glands.
- Recognize, identify, & define the anatomy and function of the human Excretory system.
  - Homeostasis; excretory organs.
  - Urinary system; Urine formation; Control of kidney function.

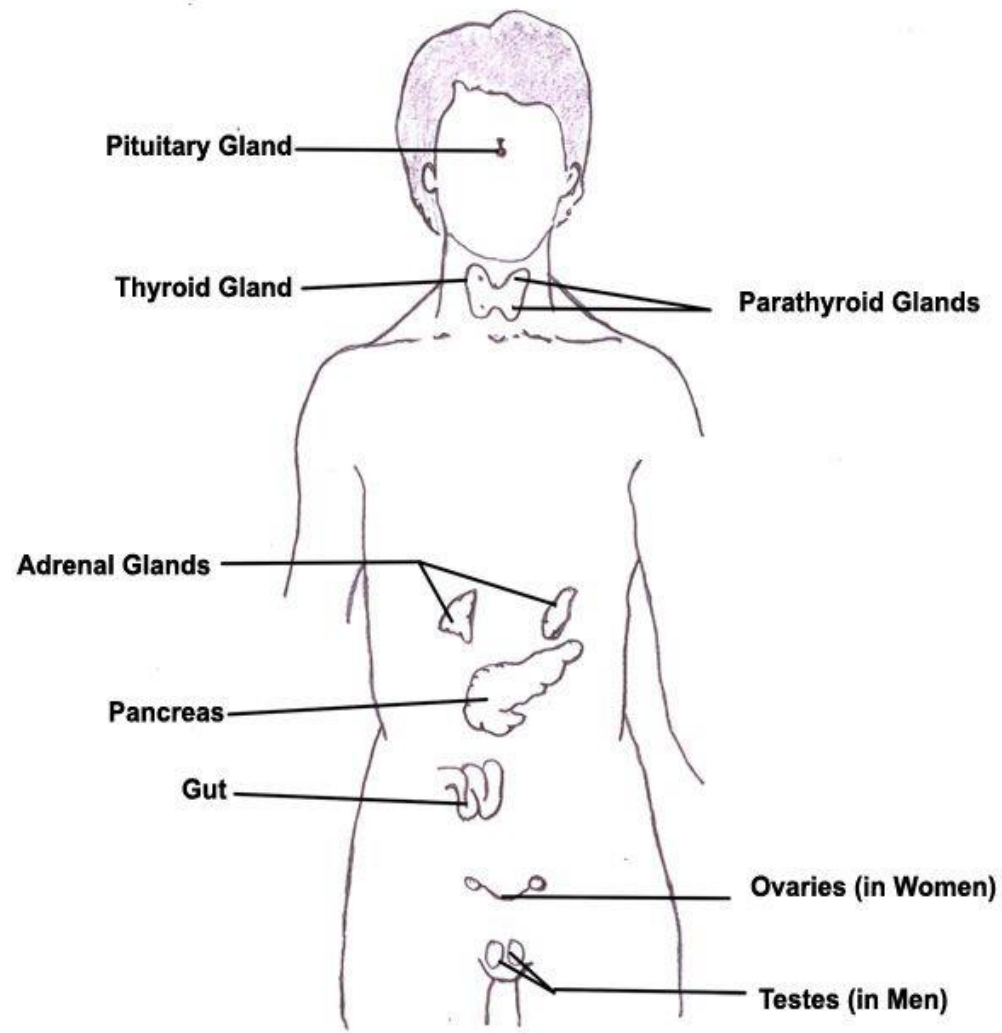
- **Science Practice: Identify/Label the Systems (Endocrine, immune, digestive, excretory) Lab**

Endocrine System

The endocrine system is made up of glands that release their products into the bloodstream.

These products deliver messages throughout the body.

The chemicals released by the endocrine system can affect almost every cell in the body.



Endocrine System

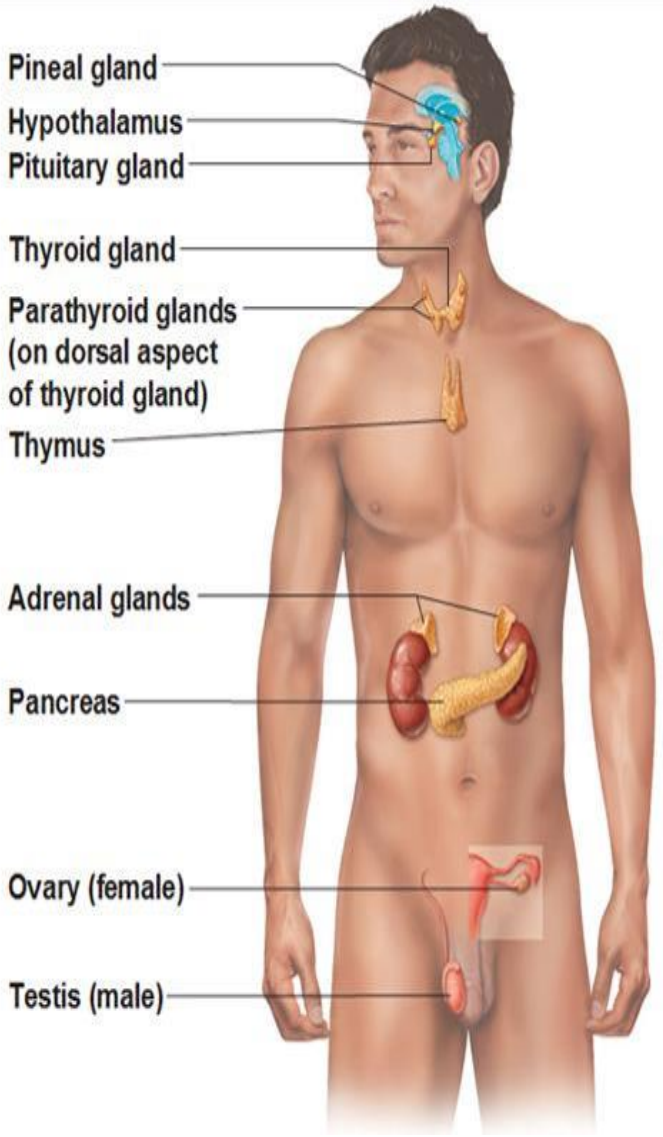
Major Endocrine Organs

Endocrine and Nervous Systems specialize in the inter-systemic communication needed to maintain body homeostasis.

The Nervous system acts faster and more locally than Endocrine System.

Endocrine System includes:

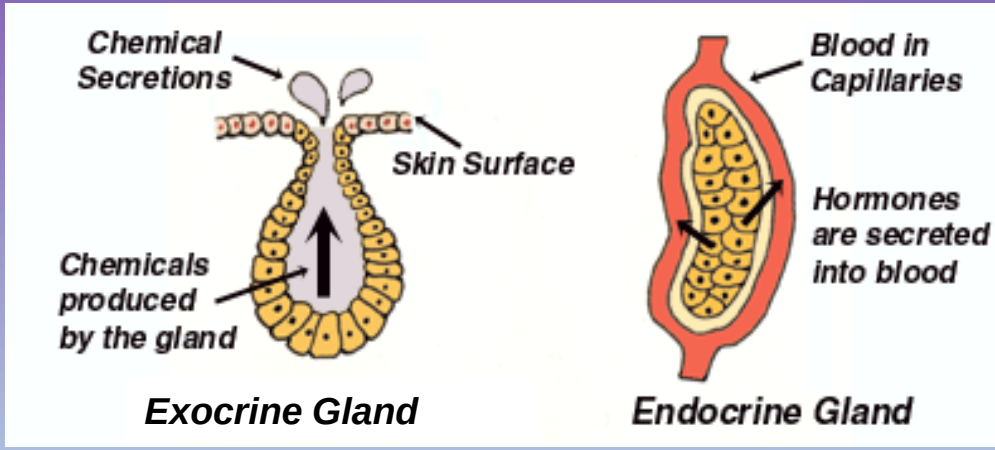
- Glands
- Hormones



Glands

Gland

– An organ that produces and releases a secretion.



Two kinds of glands:

1. Exocrine glands

- Release secretions through ducts directly to the organs that use them.

2. Endocrine glands

- Release their secretions directly into the bloodstream.

Exocrine Glands (*enrichment*)

The liver and pancreas are both exocrine and endocrine glands.

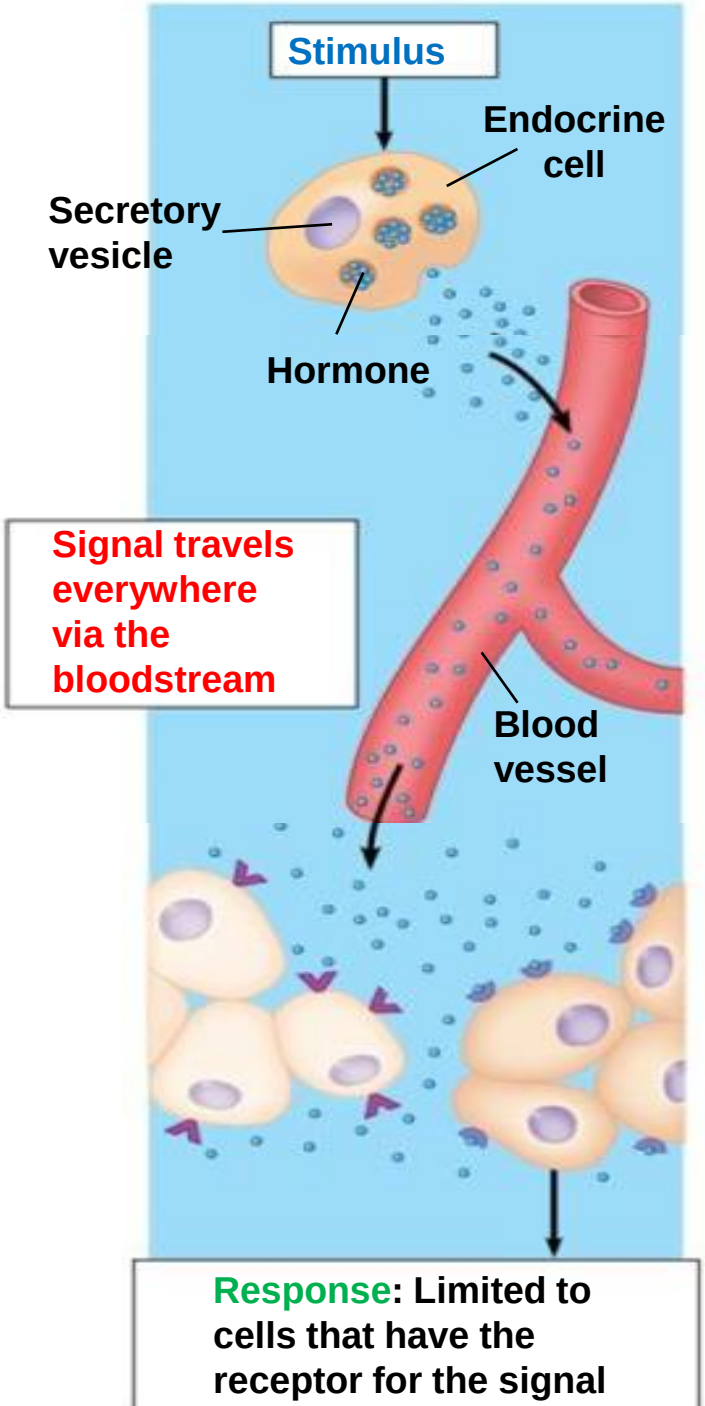
They are exocrine glands because they secrete by way of the hepatic and pancreatic ducts.

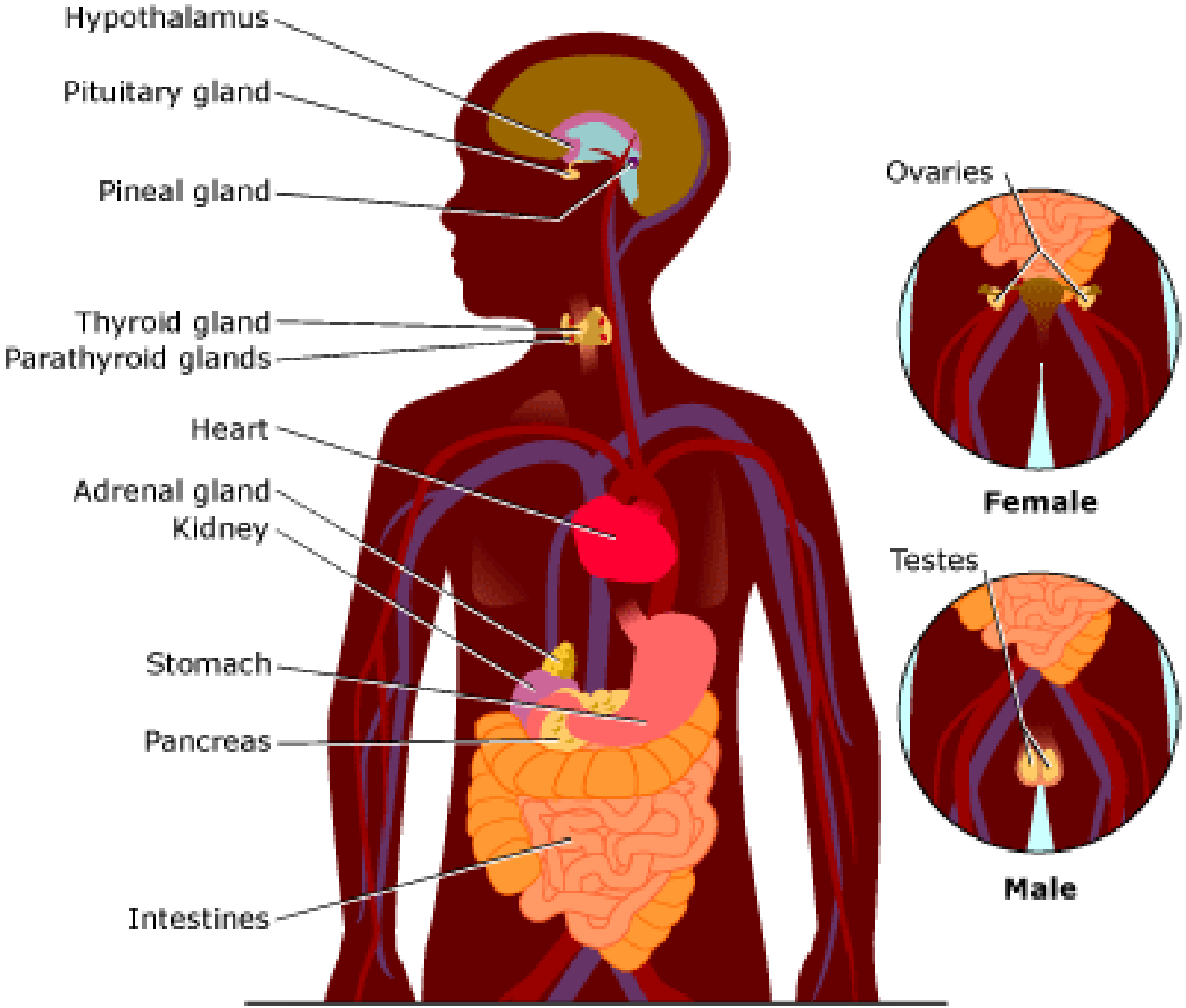
- Examples of exocrine glands in our bodies: sweat, salivary, mammary, lacrimal, sebaceous, and mucous.

Endocrine System Control

In the endocrine system, chemical signals called **Hormones** regulate body functions.

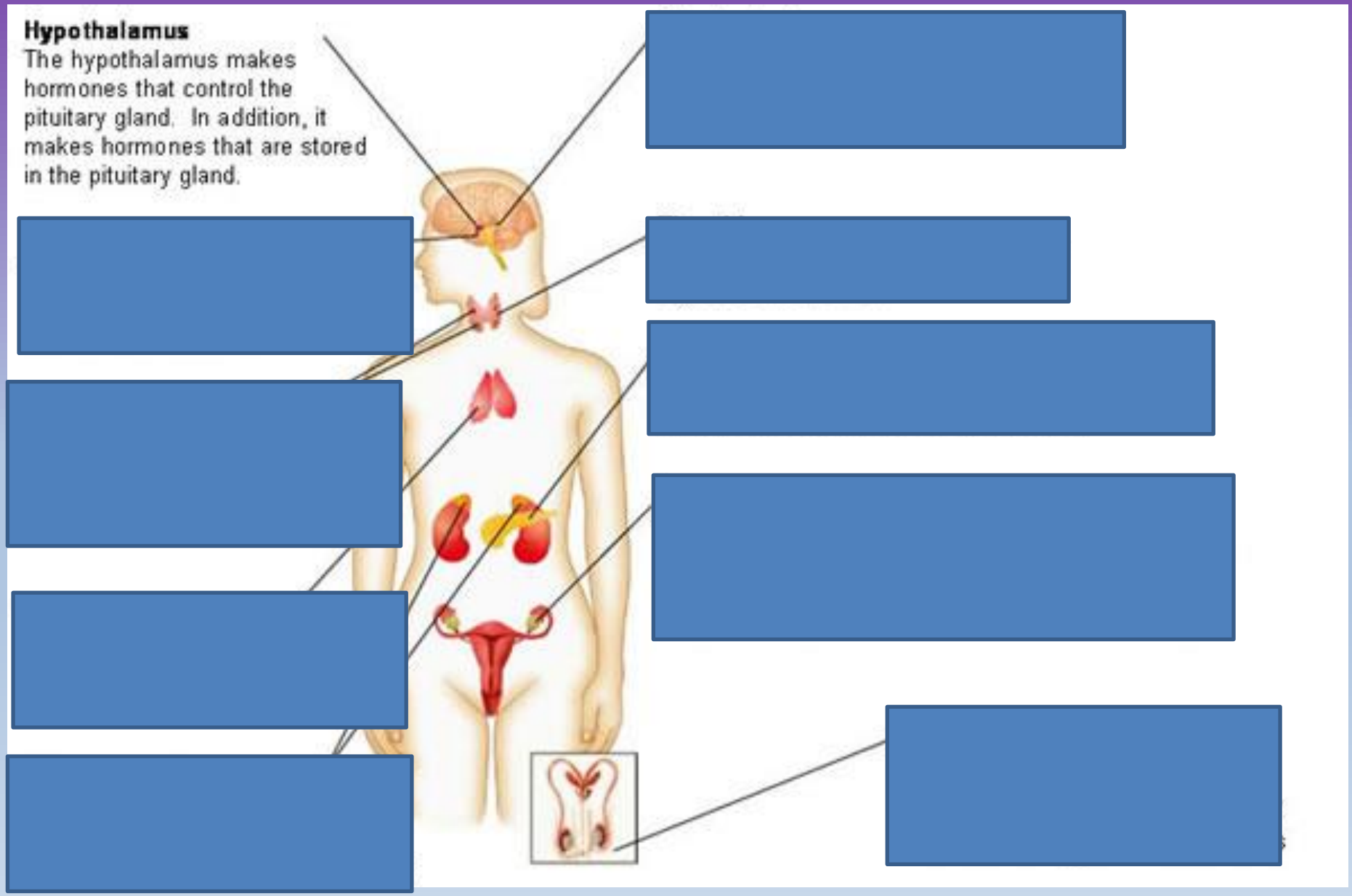
- Are chemicals released in one part of the body that travel through the bloodstream and affect the activities of cells in other parts of the body.
- Are **released into the bloodstream** by endocrine cells.
- Are carried to **all locations** in the body.
- Affect only **Target Cells** that have receptors for that specific hormone.


Stimulus
Endocrine cell
Secretory vesicle
Hormone
Signal travels everywhere via the bloodstream
Blood vessel
Response: Limited to cells that have the receptor for the signal

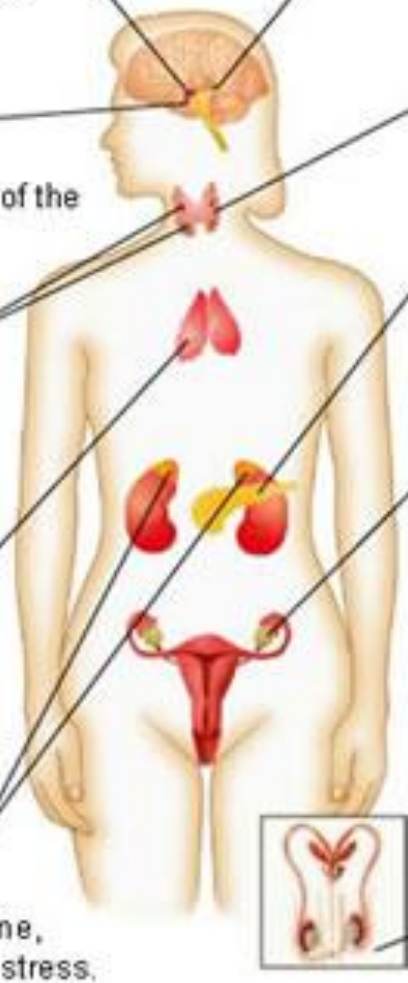


The Endocrine System

Endocrine Glands



Endocrine Glands



Hypothalamus
The hypothalamus makes hormones that control the pituitary gland. In addition, it makes hormones that are stored in the pituitary gland.

Pituitary gland
The pituitary gland produces hormones that regulate many of the other endocrine glands.

Parathyroid glands
These four glands release parathyroid hormone, which regulate the level of calcium in the blood.

Thymus
During childhood, the thymus releases thymosin, which stimulates Tcell development.

Adrenal glands
The adrenal glands release epinephrine and nonepinephrine, which help the body deal with stress.

Pineal gland
The pineal gland releases melatonin, which is involved in rhythmic activities, such as daily sleep-wake cycles.

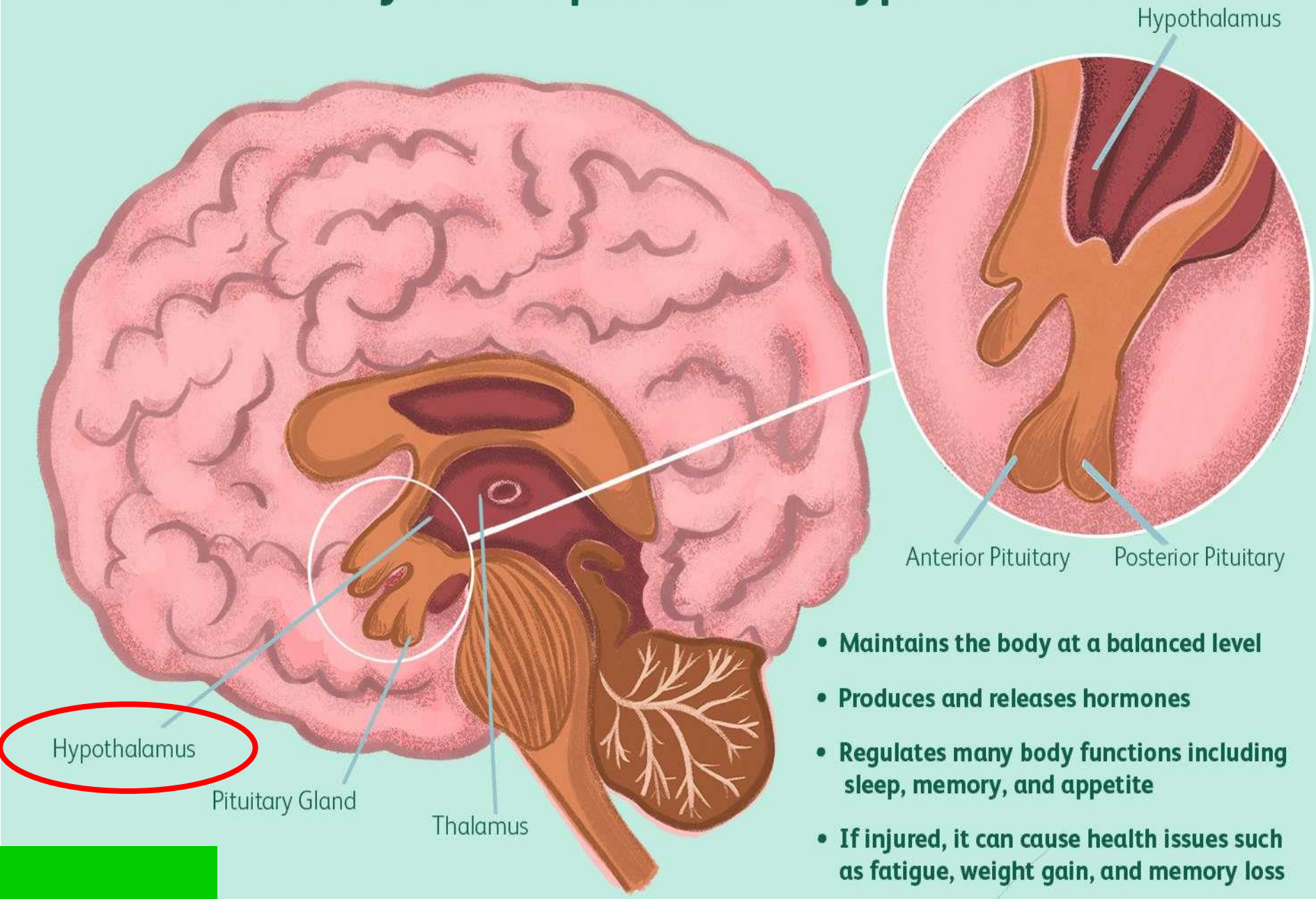
Thyroid
The thyroid produces thyroxine, which regulates metabolism.

Pancreas
The pancreas produces insulin and glucagon, which regulate the level of glucose in the blood.

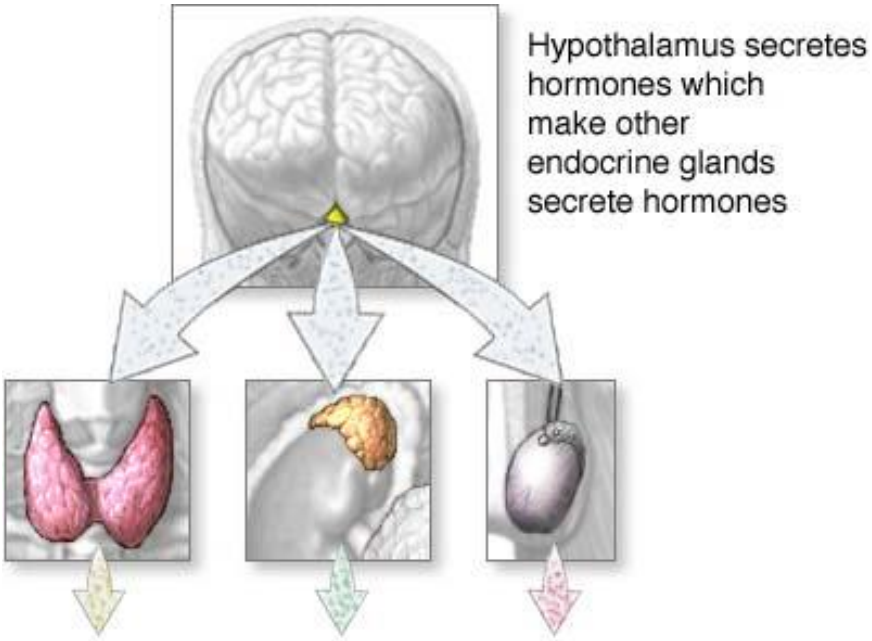
Ovary
The ovaries produce estrogen and progesterone. Estrogen is required for the development of secondary sex characteristics and for the development of eggs. Progesterone prepares the uterus for a fertilized egg.

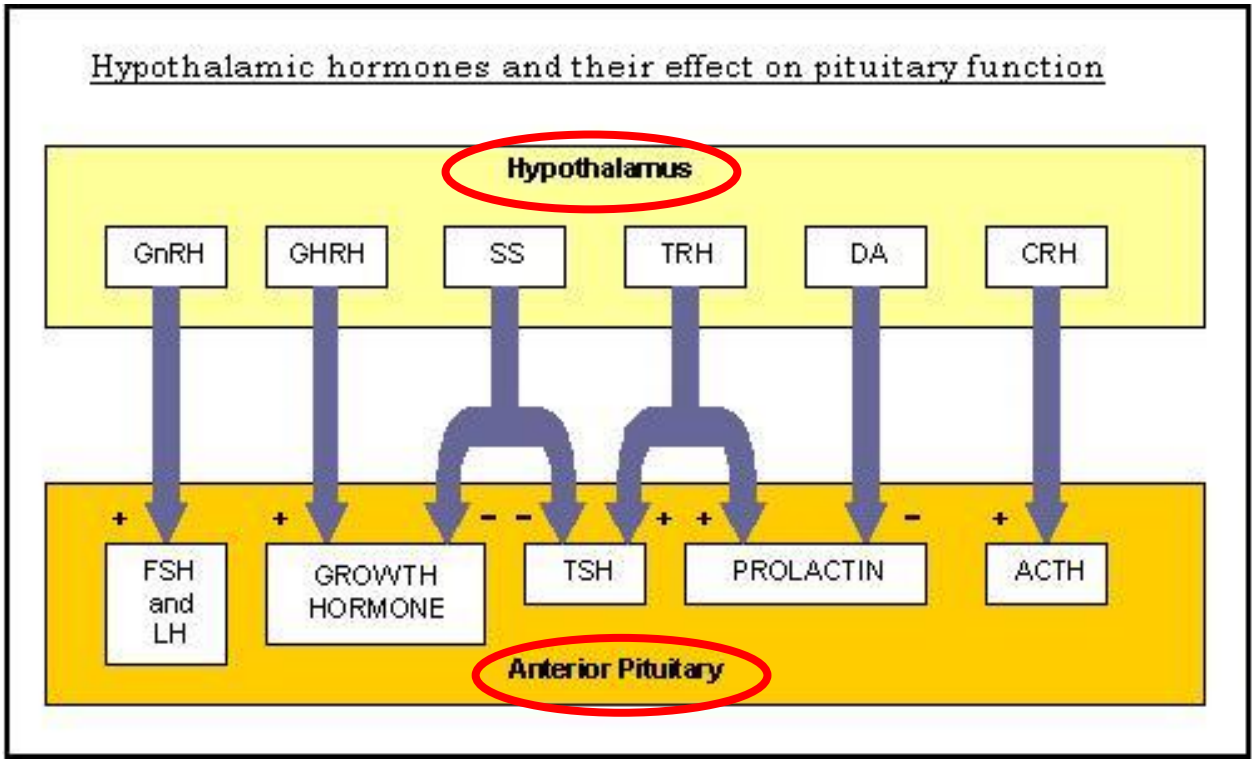
Testis
The testes produce testosterone, which is responsible for sperm production and the development of male secondary sex characteristics

Anatomy and Purposes of the Hypothalamus



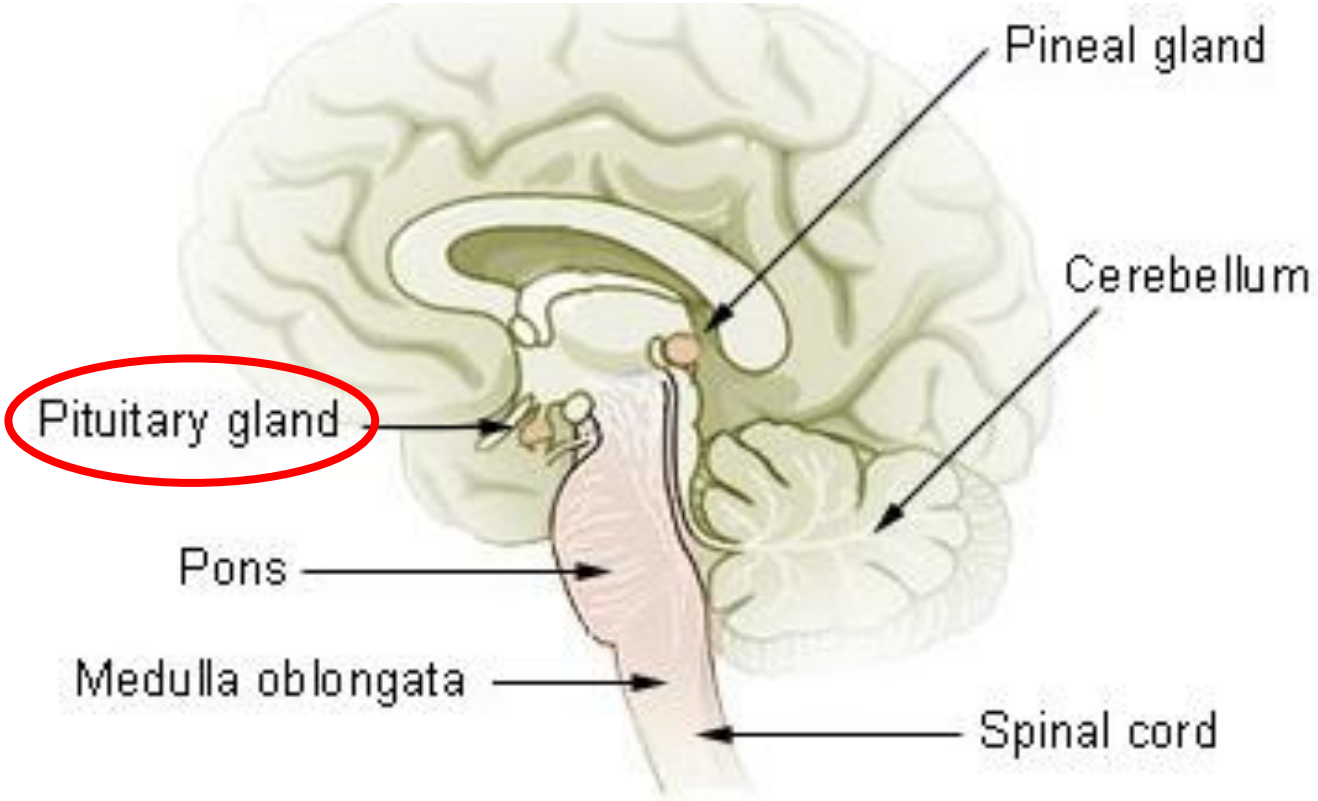
- Maintains the body at a balanced level
- Produces and releases hormones
- Regulates many body functions including sleep, memory, and appetite
- If injured, it can cause health issues such as fatigue, weight gain, and memory loss


Hypothalamus secretes hormones which make other endocrine glands secrete hormones


Hypothalamic hormones and their effect on pituitary function
Hypothalamus
GnRH
GHRH
SS
TRH
DA
CRH
+
+
- -
+ +
-
+
FSH and LH
GROWTH HORMONE
TSH
PROLACTIN
ACTH
Anterior Pituitary

Pituitary Gland

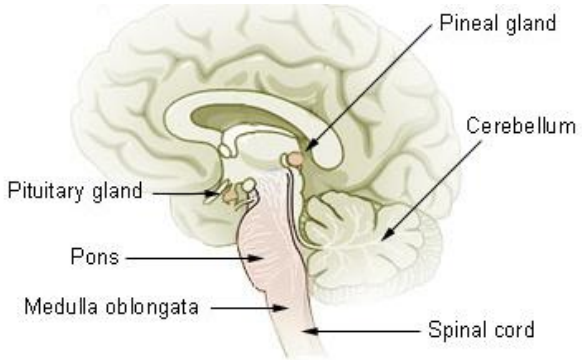
Secretes hormones which make other endocrine glands secrete hormones, “releasing hormones”; Releases FSH (menstrual cycle), LH (ovulation), ACTH (metabolism), TSH (thyroid), GH (growth).



Pituitary Gland

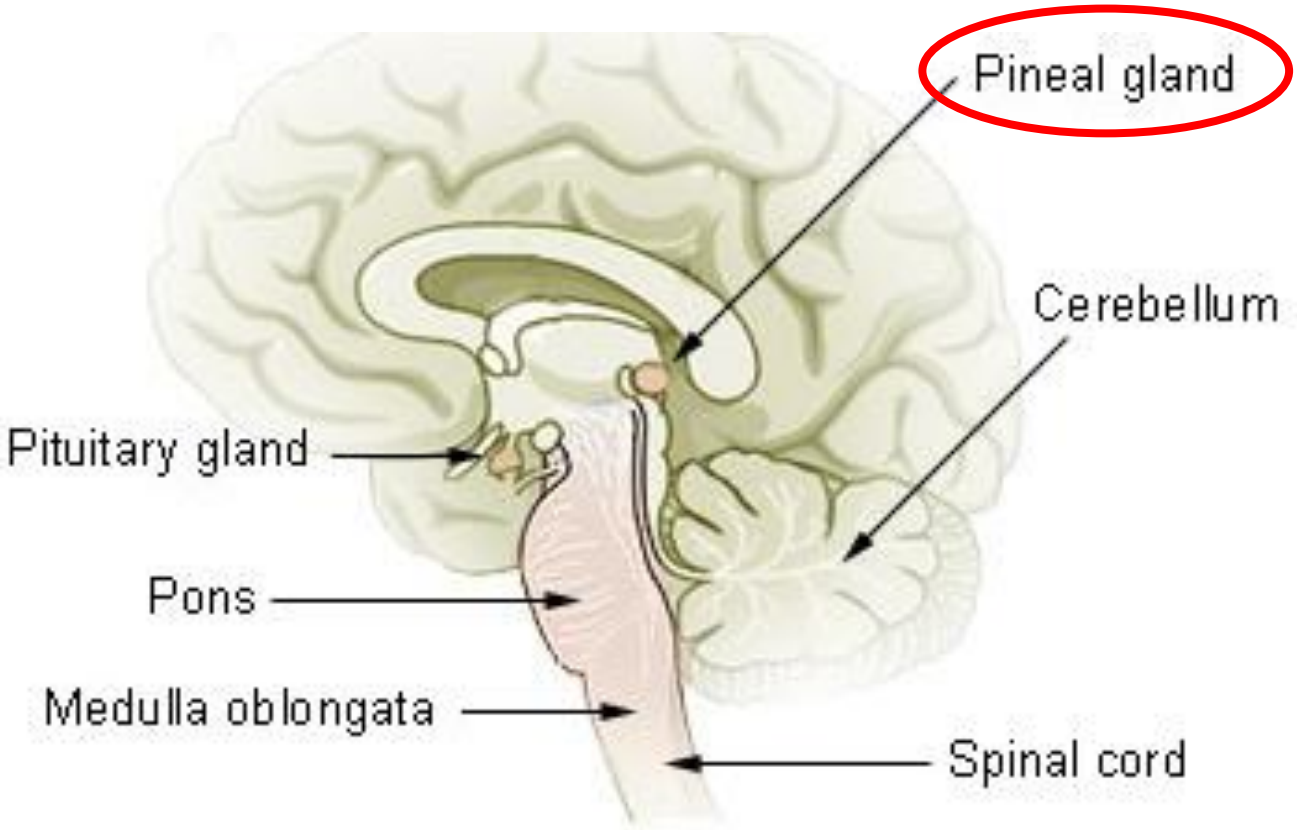
The pituitary hormones help control some of the following body processes:

- Growth.
- Blood Pressure.
- Some aspects of pregnancy and childbirth including stimulation of uterine contractions during childbirth.
- Breast milk production.
- Sex organ functions in both women and men.
- Thyroid gland function.
- The conversion of food into energy (metabolism).
- Water and osmolarity regulation in the body.



Pineal Gland

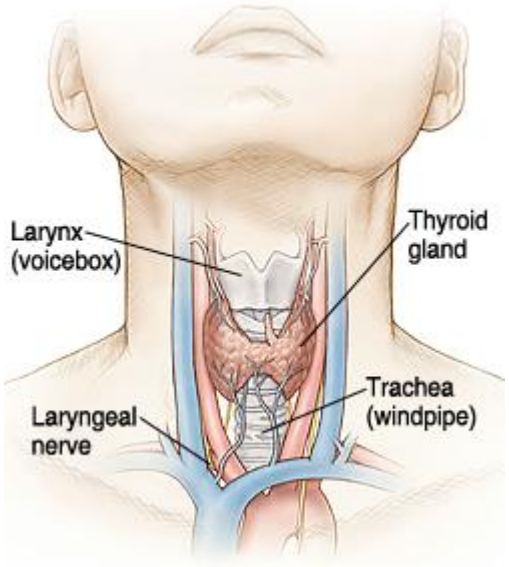
Releases melatonin, regulates rhythmic activities (sleep cycles, etc.).

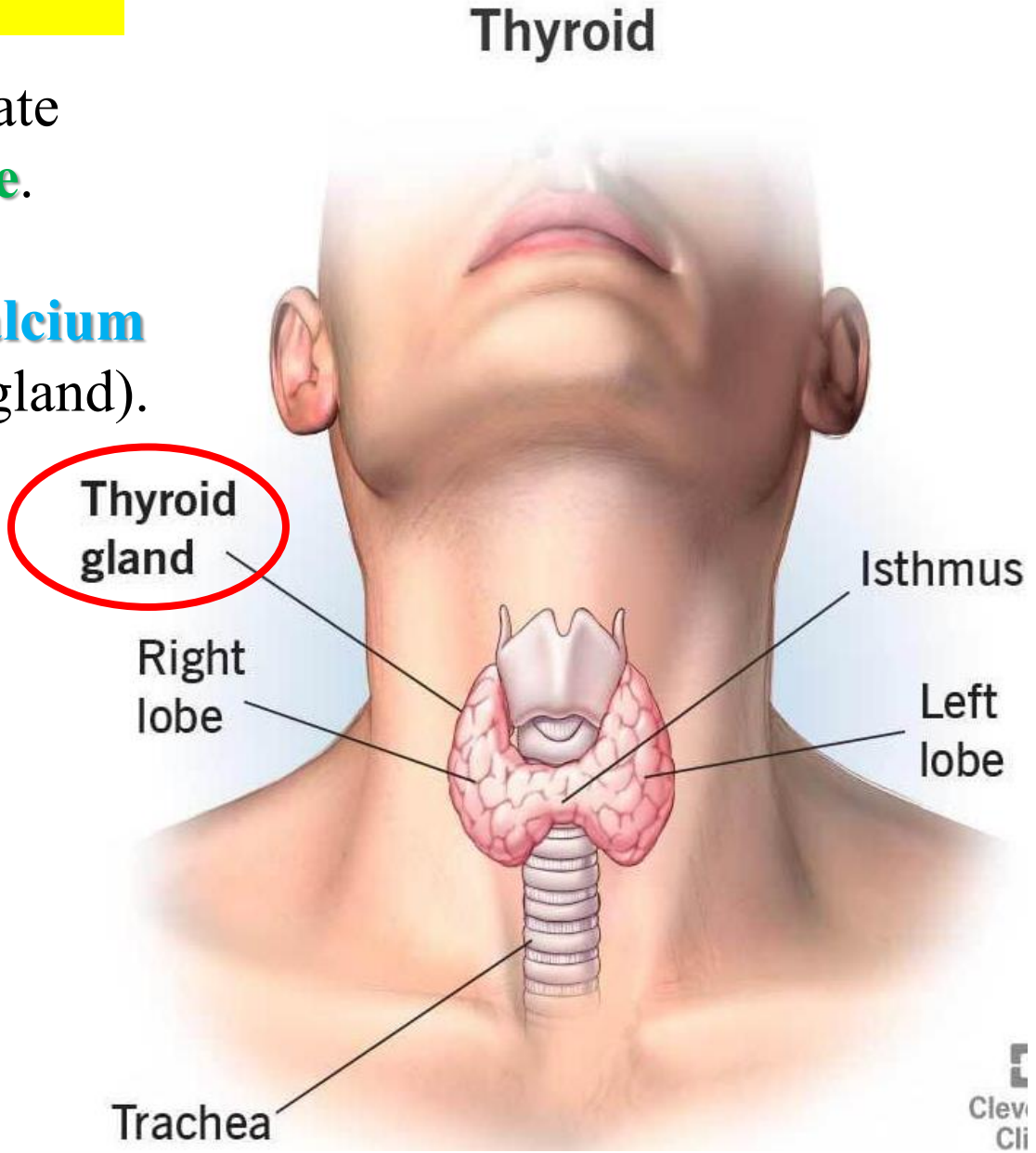


Thyroid Gland

Produces **thyroxine** to regulate metabolism, involving **iodine**.

Calcitonin reduced blood **calcium** levels (opposes parathyroid gland).





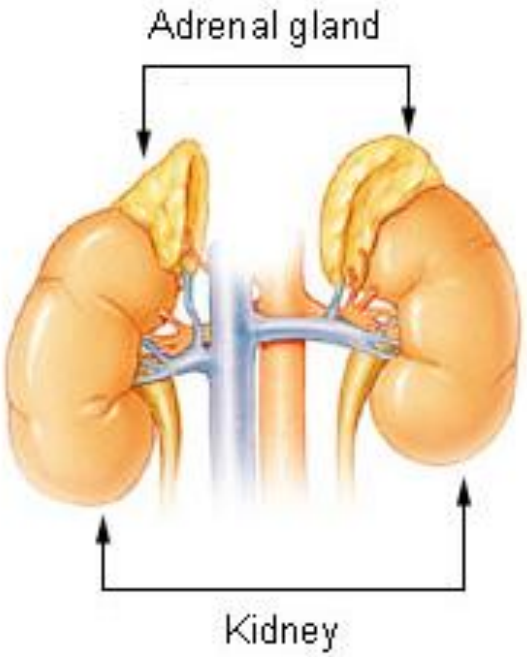
Parathyroid Gland

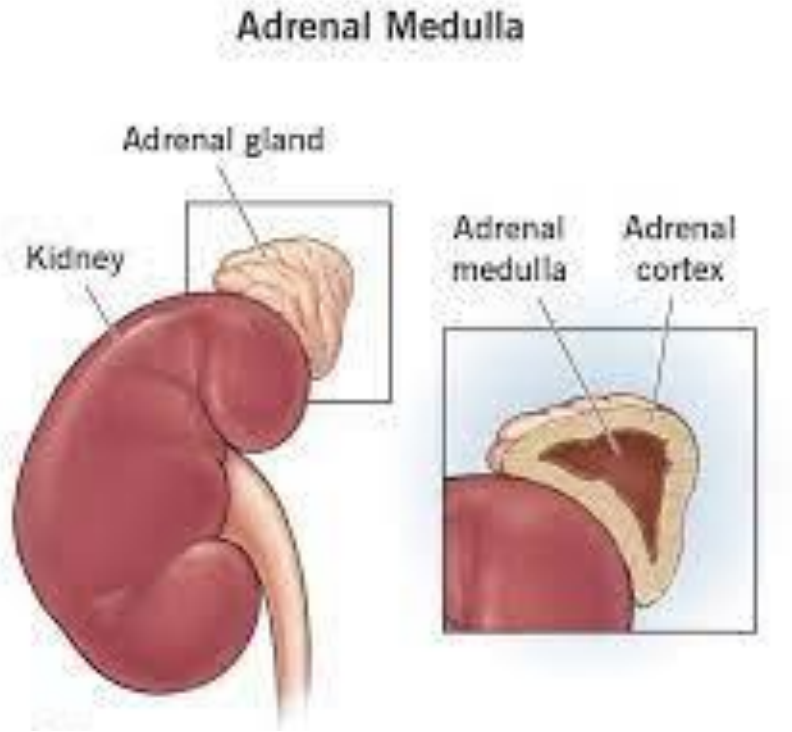
Controls calcium blood levels (nerves / muscles).

Adrenal Glands

Adrenal Cortex → steroids, sex hormones, cortisol (stress & glucose levels).

Adrenal Medulla → adrenaline, norephinephrine, epinephrine; stress reactions.

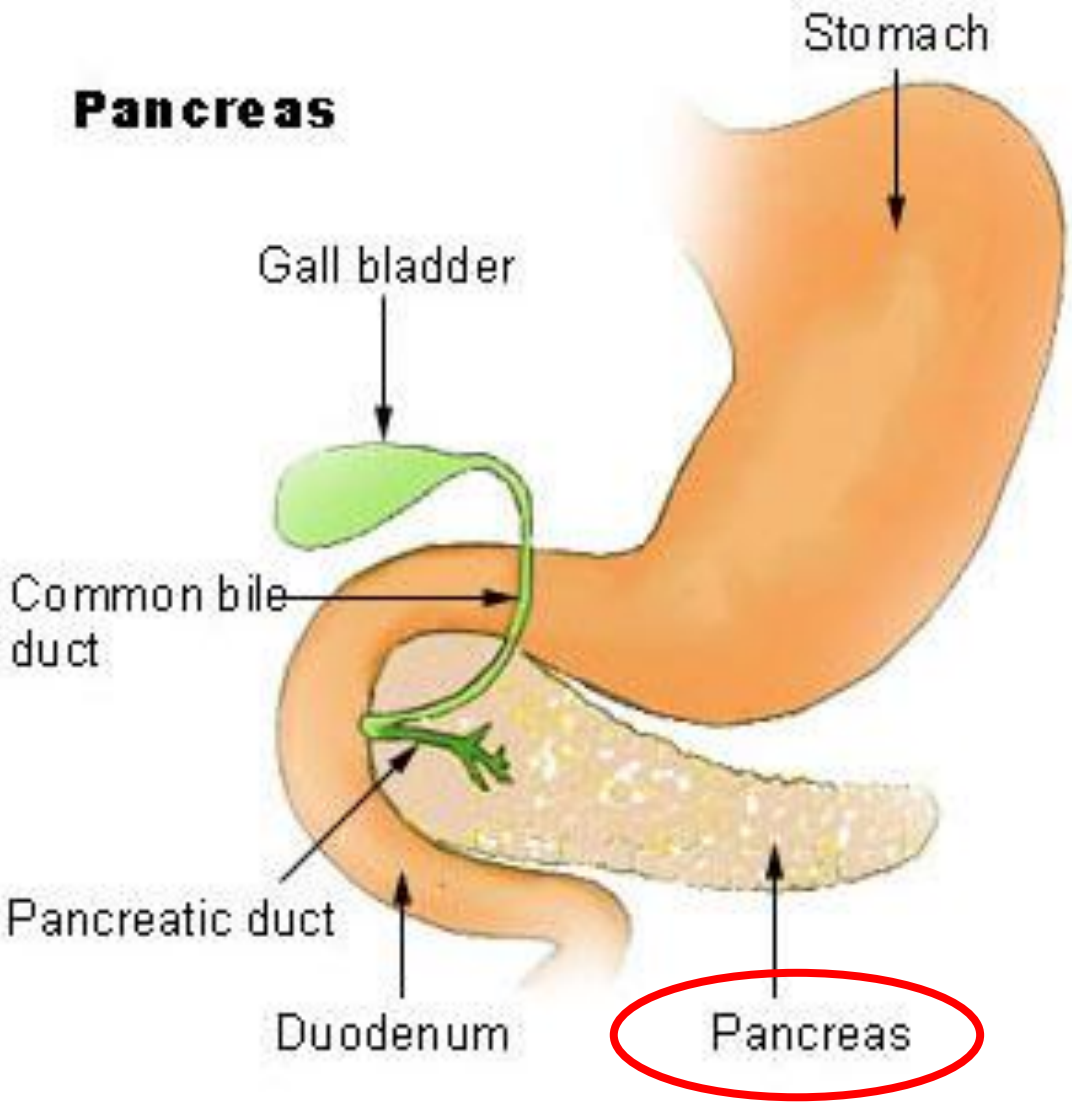




Pancreas

Regulates glucose levels in the blood.

Produces **Insulin** (causes glucose absorption) & **glucagon** (releases glucose into the blood.

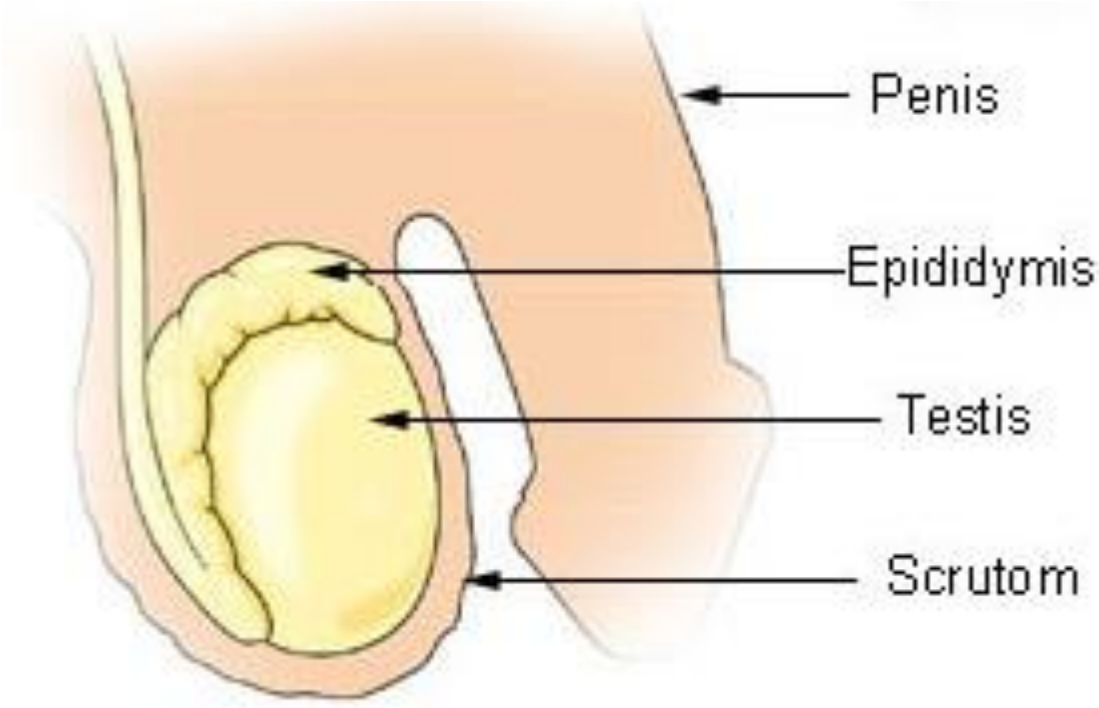


Testes

produce *testosterone:*

- sperm production
- development of male "secondary sex characteristics" (muscle, facial hair, voice box).

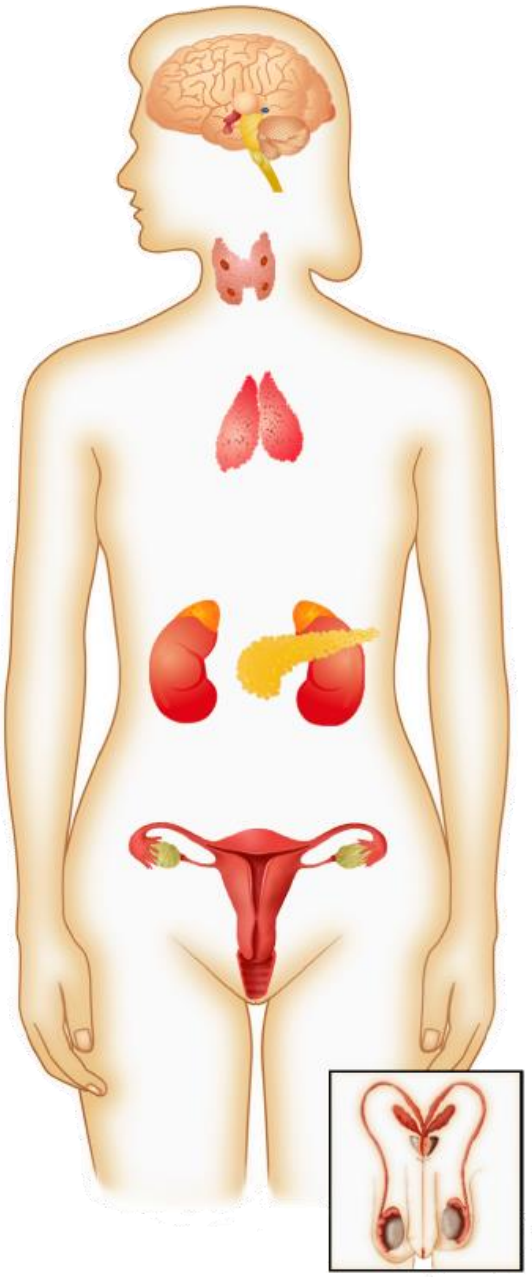
- Noticeable characteristics that distinguish 2 sexes



Ovaries

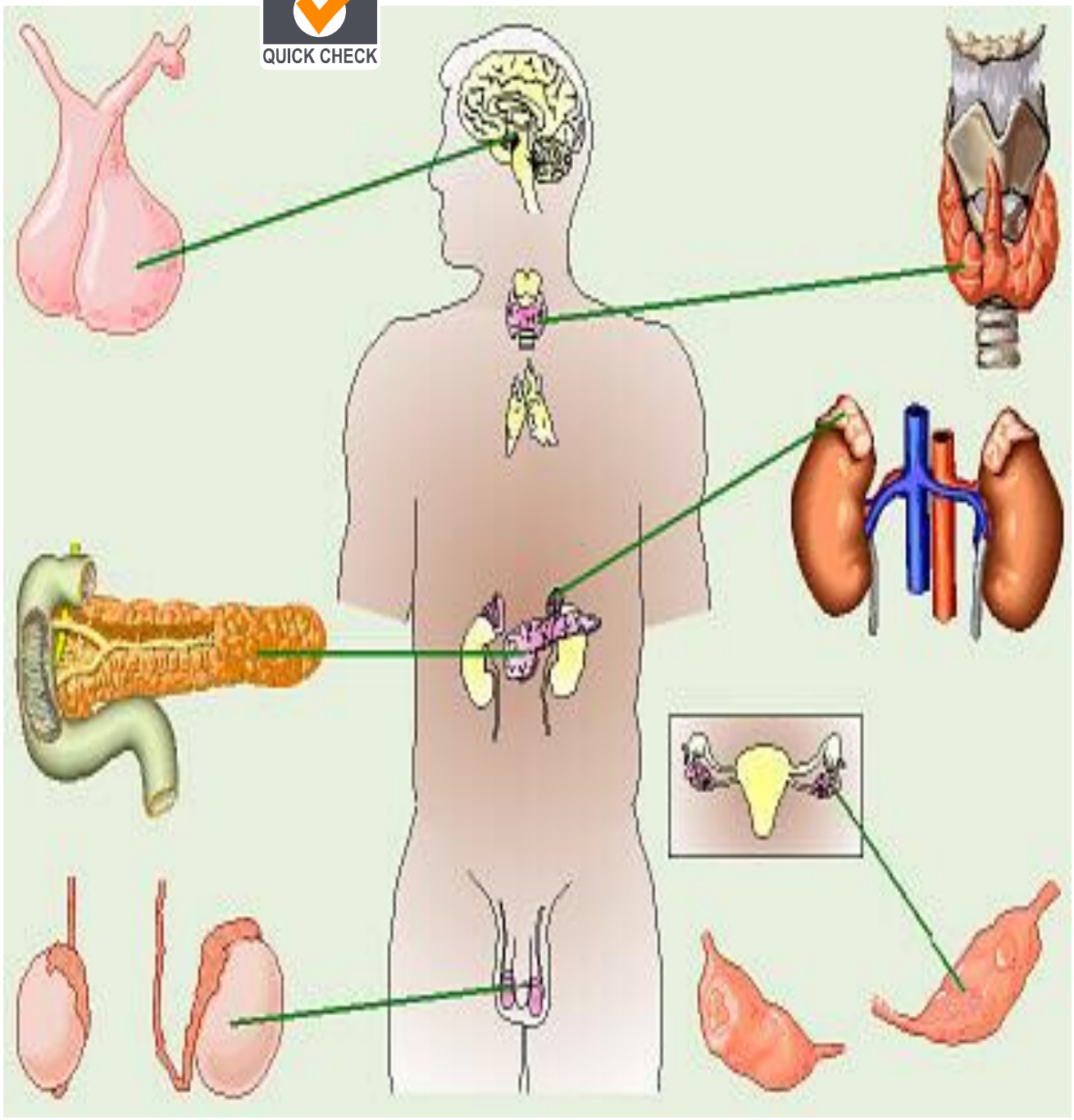
produce *estrogen* and *progesterone.*

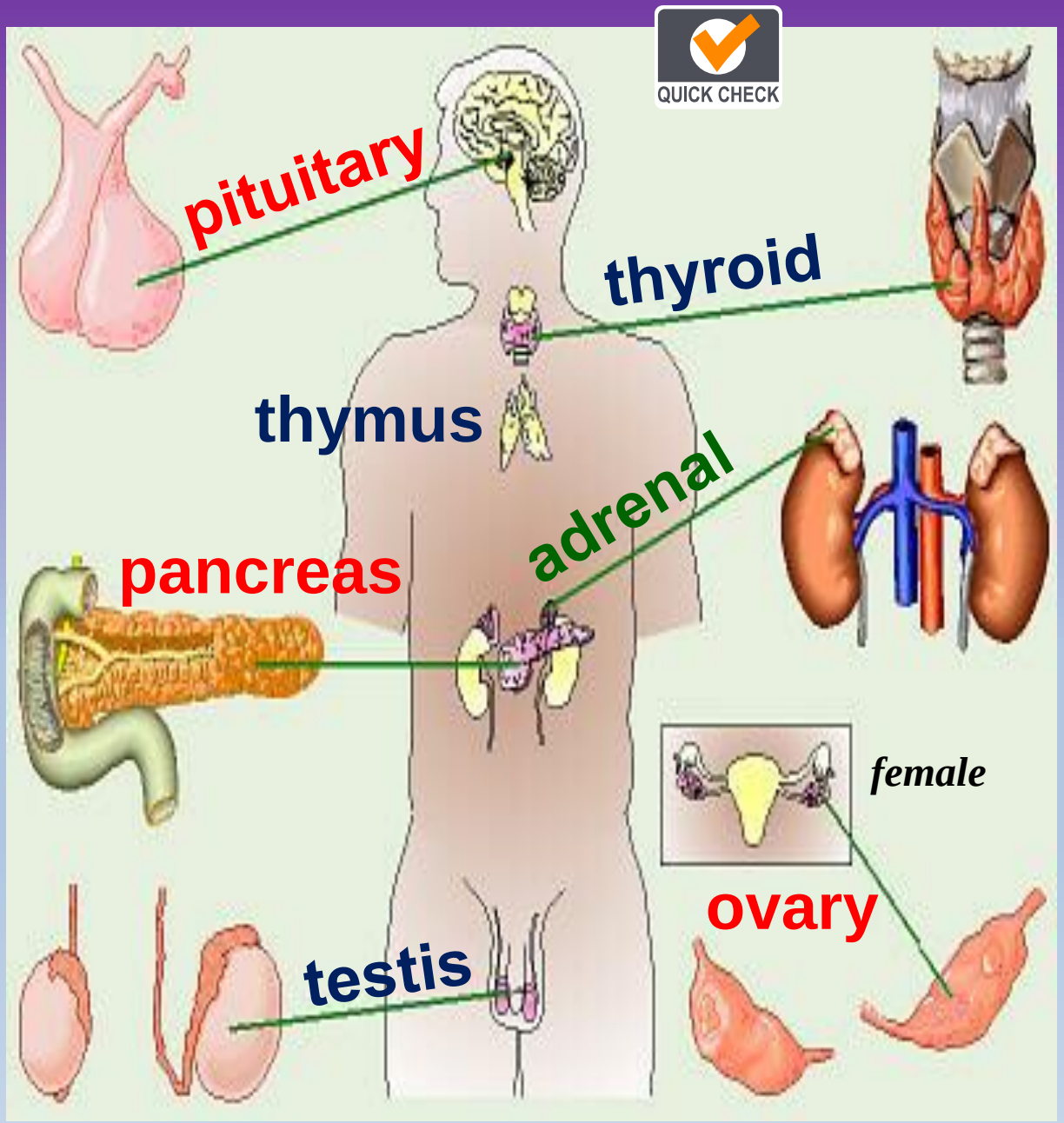
- Estrogen is required for the development of female secondary sex characteristics (breasts, hips) and the development of eggs.
- Progesterone prepares the **uterus** for a fertilized egg.



Endocrine Glands ?

- Adrenal
- Ovary
- Pancreas
- Pituitary
- Testis
- Thymus
- Thyroid





Adrenal

Ovary

Pancreas

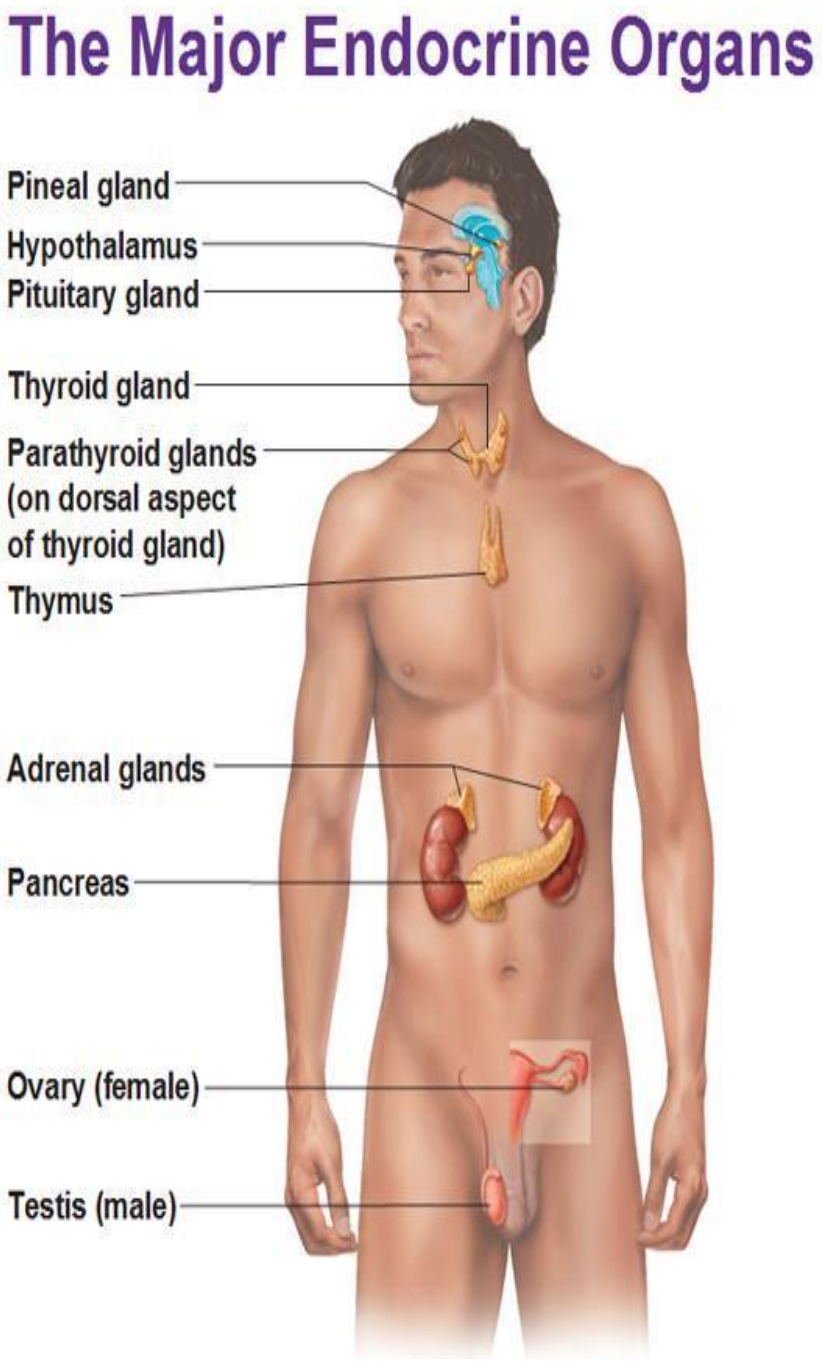
Pituitary

Testis

Thymus

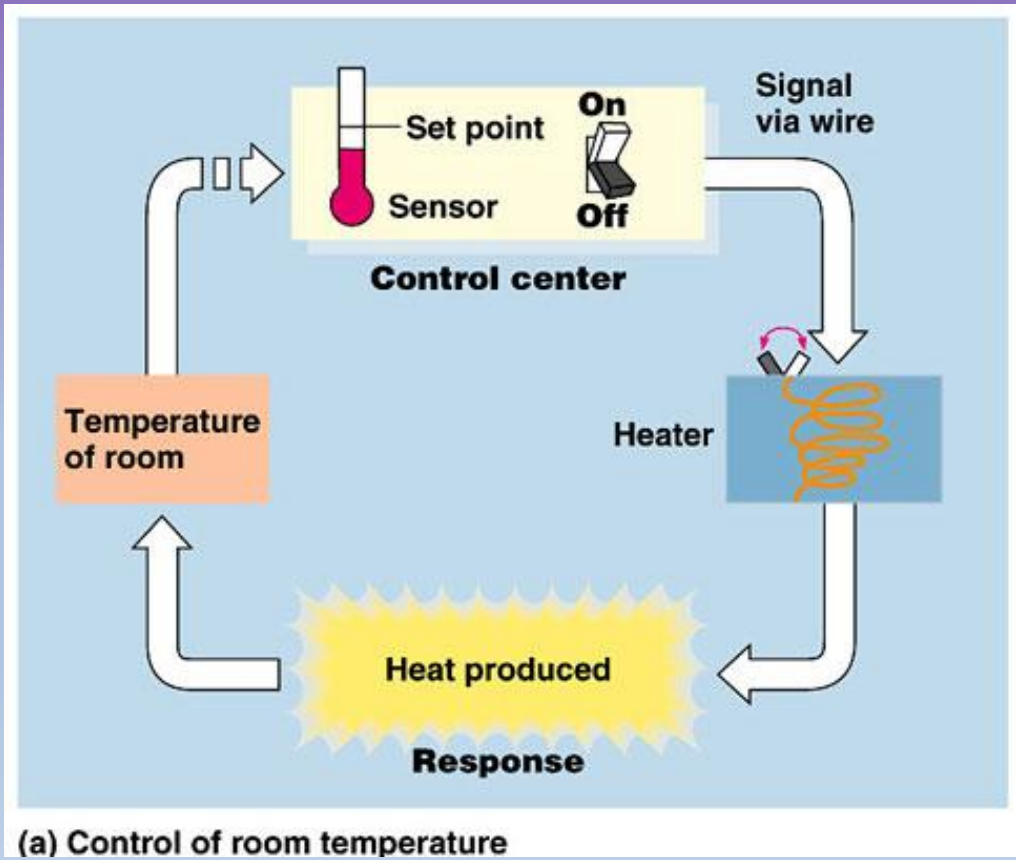
Thyroid

GLAND	HORMONE	ACTION
Pineal	Melatonin	Biological Rhythms
Anterior Pituitary	Multiple Hormones	Affects other endocrine glands
Posterior Pituitary	ADH (Antidiuretic Hormone)	Water Retention in Kidneys
Thyroid	T3/T4	Metabolism
	Calcitonin	Decreases Blood Calcium
Parathyroid	Parathyroid Hormone (PTH)	Increases Blood Calcium
Pancreas	Insulin	Decreases Blood Sugar
	Glucagon	Increases Blood Sugar
Adrenal Cortex	Glucocorticoids	Raise Blood Sugar
Adrenal Medulla	Epinephrine	Fight or Flight
Ovary (Females)	Estrogen	Female Sex Characteristics
Testes (Males)	Testosterone	Male Sex Characteristics



Control of the Endocrine System

The endocrine system is regulated by feedback mechanisms that function to maintain homeostasis.

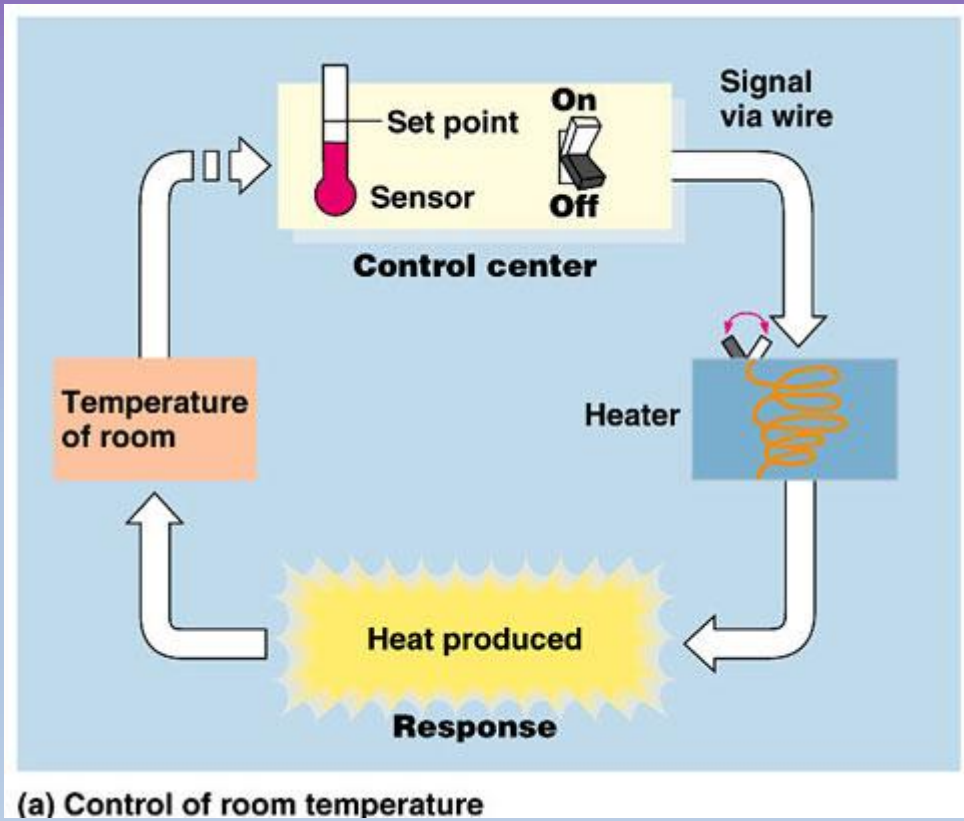


(a) Control of room temperature

Control of the Endocrine System

2 types of feedback:

1. Positive feedback
2. Negative Feedback



(a) Control of room temperature

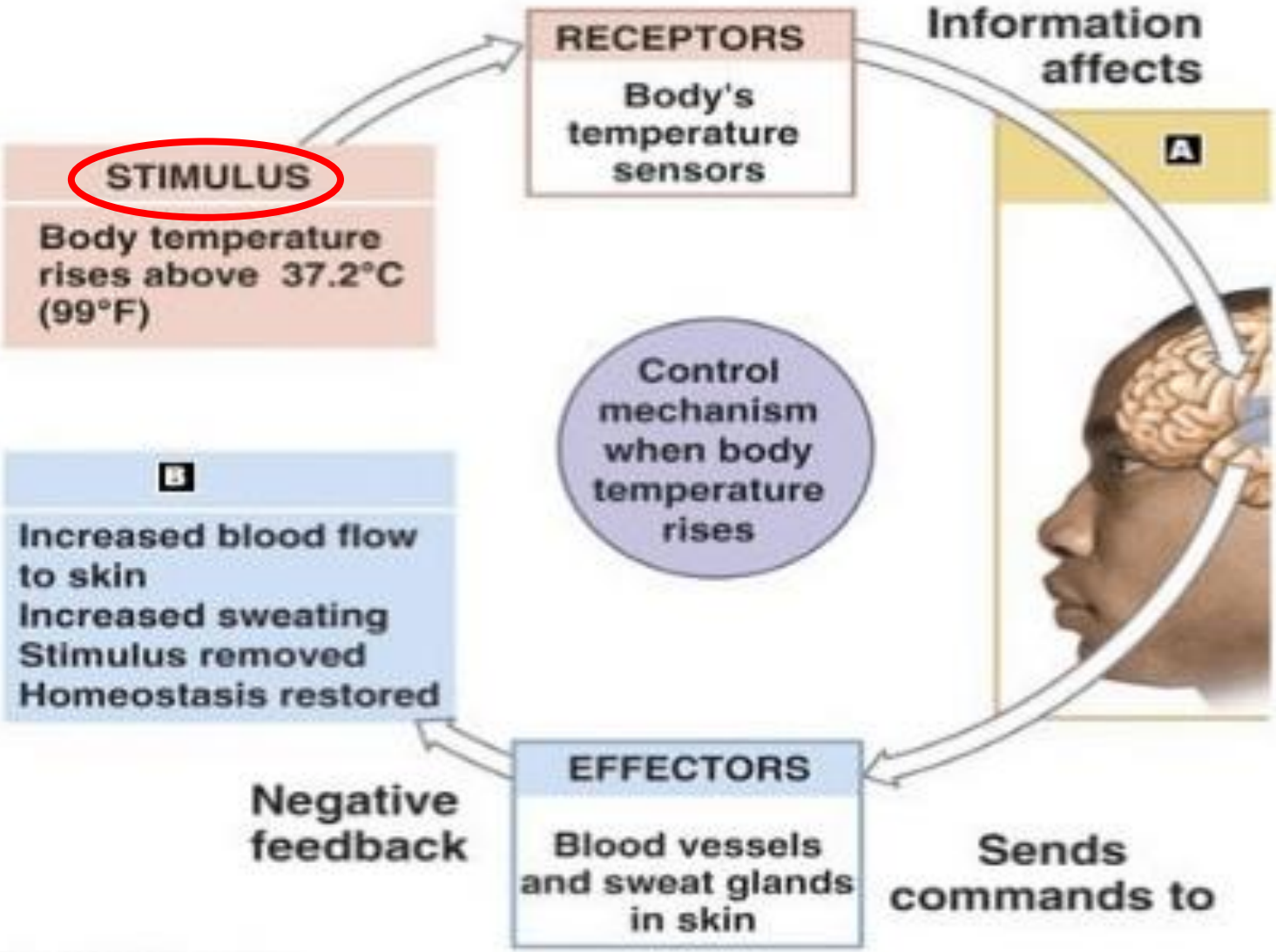
Control of the Endocrine System

1. Positive feedback

   (more product sends the signal for even more product)

   Alarm or panic can spread by positive feedback among a herd of animals to cause a stampede.

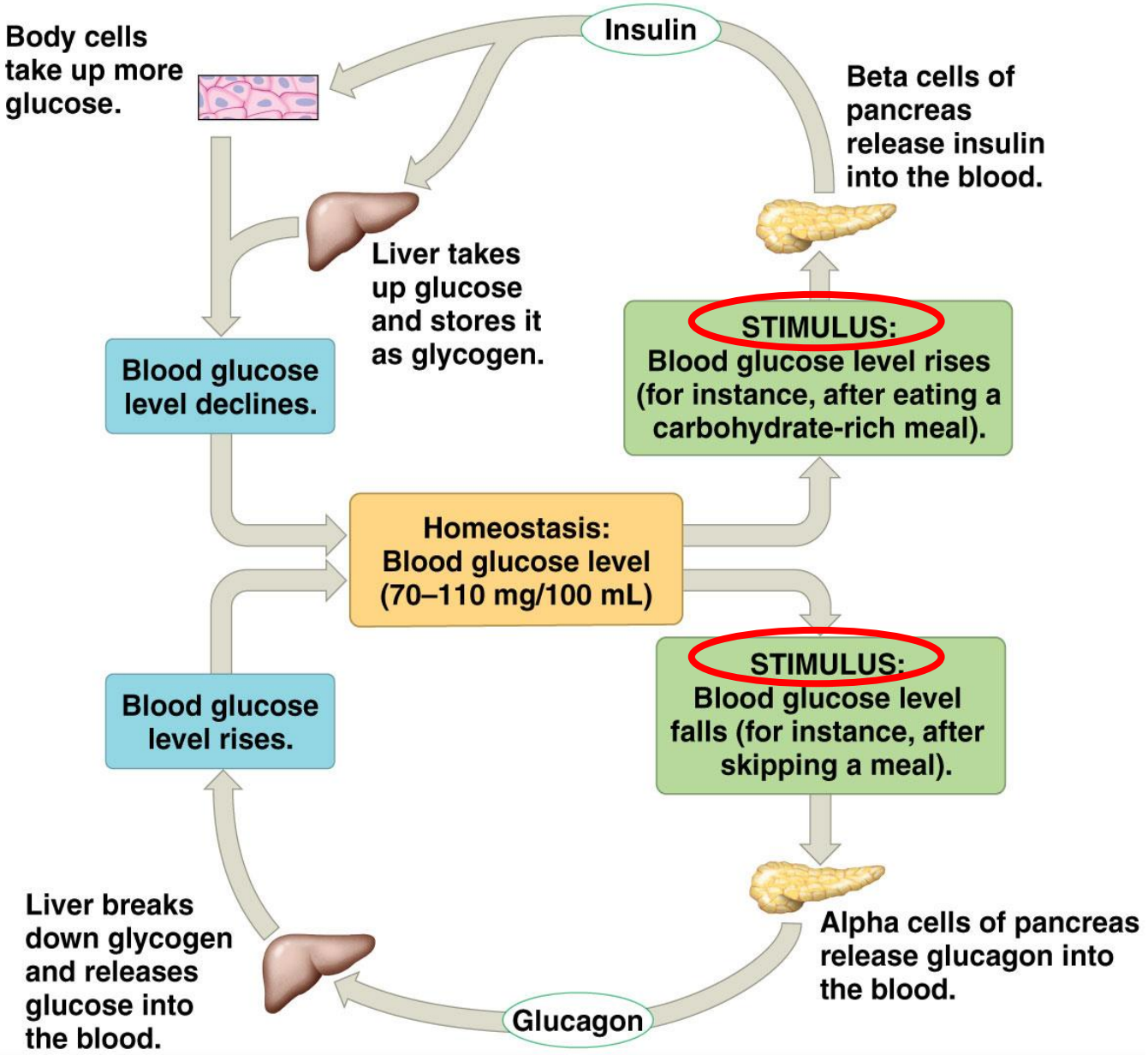
Negative Feedback System



Blood Glucose Regulation

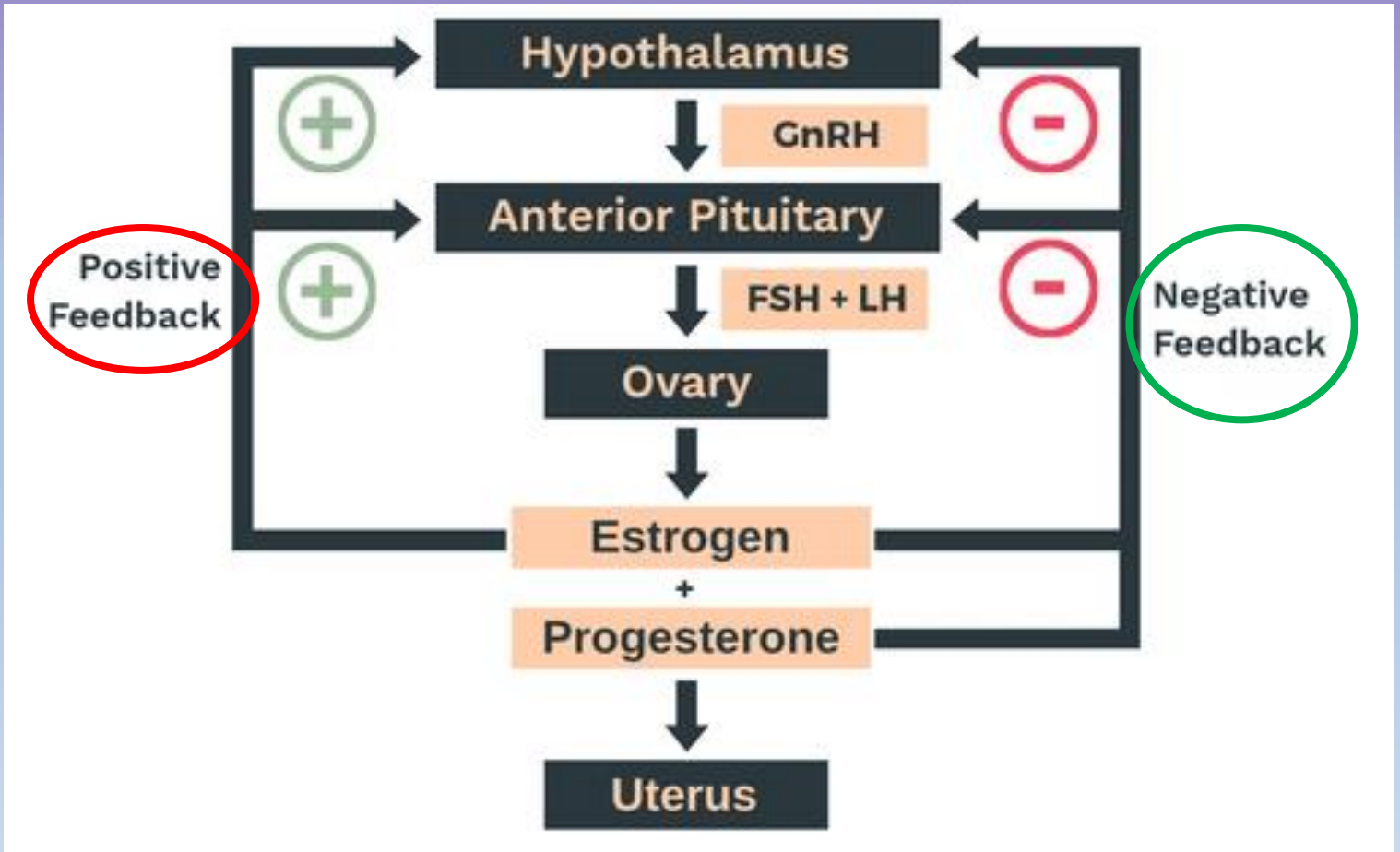
Negative Feedback Mechanism

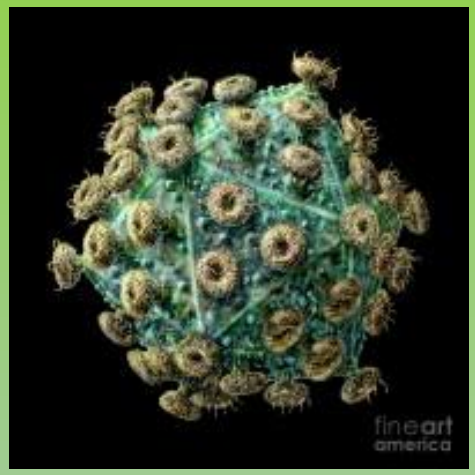
Enrichment



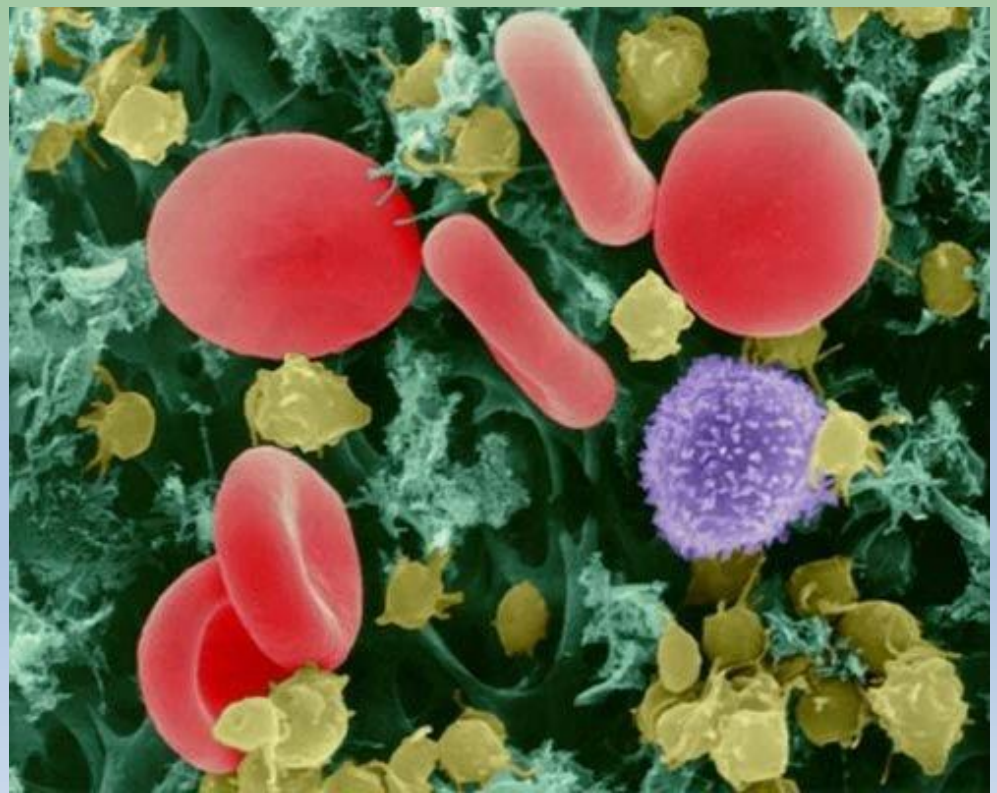
Positive feedback occurs when the rate of a process increases as the concentration of the product increases.

Negative feedback controls the rate of a process to avoid accumulation of a product.





Immune System



Immune System

Protects the body against Pathogens and Cancer cells.

The immune system recognizes, attacks, destroys, and "remembers" each type of pathogen that enters the body.

IMMUNITY

The immune system fights infection by producing cells that inactivate foreign substances or cells.

Immune System

White Blood Cells that Play Major Roles in the Immune System:

1) **Macrophages**

(Phagocytes) = cells that engulf and destroy bacteria and debris.

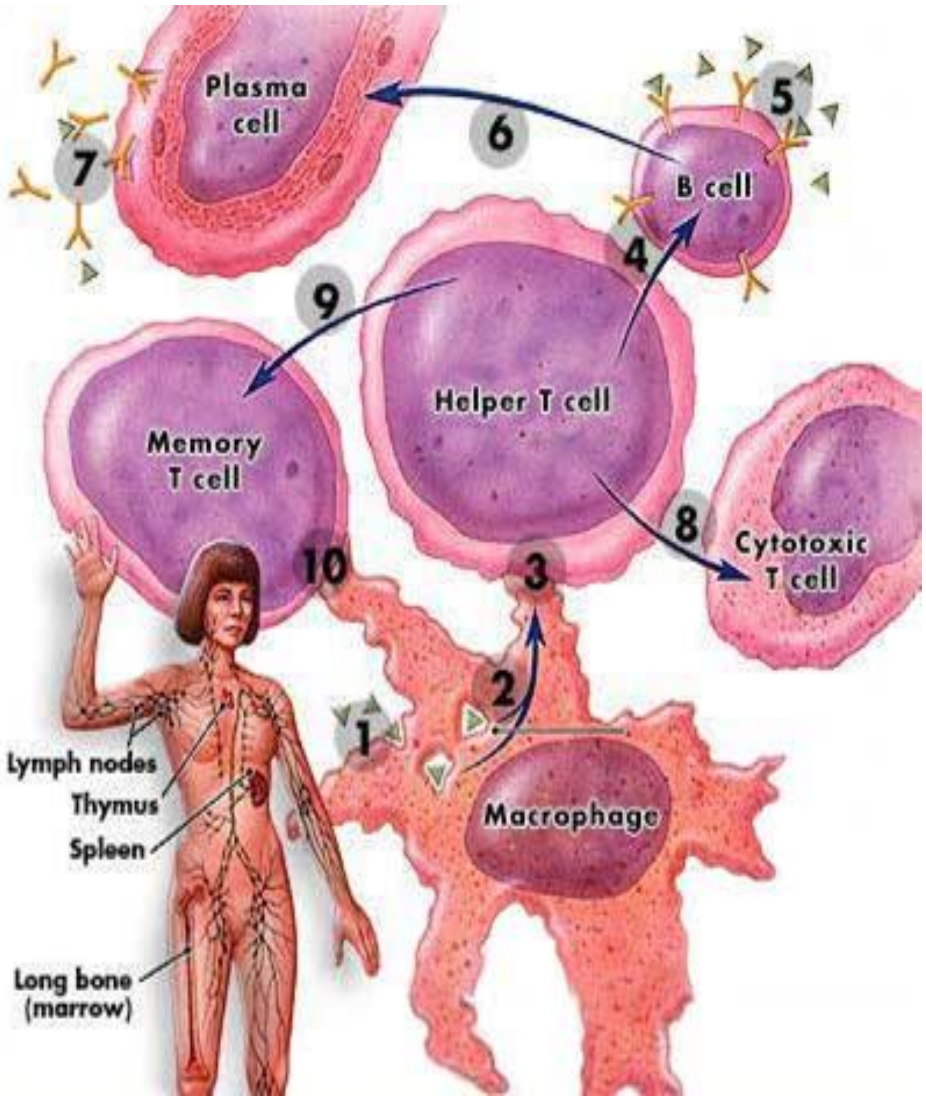
Immune System

2) B Lymphocytes

- Mature in the Red Bone Marrow
- When activated turn into Plasma Cells
- Produce Antibodies

3) T Lymphocytes

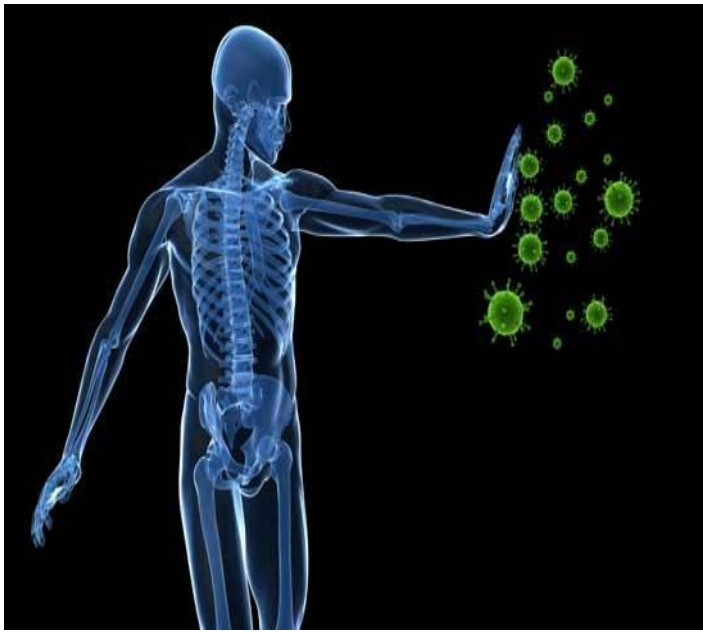
- Mature in the Thymus
- Two Main Kinds:
  - Helper (activate other parts of immune system).
  - Cytotoxic (kill infected cells.



Two General Categories

INNATE (NONSPECIFIC) Immunity

- Provides broad protection against all pathogens.

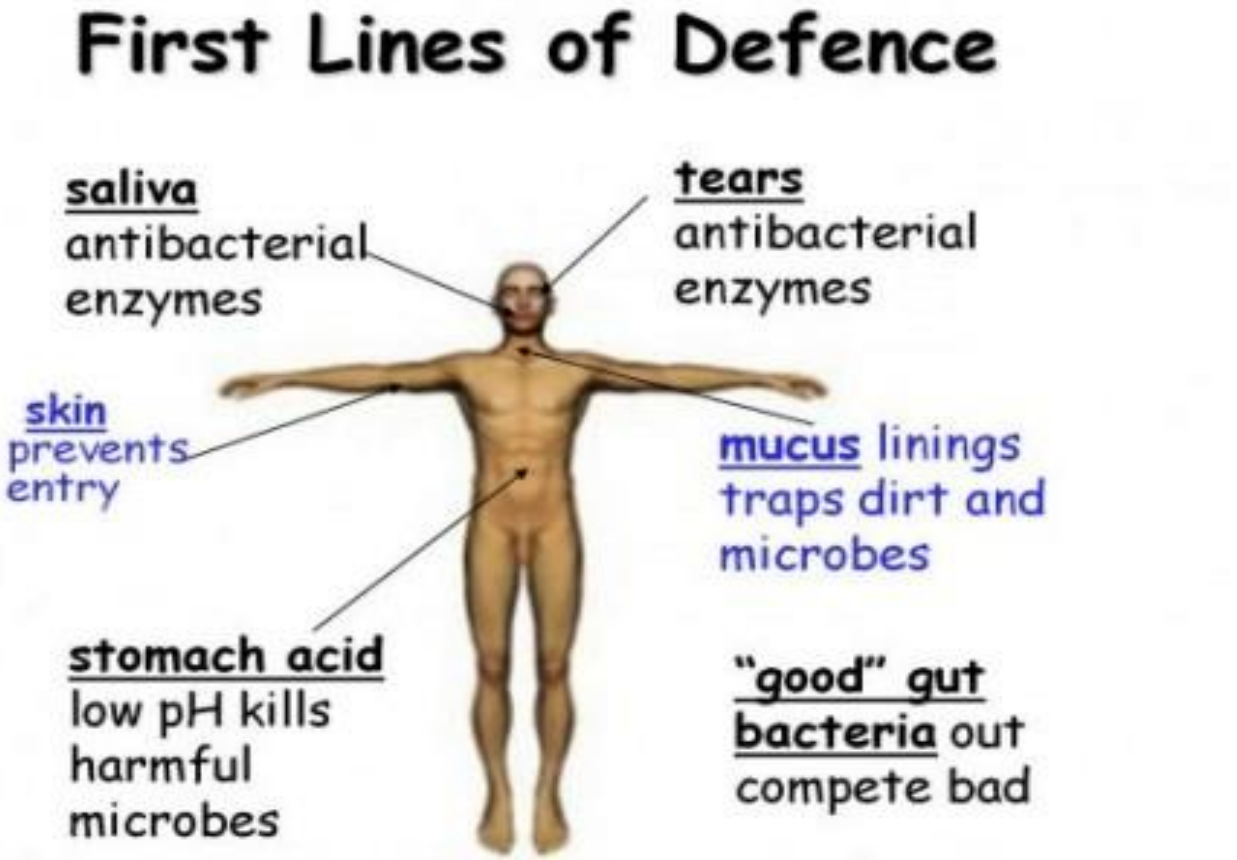


ADAPTIVE (SPECIFIC) Immunity

- Directed against specific pathogens.
- Produces "memory" that protects against future exposure to a previously encountered pathogen.

1st Line of Defense

- Nonspecific
- Act Early (skin, mucous, sweat, tears)
- Prevent pathogens from entering body.

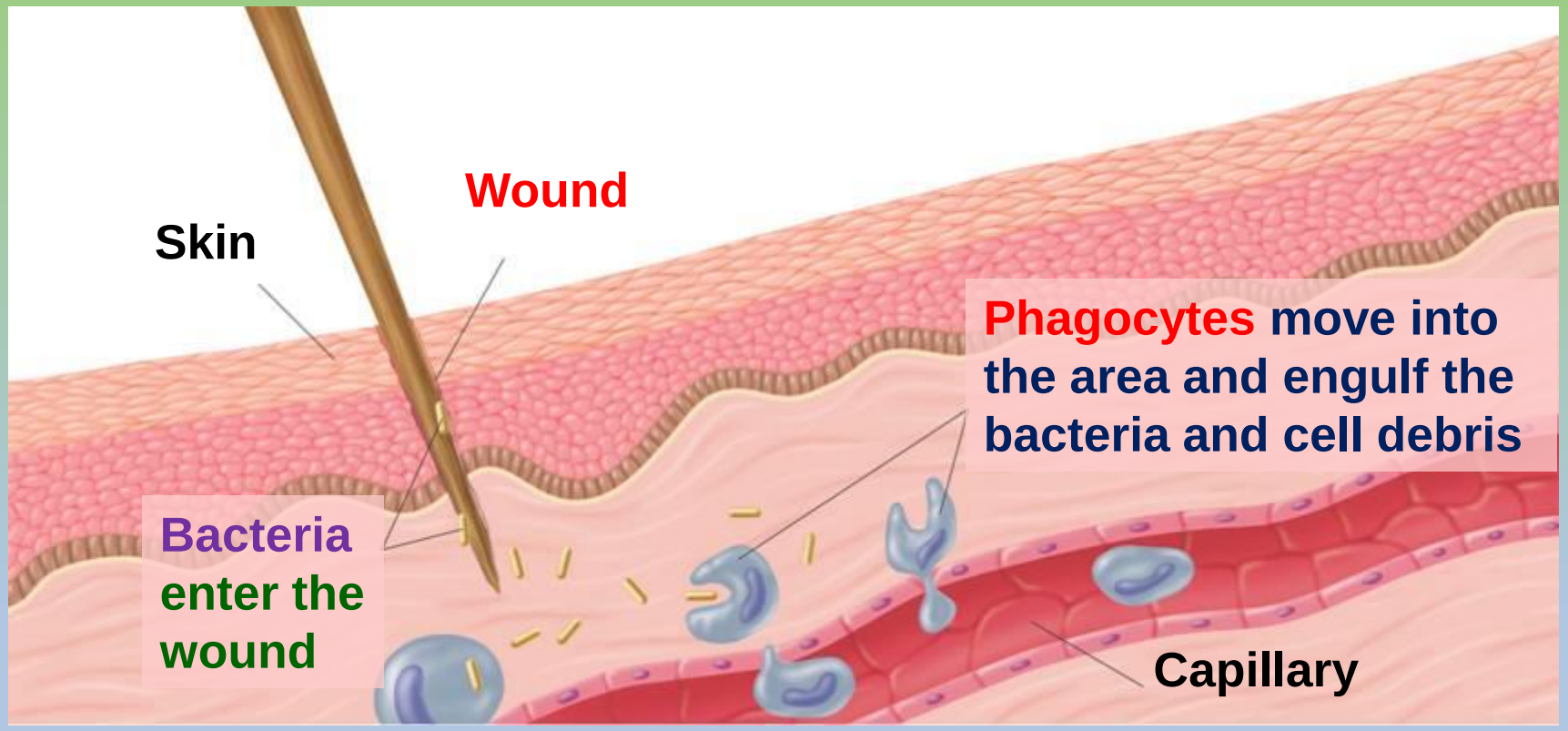


2nd Line of Defense

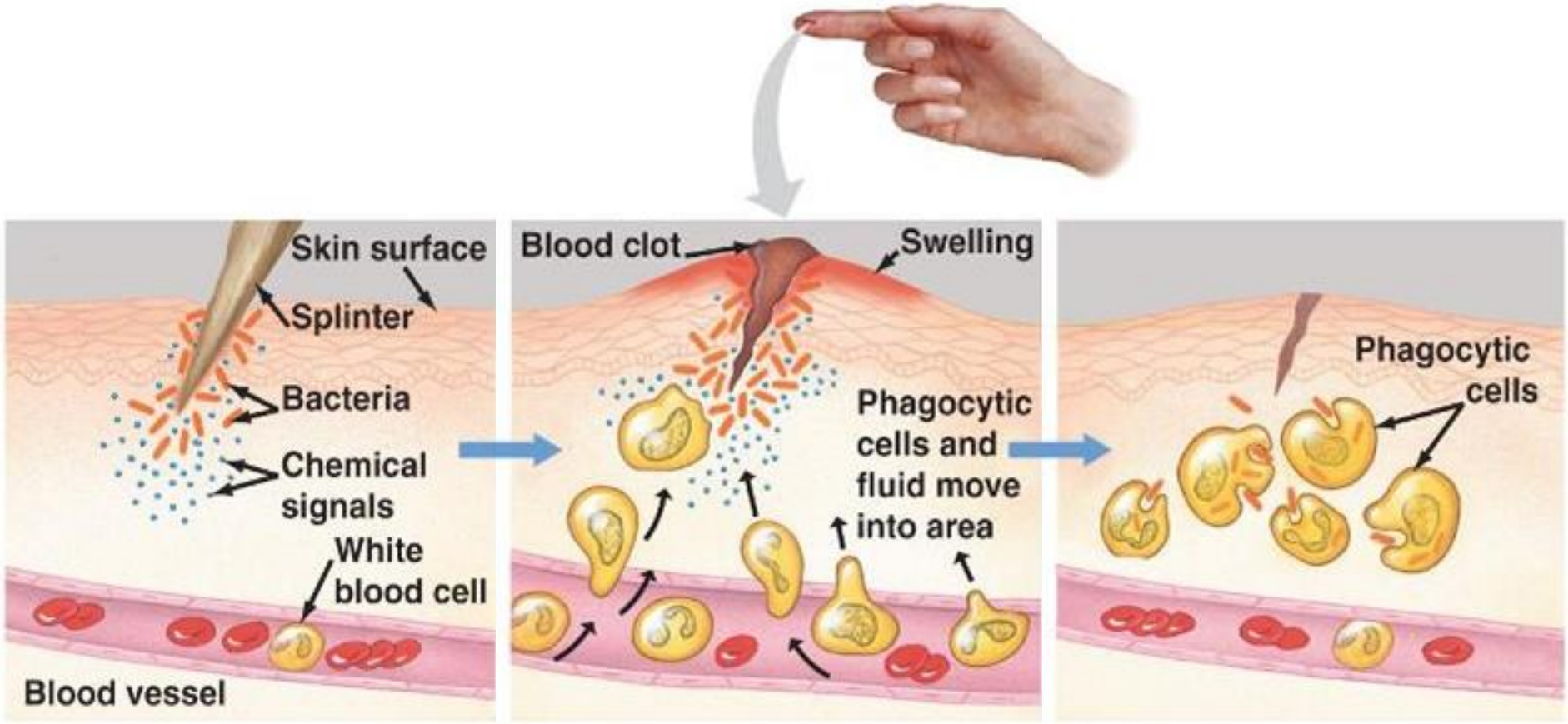
- Block, Destroy, or Remove pathogens that have entered the body.
- Macrophages: consume pathogens, promote FEVER, and activate the immune response.
- Antimicrobial Proteins: communicate with immune system cells and stimulate FEVER.
- Inflammation (nonspecific response):
  - Redness
  - Warmth
  - Swelling
  - Pain

Nonspecific Defenses

The Inflammatory Response



Inflammation



1. Tissue injury; release of chemical signals such as histamine
2. Dilation and increased leakiness of local blood vessels; migration of phagocytic cells to the area
3. Phagocytic cells engulf bacteria and cell debris; tissue heals

Nonspecific Defenses

Fever:

The immune system releases chemicals, pyrogens (inflammatants), that increase the core body temperature.

–This high temperature slows or stops the growth of pathogens.

–Increases heart rate, WBCs get to the site of infection faster.

Specific Defenses:
3rd Line of Defense

Immune Response

- If a pathogen gets past the nonspecific defenses, the immune system reacts with a series of specific defenses.

Specific Defenses: 3rd Line of Defense

–Antigen

- substance that causes an immune response.

–Antibody

- protein that tags/flags antigen.

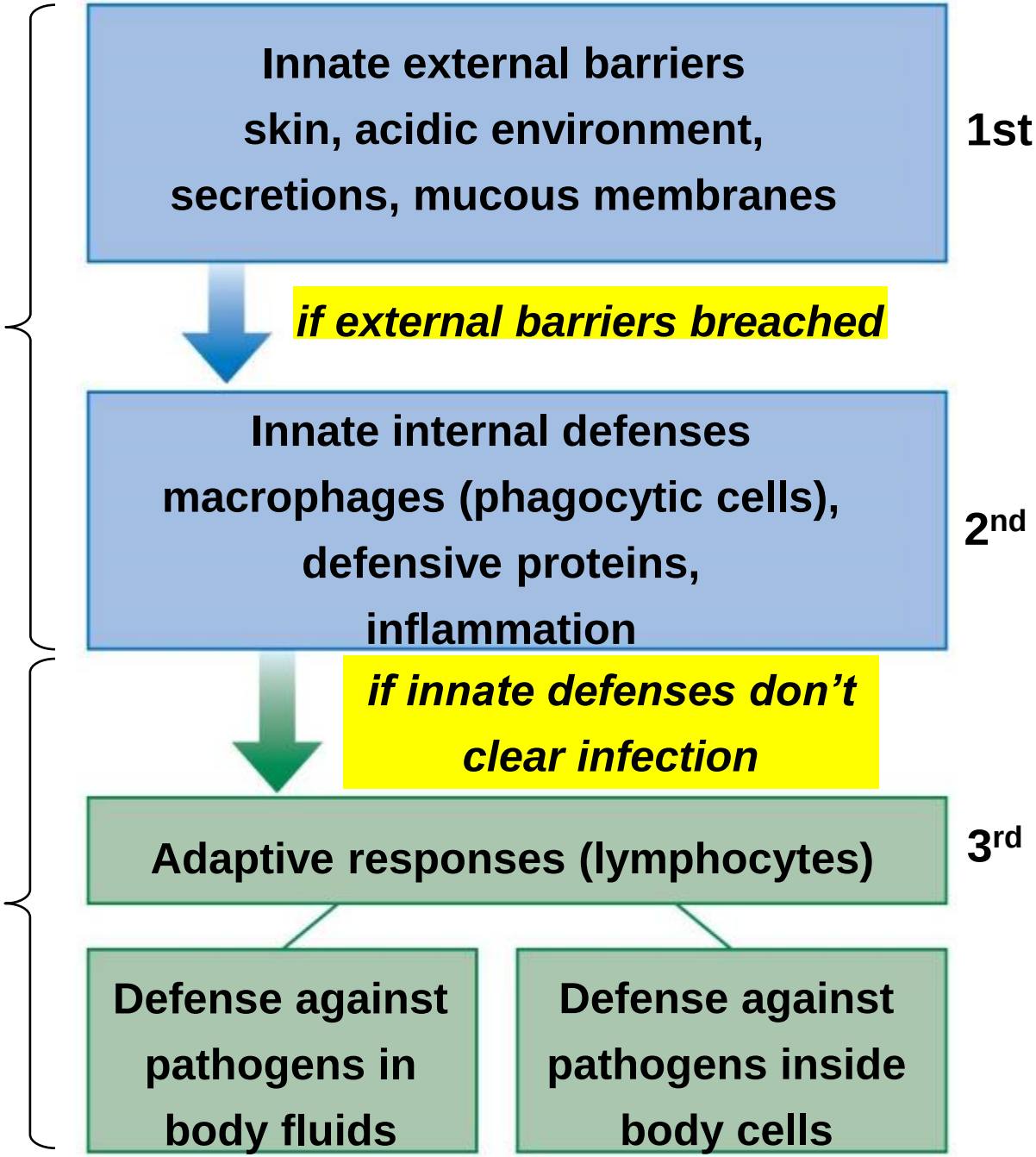
–Lymphocytes (WBC)

- Made in bone marrow.
- **B cells** – produce antibodies (target bacteria).
- **T cells** – helper cells/killer cells (target viruses and abnormal cells).

Lines of Defense

- Rapid response
- Recognize broad ranges of pathogens
- No "memory"

- Slower response
- Recognize specific pathogens
- Have "memory"



Acquired Immunity

1. Active Immunity

- Body develops immunity after exposure to a microbe (antigen).

  Natural – exposed to the disease organism

  Artificial - vaccination

2. Passive Immunity

- Body develops immunity after being given antibodies to the antigen.

  Temporary

  Ex: Nursing infants receive antibodies from mom.

  Ex: Person bitten by raccoon gets antibodies to help defend against potential rabies infection.

Primary and Secondary Immune Responses

First encounter with an antigen provokes the **PRIMARY** Immune Response, which is relatively slow.

Its legacy is Memory Cells that greatly speed the **SECONDARY** Immune Response on subsequent exposure to the ***SAME*** antigen.

- Secondary Immune Response is faster and stronger.

1. **Primary Response:**

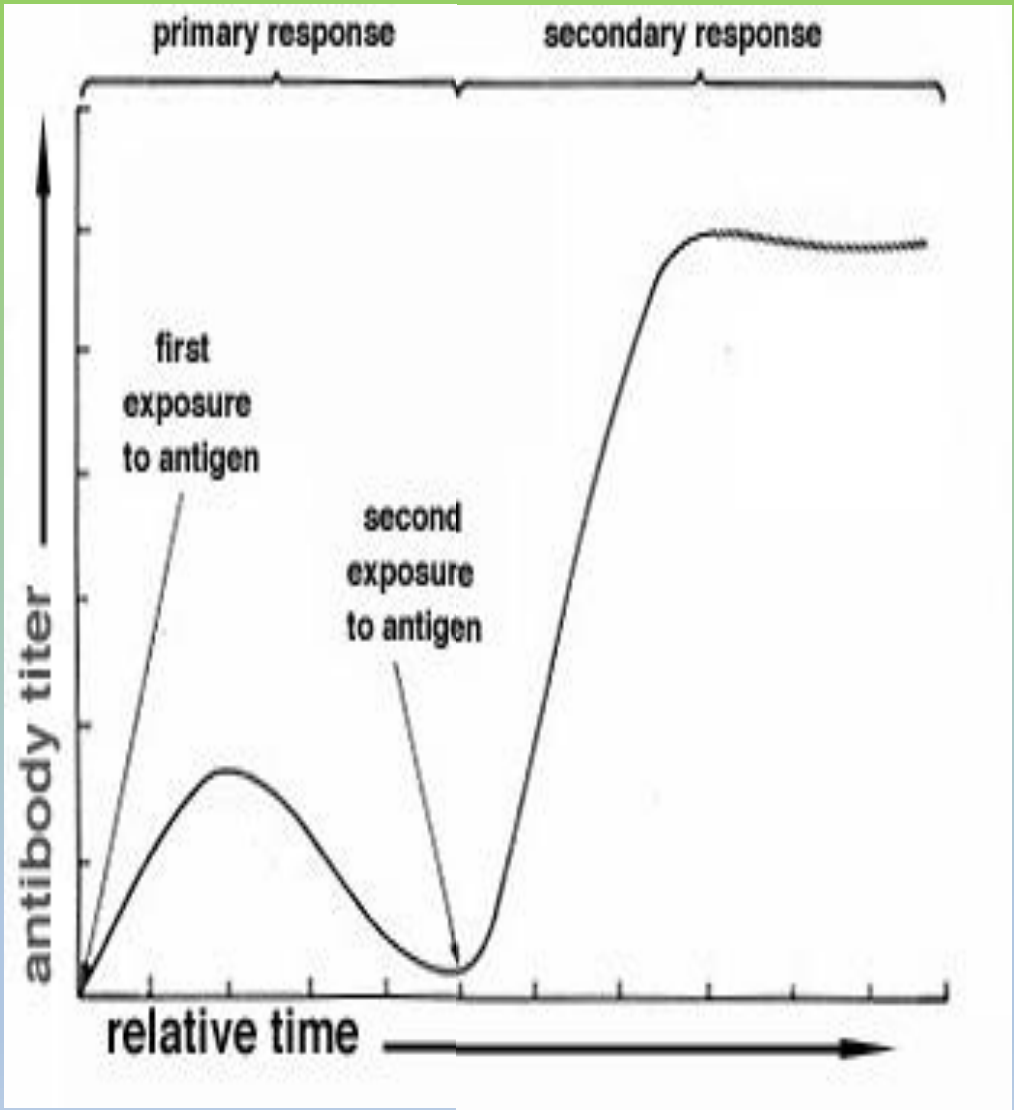
   Antibody response after first exposure to an antigen.

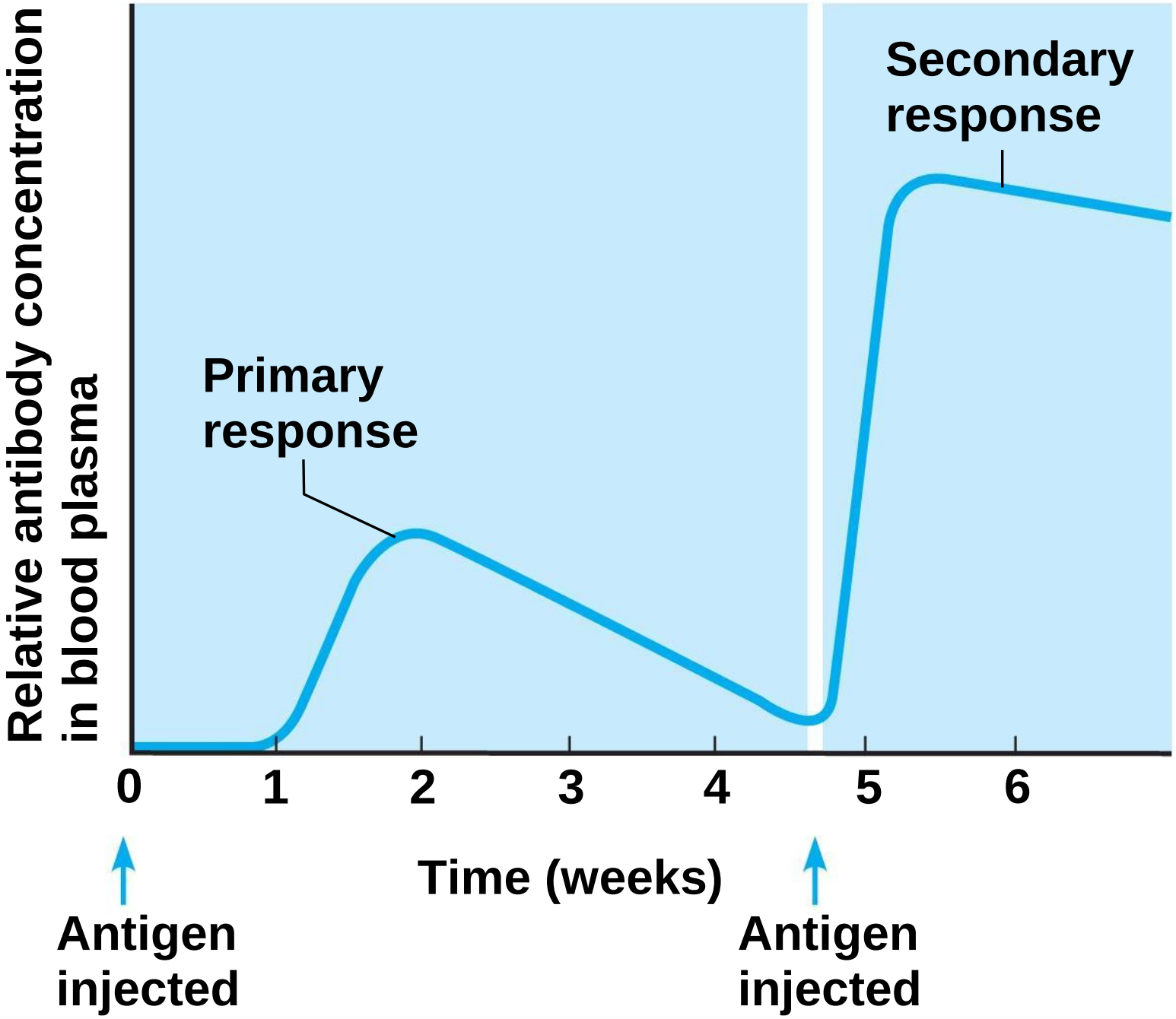
   - begins about 5 -10 days after exposure.

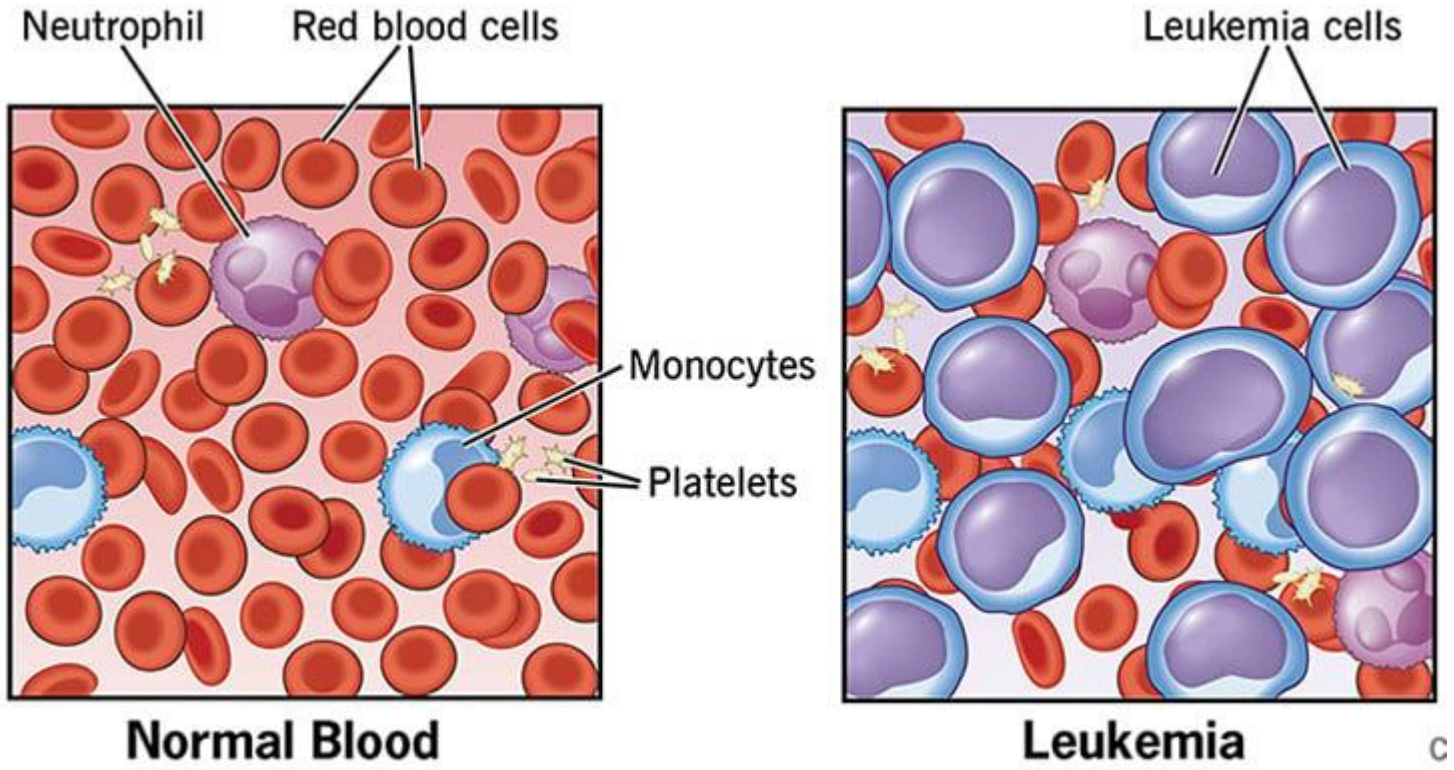
2. **Secondary Response:**

   Antibody response after second exposure to an antigen.

   - begins sooner and response is greater (than primary response).

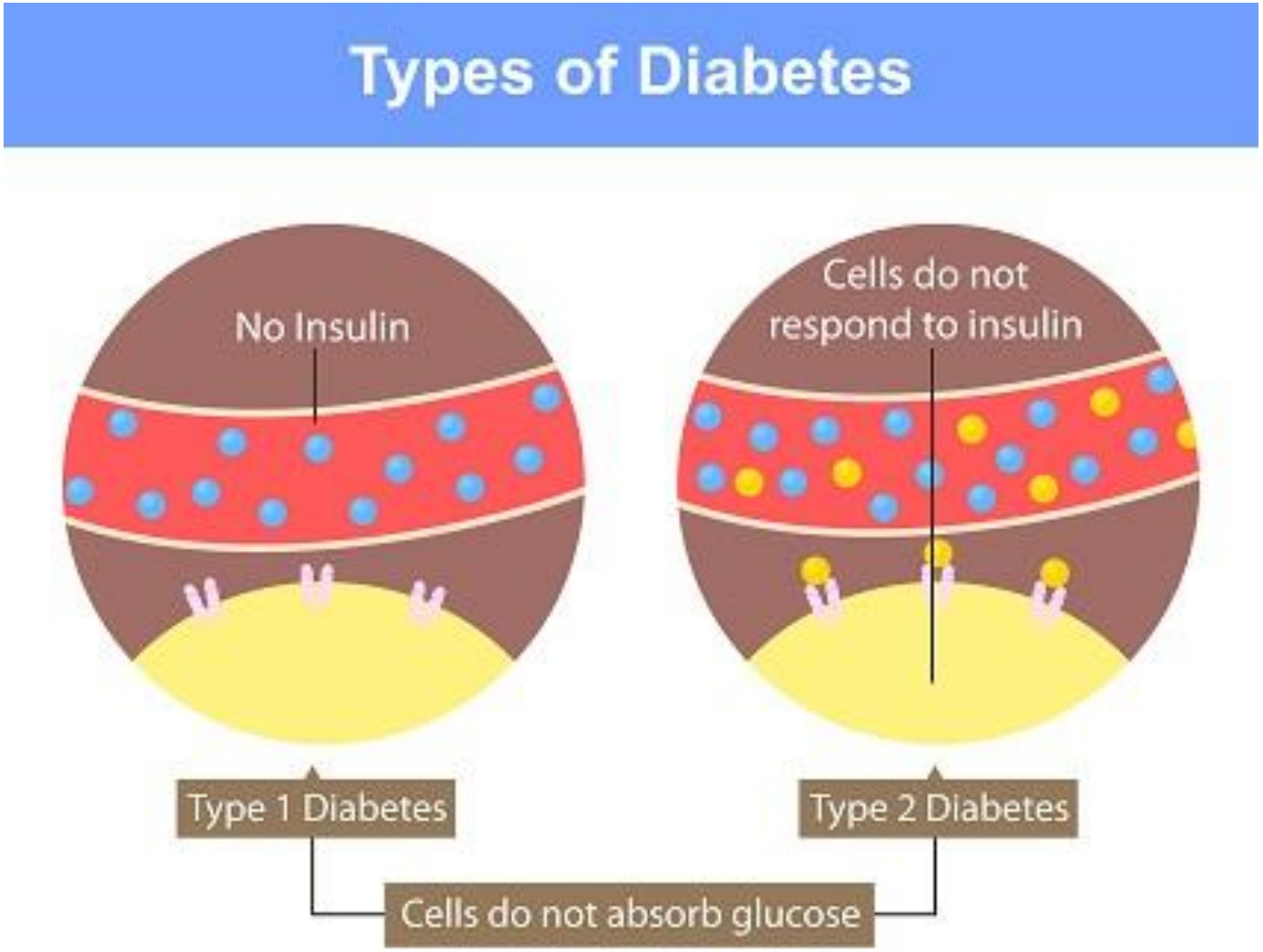



Relative antibody concentration in blood plasma
Secondary response
Primary response
0
1
2
3
4
5
6
Time (weeks)
Antigen injected
Antigen injected



Leukemia is cancer affecting the blood and bone marrow.

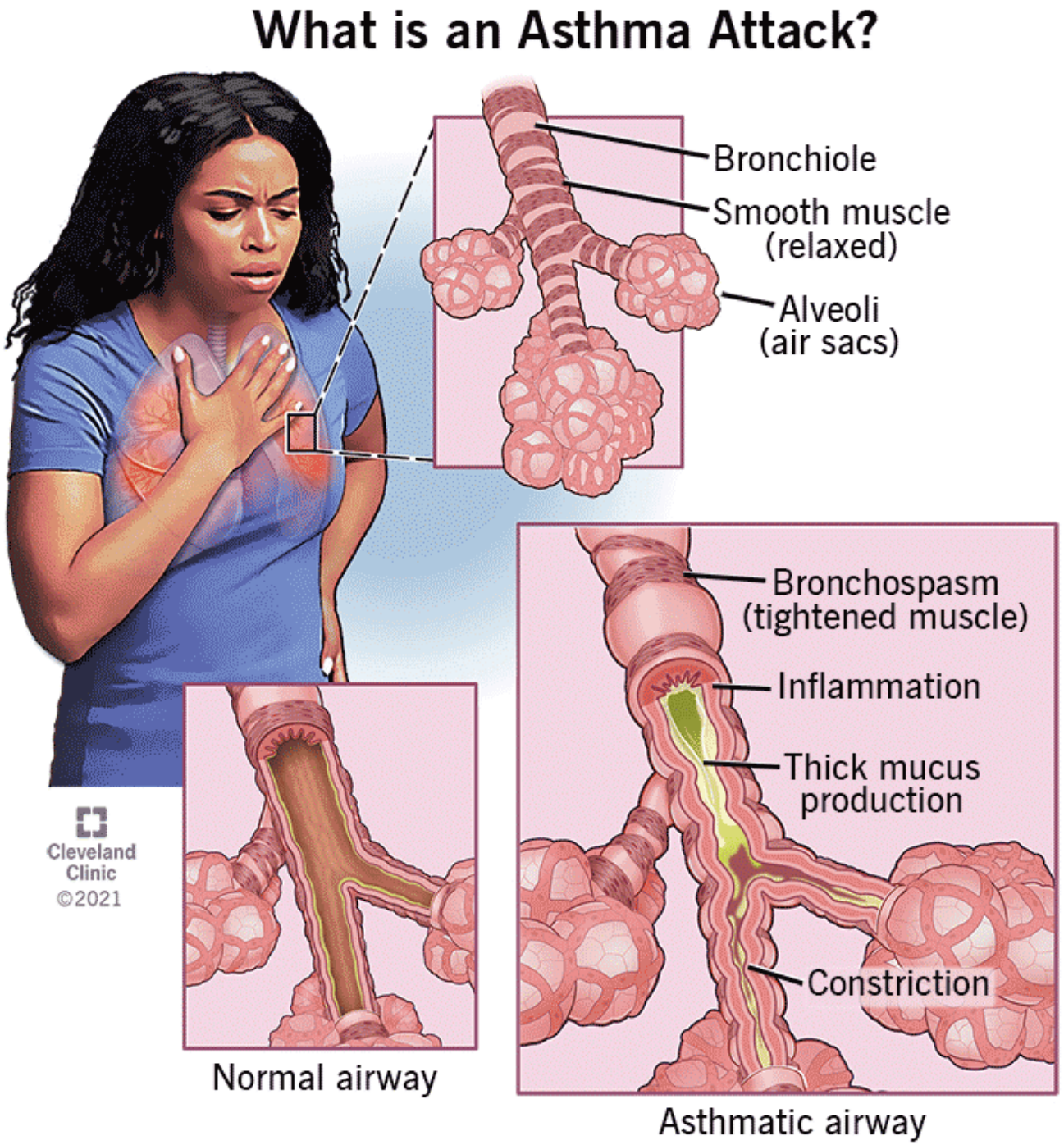
It occurs when the body produces abnormal white blood cells that don't function properly and can't fight off infection.



Diabetes is an autoimmune deficiency (the body attacks itself by mistake), a chronic condition in which the pancreas produces little or no insulin.

Rheumatoid arthritis is an autoimmune deficiency (the body attacks its own tissue), including joints.

A chronic inflammatory disorder affecting many joints, including those in the hands and feet.



ASTHMA usually occurs due to an overactive immune system, reacting to environmental triggers and causing inflammation in the lungs and symptoms such as coughing, wheezing, and shortness of breath.

TRY IT

1. Type of WBC in the 2nd immune response destroying pathogens.

2. ___ Immunity deals with specific pathogens and produce "memory" (e.g. B and T cells).

3. ___ Immunity → Body develops immunity after exposure to a microbe (antigen; e.g. vaccine).

4. Nonspecific; Act Early (skin, mucous, sweat, tears); Prevent pathogens from entering body.

5. The body's __ includes fever and inflammation.

6. Antigen, antibody & lymphocytes (WBC).

TRY IT

1. Type of WBC in the 2nd immune response destroying pathogens.

   macrophage

2. ___ Immunity deals with specific pathogens and produce "memory" (e.g. B and T cells).

   Adaptive

3. ___ Immunity → Body develops immunity after exposure to a microbe (antigen; e.g. vaccine).

   Active

4. Nonspecific; Act Early (skin, mucous, sweat, tears); Prevent pathogens from entering body.

   1st line of defense

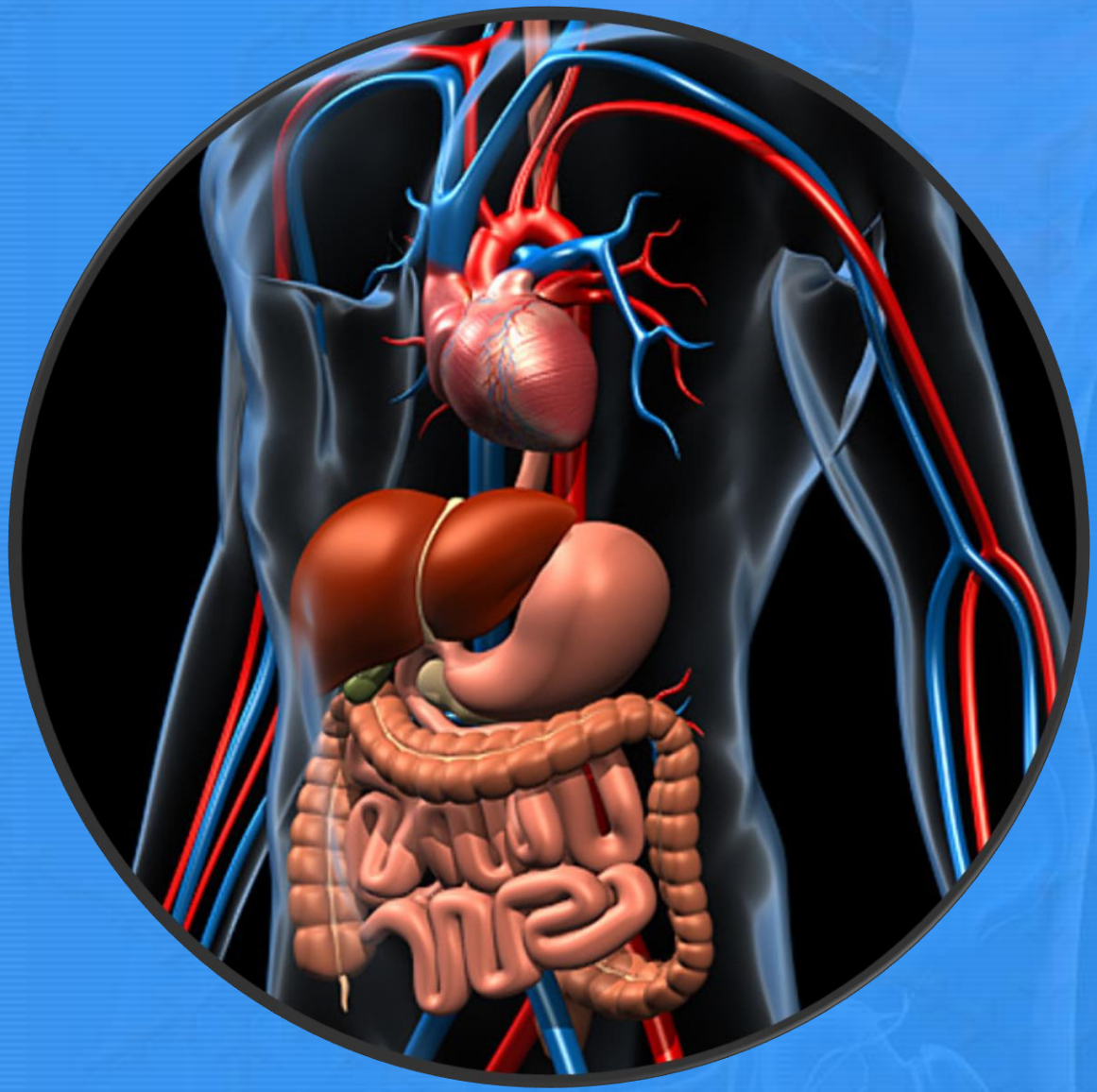
5. The body's __ includes fever and inflammation.

   2nd line of defense

6. Antigen, antibody & lymphocytes (WBC).

   3rd line of defense

Digestive System



Nutrients

Substances in food your body uses to produce **energy** and raw materials for growth and repair.

1. carbohydrates
2. proteins
3. lipids
4. vitamins
5. minerals
6. nucleic acids
7. water

Nutrient (what you eat)		**Subunits** (what they are broken down to)
Carbohydrates		monosaccharides
Proteins		amino acids
Lipids		glycerol and fatty acids
Nucleic acids		nucleotides

Vitamins:

- **ORGANIC molecules** that are vital to maintaining a healthy body.
  - Ex: Vitamins A, B, C ,D , E, K
  - Sources: variety of foods

Minerals:

- **INORGANIC** chemical elements needed for proper body function.
- Ex: iron, potassium, calcium, sodium, phosphorus, zinc, iodine
- Sources: variety of foods

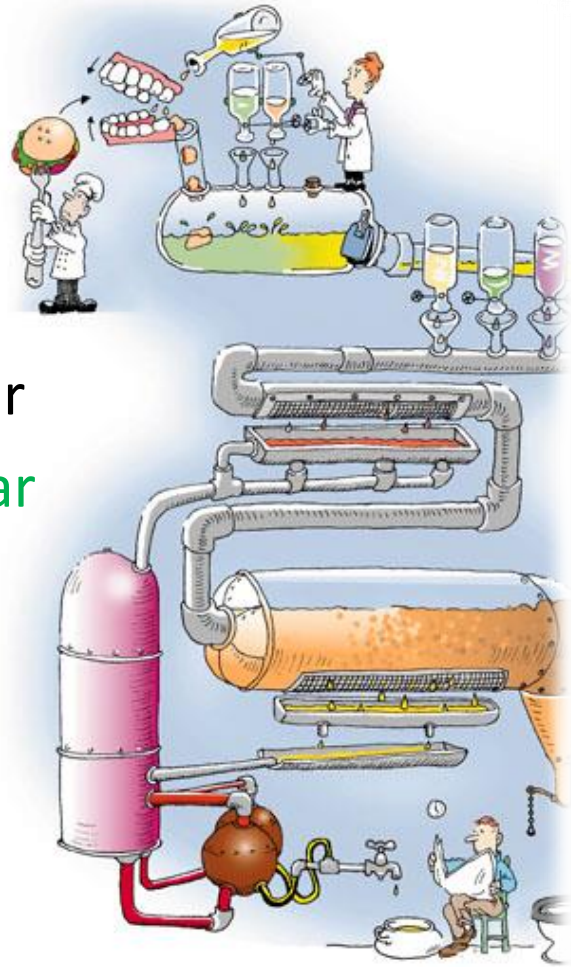
"You are What you Eat"
Digestive System

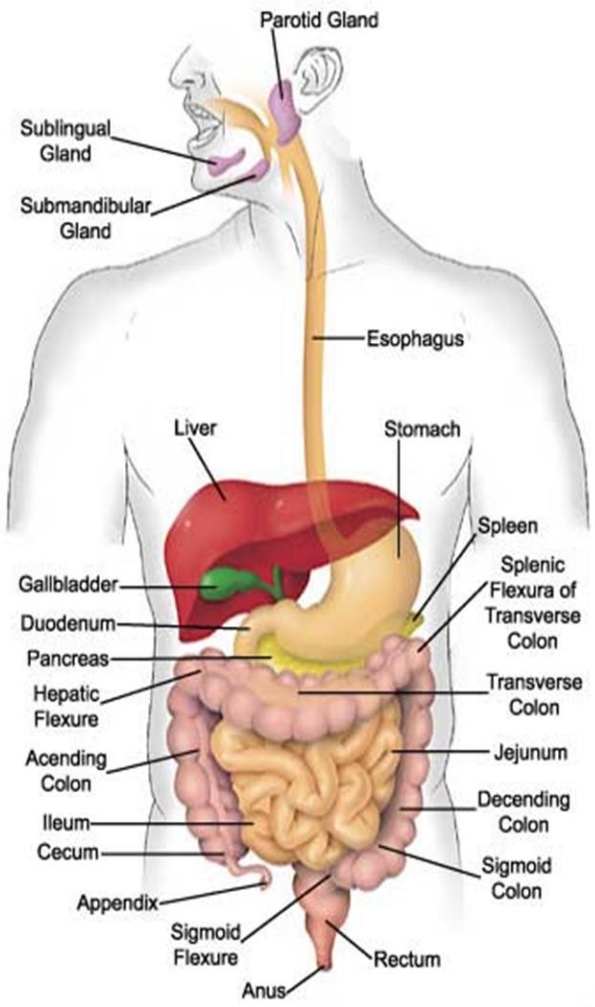
Food is processed in four stages:

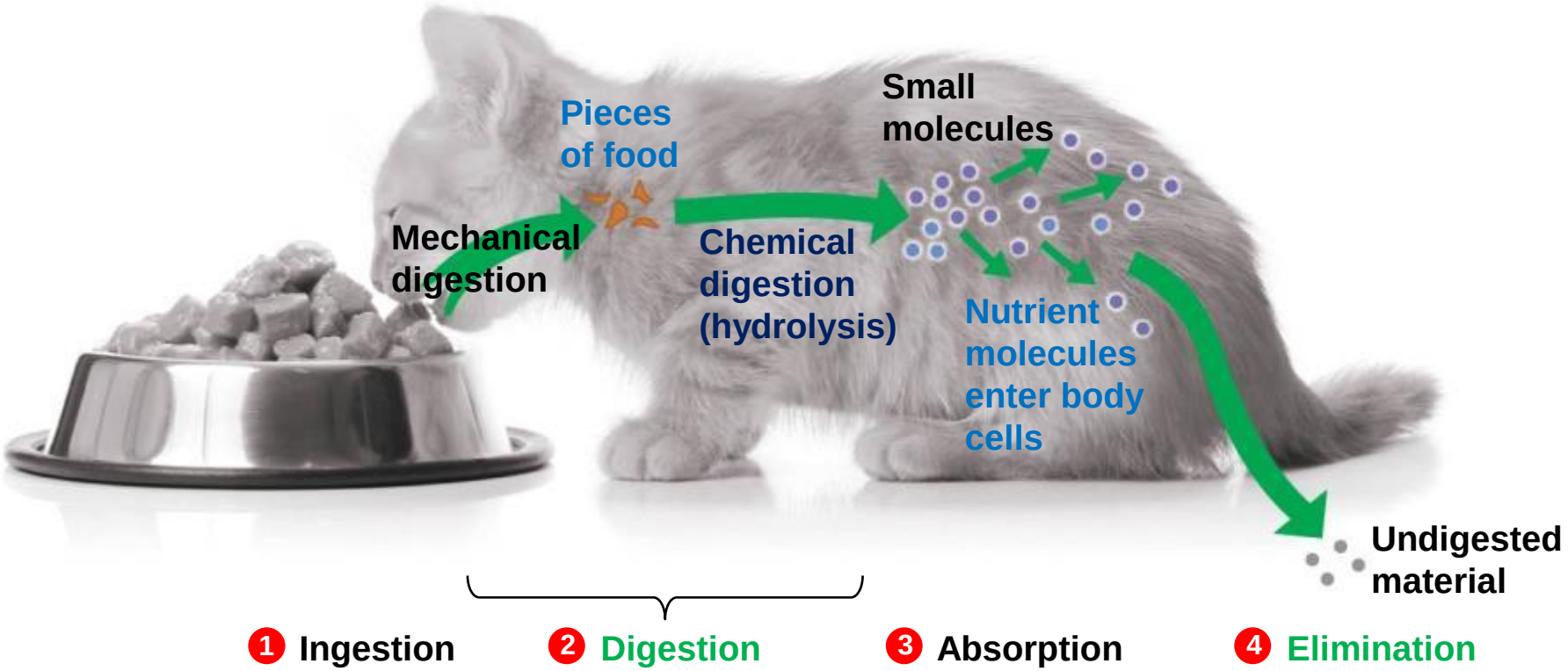
1. **Ingestion** is the act of eating.
2. **Digestion** is the breaking down of food into molecules small enough for the body to absorb.
3. **Absorption** is the take-up of the products of digestion by the cells lining the digestive tract.
4. **Elimination** is the removal of undigested materials from the digestive tract.

Steps in Digestion

1. Ingestion
2. Digestion
   A. Mechanical
   B. Chemical
      1) Intracellular
      2) Extracellular
      3) Hydrolysis
      4) Enzymes
3. Absorption
4. Elimination





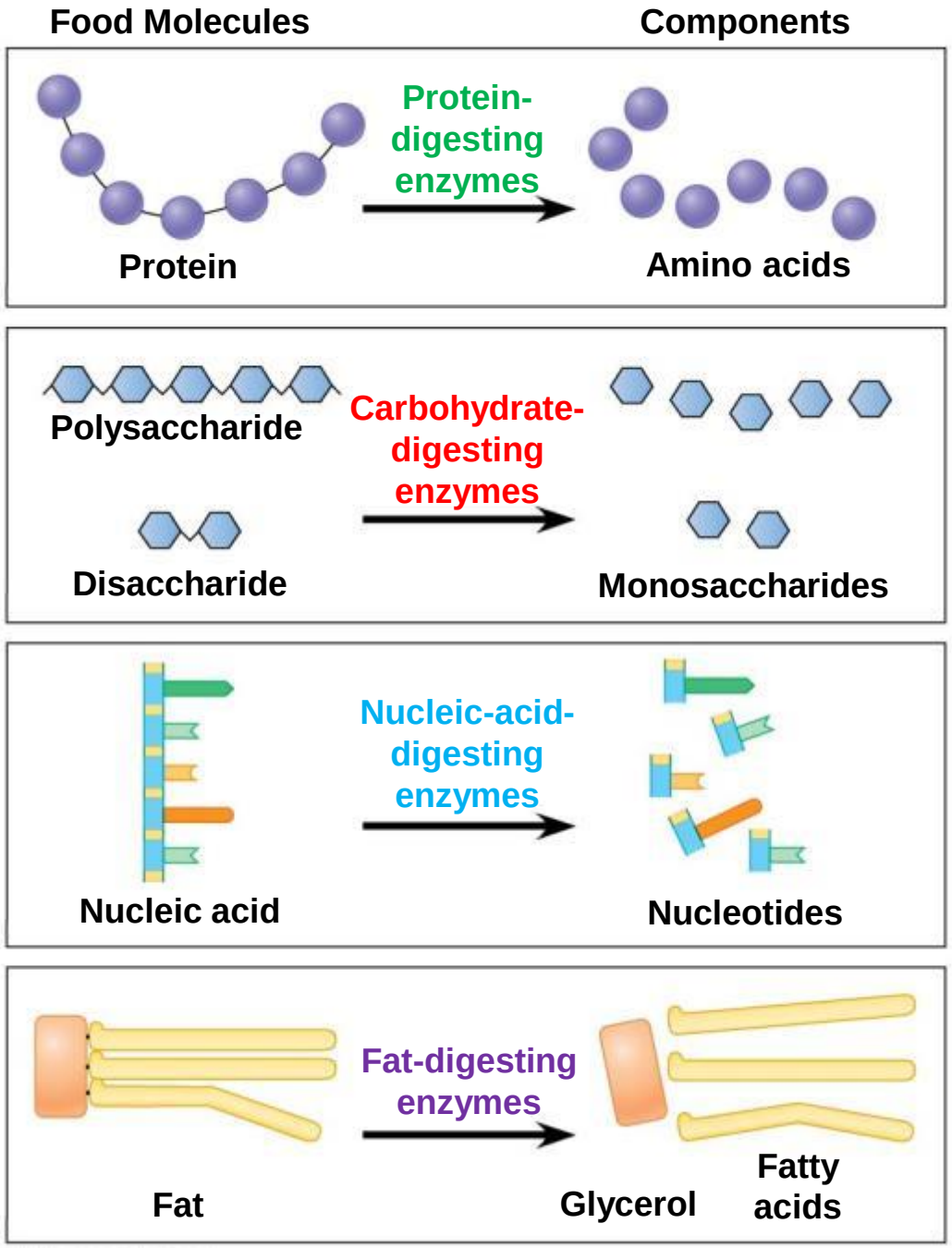

Pieces of food
Small molecules
Mechanical digestion
Chemical digestion (hydrolysis)
Nutrient molecules enter body cells
Undigested material
1 Ingestion
2 Digestion
3 Absorption
4 Elimination

Digestive System

Two Methods of Digestion:

1) MECHANICAL Digestion: involves grinding of food and mixing it with digestive juices.
   - **Teeth** and **Stomach**

2) CHEMICAL Digestion: involves chemically breaking down the food into soluble substances that the body can use.
   - **Enzymes and Digestive Juices**


Food Molecules
Components
Protein-digesting enzymes
Protein
Amino acids
Polysaccharide
Carbohydrate-digesting enzymes
Disaccharide
Monosaccharides
Nucleic-acid-digesting enzymes
Nucleic acid
Nucleotides
Fat-digesting enzymes
Fat
Glycerol
Fatty acids

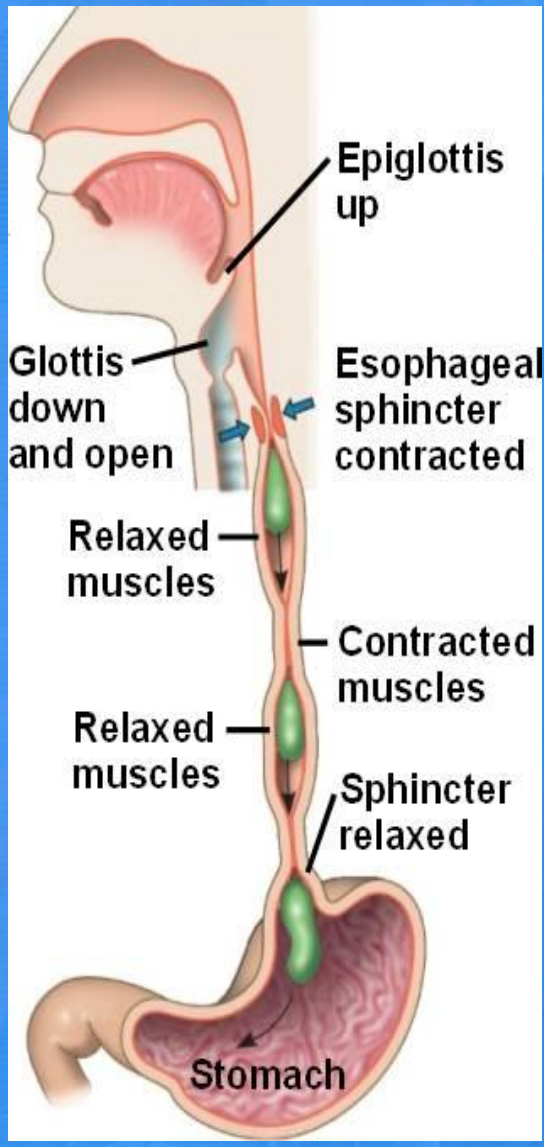
Digestive System

Organs of the Digestive System are divided in two groups:

1) **ALIMENTARY CANAL**

Tube ~ 9 m (30 feet) long that runs from the mouth to the anus.

- **Mouth, Pharynx, Esophagus, Stomach, Intestines**
- **PERISTALSIS:** type of muscle contractions by which food is moved along the alimentary canal.

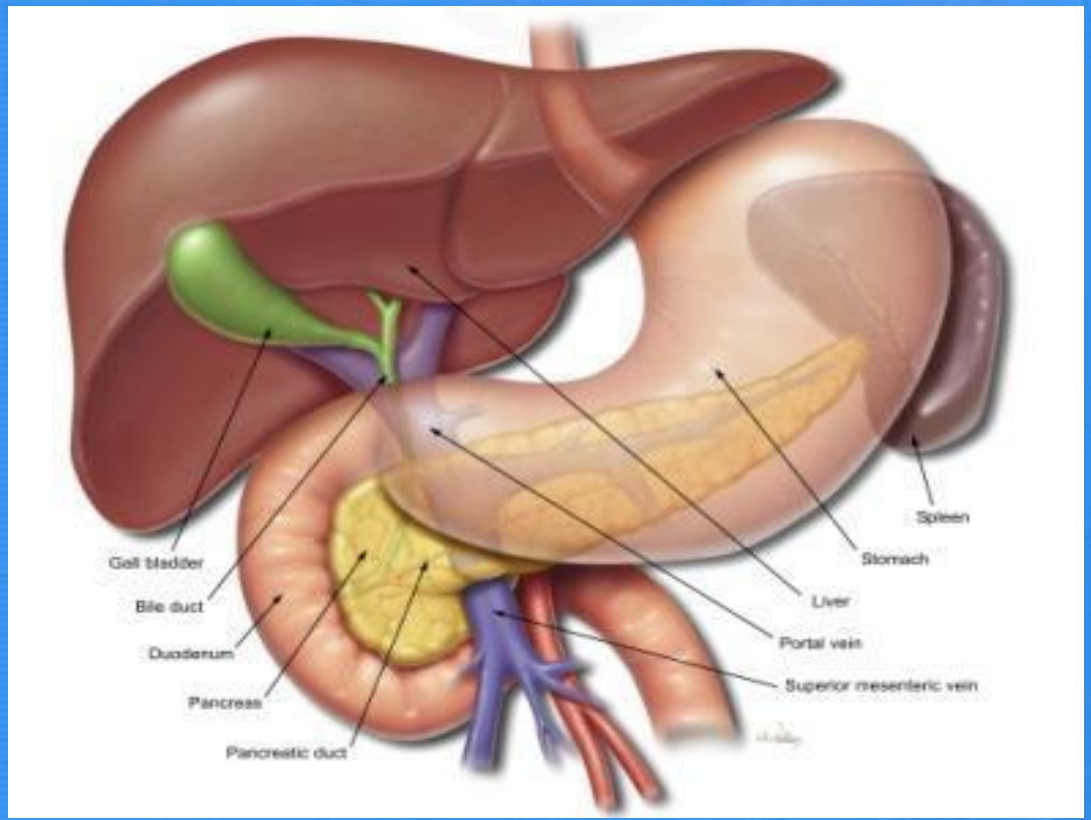


Digestive System

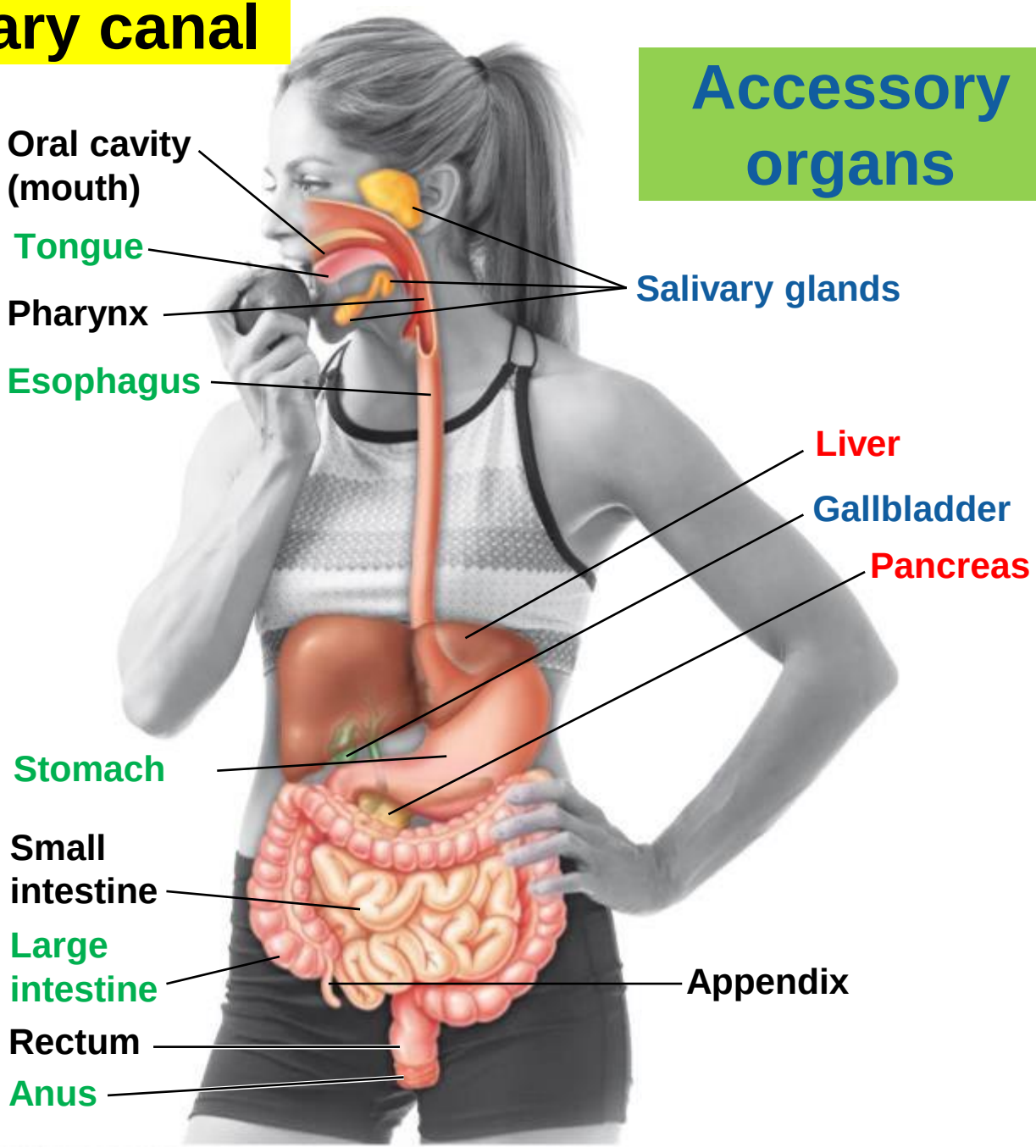
2) ACCESSORY ORGANS

Organs attached to the alimentary canal by ducts (tubes).

- **Salivary Glands, Gallbladder, Liver & Pancreas**



Alimentary canal



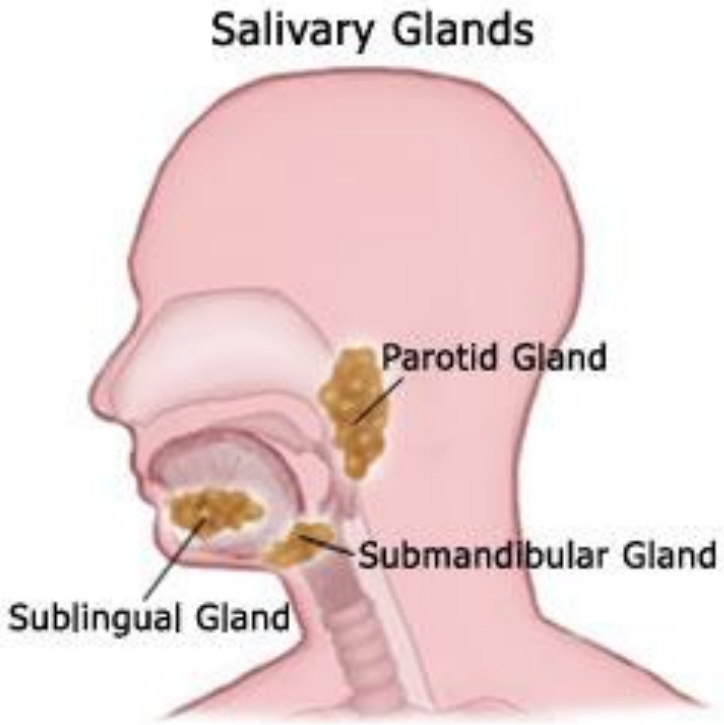
Mouth

- **Mechanical** (physical) digestion begins in the mouth as the tongue moves the food between the teeth for chewing.
- **Saliva** contains the enzyme **Amylase** for chemically digesting **Starch** into **maltose.**
- Tongue forms a **Bolus** for swallowing.

Salivary Glands & Digestion

Salivary Glands

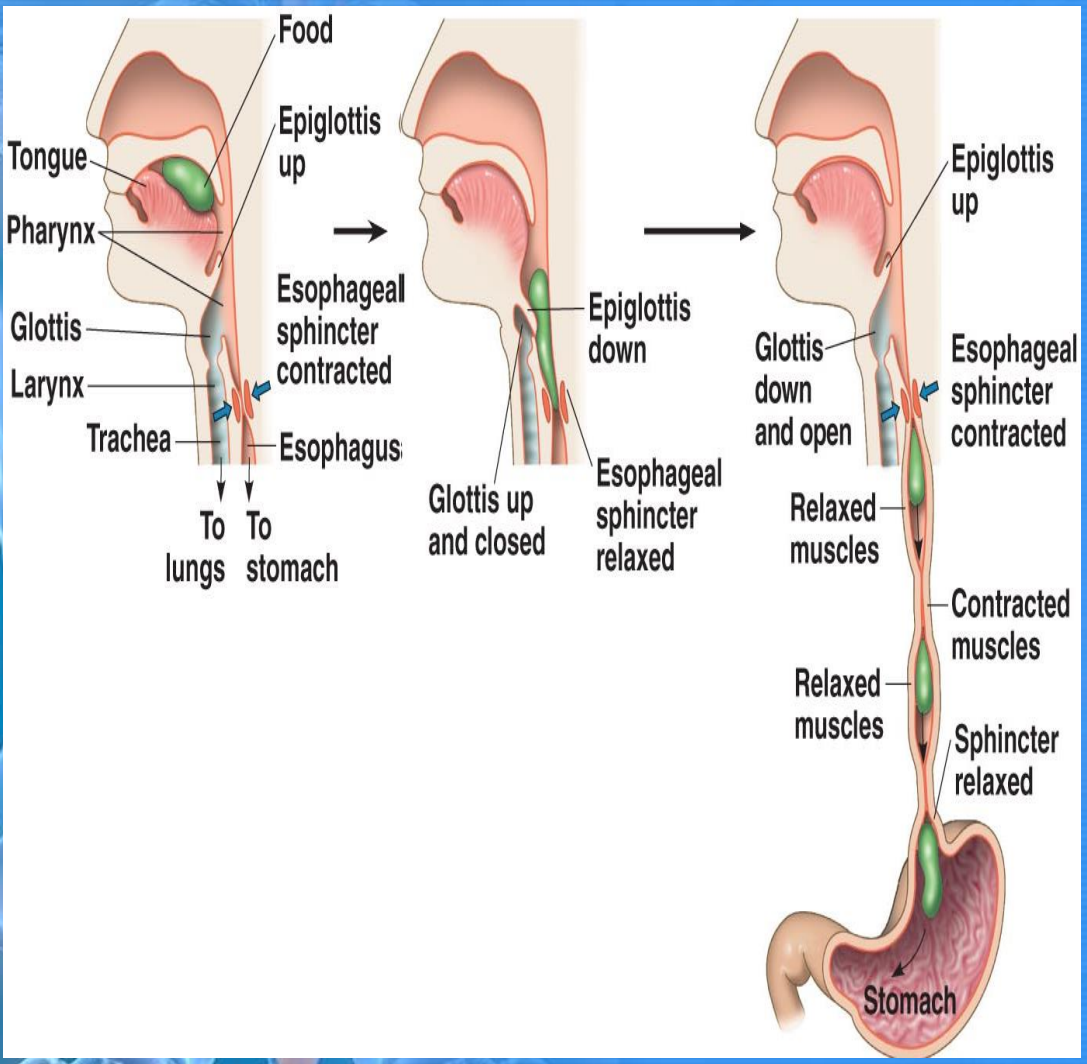
1. Moisten
2. Lubricate
3. Chemical Digestion



Salivary Amylase

Starch ⟶ Maltose

Esophagus

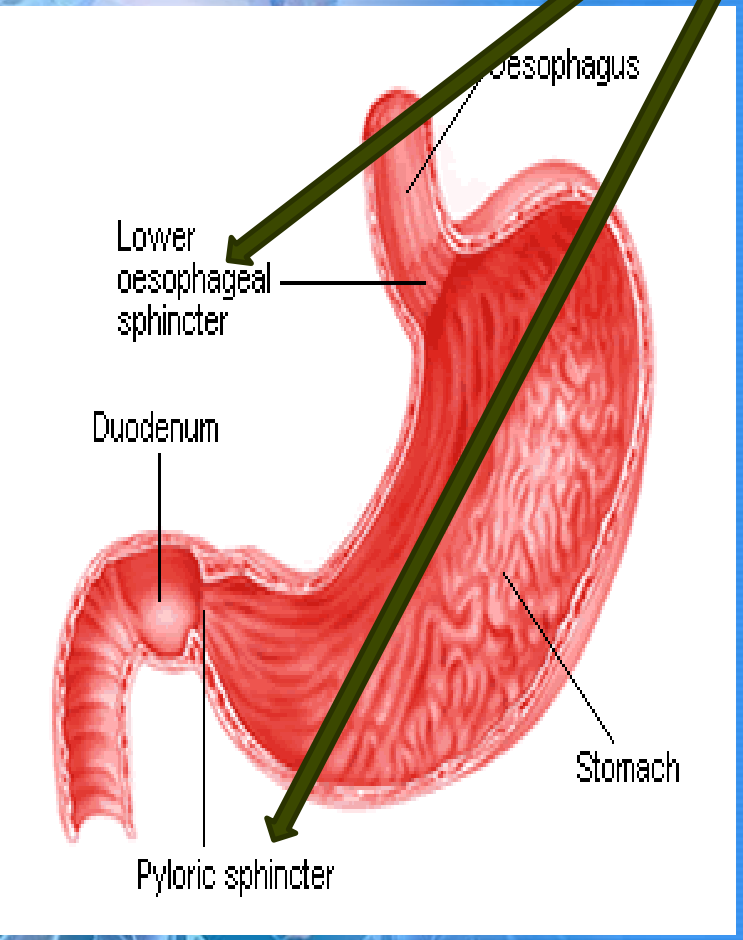


The tongue moves the chewed food into the **Pharynx** at the back of the mouth where swallowing starts.

- Trachea is blocked by the **Epiglottis**

Swallowing begins the **peristalsis**, wave-like contractions of muscle that pushes the food through the **Esophagus**.

Stomach



Mechanical digestion

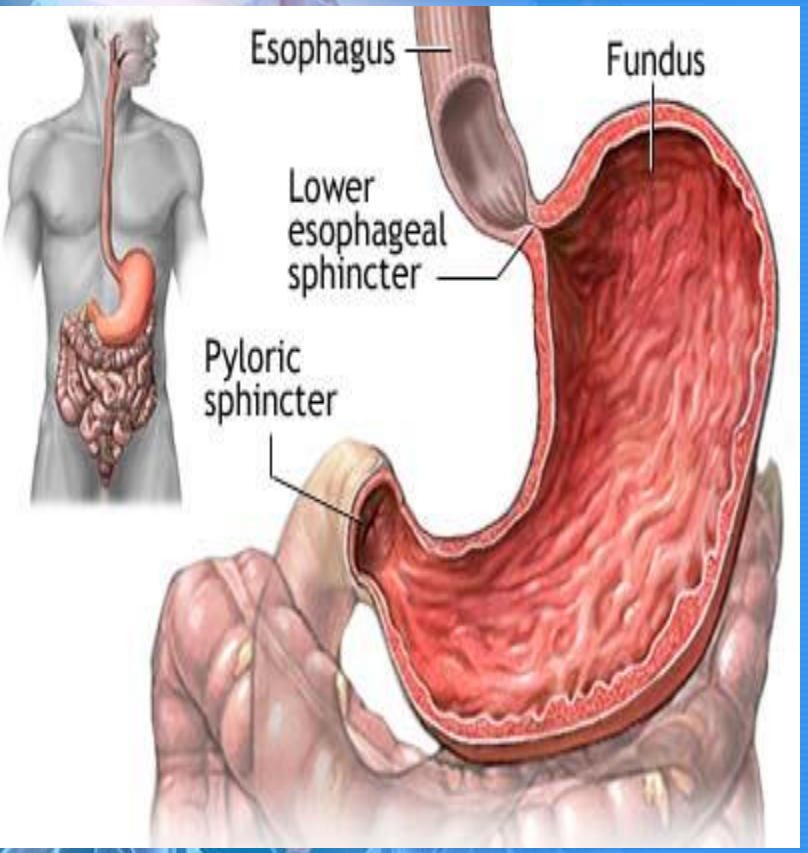
Closed sphincters at each end of the stomach keep the food inside while muscles in the wall of the stomach carry on peristalsis.

- Food is churned for up to 4 hours.

Chemical digestion

- Glands in the stomach lining produce fluids that contain:
  - **Pepsin** → enzyme that digests **protein.**
  - **Hydrochloric acid**

Stomach



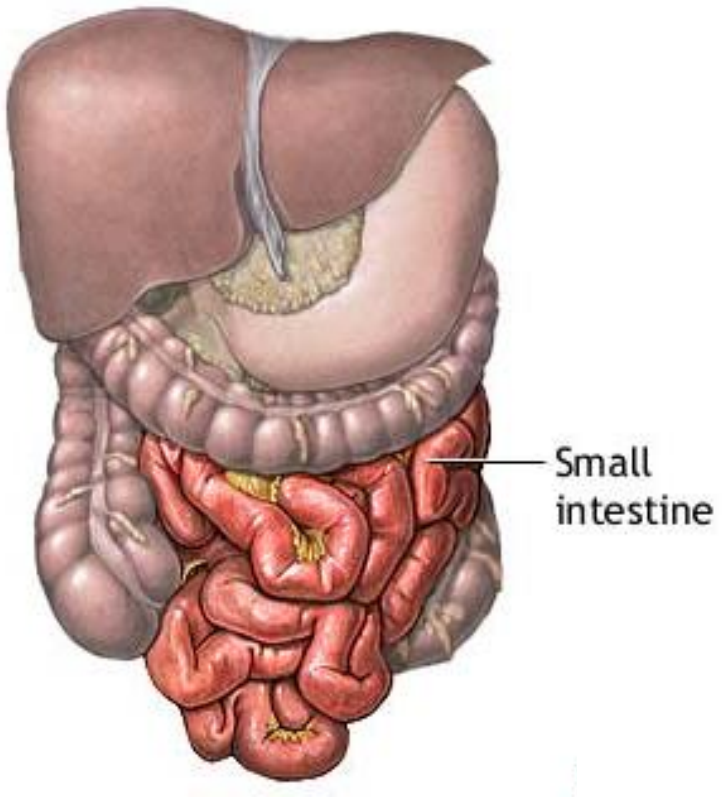
Hydrochloric Acid helps to digest certain foods and also kills some microbes that enter the stomach.

Enzymes (pepsin, rennin) continue the digestive process.

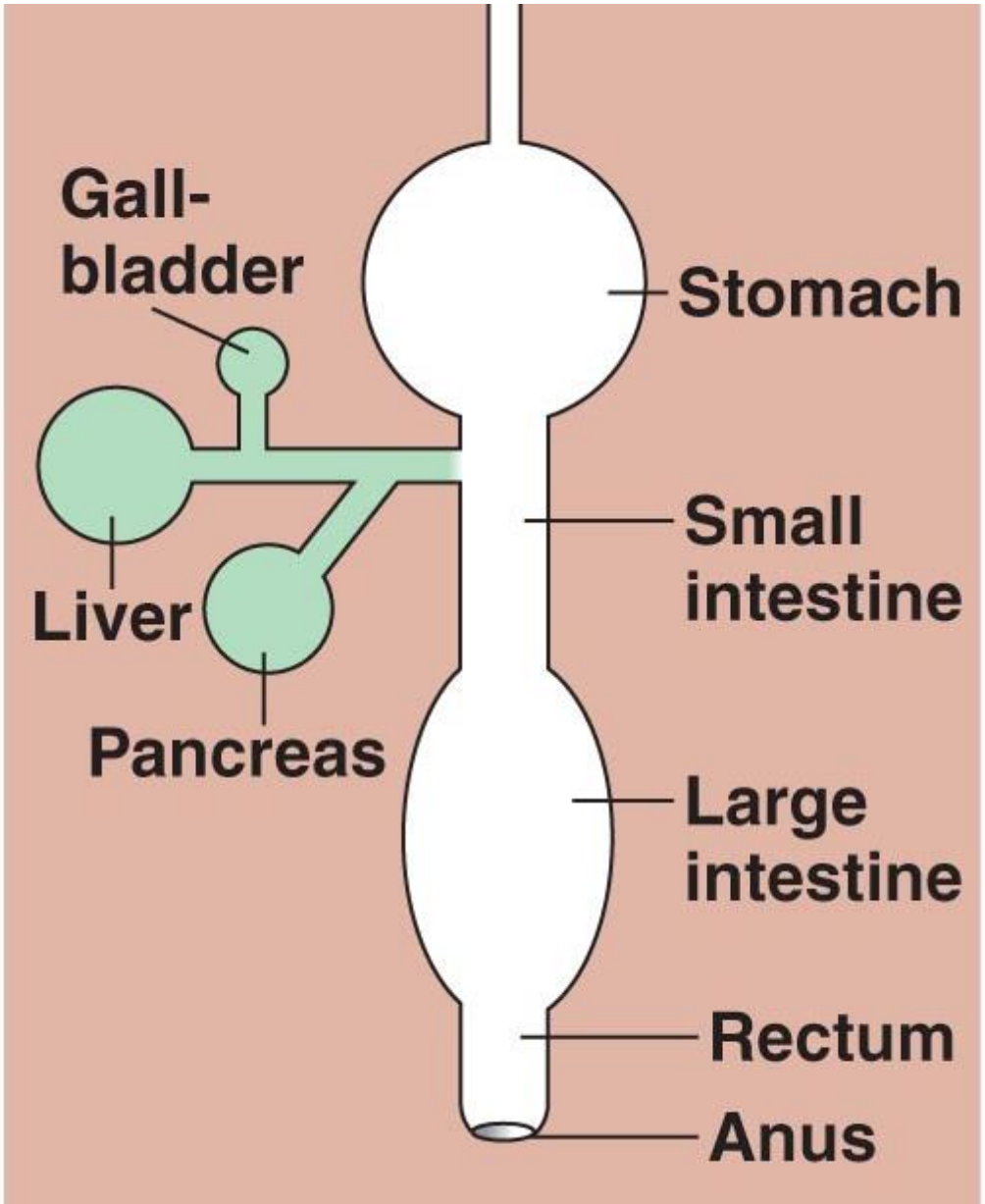
Acid and enzymes do not digest the stomach itself because it is protected by a thick layer of **Mucus**.

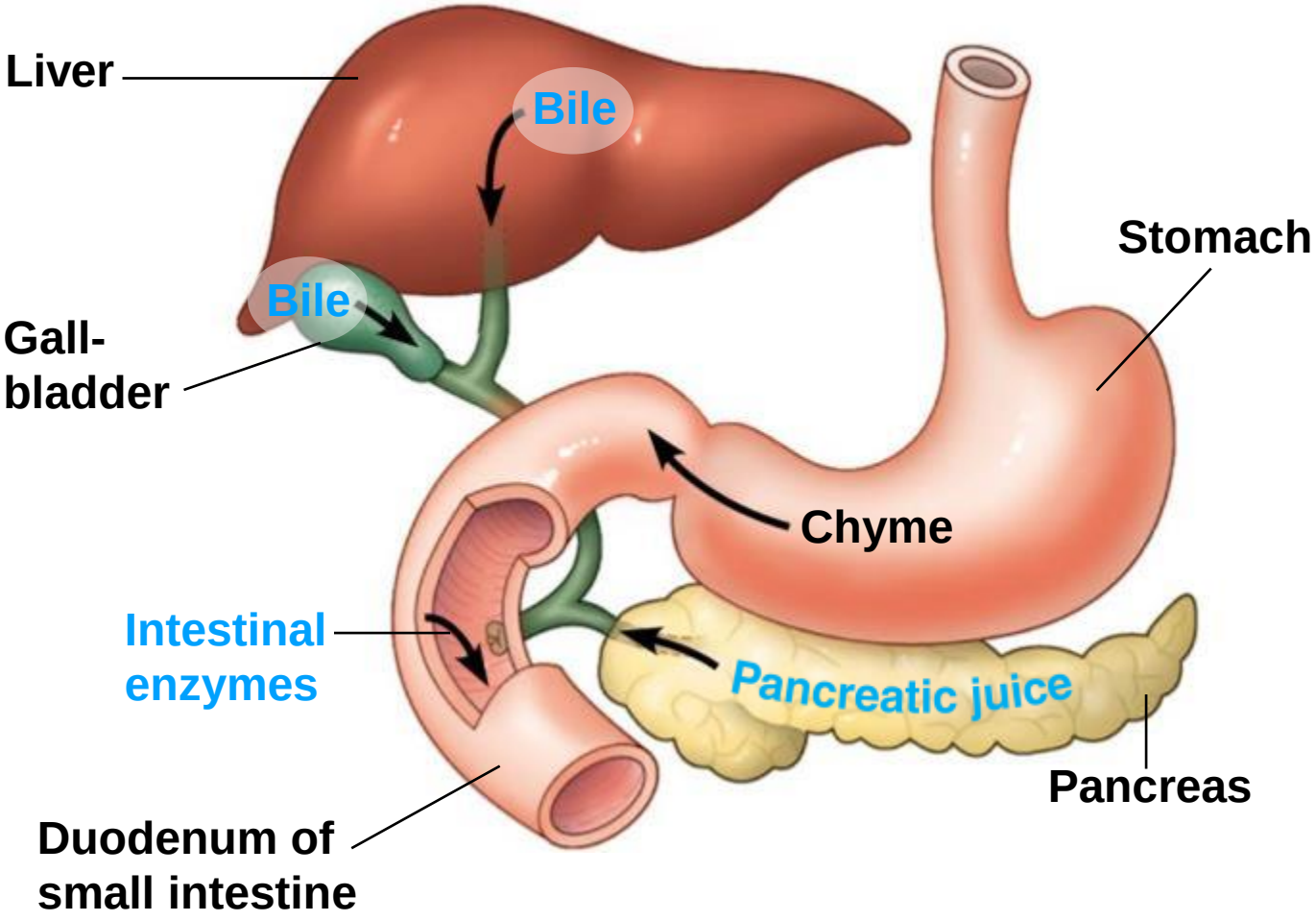
In the stomach, the mixture of food, enzymes and acid becomes a semiliquid called **Chyme**.

Small Intestine (SI)



Materials from liver, gall-bladder and pancreas are delivered to SI.

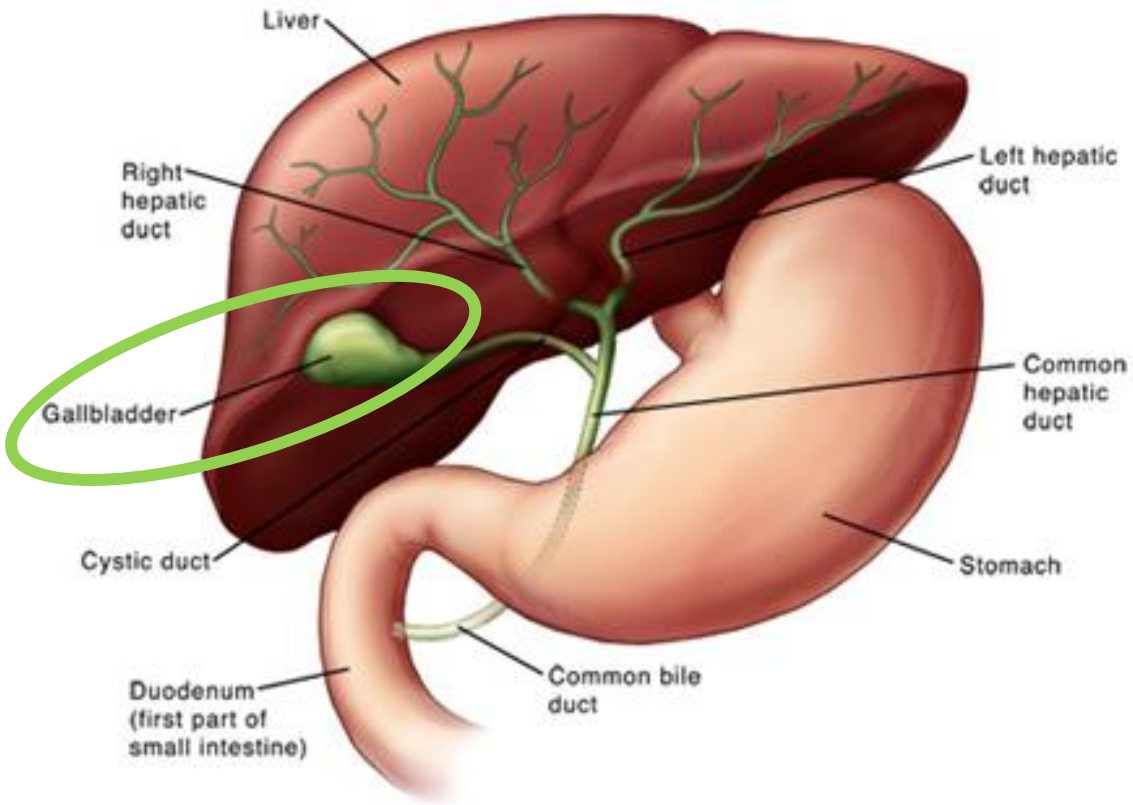



Liver
Bile
Bile
Gall-
bladder
Stomach
Chyme
Intestinal
enzymes
Pancreatic juice
Pancreas
Duodenum of
small intestine

Liver & Gallbladder

1. Bile
   - Produced by liver
   - Stored in gallbladder

2. What is in bile?
   1. Water
   2. Bile salts
   3. Broken down RBC (red blood cell) pigments

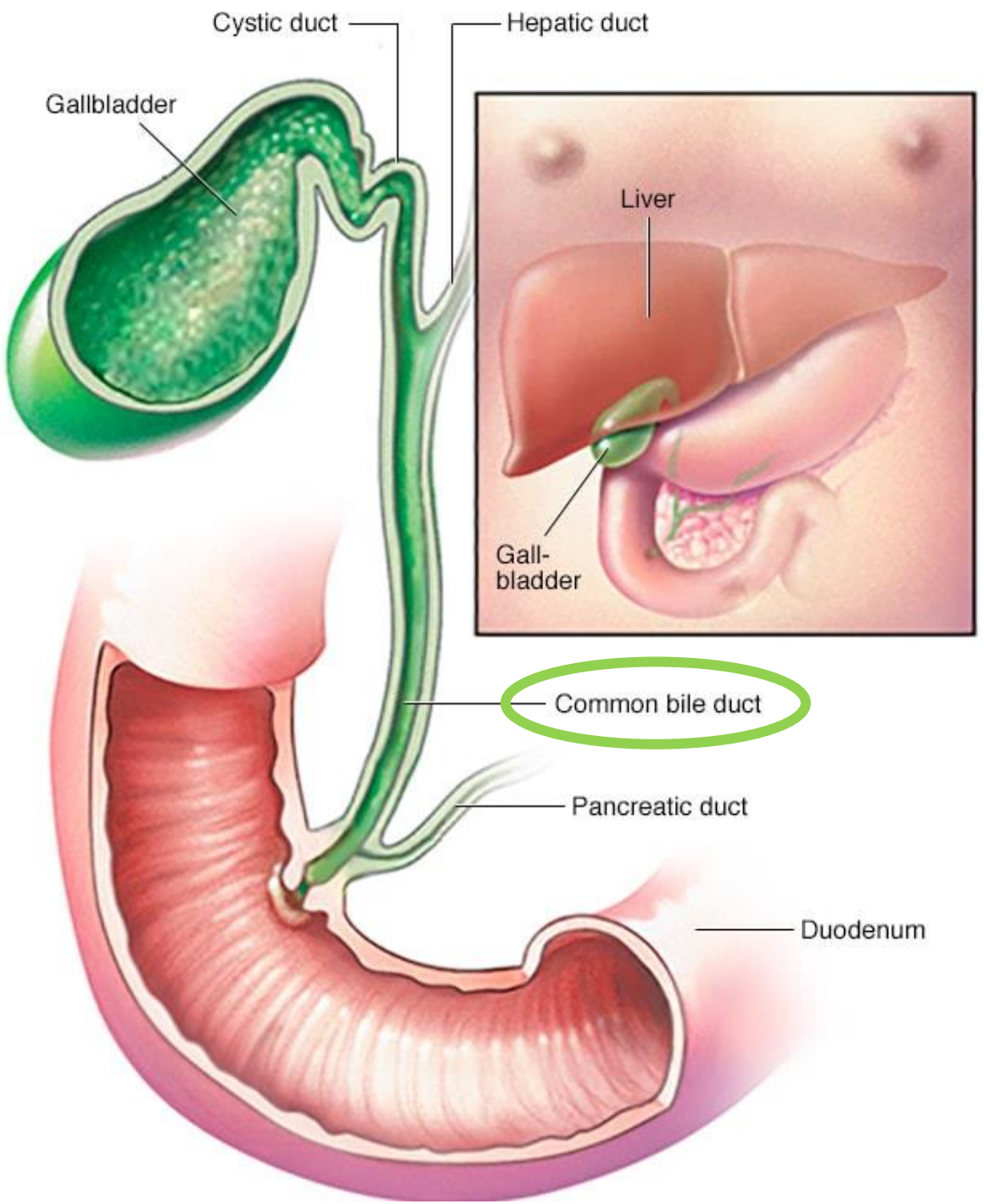


How does bile aid digestion?

- Physical (mechanical) digestion
  - Emulsification (break down) of fat

How does bile get to the Small Intestine?

Common Bile Duct

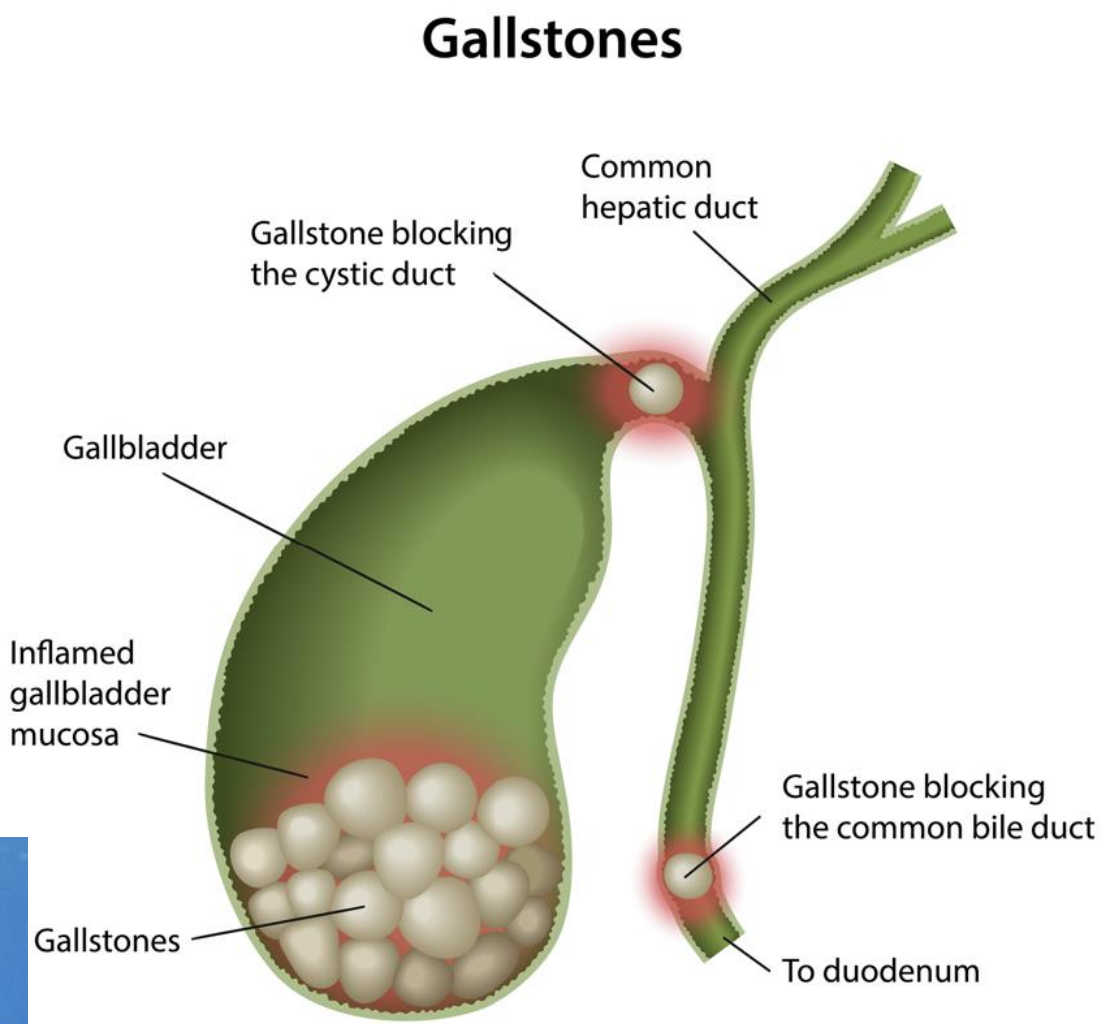


What are Gallstones?

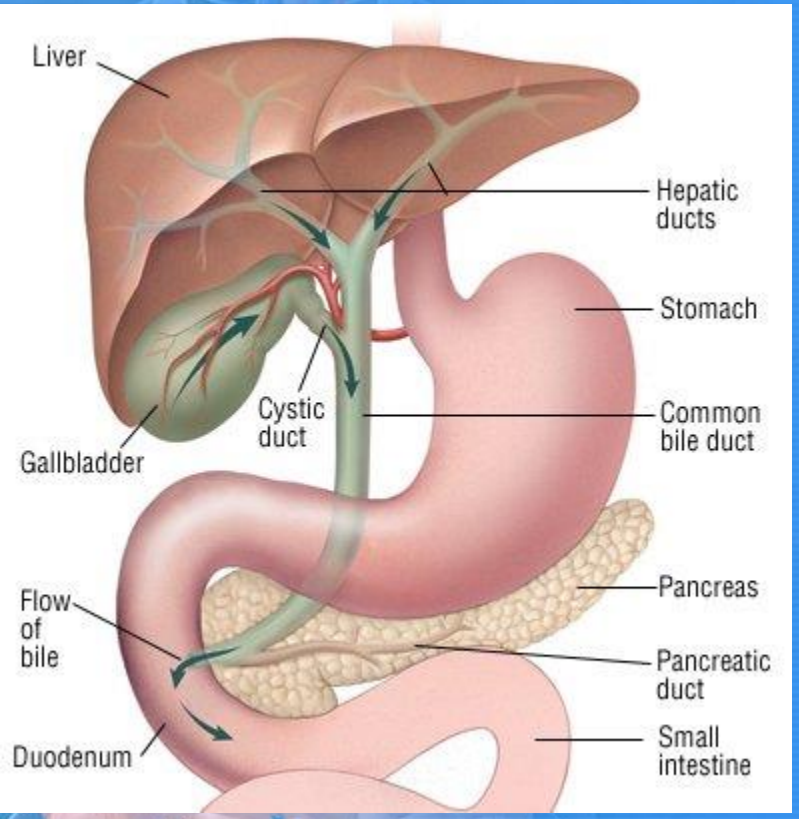
- Hardened deposits of bile
  - Possibly caused by too much cholesterol (fatty diet) or bilirubin (breaks down RBCs)

Treatment

Surgery or medication to dissolve gallstones.



Liver



The liver is an accessory digestive organ.

The "Master Chemist of the Body" (>500 functions).

- Adjust the contents of the blood to meet the body's needs.
- The liver receives blood from the **Hepatic Portal Vein** and various arteries.
- This blood carries food and other substances absorbed by the small intestine.

Liver

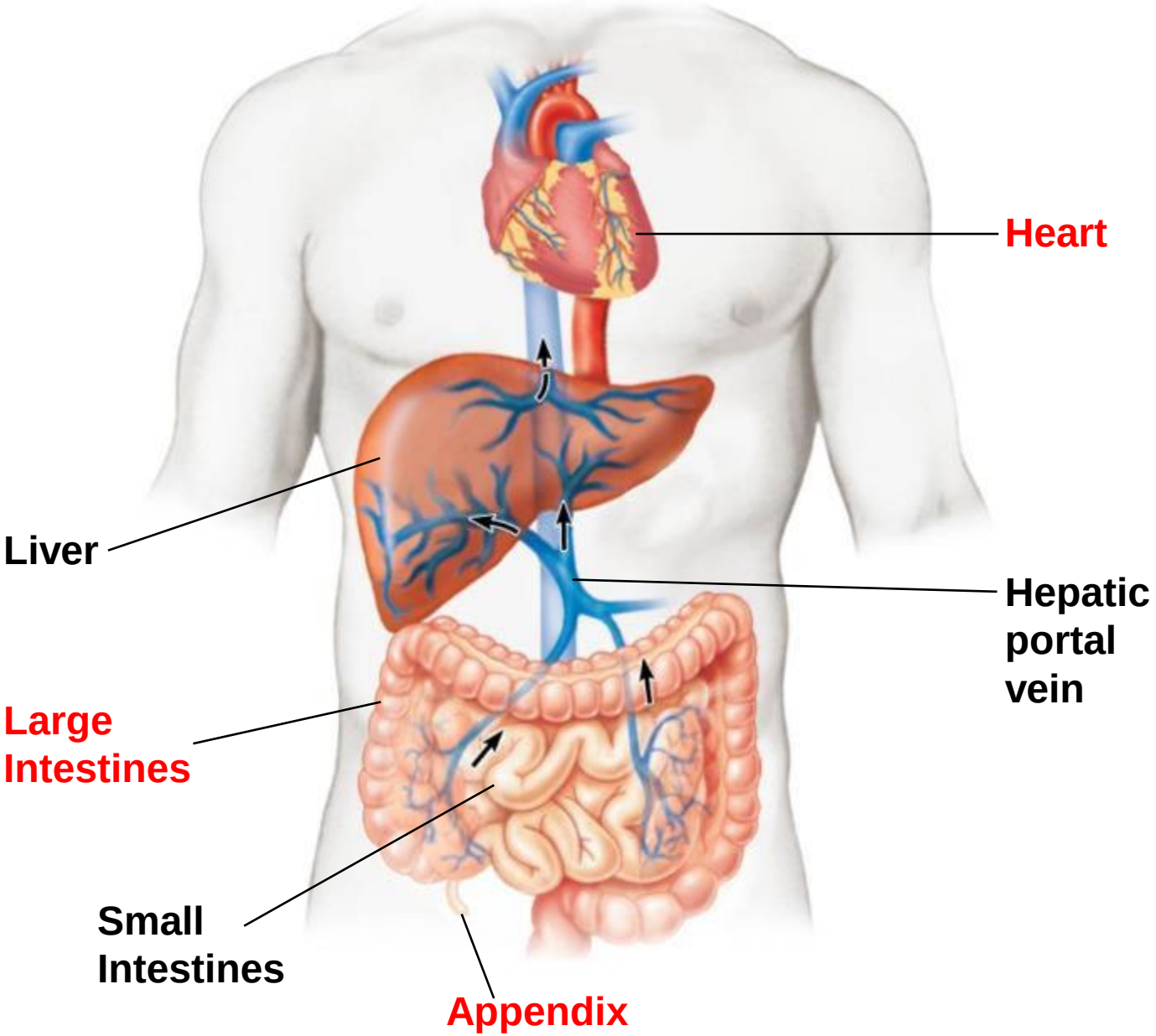
The main function of the liver within the digestive system is to process the nutrients absorbed from the small intestine.

Bile **from the liver secreted into the small intestine also plays an important role in digesting fat and some vitamins.**

The liver takes the raw materials absorbed by the intestine and makes all the various chemicals your body needs to function.

Digested food in the small intestine is absorbed into the capillaries inside the villi.

- Blood then carries these absorbed molecules to the LIVER.


Heart
Liver
Hepatic portal vein
Large Intestines
Small Intestines
Appendix

Pancreas

The pancreas has two main functions: an exocrine function that helps in digestion and an endocrine function that regulates blood sugar (insulin & glucagon).

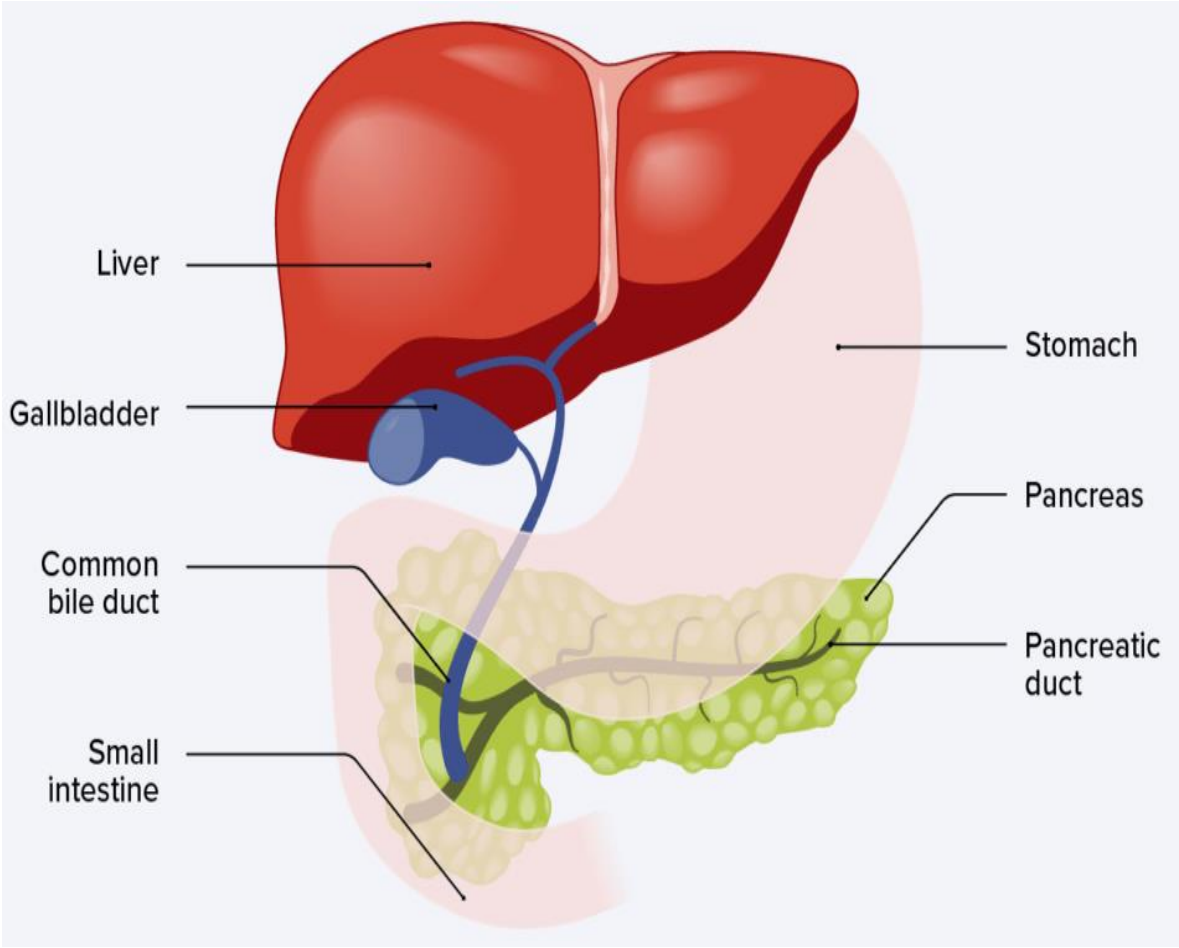
Releases bicarbonate to neutralizes stomach acid.

Releases Pancreatic 'Juice' for digestion.

1. Lipase (fats)
2. Trypsin & chymotrypsin (proteins)
3. Amylase (carbohydrates)

How does pancreatic 'juice' get to the SI?

- Pancreatic duct joins the common bile duct.

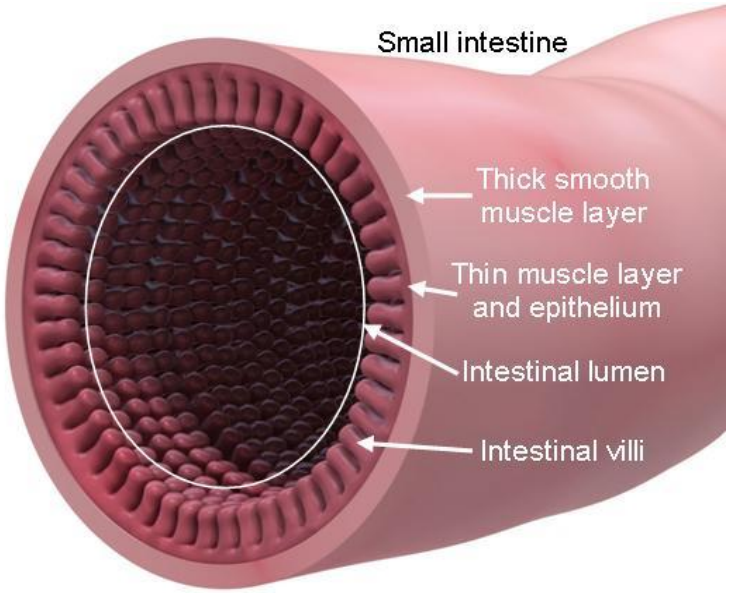


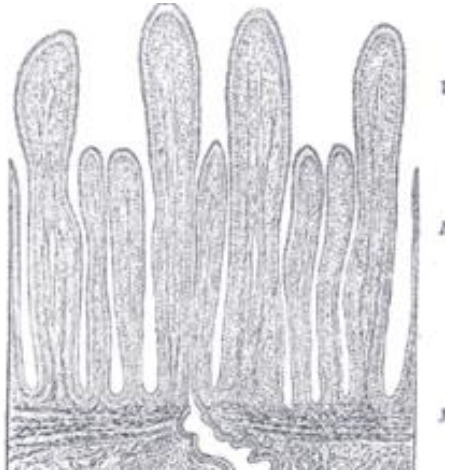
Small Intestine (SI)

Why is it called the small intestine?

- **Small diameter (up to 23 feet long!)**

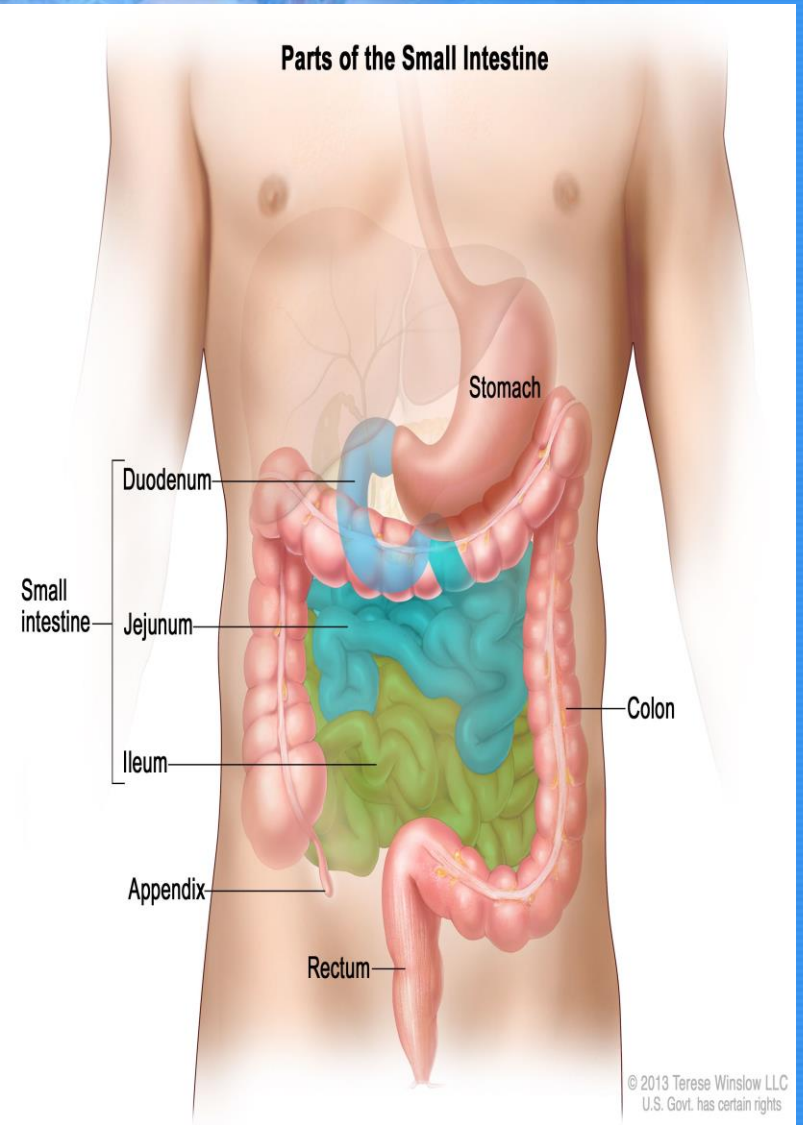
1. Among others, it releases **sodium bicarbonate** to **neutralize acid** in Chyme.
2. 90% of chemical digestion occurs there.
3. Absorption
   - Villi and microvilli increase Surface Area (SA).
4. Peristalsis





intestinal villi

Small Intestine



The small intestine has three sections:

Duodenum

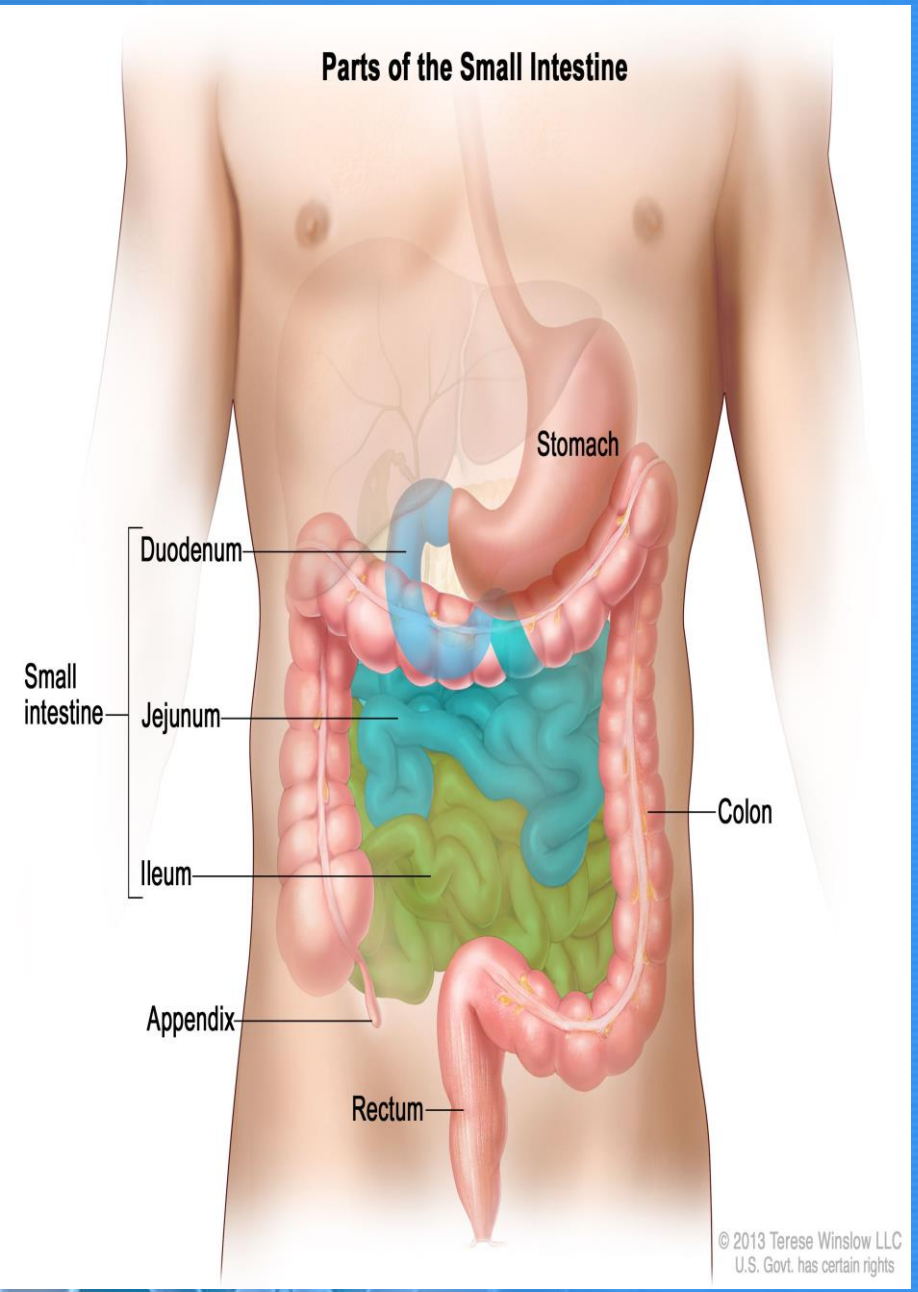
- Absorbs vitamins, minerals, and nutrients.

Jejunum

- Absorbs sugars, amino acids and fatty acids.

Ileum

- Absorbs nutrients (B-12) & bile.
- Connects to colon.



Duodenum

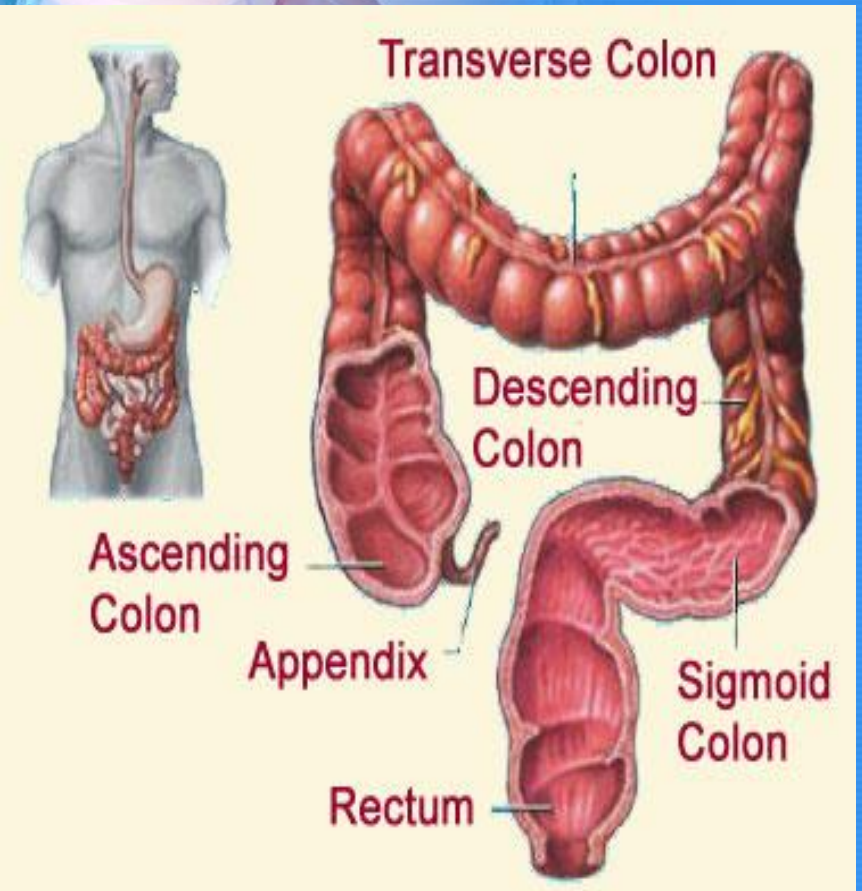
- **Bile:** from **liver**
- **Pancreatic Juice**: from Pancreas

Pancreatic Juice contains:

- **Trypsin** and **Chemotrypsin** digest **proteins.**
- **Lipase** digests **fats.**
- **Pancreatic Amylase** digests **starch.**
- **Nucleases:** digest **nucleic acids.**

Large Intestines (colon)

At the end of the small intestine, the remaining undigested foods and fluids enter the **Large Intestine**.

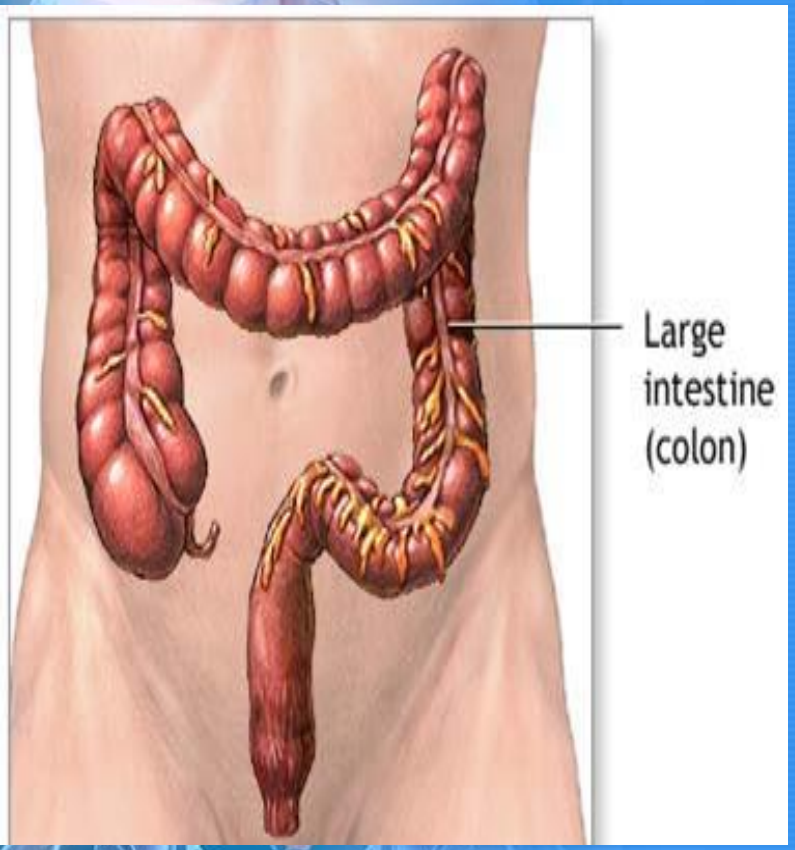


1.5 m (5 ft.) long

Little or no digestion occurs here.

Absorbs WATER, minerals and some vitamins.

Intestines



Many **friendly bacteria** live and reproduce in the large intestine (e. coli).

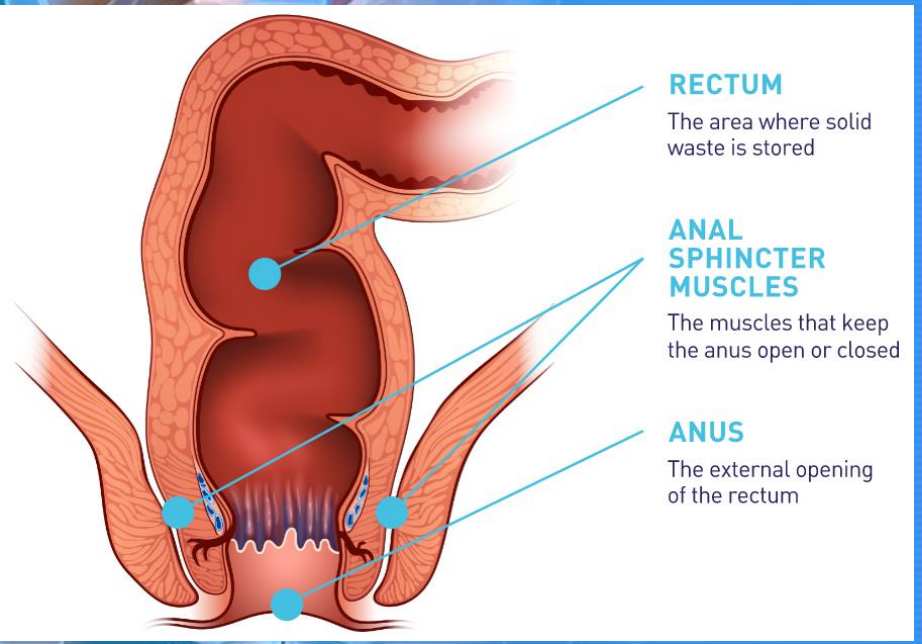
Usually they do not cause disease.

They produce certain vitamins (K for blood clotting) and digest food that humans cannot digest.

The "End"

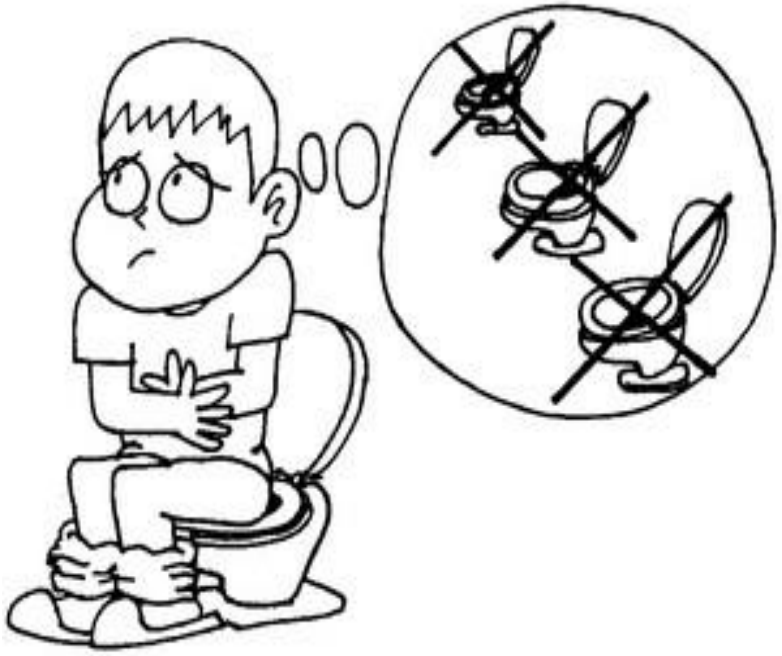
Material left after large intestine absorbs most of the water is called **FECES (food debris and bacteria).**

Peristalsis moves feces from the large intestine to the **Rectum** through the **Anus**, the last valve of the alimentary canal.

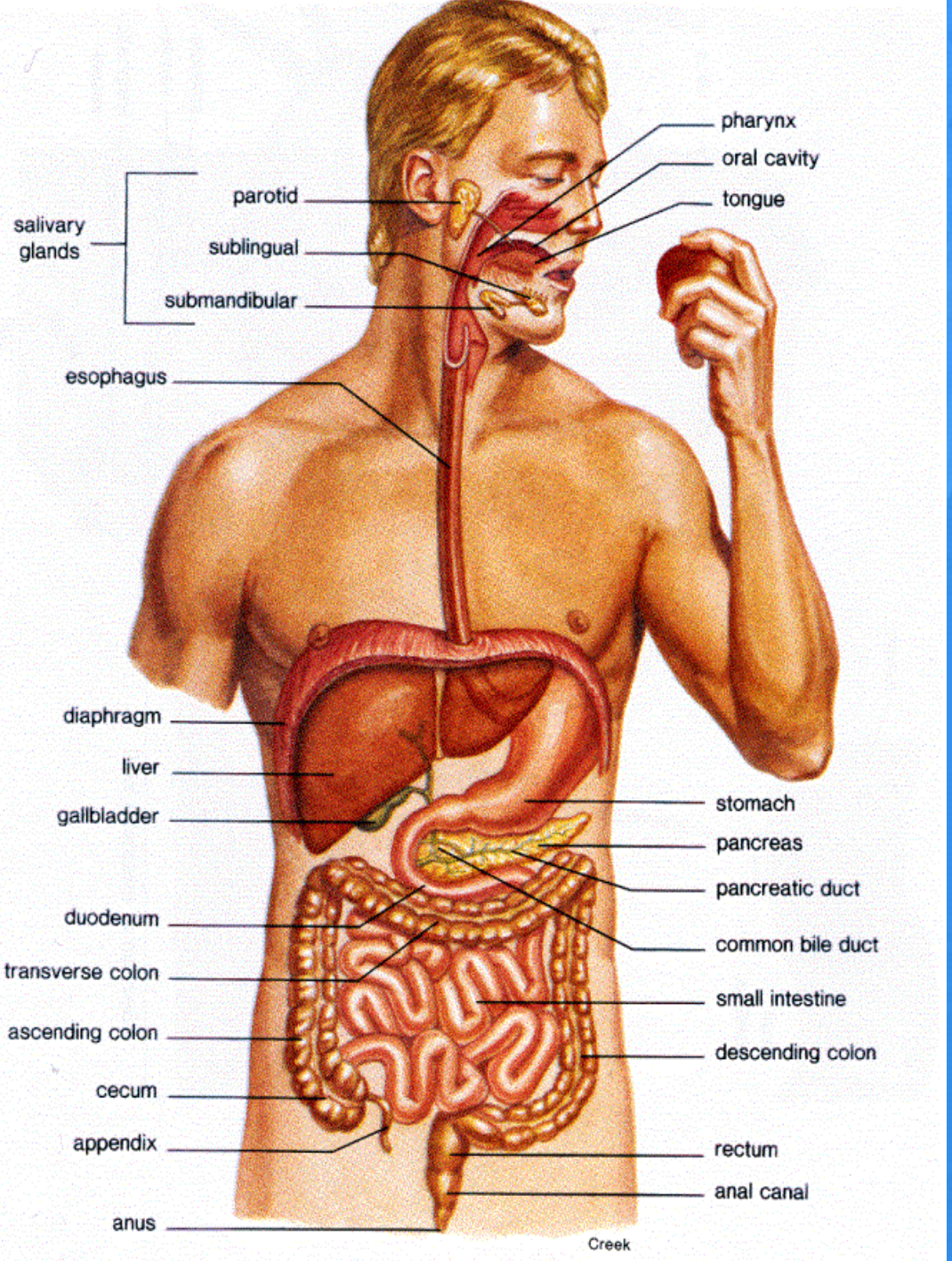


DIARRHEA occurs when too little water is reclaimed from the contents of the large intestine.

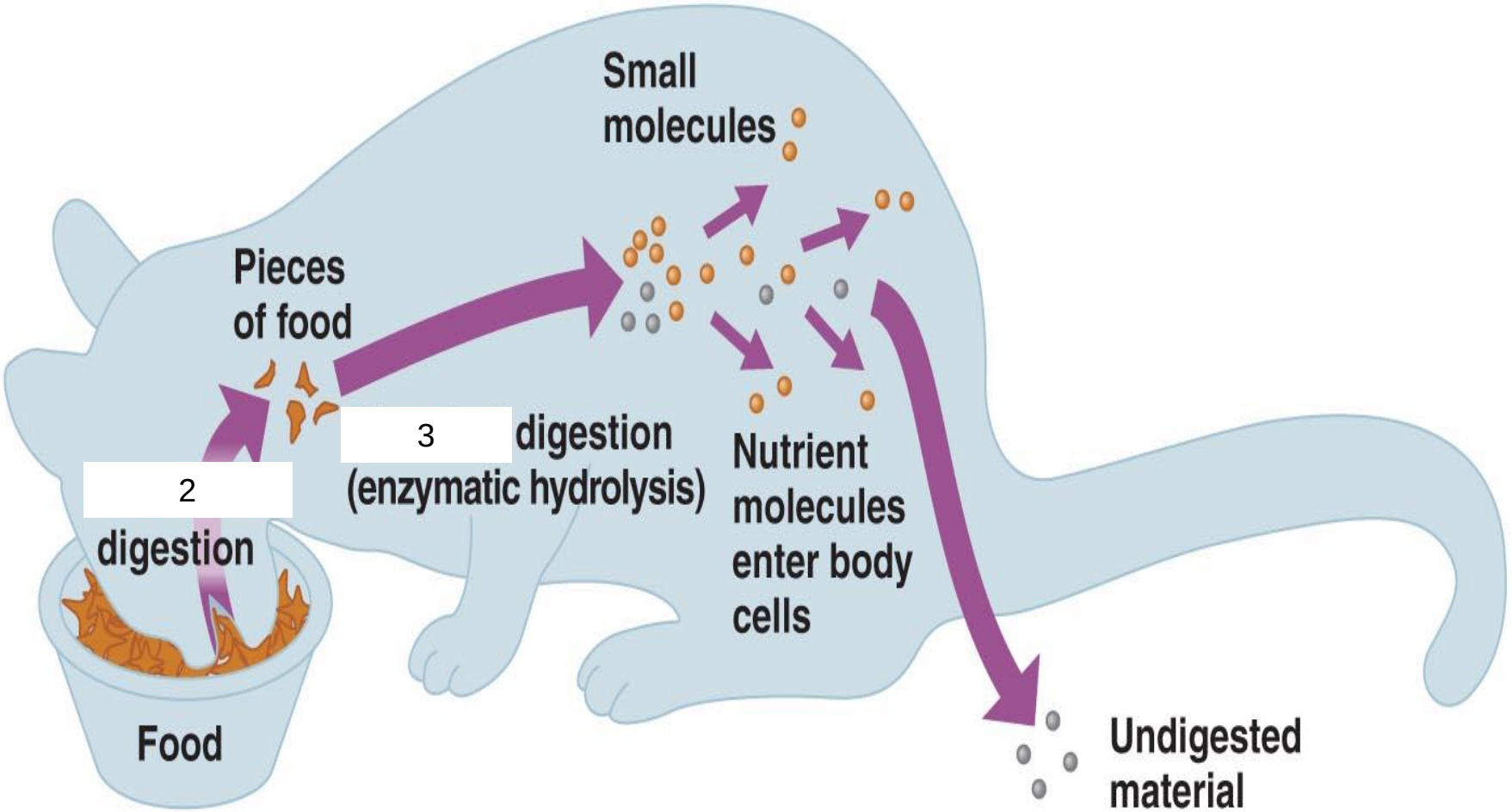
CONSTIPATION occurs when too much water is reclaimed.



Digestive System



QUICK CHECK



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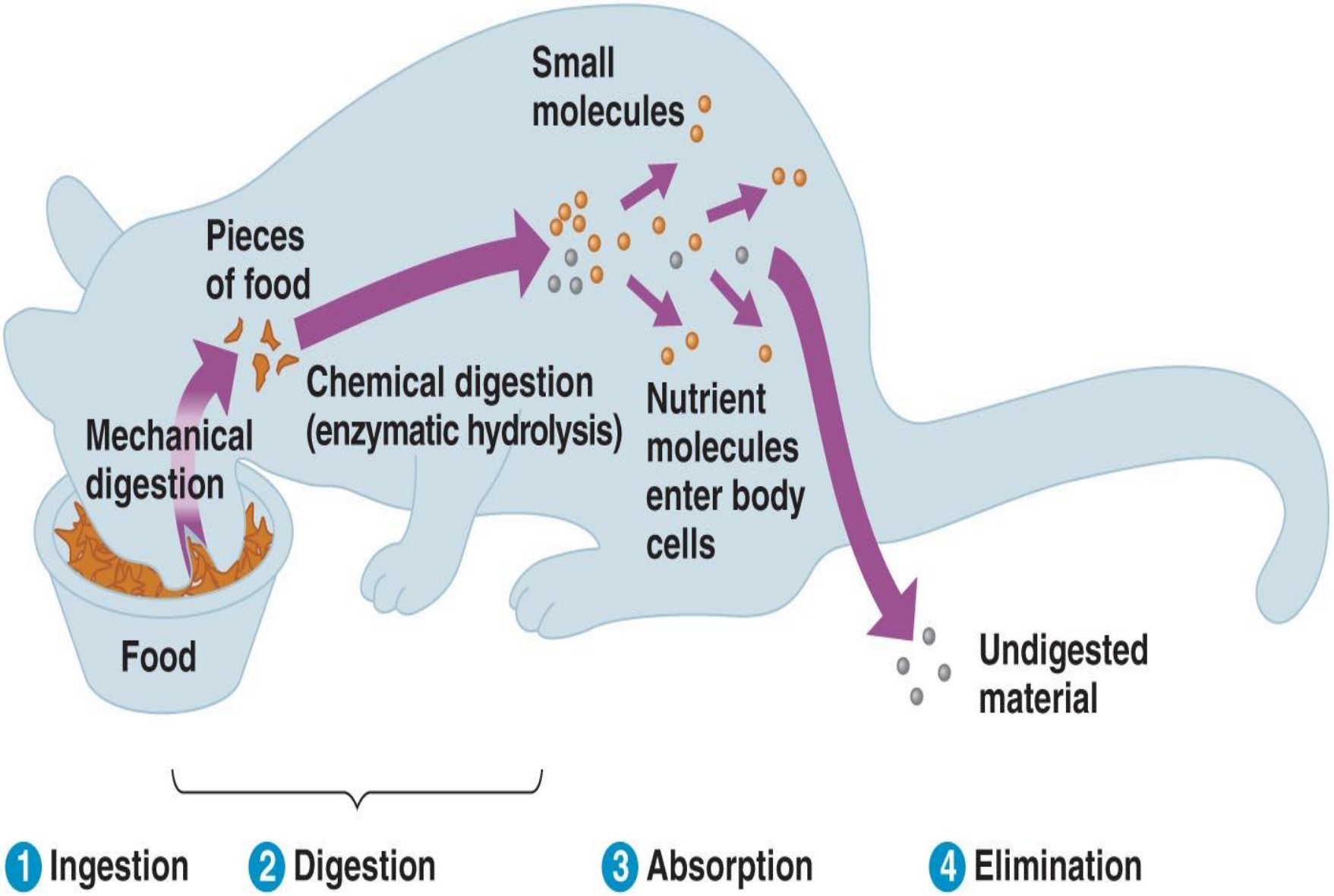
QUICK CHECK


Small molecules
Pieces of food
Chemical digestion (enzymatic hydrolysis)
Mechanical digestion
Nutrient molecules enter body cells
Food
Undigested material
1 Ingestion
2 Digestion
3 Absorption
4 Elimination

TRY IT

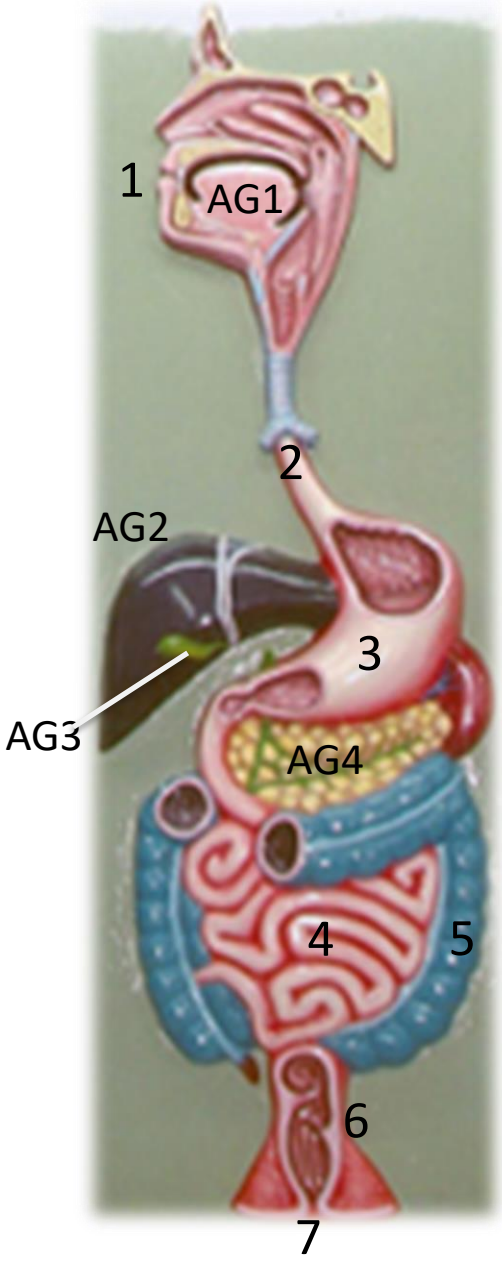
Parts & Flow of Human Digestive System

?

1. ?
2. ?
3. ?
4. ?
5. ?
6. ?
7. ?

Accessory Glands

1. ?
2. ?
3. ?
4. ?



- What are the two groups of the digestive system.
- List each part from top to bottom.

TRY IT

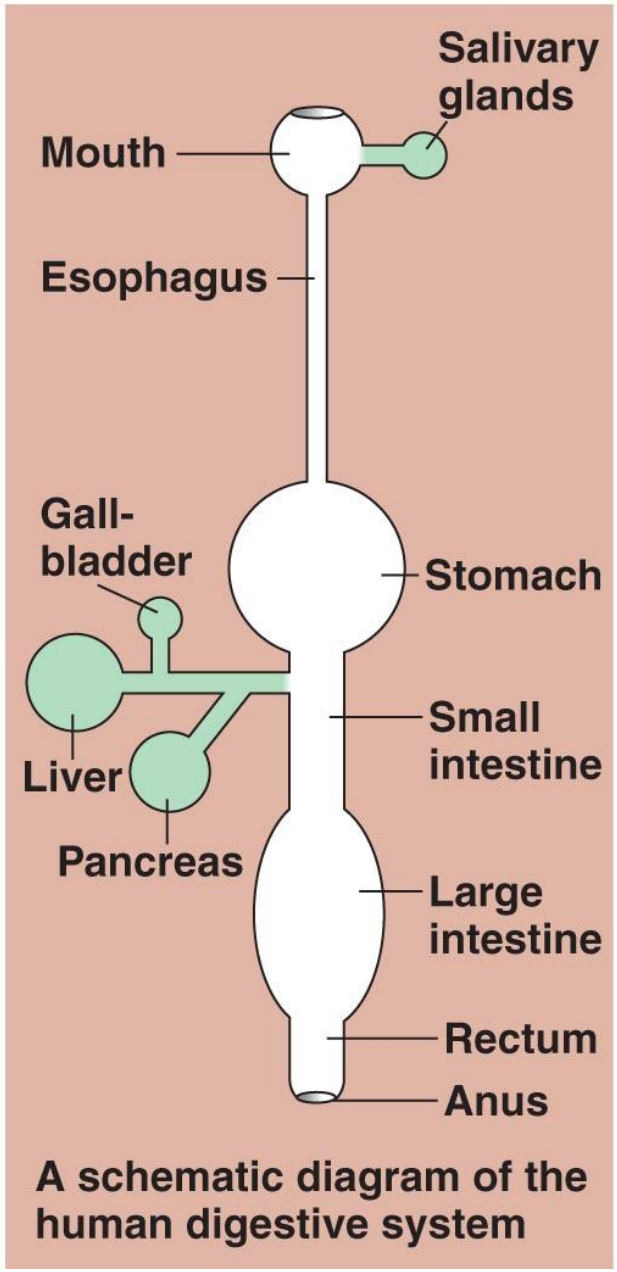
Parts & Flow of Human Digestive System

Alimentary Canal

1. Mouth
2. Esophagus
3. Stomach
4. Small Intestine
5. Large Intestine
6. Rectum
7. Anus

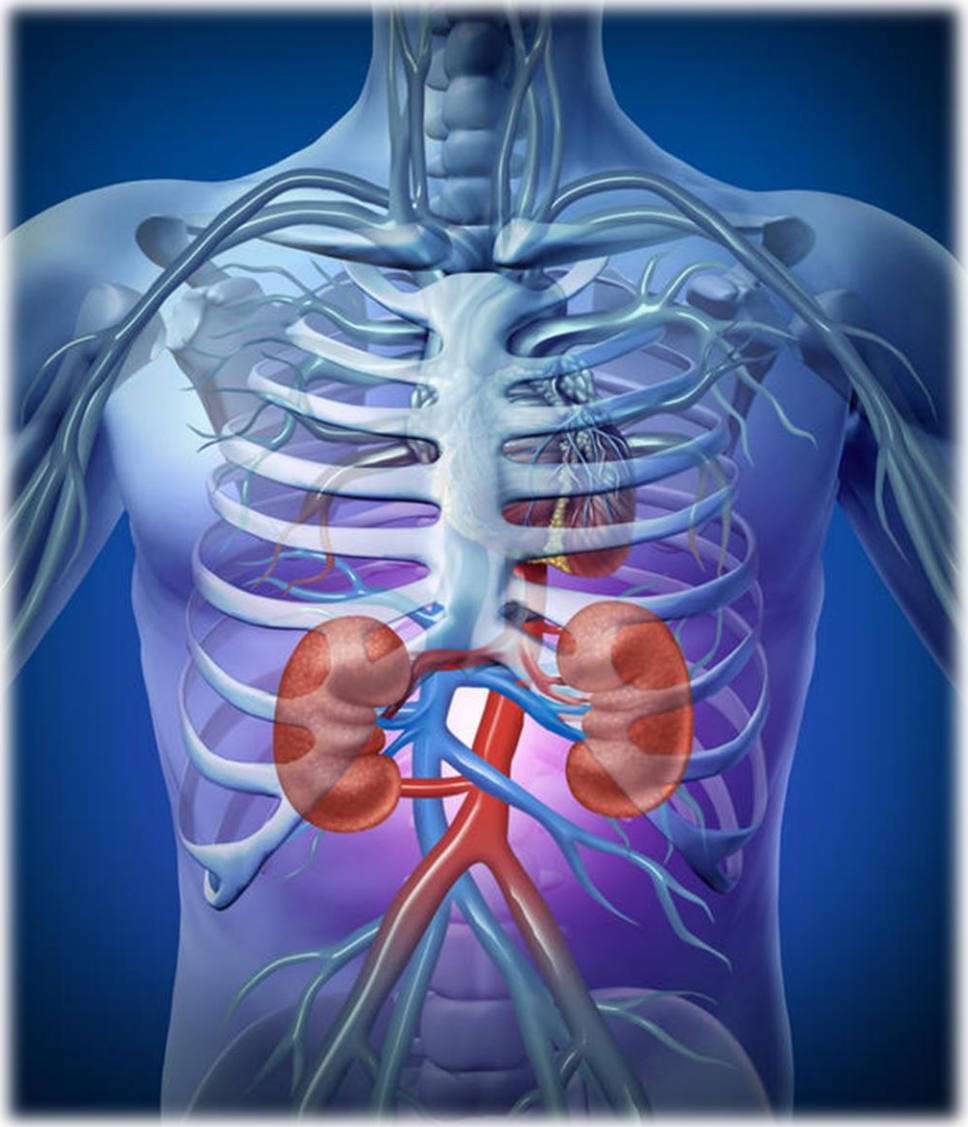
Accessory Glands

1. Salivary glands
2. Liver
3. Gallbladder
4. Pancreas



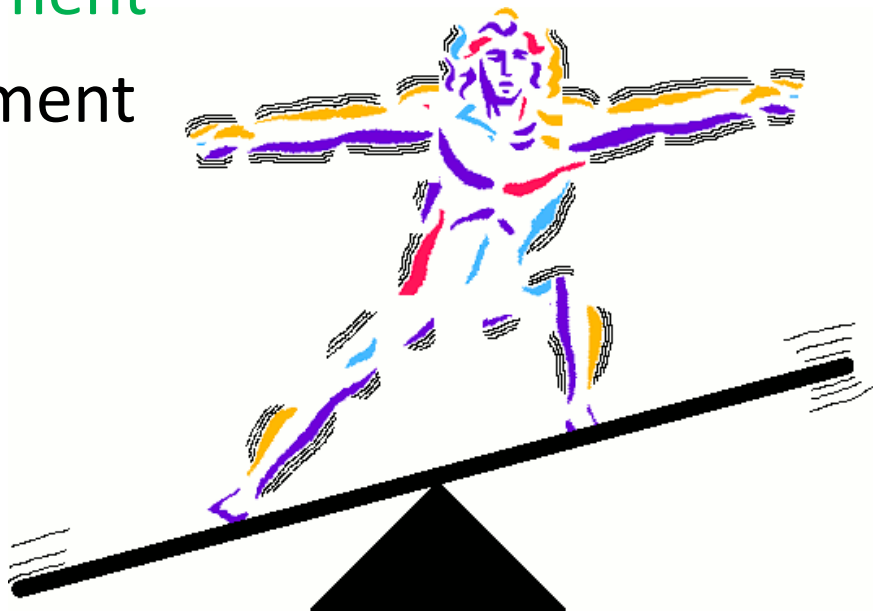
A schematic diagram of the human digestive system

Excretion



Homeostasis

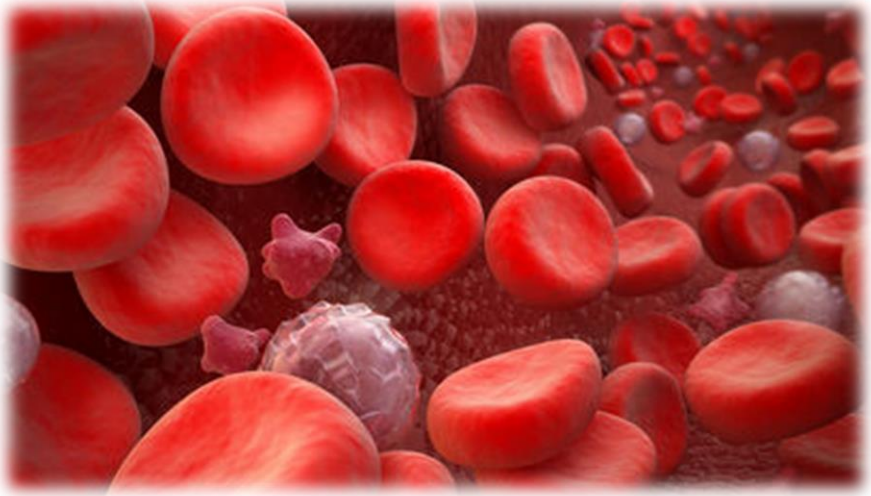
- Process by which organisms maintain a relatively stable internal environment.
- In response to changes in:
  - External environment
  - Internal environment



Excretion

Function:

- Rid the body of cellular waste.



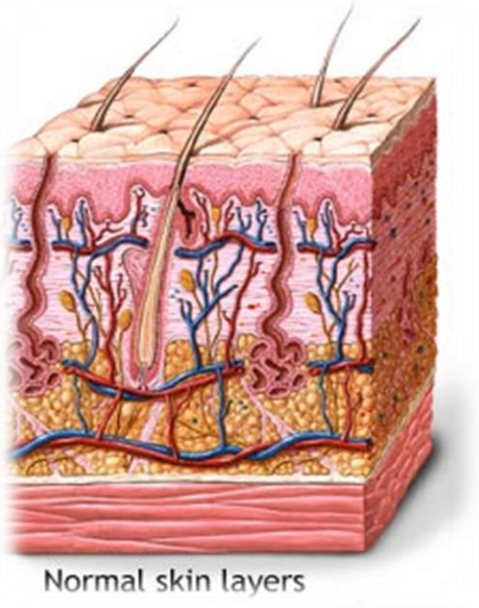
Types of waste in humans:

- CO_2
- Excess water
- Salts
- Urea
  - Nitrogenous waste formed from metabolism of amino acids.

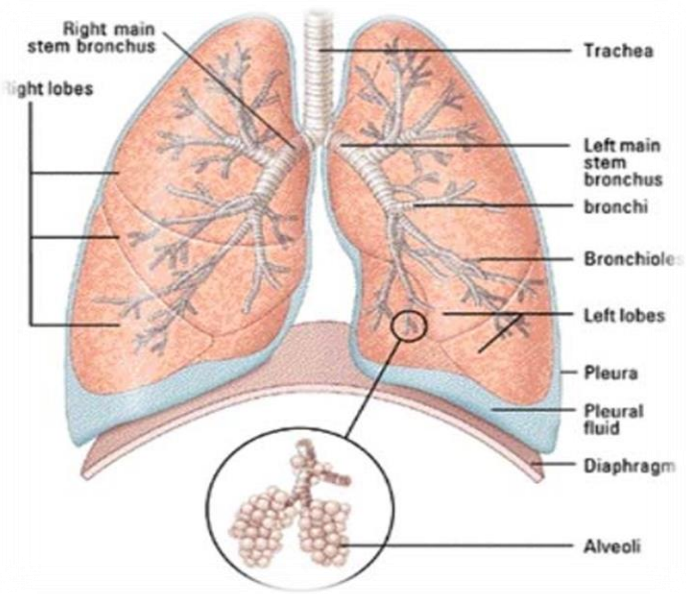
Organs of the Excretory System

Skin: excretes 'sweat'

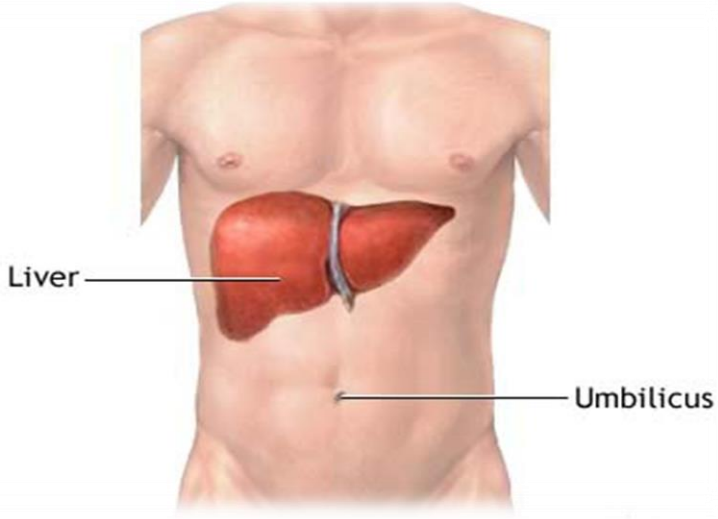
– excess water, salts and small amount of urea.



Lungs: excrete CO_2



Liver: detoxifies the blood and converts harmful substances into urea.

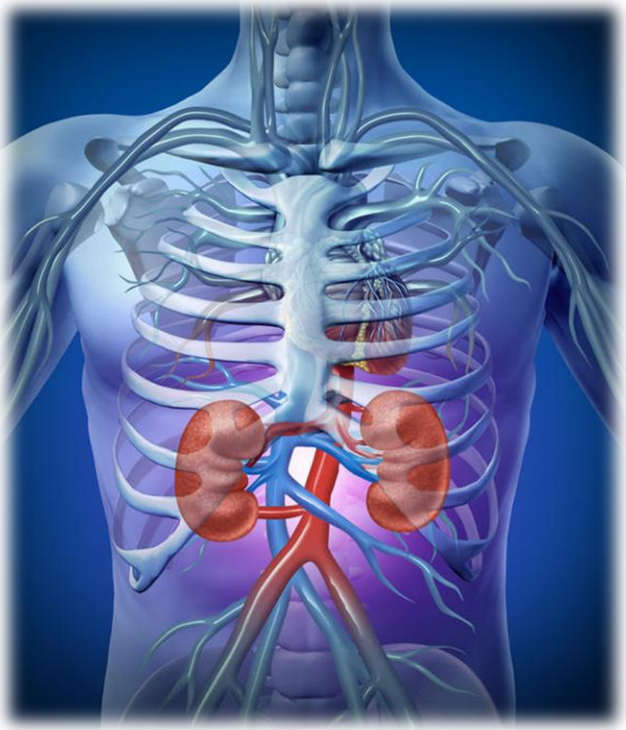


Organs of the Excretory System

Kidneys

The primary excretory organ in humans (part of urinary system).

- excrete water, urea, salts and other wastes from the blood.
- maintain blood pH.
- regulate water content and blood volume.



Urinary System Anatomy

Kidney

- Primary excretory organ in humans.
- Produces urine.

Ureter

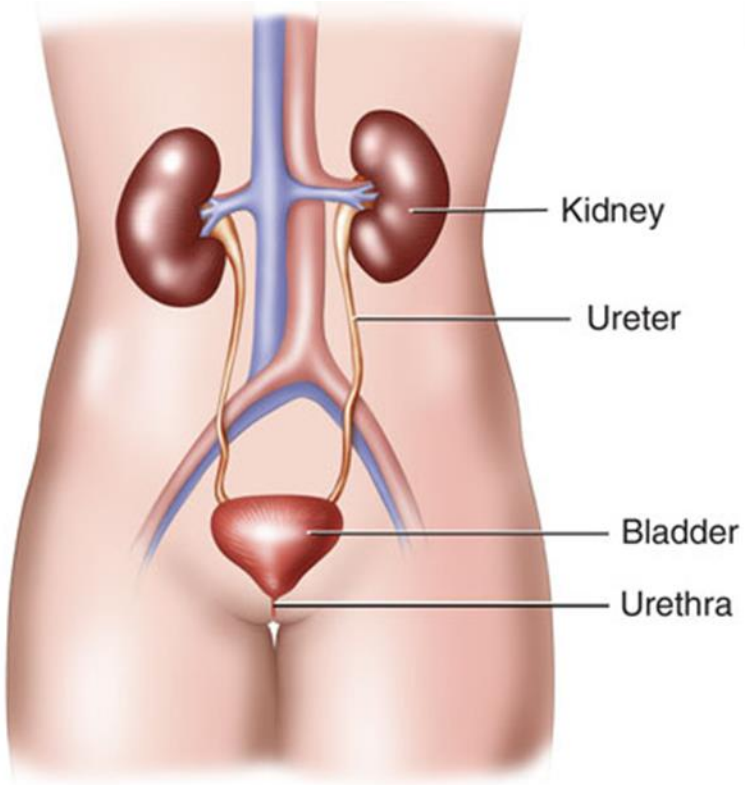
- Tube that leaves each kidney, carrying urine to the urinary bladder.

Urinary bladder

- saclike organ where urine is stored before being excreted.

Urethra

- tube that leaves the bladder and delivers urine to external environment.

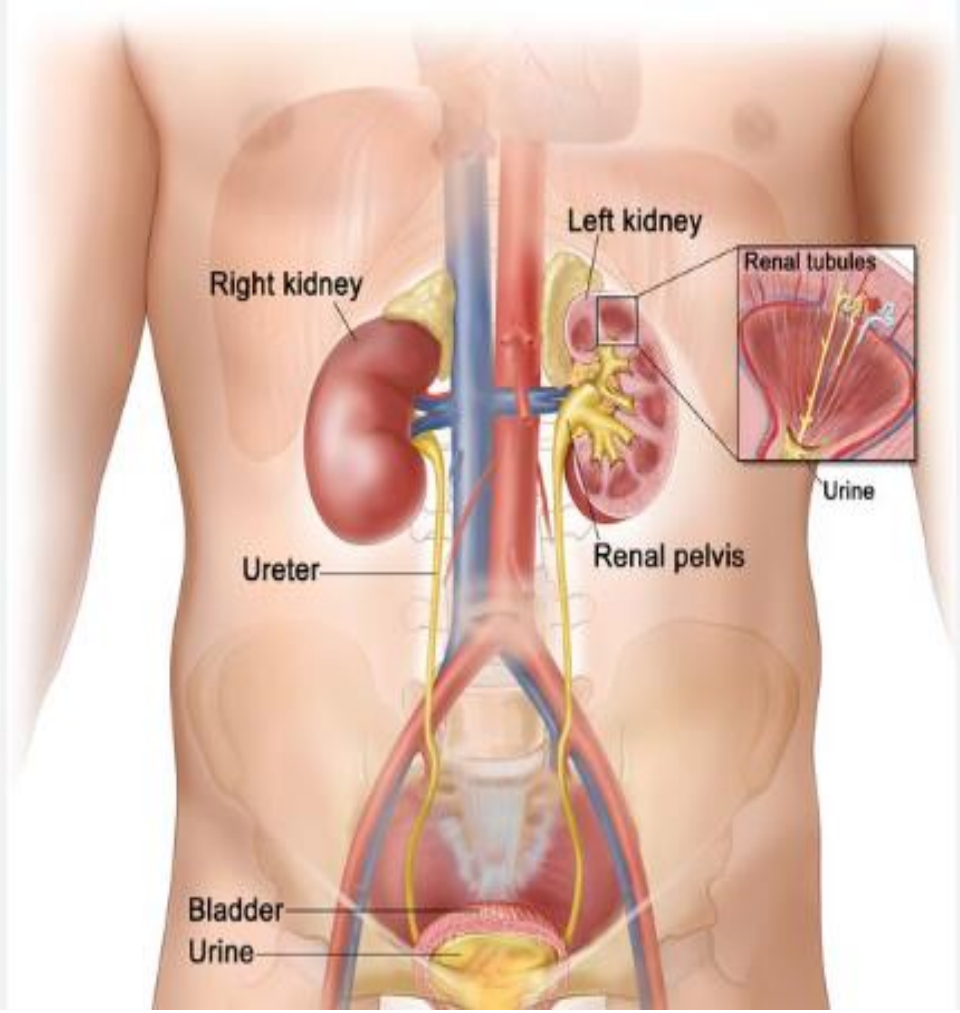


The Kidneys

Blood enters the kidney through the renal artery.

The kidney removes waste products and passes them to the ureter.

The clean, filtered blood leaves the kidney through the renal vein and returns to circulation.



Enrichment

Kidney Structure

Renal Cortex

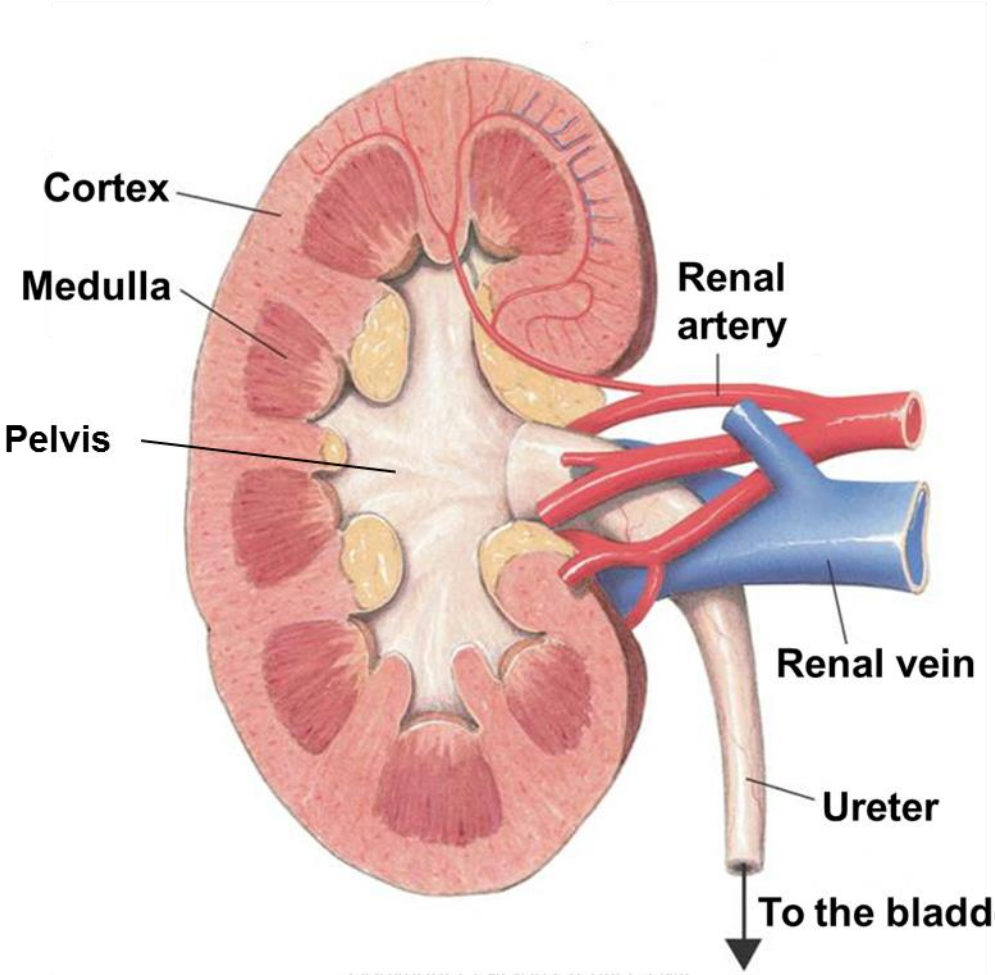
– Outer-most area

Renal Medulla

– Middle area

Renal Pelvis

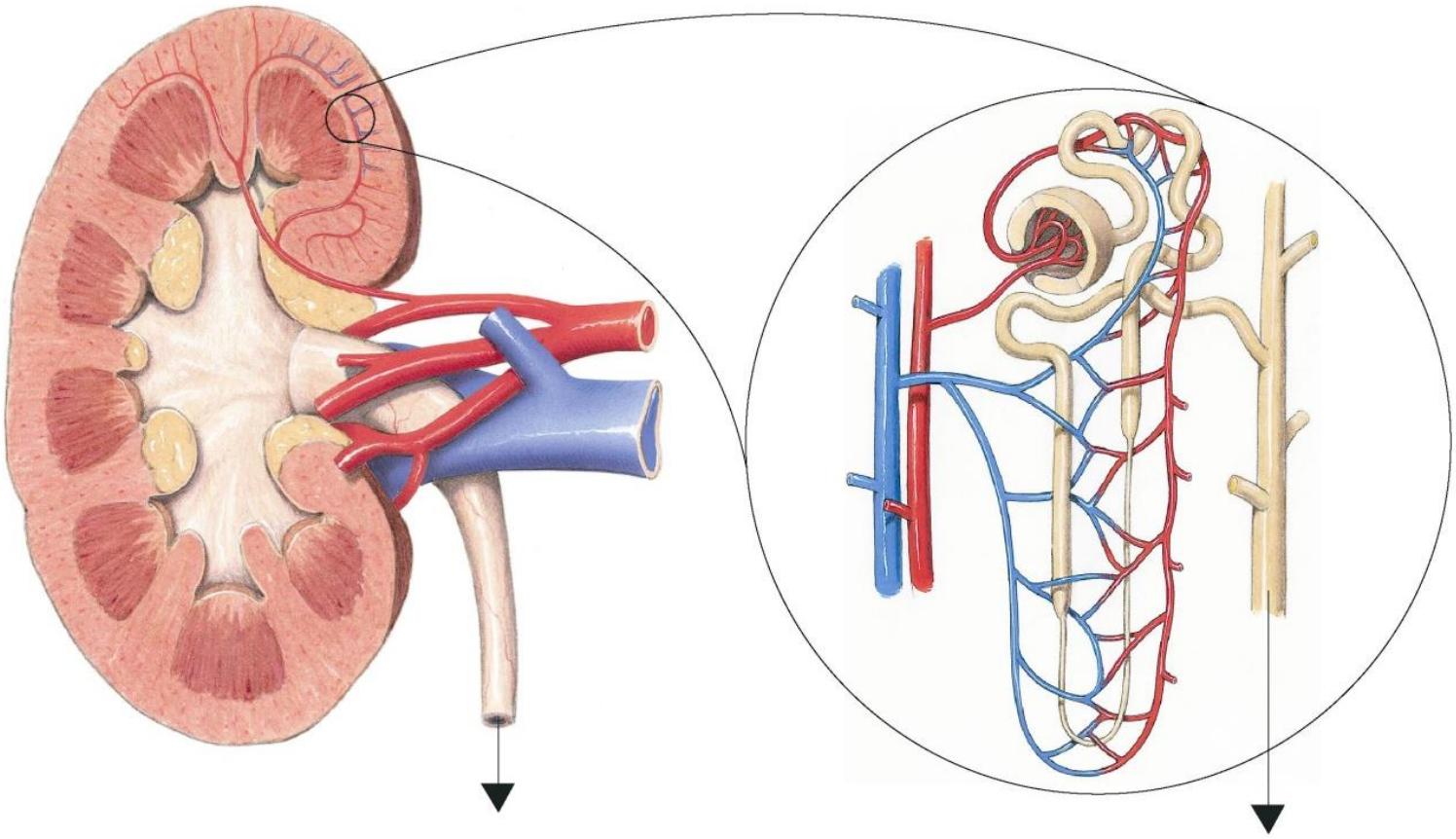
– Inner-most area



Nephron

The functional unit of the kidney.

- Purifies the blood.



Nephron Structure

Glomerulus

- Ball of capillaries

Bowman's capsule

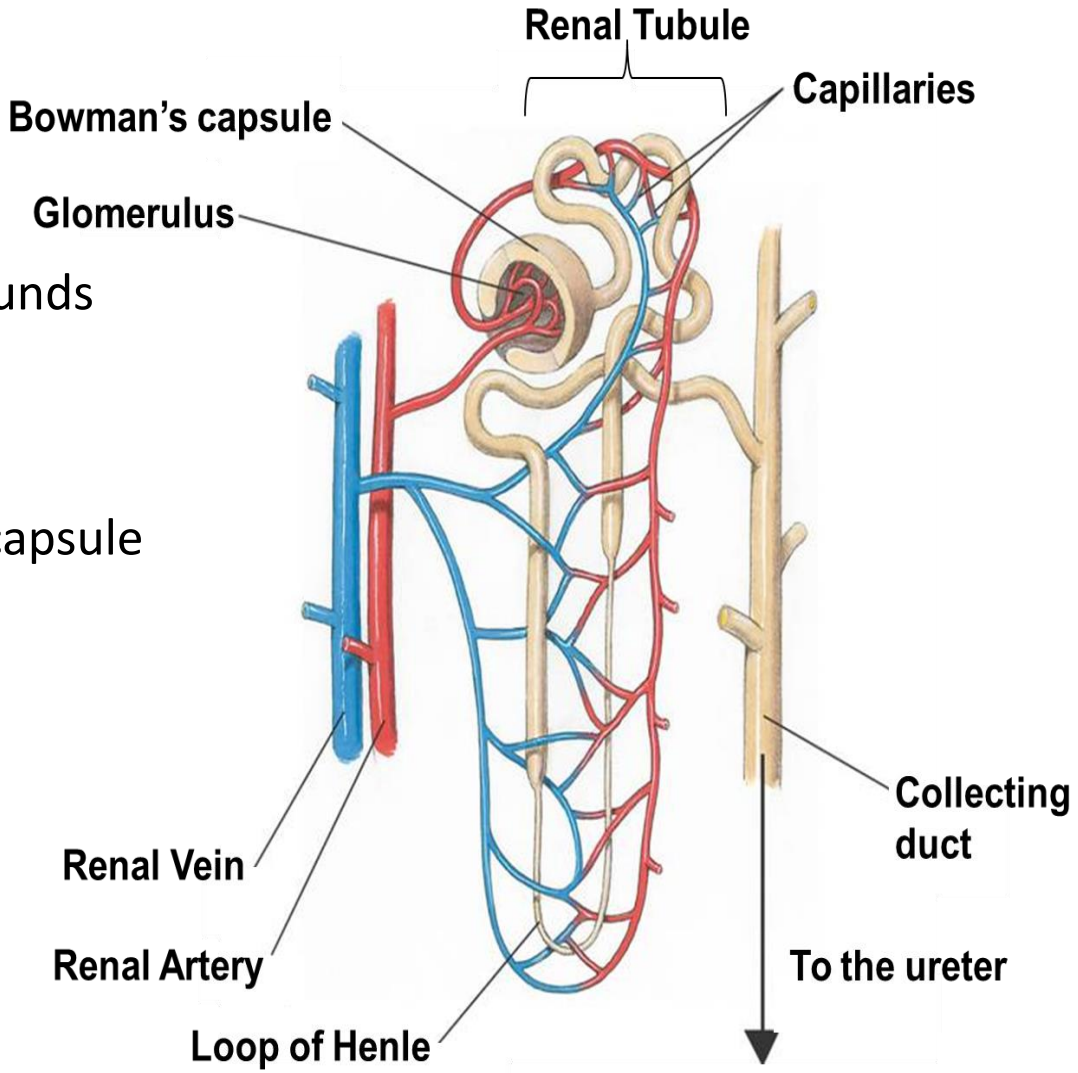
- Cup-like structure that surrounds glomerulus

Renal tubule

- Tube connecting Bowman's capsule to collecting duct
- Includes Loop of Henle
  - Site of reabsorption
- Capillaries intertwined

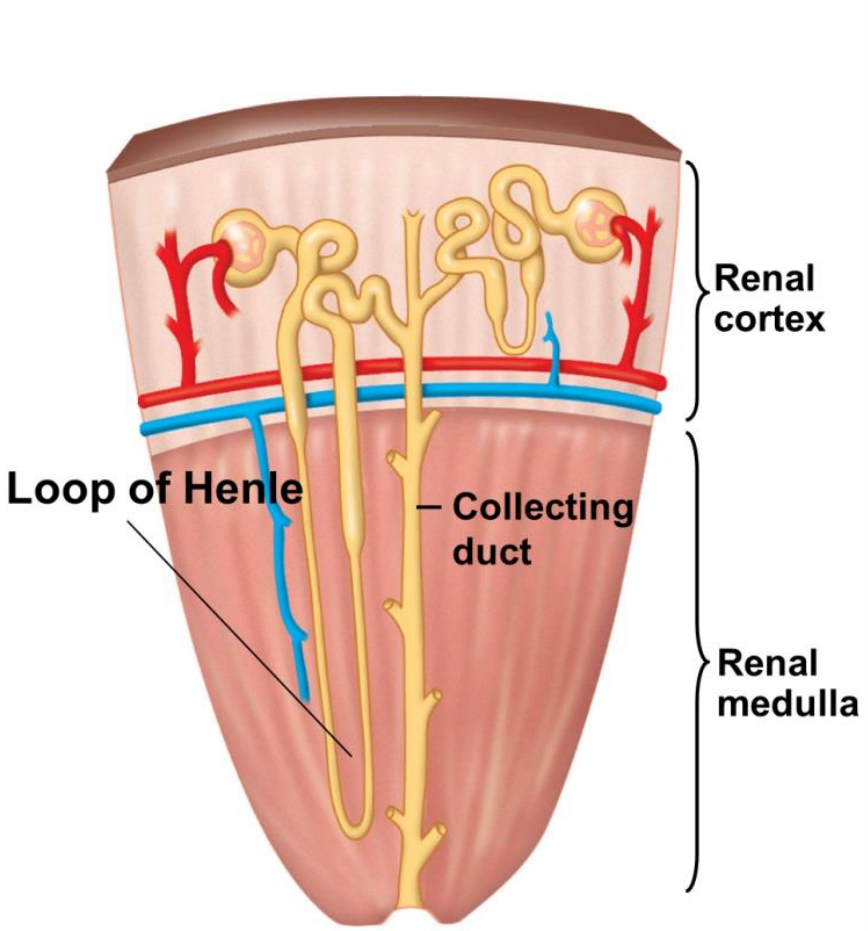
Collecting duct

- Collects urine from several nephrons



Nephron Orientation

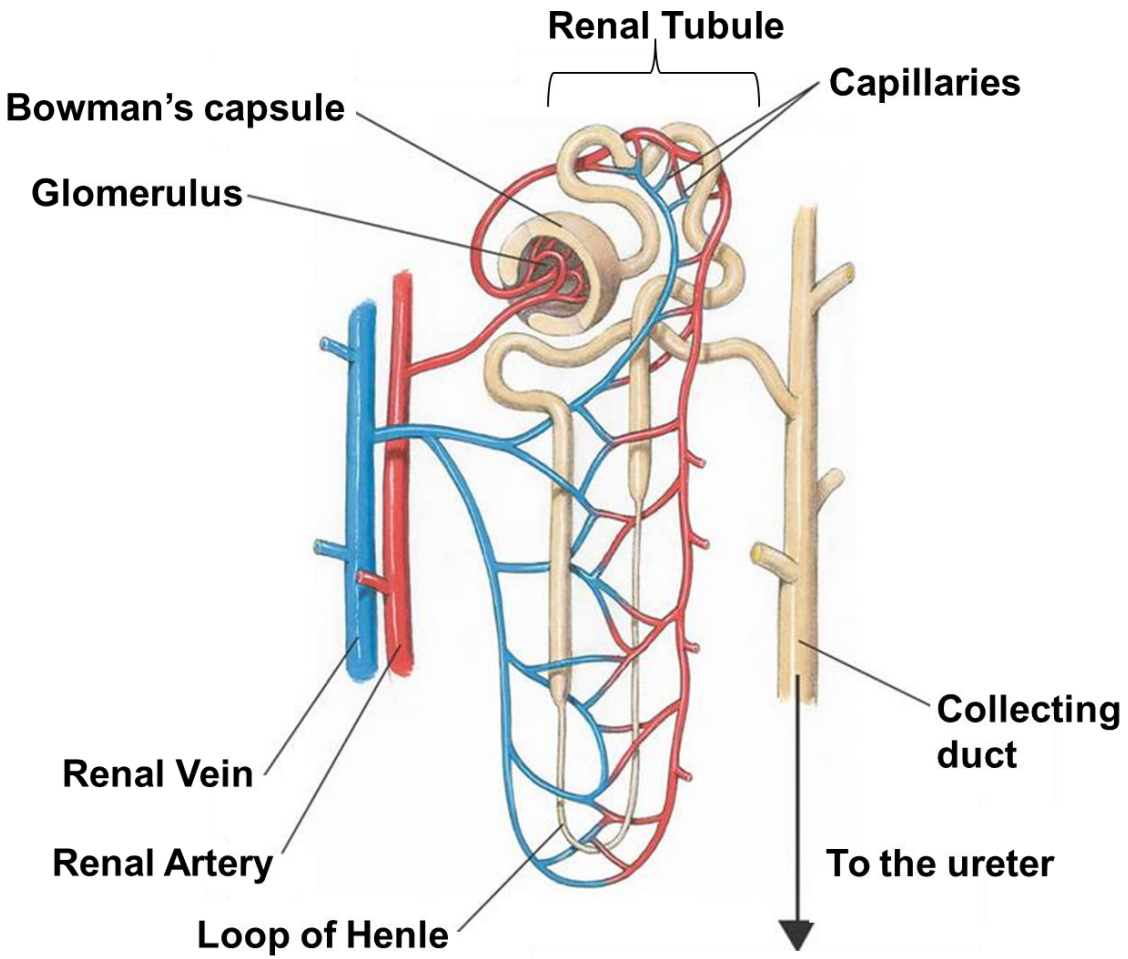
Nephrons are primarily located in the renal cortex except for their Loops of Henle, which descend into the renal medulla.



Urine Formation

Urine is formed by two key processes:

- Filtration
- Reabsorption



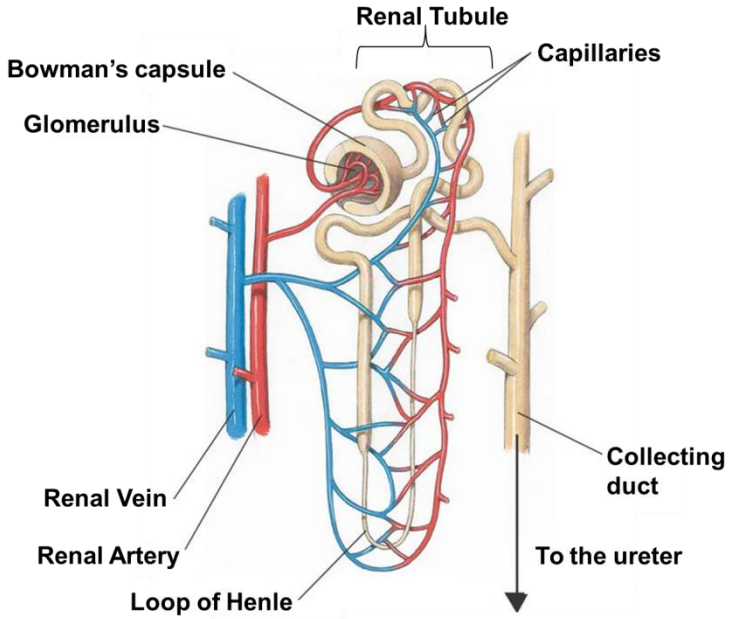
Urine Formation: Filtration

Non-selective process of pushing fluid through the glomerulus into Bowman's capsule.

- Blood cells are too large to pass so they remain in the blood.

Filtered liquid is now called **filtrate.**

- Water
- Urea
- Glucose
- Amino acids
- Salts



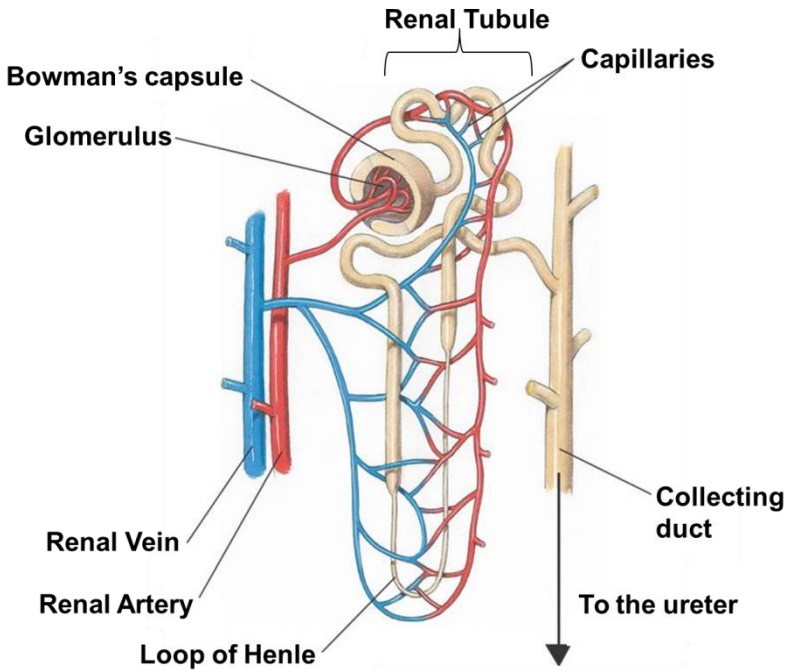
Urine Formation: Reabsorption

Selective process of removing 'good stuff' from the filtrate

Occurs in the Loop of Henle.

- 'Good stuff' moves from Loop of Henle back to capillaries.

Filtrate	Reabsorbed
Water	Water
Urea	
Glucose	Glucose
Amino Acids	Amino Acids
Salts	

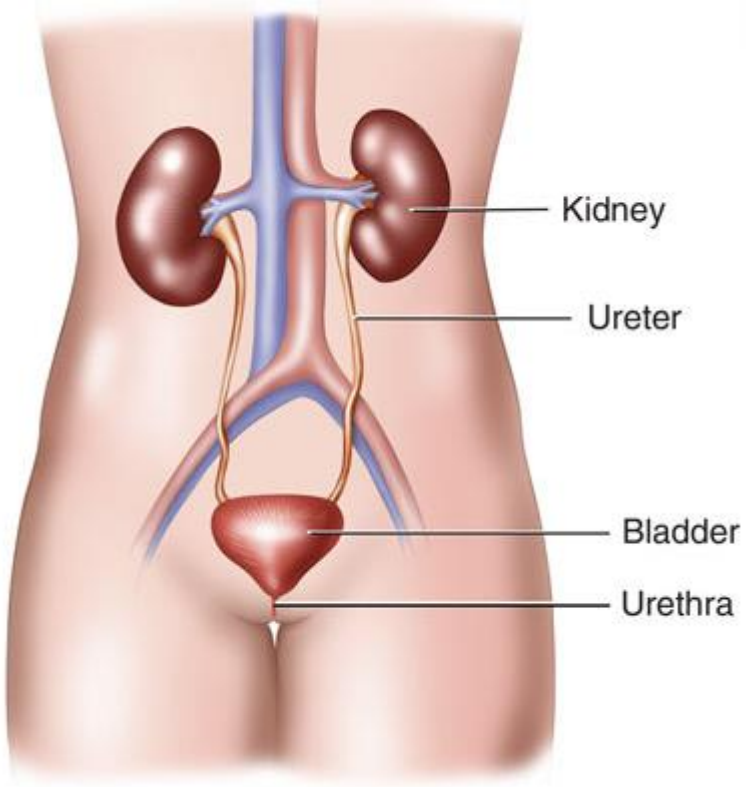


Urine

Urine = excess water + urea + excess salts

Collects in the collecting ducts, empties into renal pelvis then exits the kidneys via the ureters.

Stored in the urinary bladder before exiting the body via the urethra



Summary:
Pathway of Excretory (Cellular) Waste

1. Produced in cell.
2. Diffuses into blood stream.
3. Carried by blood to nephron of kidney.
4. Enters glomerulus.
5. Filtered into bowman's capsule and passes to renal tubule.
6. Travels from renal tubule (including Loop of Henle) to collecting duct.
7. Enters renal pelvis from collecting duct.
8. Waste (in form of urine) then passes through ureters.
9. Urine is stored in bladder until released by passing through urethra.

Control of Kidney Function

When you drink a liquid, it is absorbed into the blood through the digestive system.

The concentration of water in the blood increases;

Decreasing the rate of kidney water reabsorption.

Less water is returned to the blood.

Excess water is excreted as urine.

Control of Kidney Function

When the kidneys detect an increase in salt …

they respond by returning less salt to the blood by reabsorption.

The excess salt is excreted in urine, thus maintaining the composition of the blood.

Hemodialysis