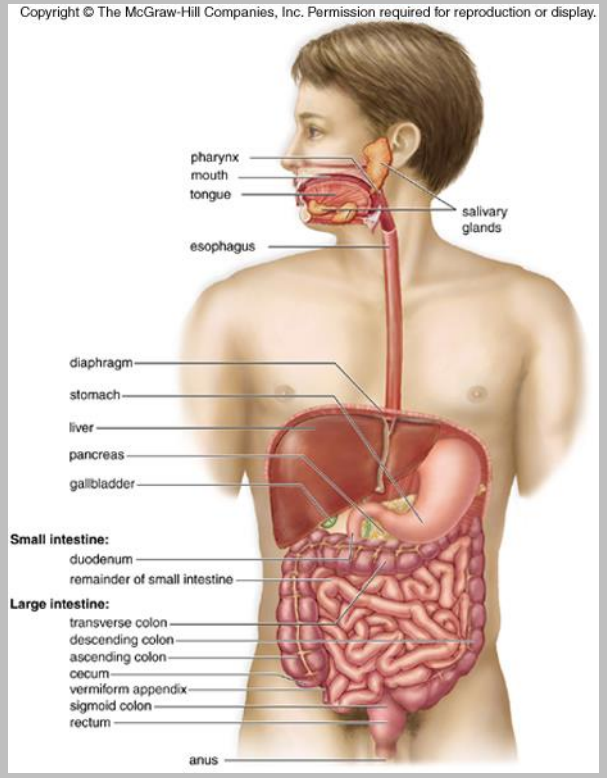
TERM 2 Exam REVIEW

Chapter 10-14

Unit 4: Digestion

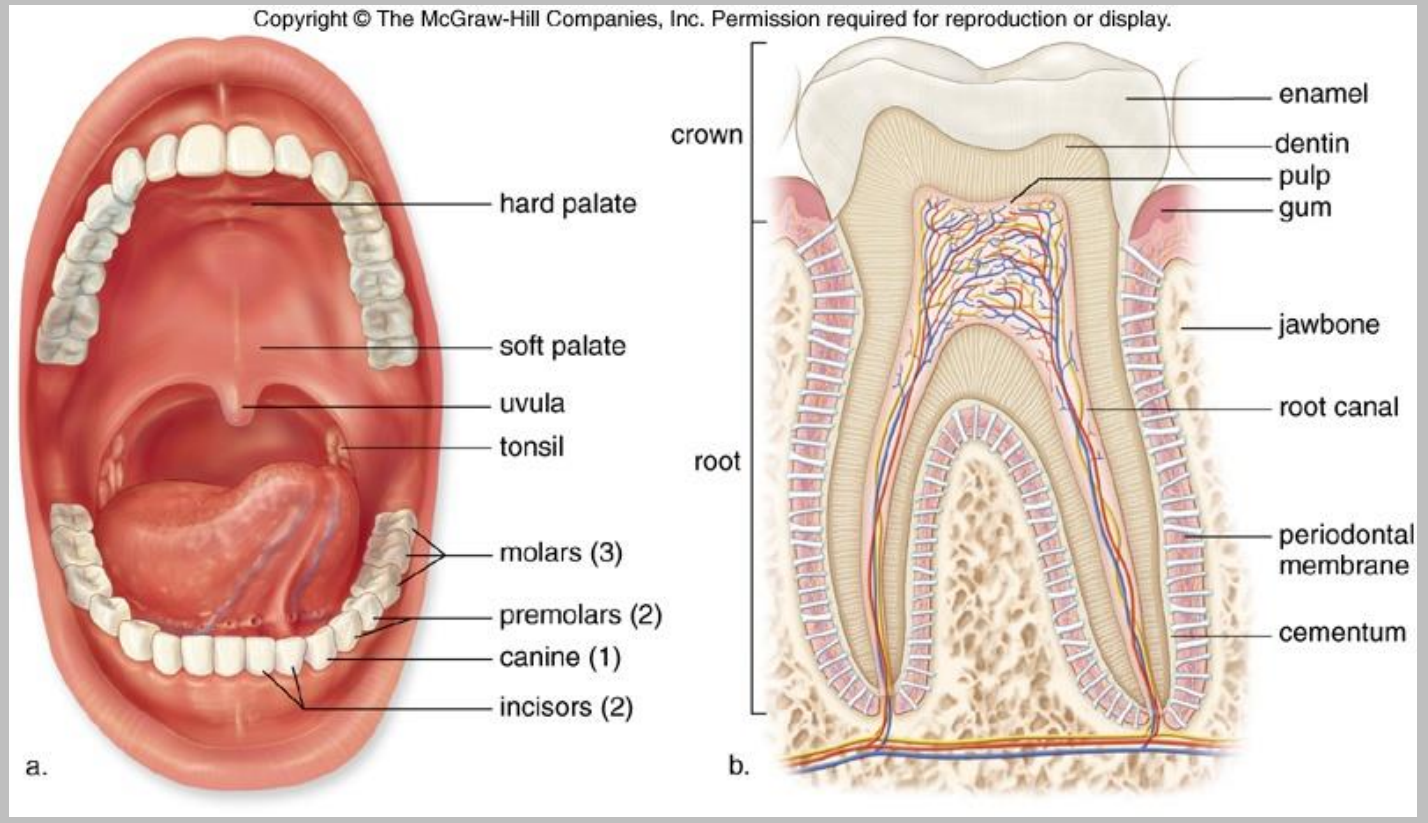
Digestive Structures and Functions

- Digestion is the chemical breakdown of food by enzymes.
- Physical digestion is mixing, churning and emulsifying of food
- Digestion involves hydrolytic enzymes which work at specific pH's
- Any molecules not digested and not absorbed are considered waste and are excreted via the rectum.



Mouth

- Teeth for tearing, chewing & grinding the food
  - Incisors for biting & tearing
  - Canines for tearing
  - Premolars and molars for grinding & chewing
- Hard palate at front roof of mouth
- Soft palate at back roof of mouth
  - When swallowing the tongue pushes up the soft palate to close off the nasal cavity so food goes down towards esophagus
- Uvula may be involved in creating a good seal for nasal cavity during swallowing
- Tonsils involved in immunity
- Tongue for mixing food with saliva

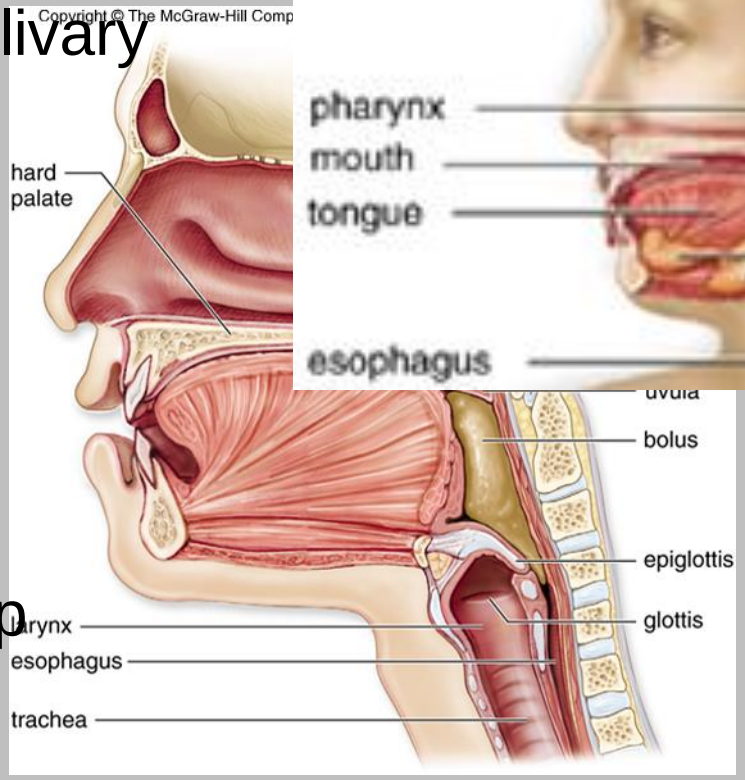


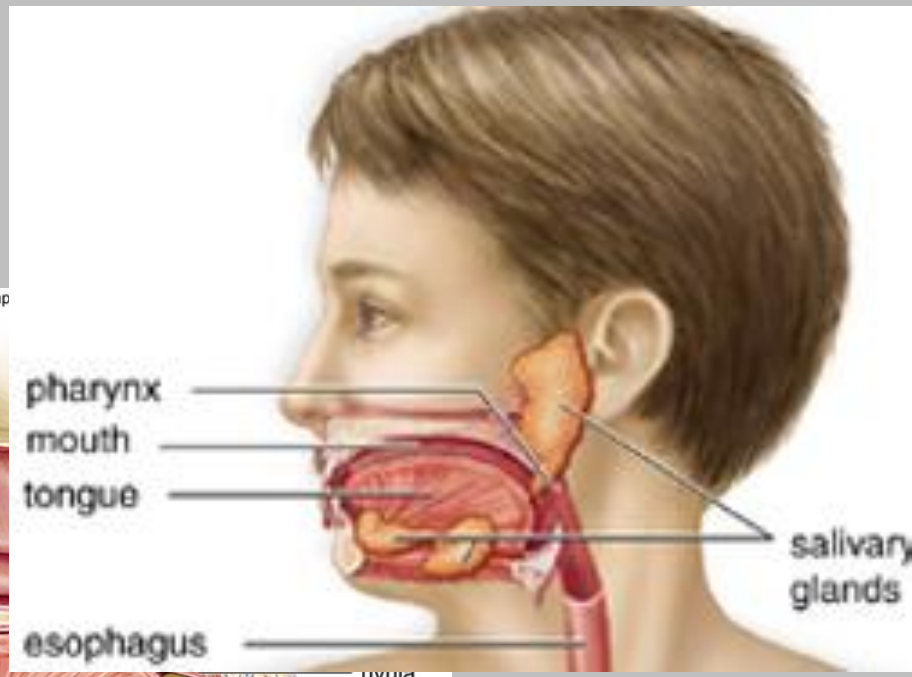
Salivary Glands & Swallowing

- Salivary glands secrete water, mucus, and salivary amylase

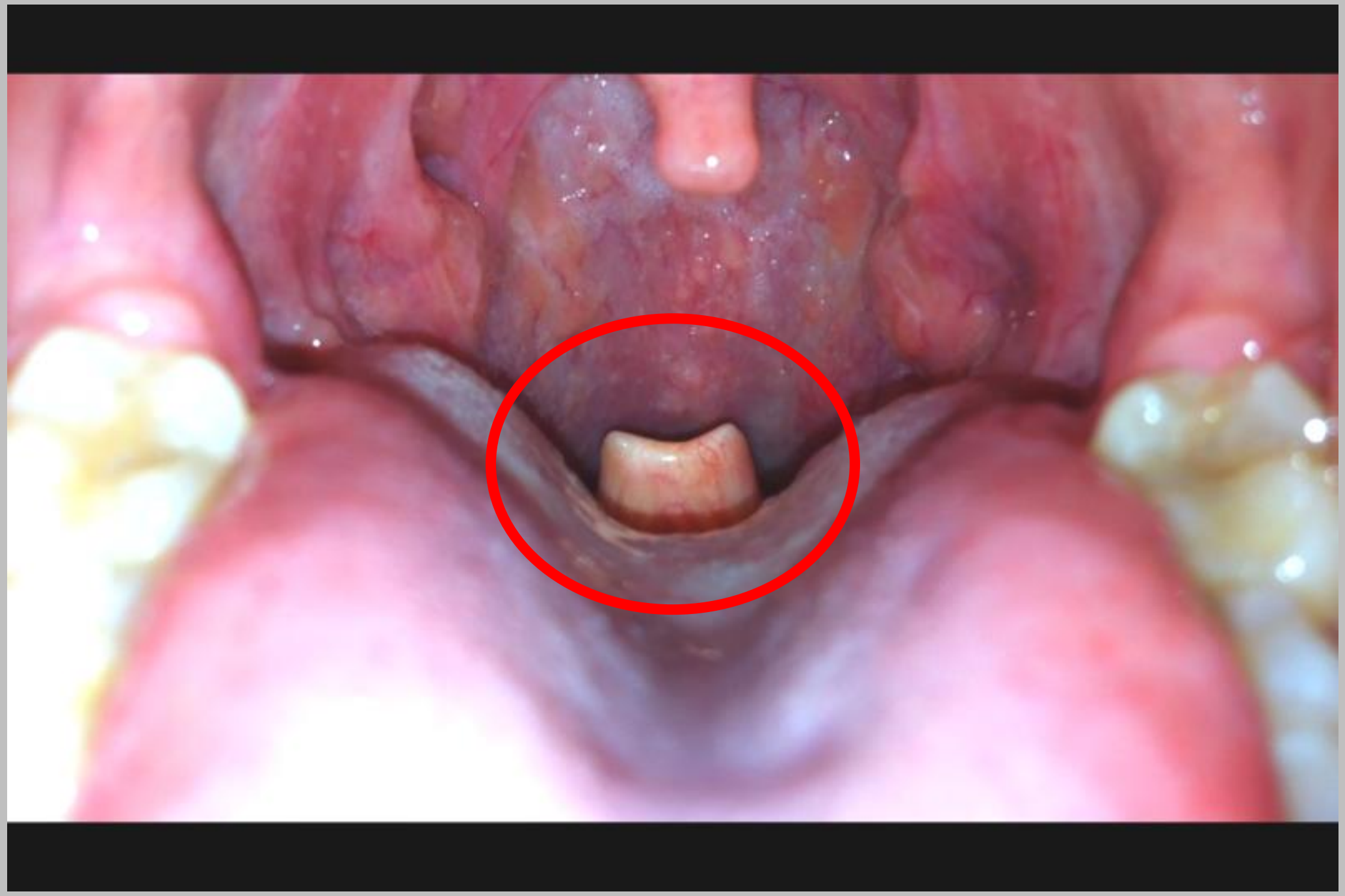
  Salivary amylase digests starch to maltose by hydrolysis

Starch + H_2O —(Salivary amylase)→ maltose



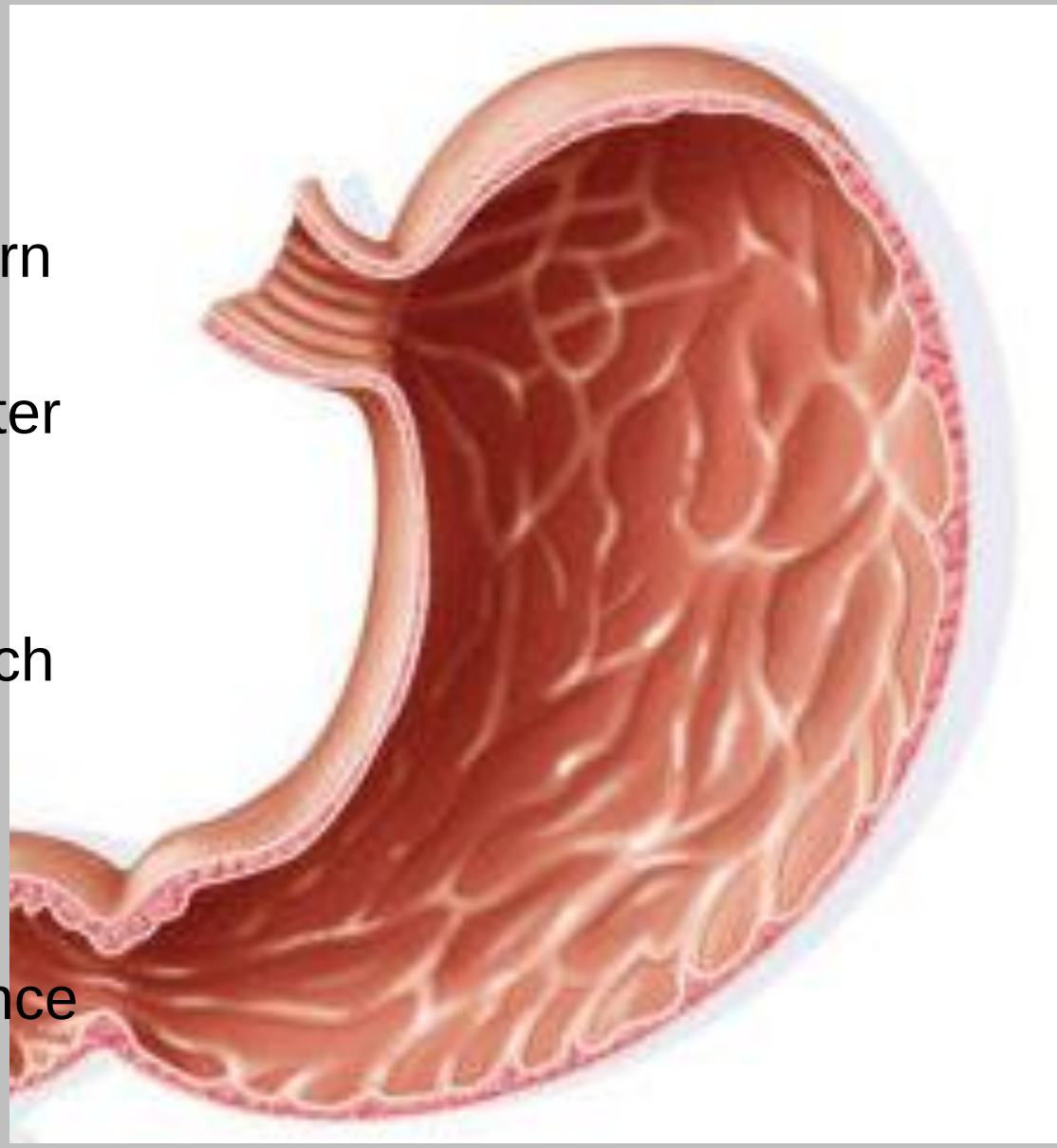


- Swallowing involves the soft palate moving up to block nasopharynx (to nasal cavity) & the epiglottis moving down to block the opening to the lungs (the glottis)

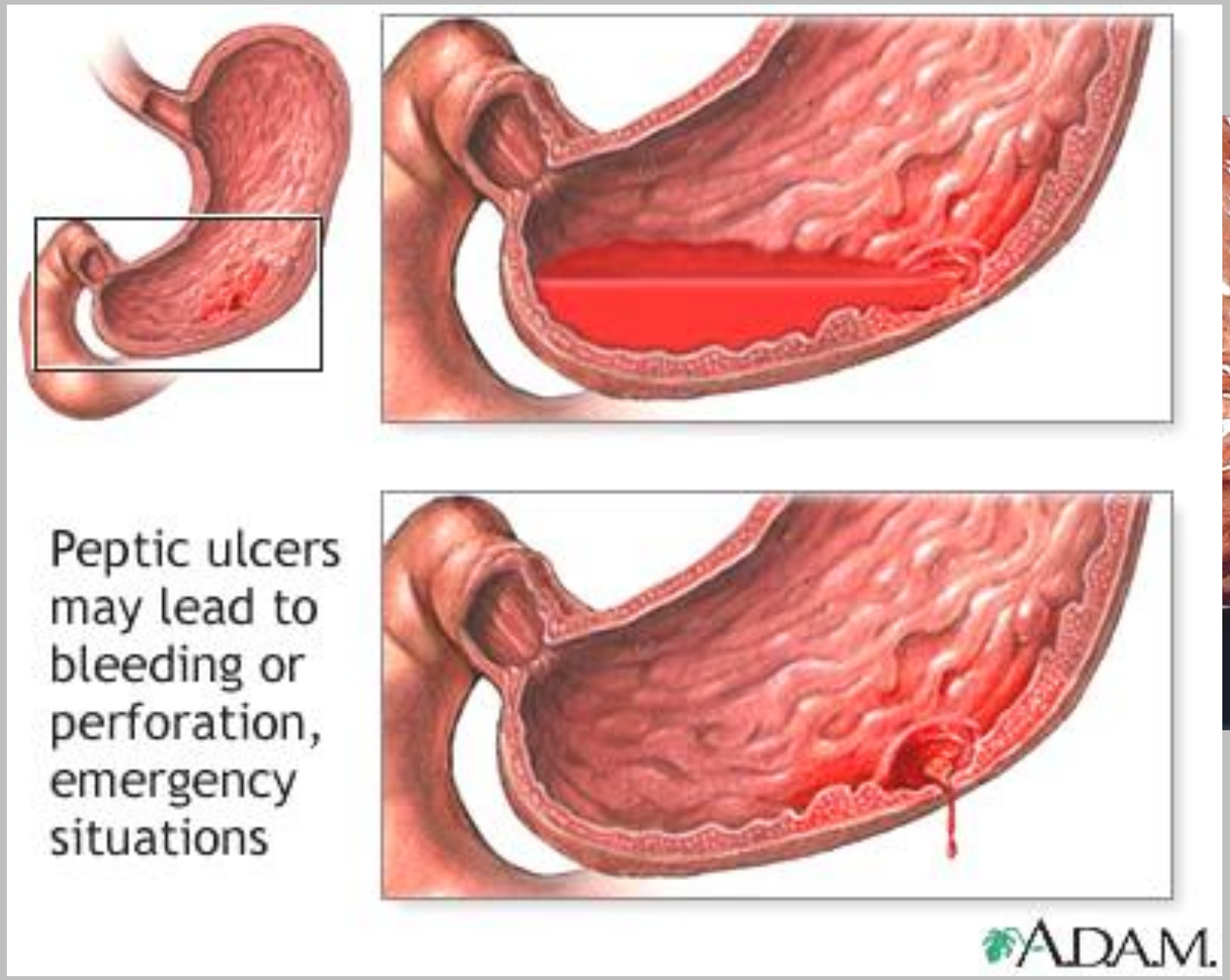


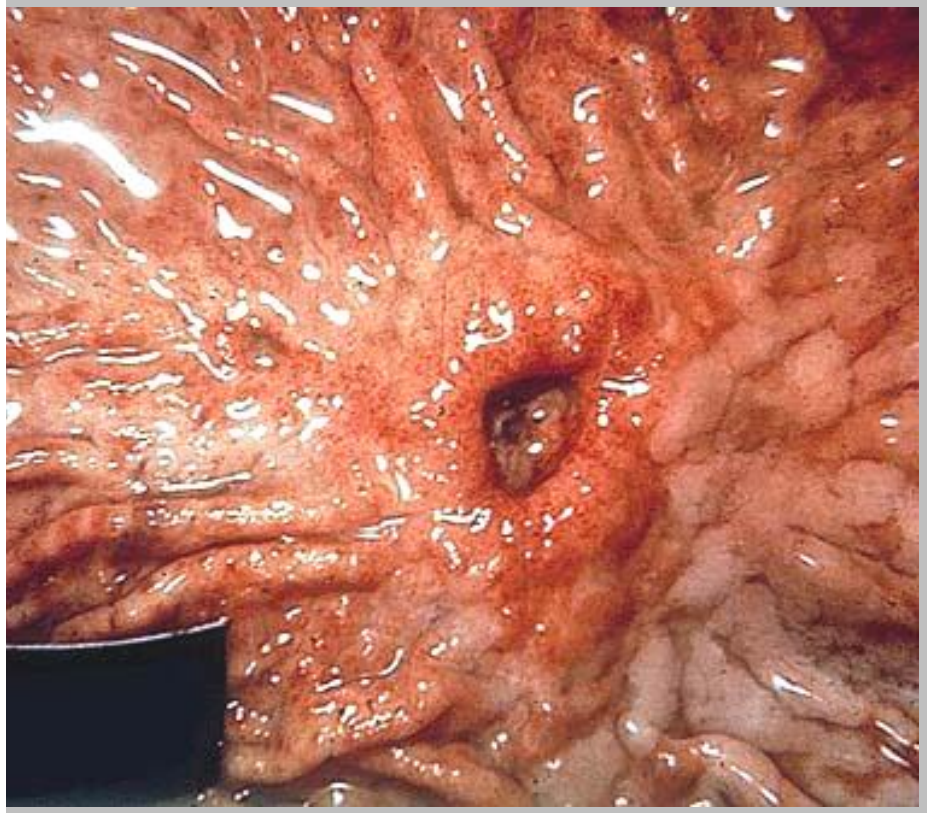
Stomach

- Smooth muscle causes peristalsis down the esophagus and it continues in the stomach to churn food with acid
- Food enters the stomach via the cardiac sphincter
- Gastric juices are secreted from gastric glands when the GASTRIN hormone stimulates them.
- Mucus secreted protects the lining of the stomach
- Gastric glands secrete HCl to make a pH of 2, water, pepsinogen
- Bacteria can be killed by stomach acid
- Pepsinogen is converted to pepsin in the presence of HCl.
- Pepsin digests proteins to peptides

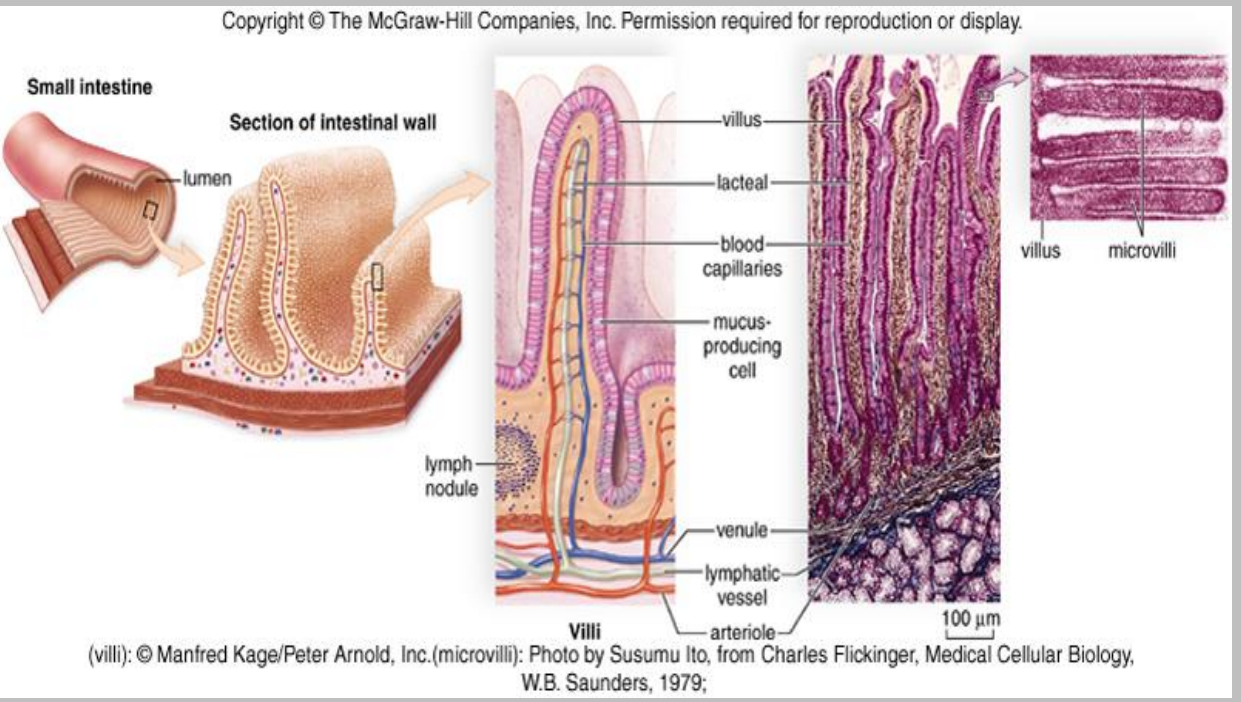


$$\text{Proteins} + H_2O \xrightarrow{\text{pepsin}} \text{peptides}$$


Peptic ulcers may lead to bleeding or perforation, emergency situations
A.D.A.M.

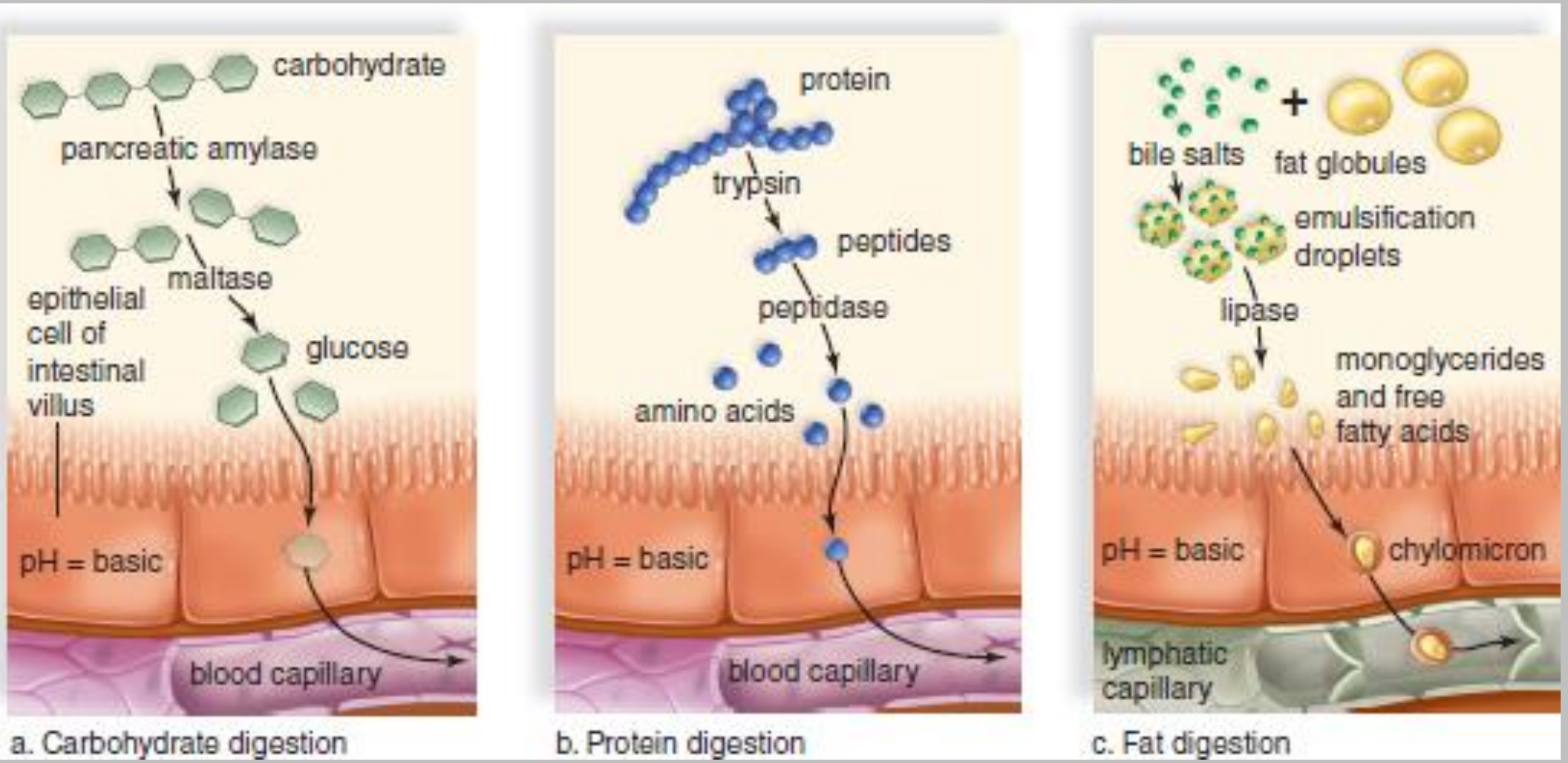


Small Intestine



- 3 parts = duodenum, jejunum, ileum
- Acid chyme enters duodenum via the pyloric sphincter
- Pancreatic juices from pancreas enter via pancreatic duct
- Bile from Liver and gall bladder enter via bile duct
- Sodium bicarbonate ($NaHCO_3$) from pancreas neutralizes acid chyme to a pH = 8.5
- Pancreatic enzymes and intestinal enzymes from the duodenum complete digestion of molecules; ie. Starch, protein, lipids, nucleic acids

- Absorption of nutrients occurs along small intestine which has a high surface area due to villi
- Glucose, amino acids, phosphate group, pentose sugar, nitrogenous base enter blood capillary
- Fatty acids and glycerol reform into a lipoprotein and are absorbed into the lacteal


carbohydrate
pancreatic amylase
maltase
epithelial cell of intestinal villus
glucose
pH = basic
blood capillary
a. Carbohydrate digestion
protein
trypsin
peptides
peptidase
amino acids
pH = basic
blood capillary
b. Protein digestion
bile salts
+
fat globules
emulsification droplets
lipase
monoglycerides and free fatty acids
pH = basic
chylomicron
lymphatic capillary
c. Fat digestion

Digestive Reactions in Small Intestine

Starch + H2O —(Pancreatic amylase)→ Maltose — Pancreatic Enzyme

Maltose + H2O —(Maltase)→ Glucose — Small Intestine Enzyme

Proteins + H2O —(Trypsin)→ Peptides — Pancreatic Enzyme

Peptides + H2O —(Peptidase)→ Amino Acids — Small Intestine Enzyme

Bile Emulsifies Lipids to lipid droplets — Liver & Gall Bladder

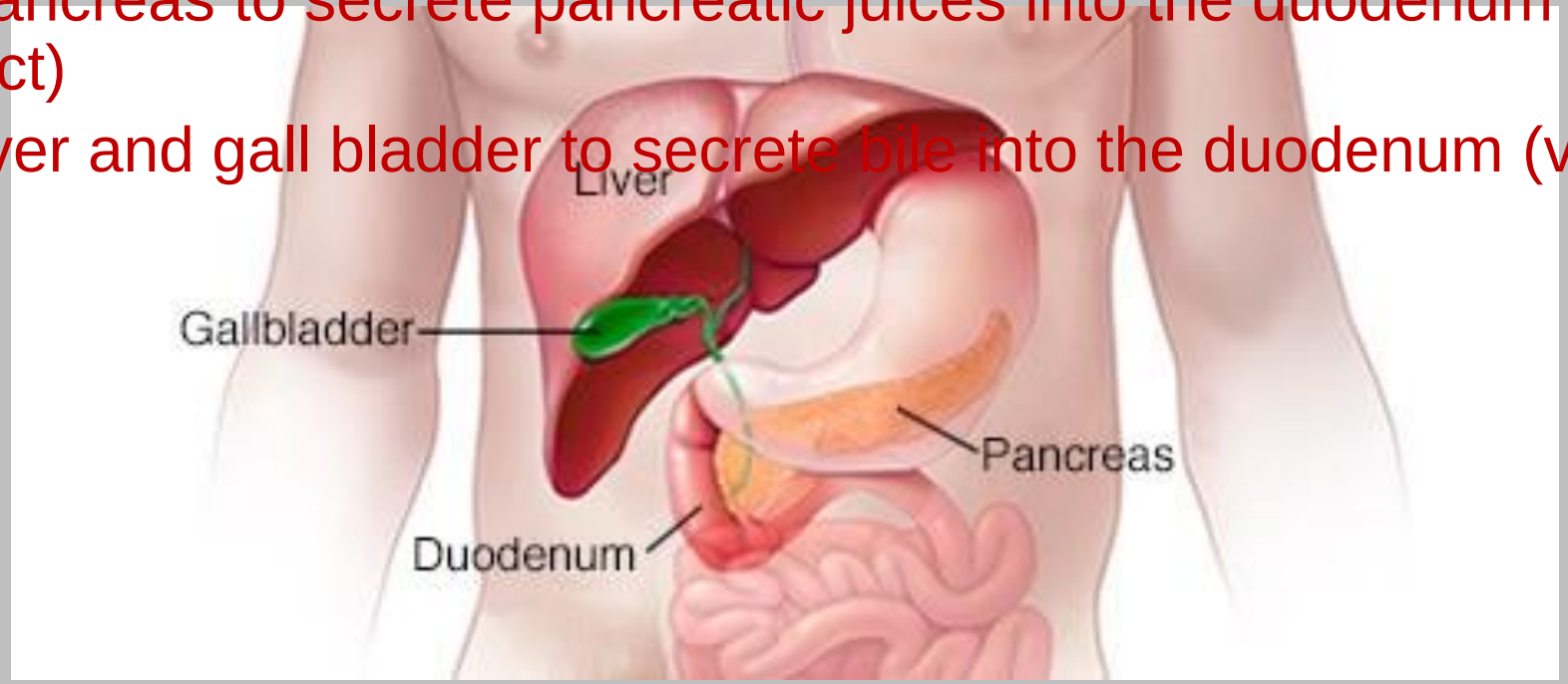
Lipid Droplets + H2O —(Nuclease)→ Fatty Acids + Glycerol — Pancreatic Enzyme

Nucleic Acids + H2O —(Nuclease)→ Nucleotides — Pancreatic Enzyme

Nucleotides+ H2O —(Nucleosidase)→ Phosphate group + pentose sugar + nitrogenous base — Small Intestine Enzyme

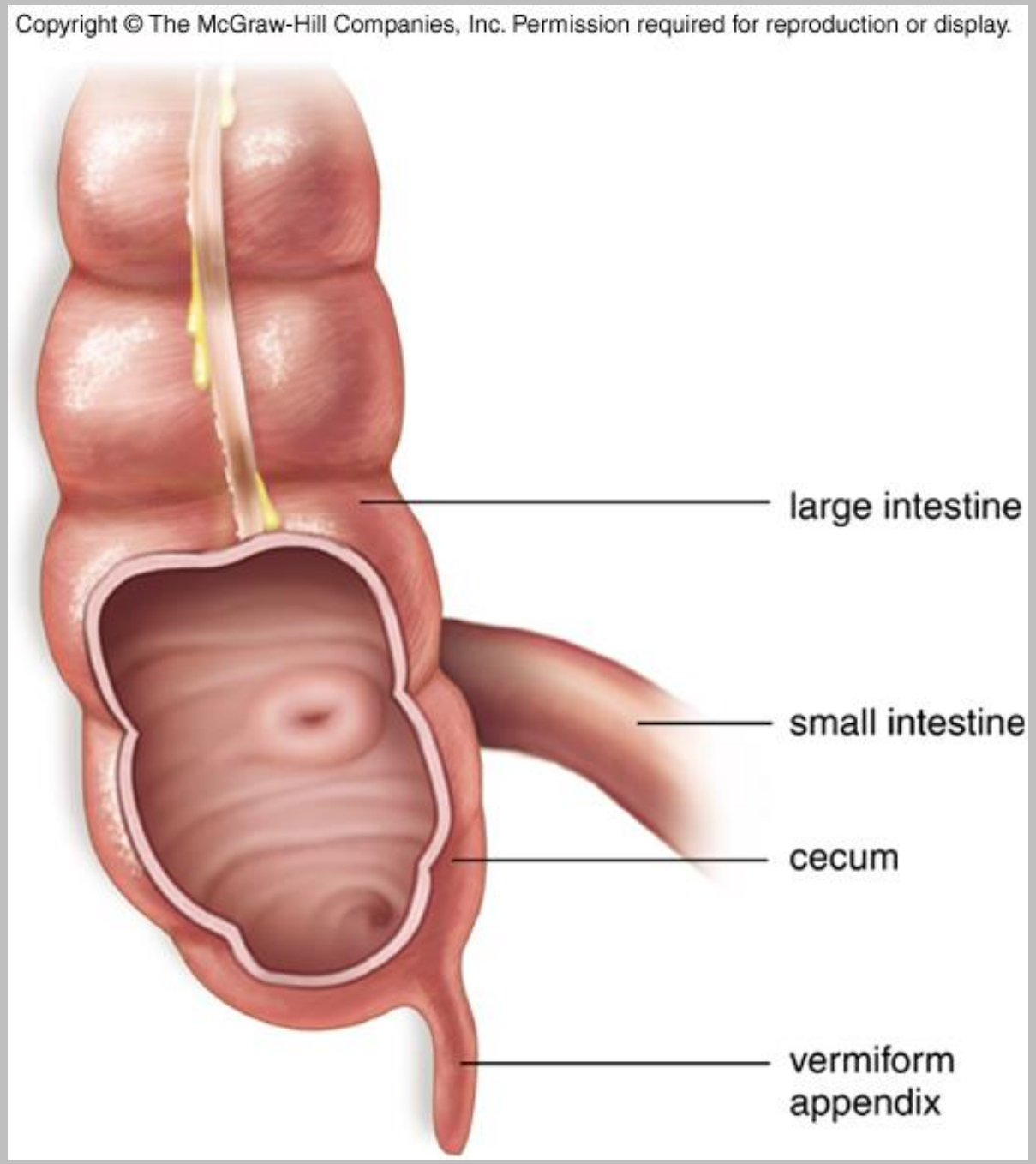
Summary of Hormones

- Gastrin
  - Secreted when the stomach stretches, when proteins enter the stomach, and due to the thought, smell or taste of food.
  - Causes gastric glands to secrete gastric juices in the stomach
- CCK & Secretin
  - Secreted from the intestinal glands in the duodenum when acid chyme enters the duodenum from the stomach
  - Causes the pancreas to secrete pancreatic juices into the duodenum (via the pancreatic duct)
  - Causes the liver and gall bladder to secrete bile into the duodenum (via the bile duct)

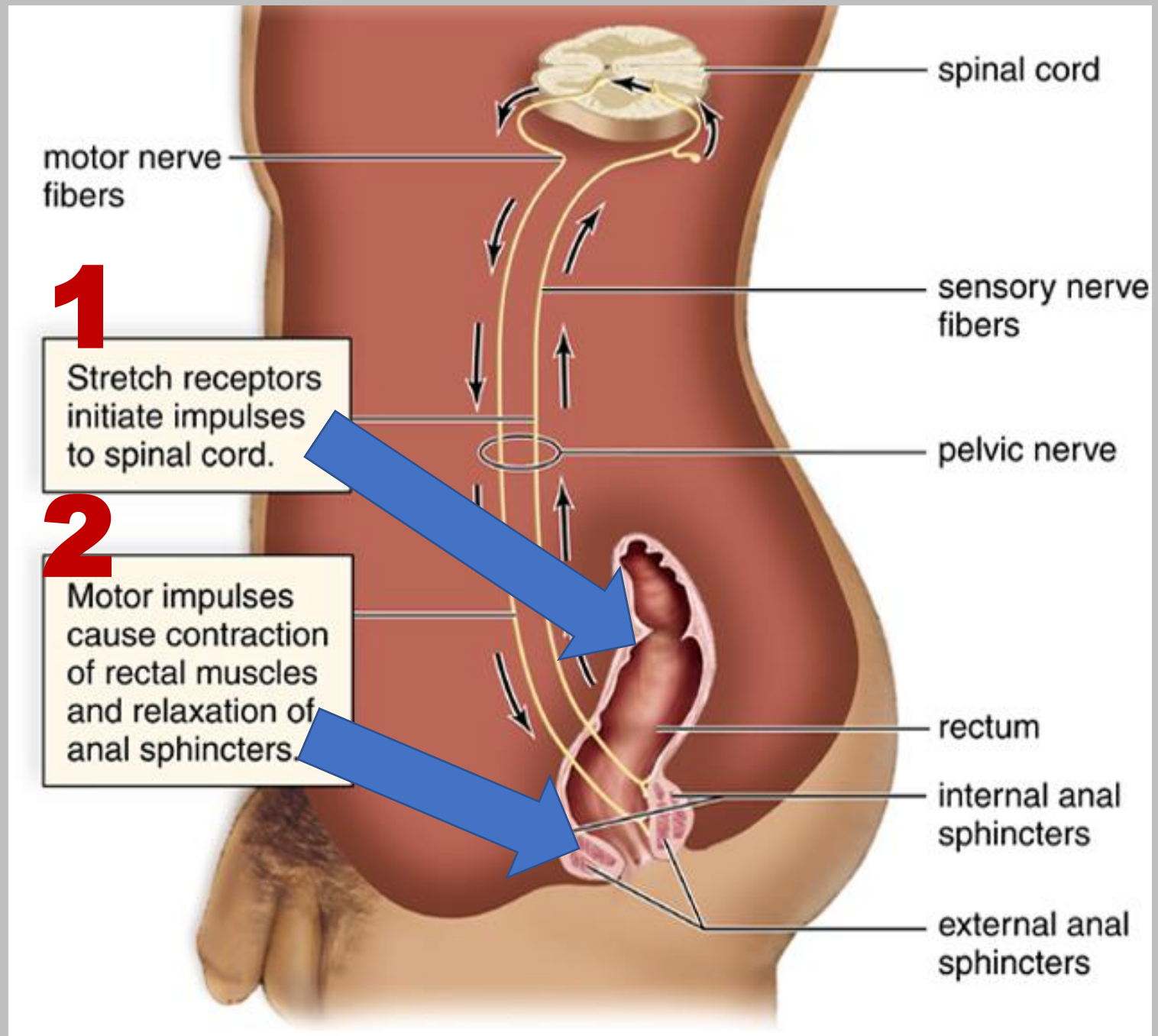


Large Intestine = Colon

- Site of water absorption
- Houses E.Coli for continued digestion and production of vitamins
- Feces solidifies as water is absorbed
- Indigestible fibre and other molecules exit body after the defecation reflex in the rectum



Defecation reflex



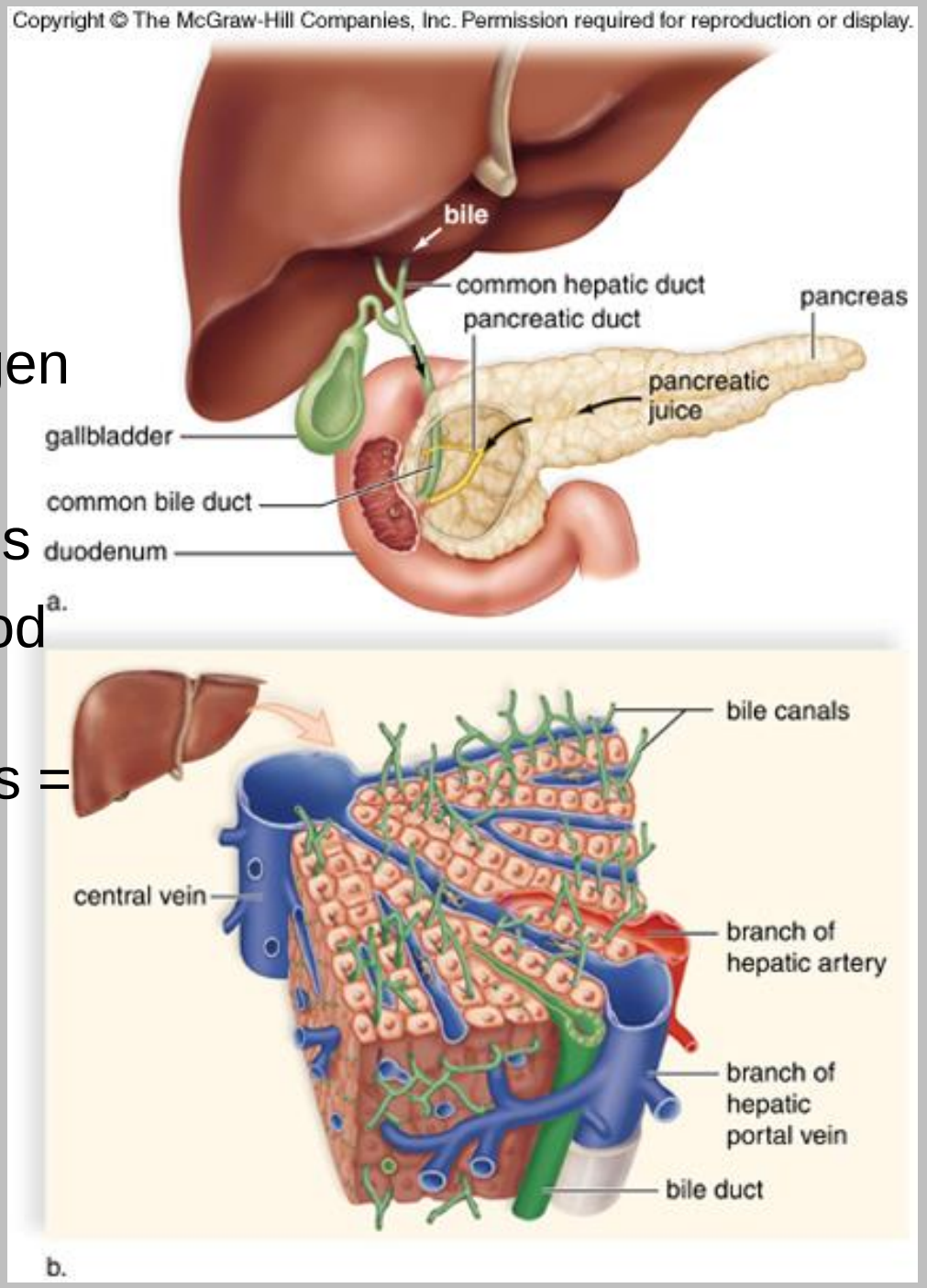
- Feces enters the rectum causing it to stretch
- This sends a signal to the spinal cord and back as a reflex
- This causes the rectum to contract and the internal anal sphincter to relax
- You relax the external sphincter voluntarily during a convenient time.

Internal sphincters are involuntary

External sphincters are voluntary

Liver

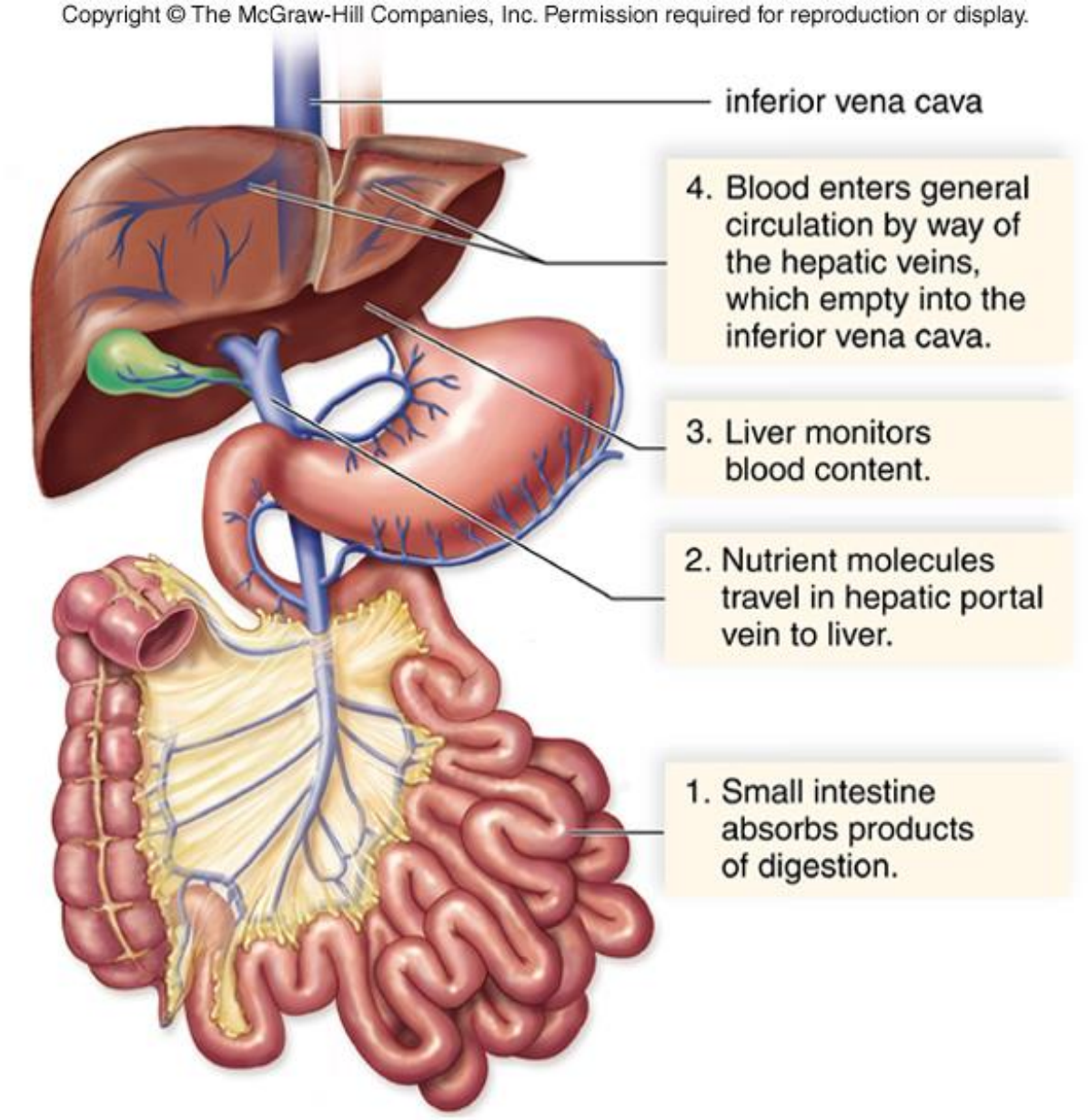
- Detoxifies blood
- Regulates cholesterol
- Stores glucose as glycogen
- Stores vitamins and iron
- Produces plasma proteins
- Breaks down old red blood cells (hemoglobin)
- Breaks down amino acids = produces urea
- Produces bile from breakdown of hemoglobin



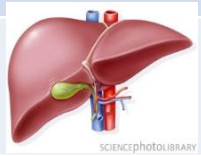
PANCREAS

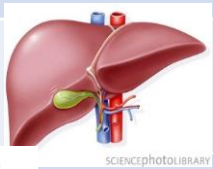
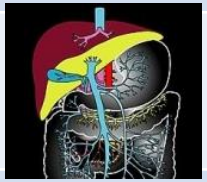
- Produces insulin and glucagon to regulate blood glucose
- Produces digestive enzymes and $NaHCO_3$ to neutralize acid chyme
- Enzymes produced by the pancreas =
  - trypsin
  - pancreatic amylase
  - lipase
  - nuclease

Hepatic Portal Vein :

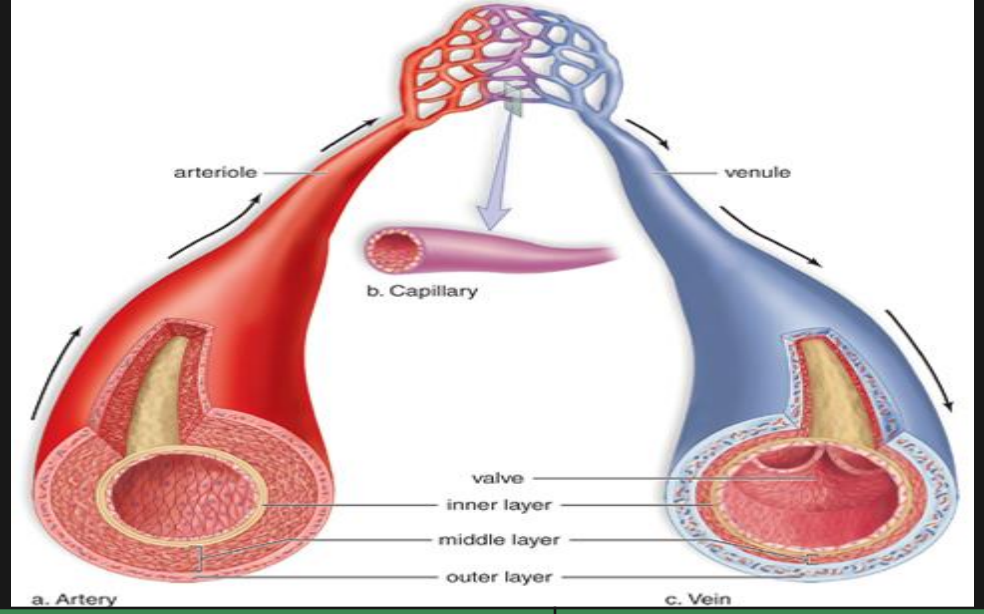


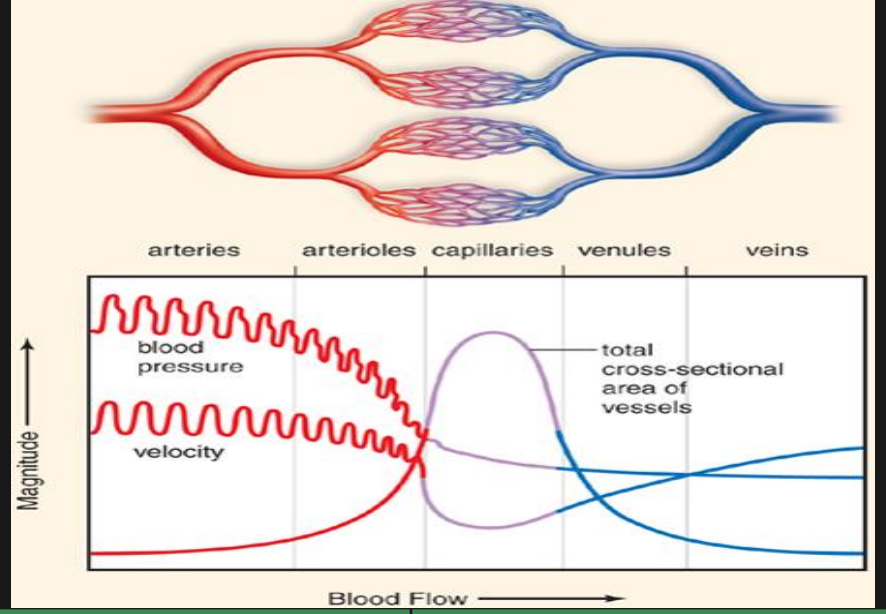
Carries absorbed nutrients from digestive tract to liver for processing and joining general circulation to rest of body.

Match Image	Structure	Function
 		Contains rugae to expand and hold food
		Detoxifies blood
		Brush border to increase surface area
		Closes opening to larynx when swallowing
		Site of water absorption
		May function in immunity but no real known function
		Feces stored and site of defecation
		Stores bile produced by liver
		Secretes a substance responsible for neutralizing acid chyme

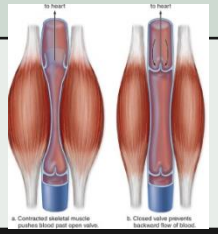
Match Image	Structure	Function
		Secretes hormones that regulate blood sugar
		Produces urea and regulates cholesterol
		Site of complete digestion of food and absorption of molecules
		pH = 2
		Mucus protects lining
		Blood high in nutrients carried to liver through this
		Where small intestine and large intestine join
		Contains the lacteal for fat absorption
		When swallowing, it moves up to guide food into esphagus

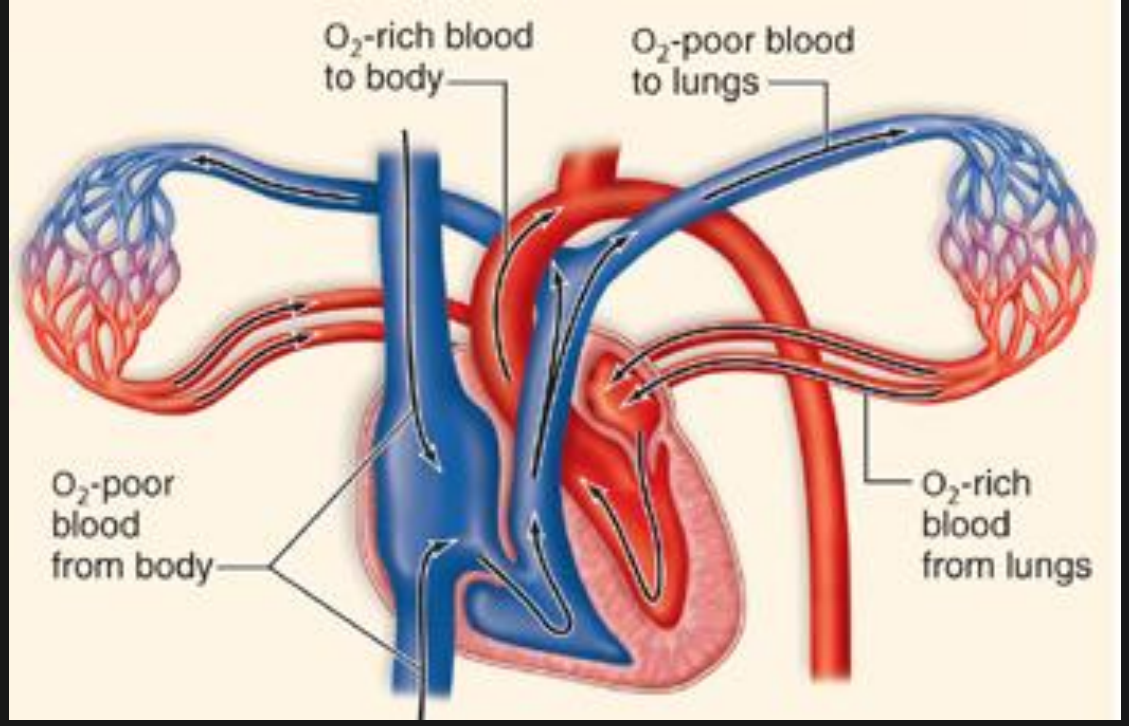
CHAPTER 10: THE HEART, CIRCULATION & BLOOD





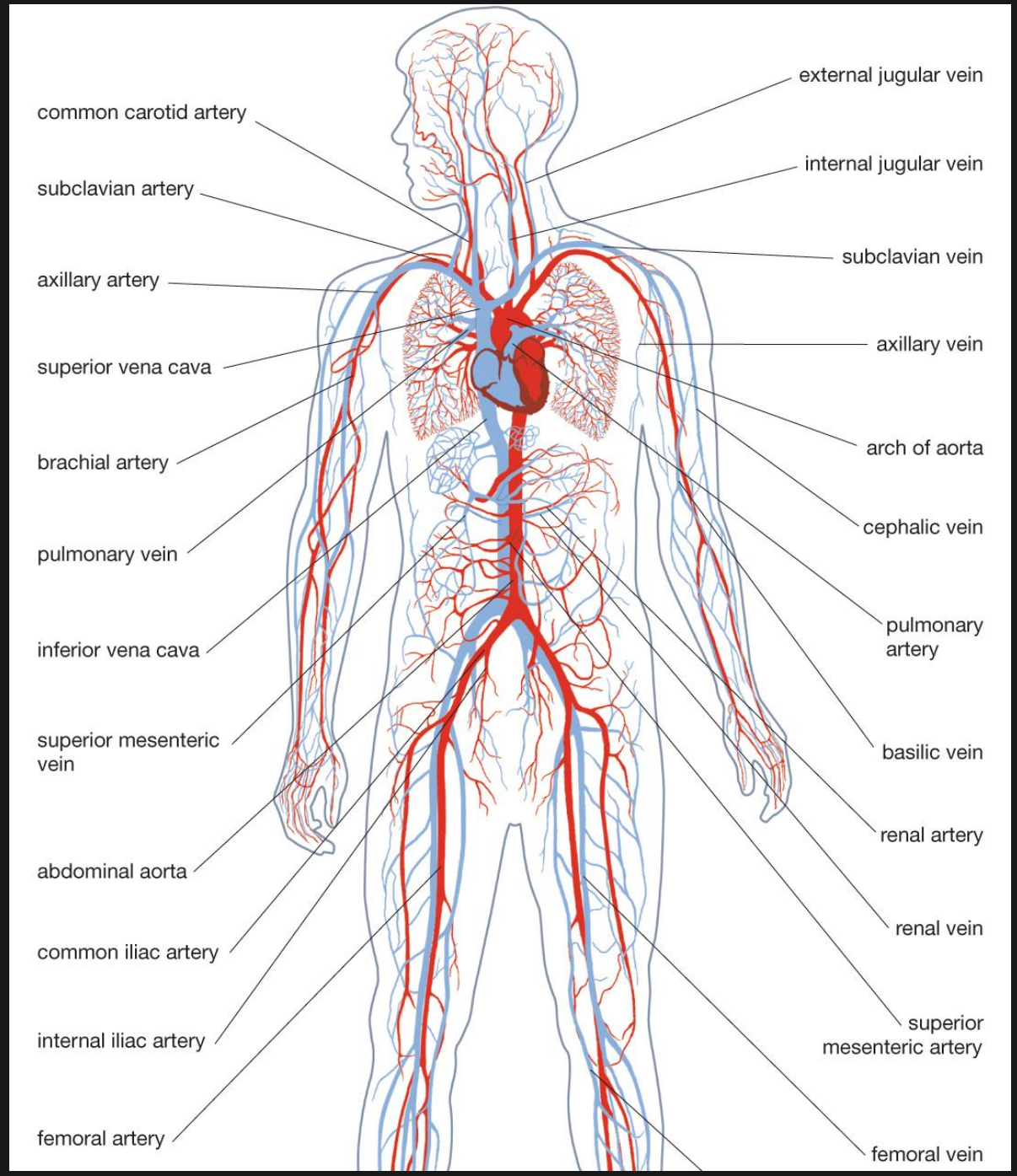
Arteries	Capillaries	Veins
Carries blood AWAY from heart	At tissues for nutrient/waste & gas exchange	Carries blood TOWARDS heart
Thick elastic wall to withstand high BP	Thin wall = 1 cell think to facilitate nutrient/waste & gas exchange	Thin wall due to low BP and with larger lumen to hold more blood
Highest BP	Low BP	Lowest BP
Low Cross-sectional Area	High Cross-sectional Area	Low Cross-sectional Area
High velocity	Low velocity	High velocity
Elastic wall recoils with every heart beat = pulse	Sphincters can constrict to divert blood flow to essential organs	Valve and skeletal muscle contraction help blood flow towards heart





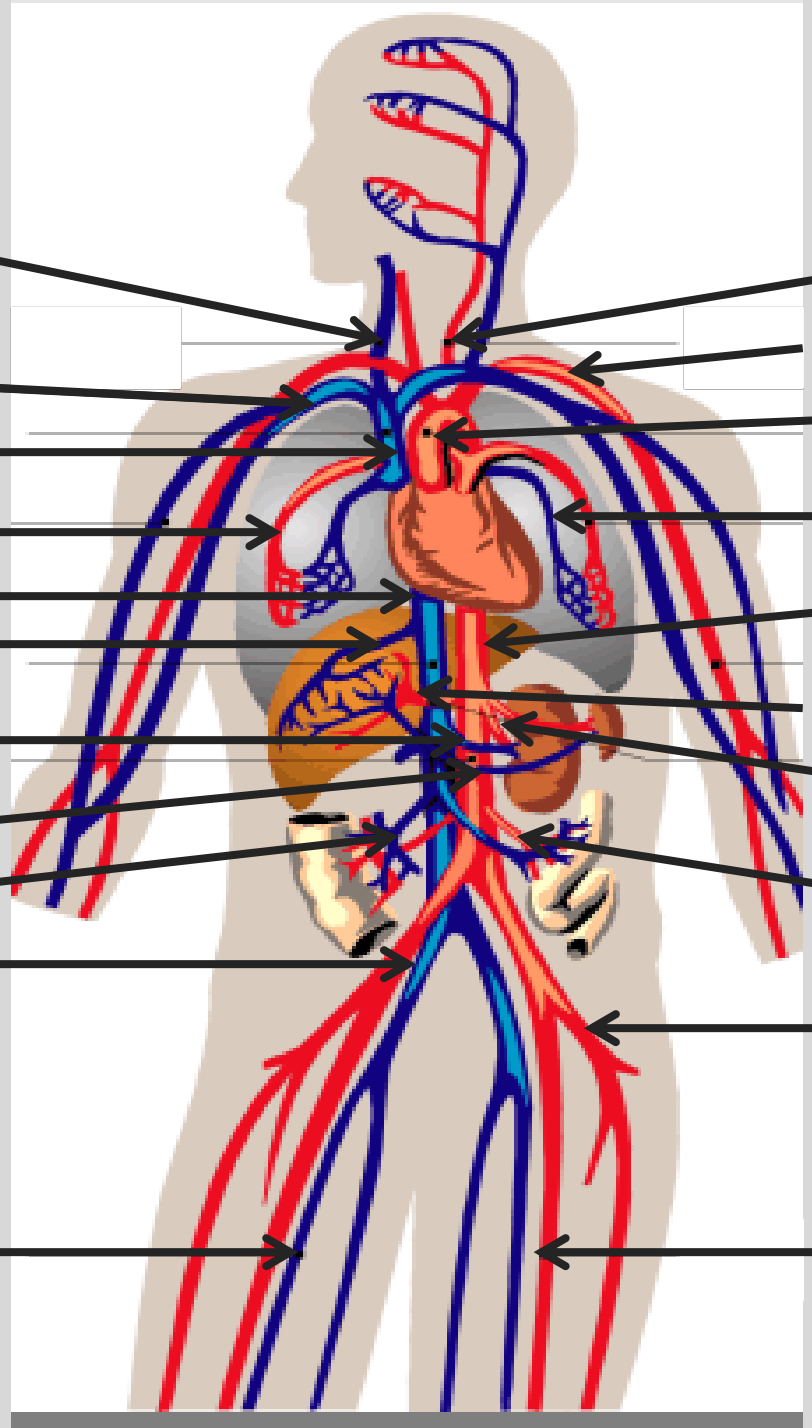
PULMONARY Circulation	SYSTEMIC Circulation
Carries blood to and from Lungs	Carries blood to and from body tissues (except lungs)
Right side of heart through lungs to left side of heart	Left side of heart through body to right side of heart
Arteries carry blood low in O2 and high in CO2	Arteries carry blood high in O2 and low in CO2
Veins carry blood high in O2 and low in CO2	Veins carry blood low in O2 and high in CO2

https://www.youtube.com/watch?v=_bffo4wXr8g&t=574s



VEINS

ARTERIES



Jugular Vein

Subclavian Vein

Superior Vena Cava

Pulmonary Vein

Inferior Vena Cava

Hepatic Vein

Renal Vein

Hepatic Portal Vein

Mesenteric Vein

Iliac Vein

Femoral Vein

Carotid Artery

Subclavian Artery

Aorta

Pulmonary Artery

Abdominal Aorta

Hepatic Artery

Renal Artery

Mesenteric Artery

Iliac Artery

Femoral Artery

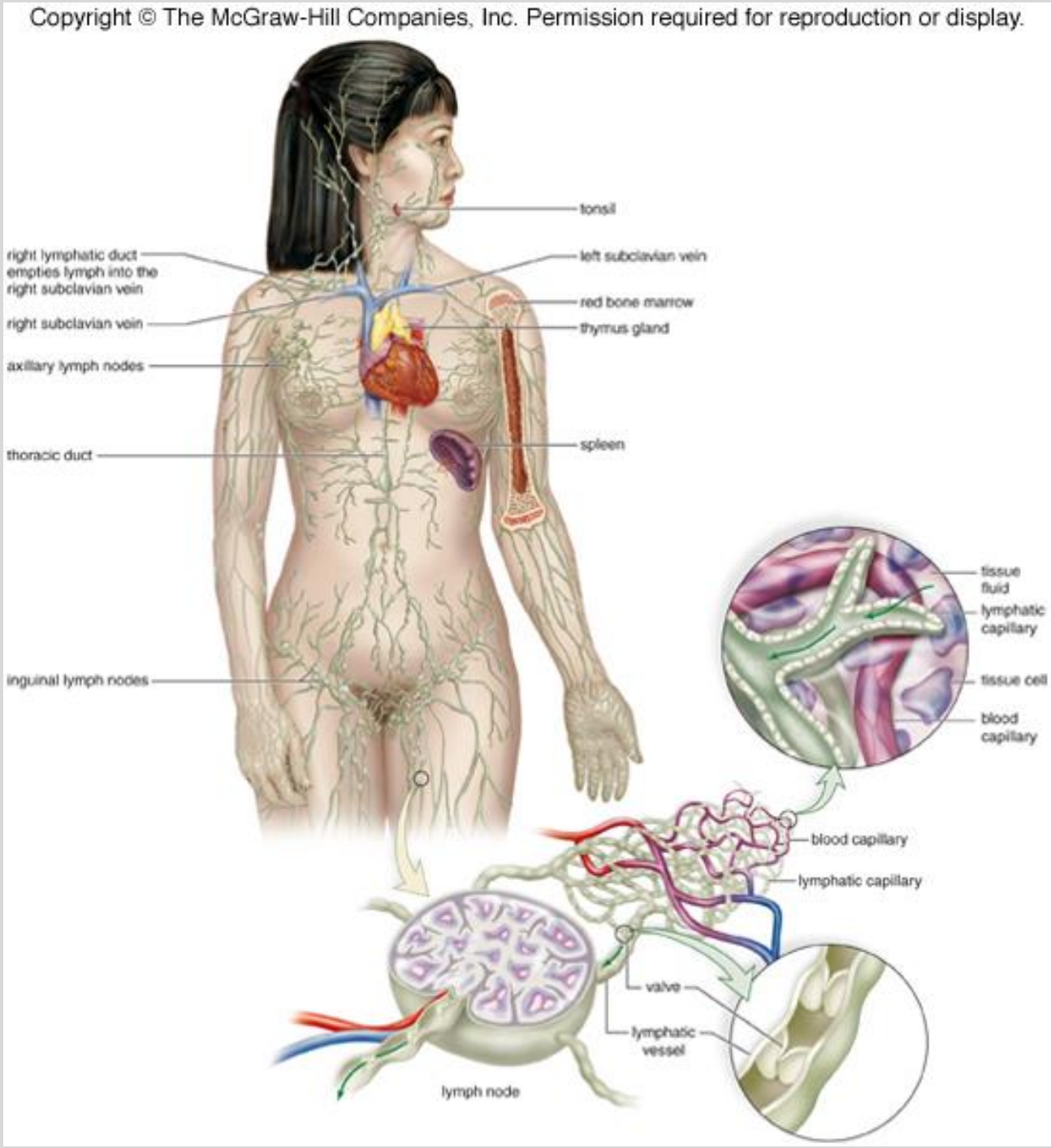
Lymphatic System

1. Absorbs and returns excess tissue fluid to the bloodstream

2. Absorbs fats/lipids from the digestive tract & transports them to the bloodstream

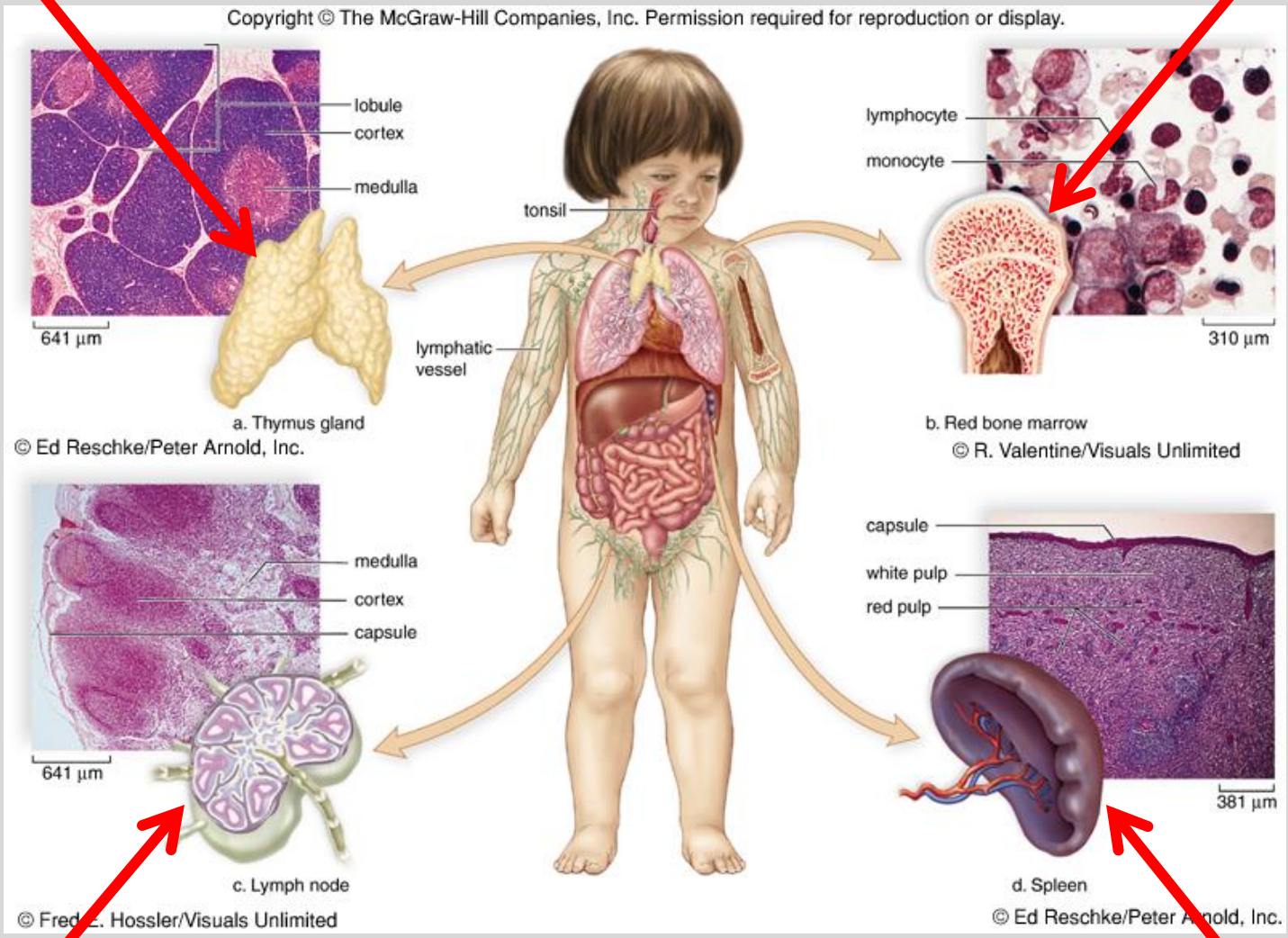
3. Helps defend the body against disease

- Lymph contains tissue fluid, bacteria, viruses, old cell parts or debris, antibodies
- Lymph fluid moves by skeletal muscle contraction and valves
- Lymph is delivered back to blood at the subclavian veins



WBC and Antibody production (T-cells)

Produces RBC,WBC & platelets

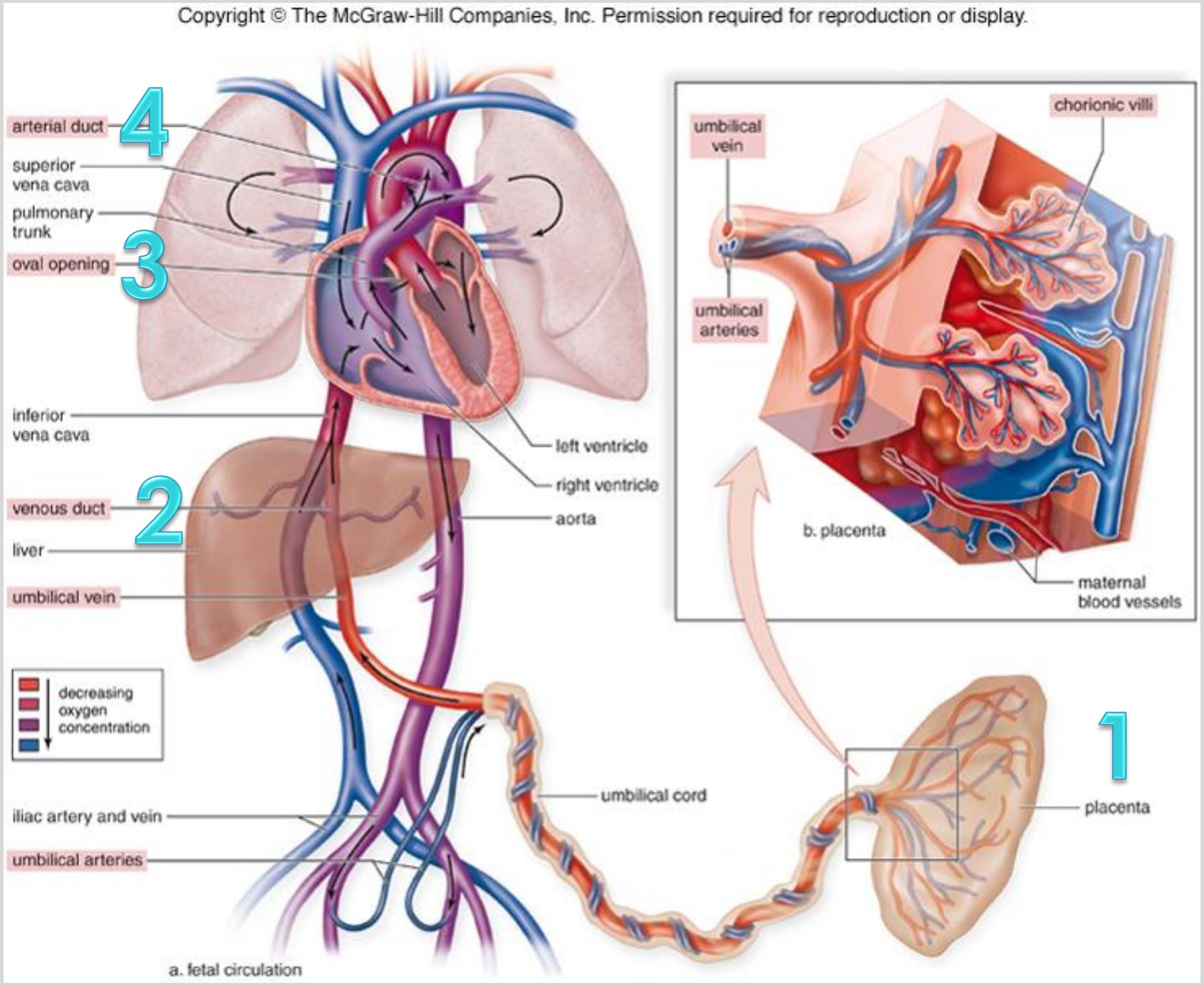


Cleanses lymph of bacteria, viruses and cellular debris. Also, WBC and antibody production

Stores & cleanses blood (old RBCs)

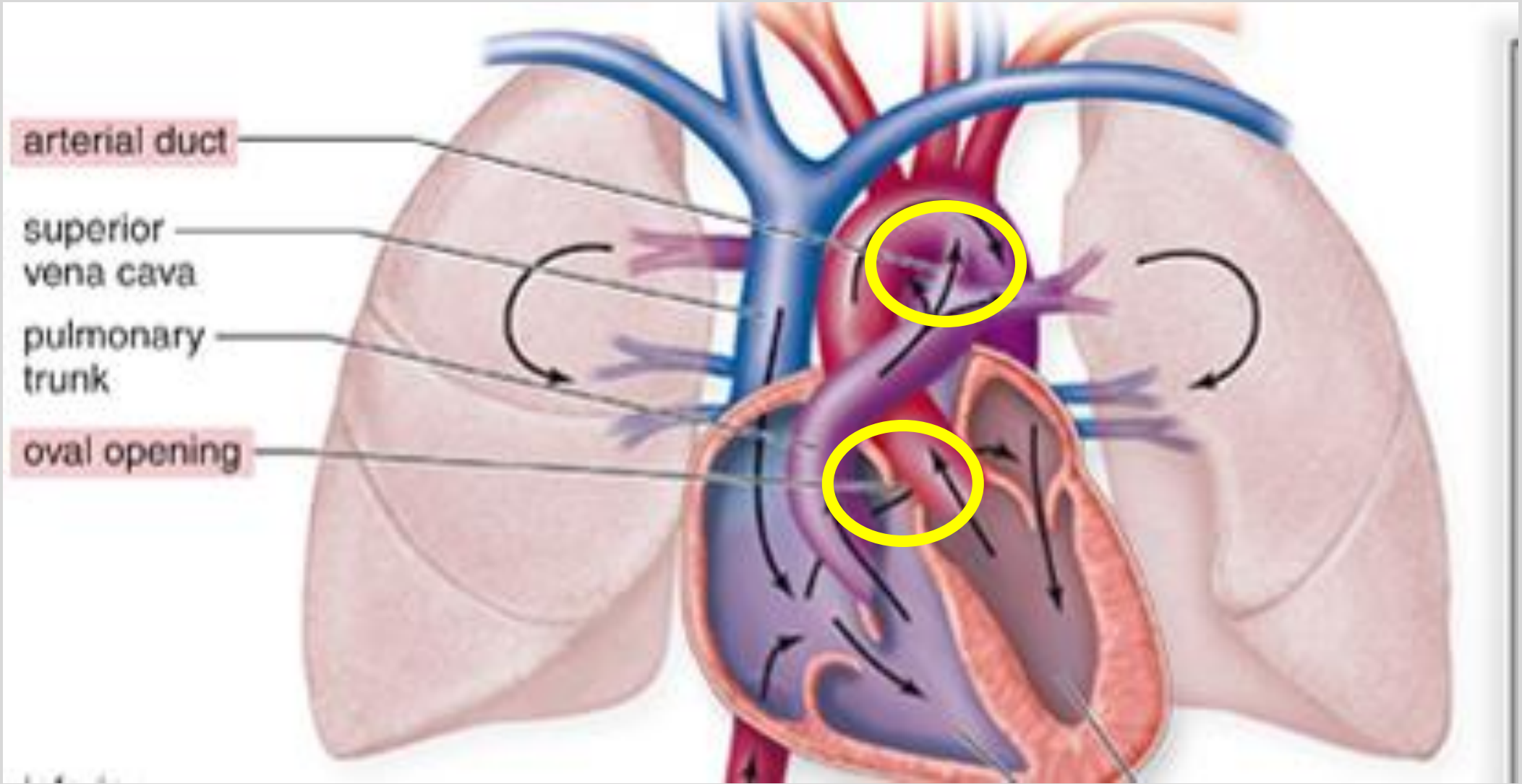
Fetal Circulation

- During fetal development, the organs are developing
- Lungs, digestion, and liver are not functional
- Due to this, there are 4 main circulatory differences between fetus and adult circulation



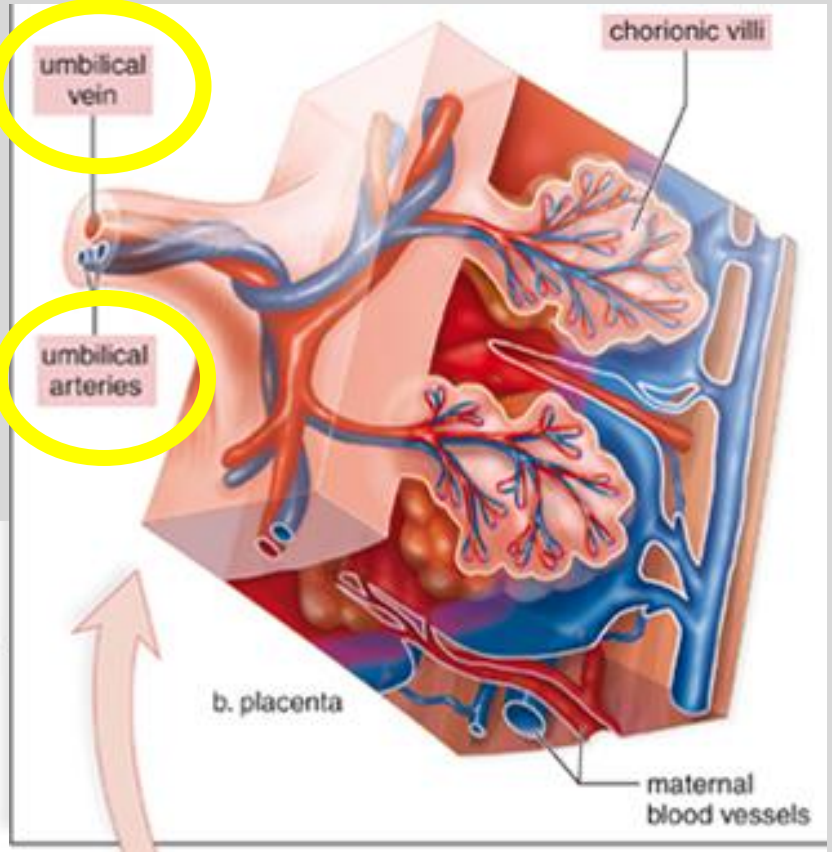
Two differences exist that bypass the lungs

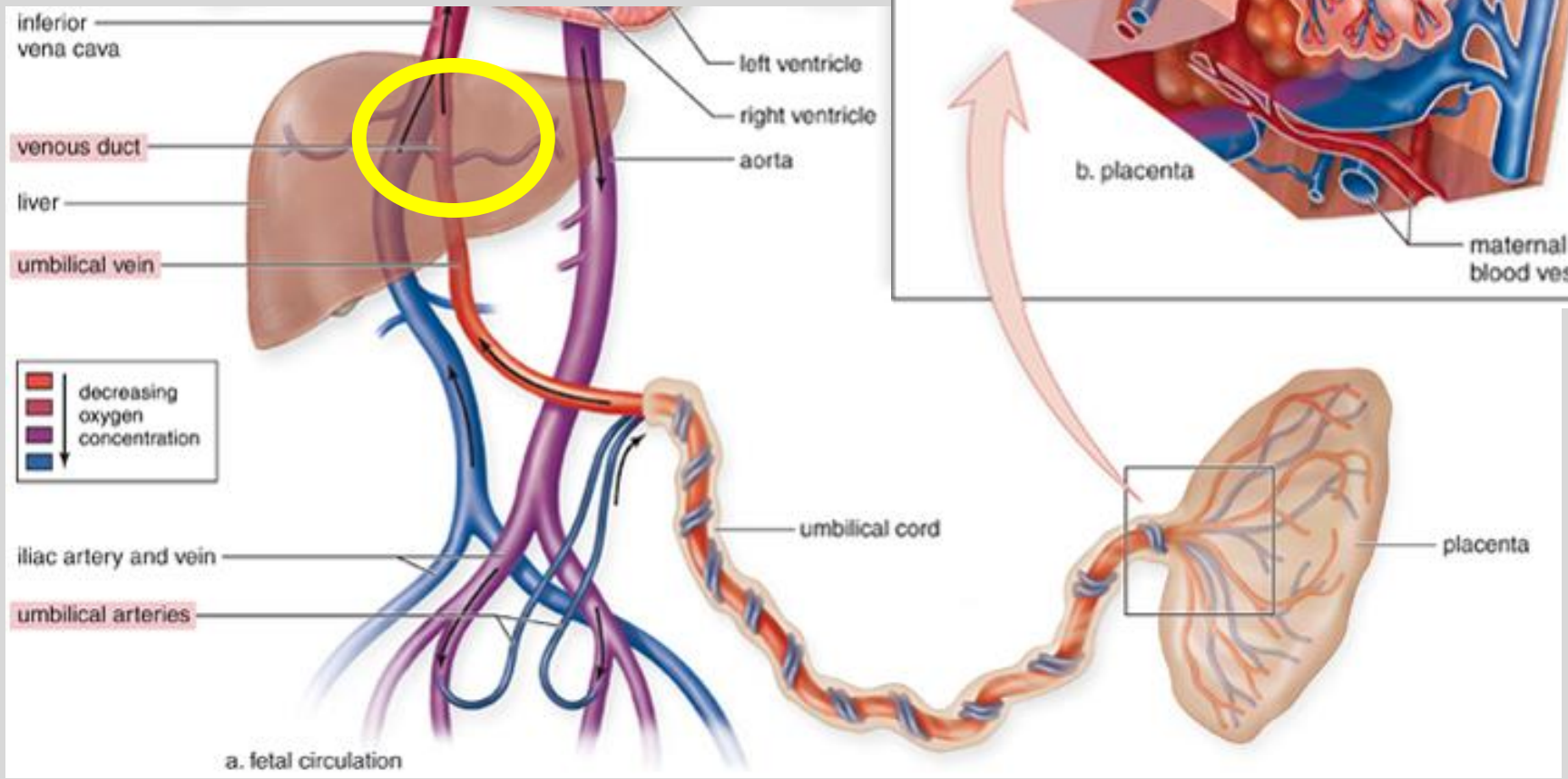
1. Arterial Duct (ductus arteriosus) = between pulmonary trunk and aorta
2. Oval Opening (foramen ovale) = between right and left atria



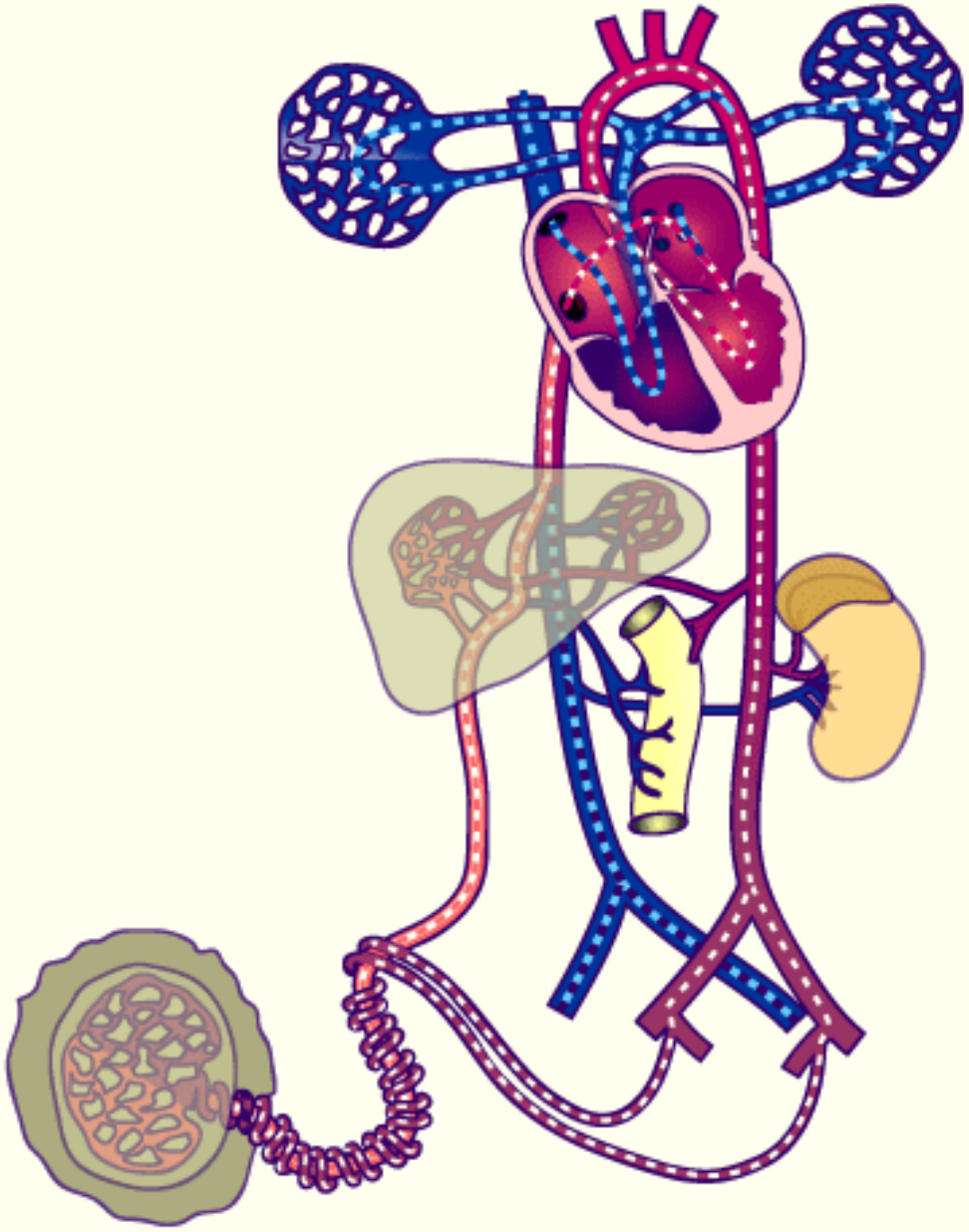
Two differences exist that deliver nutrients & O2 from placenta and take wastes & CO2 to placenta

1. Umbilical cord = 2 arteries carry CO2 & waste to placenta for exchange; 1 vein carries O2 & nutrients from placenta to fetus
2. Venous Duct (ductus venosus) = connects umbilical vein to inferior vena cava and bypasses liver.

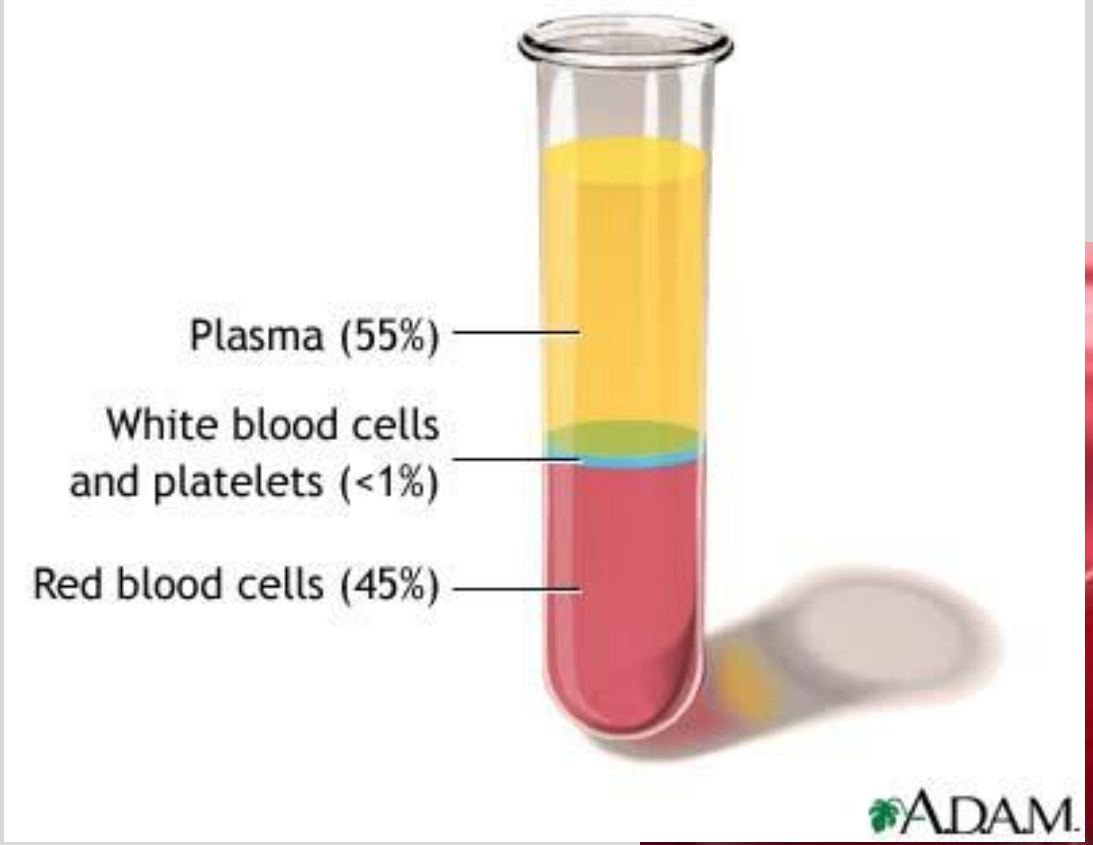




before birth



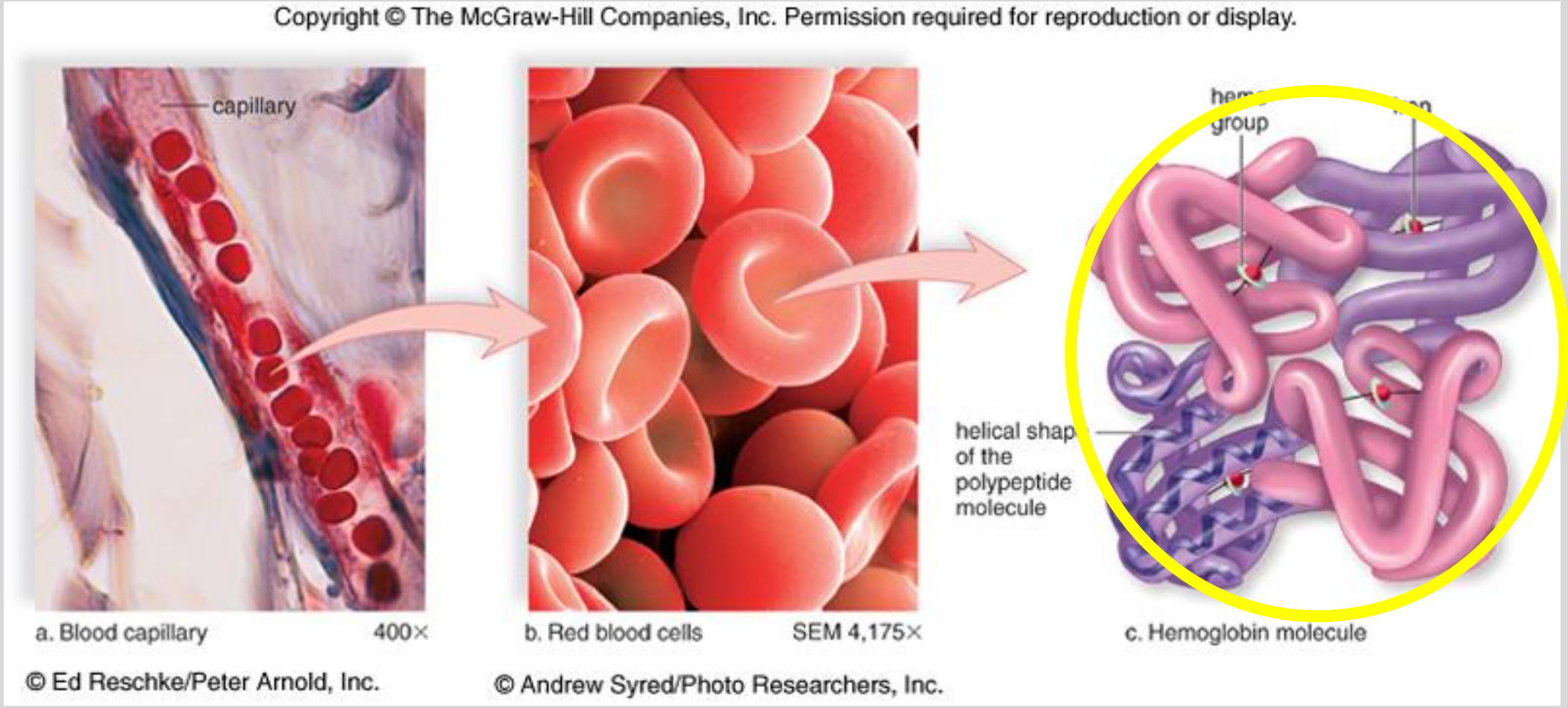
Formed Elements = 45% of blood
RBC, WBC, Platelets



Red Blood Cells (RBCs)

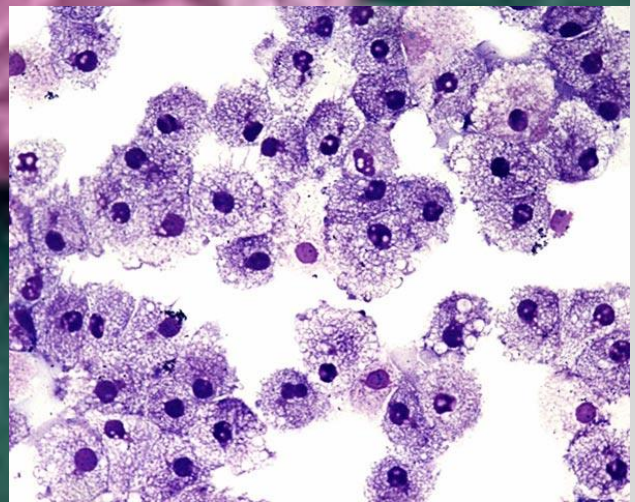
- Contain hemoglobin
- Carry O_2 and CO_2 throughout body
- No nucleus and biconcave shape
- Formed in Red Bone marrow

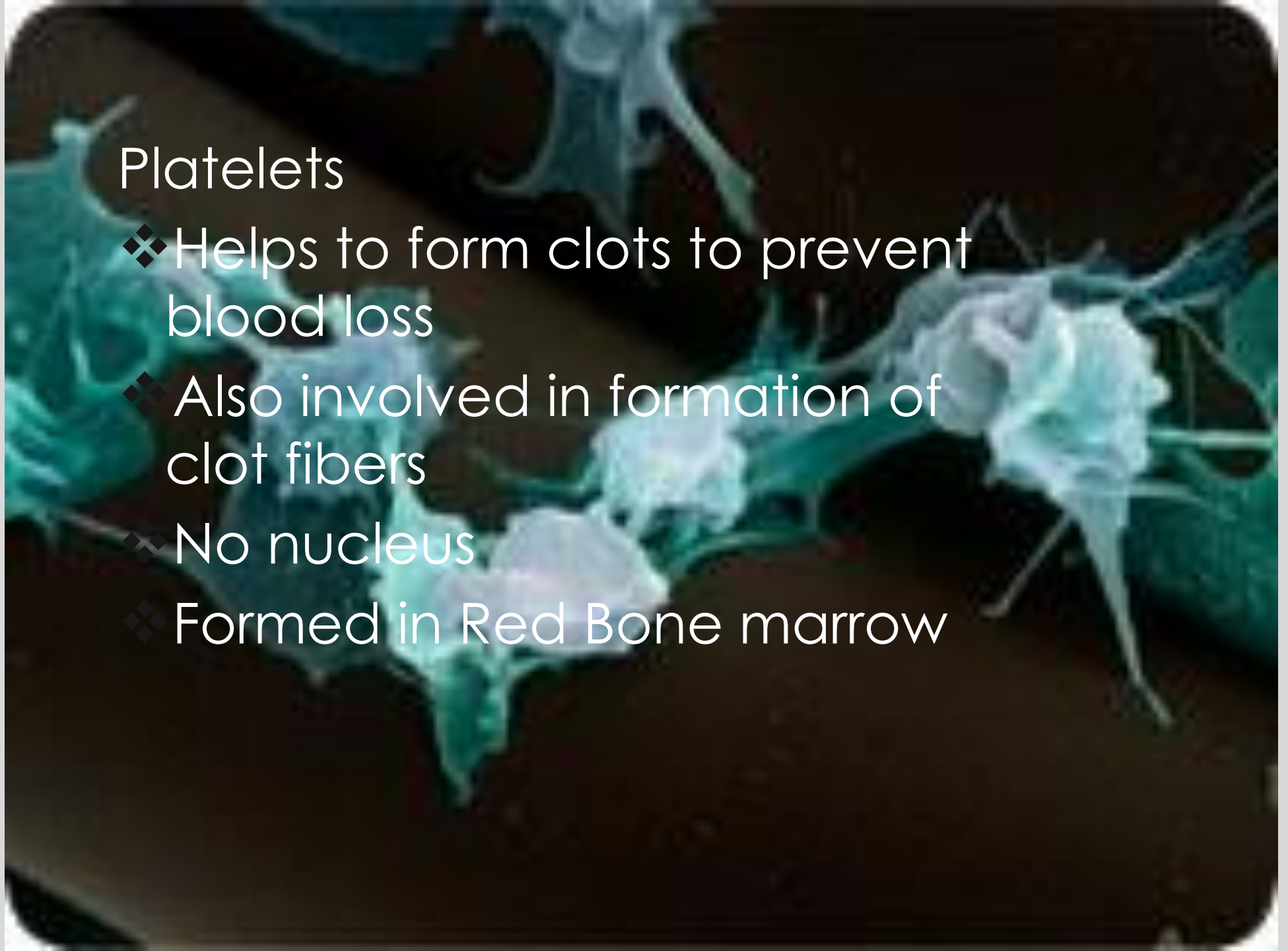
Hemoglobin inside RBCs carry the oxygen, carbon dioxide gases as well as help with buffering at tissues by carrying hydrogen ions.
Hemoglobin is a quaternary protein consisting of 4 polypeptides
The heme group contains iron and when O2 attaches, blood turns bright red.



White Blood Cells (WBCs)

- Larger than RBCs
- Provides immunity by carrying out phagocytosis of antigens and forming antibodies
- Contains nucleus (lobed in some)
- Formed in Red Bone marrow

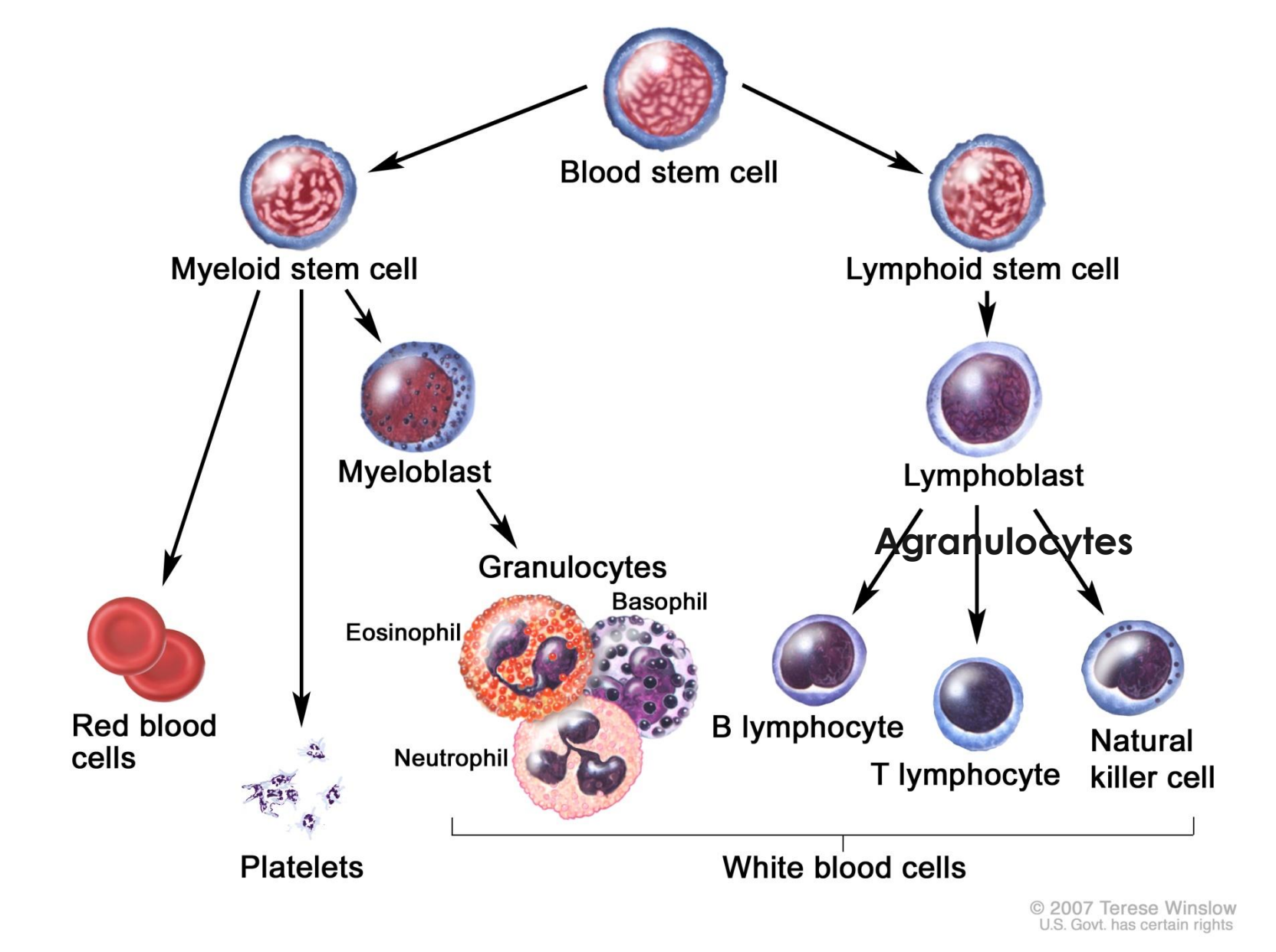




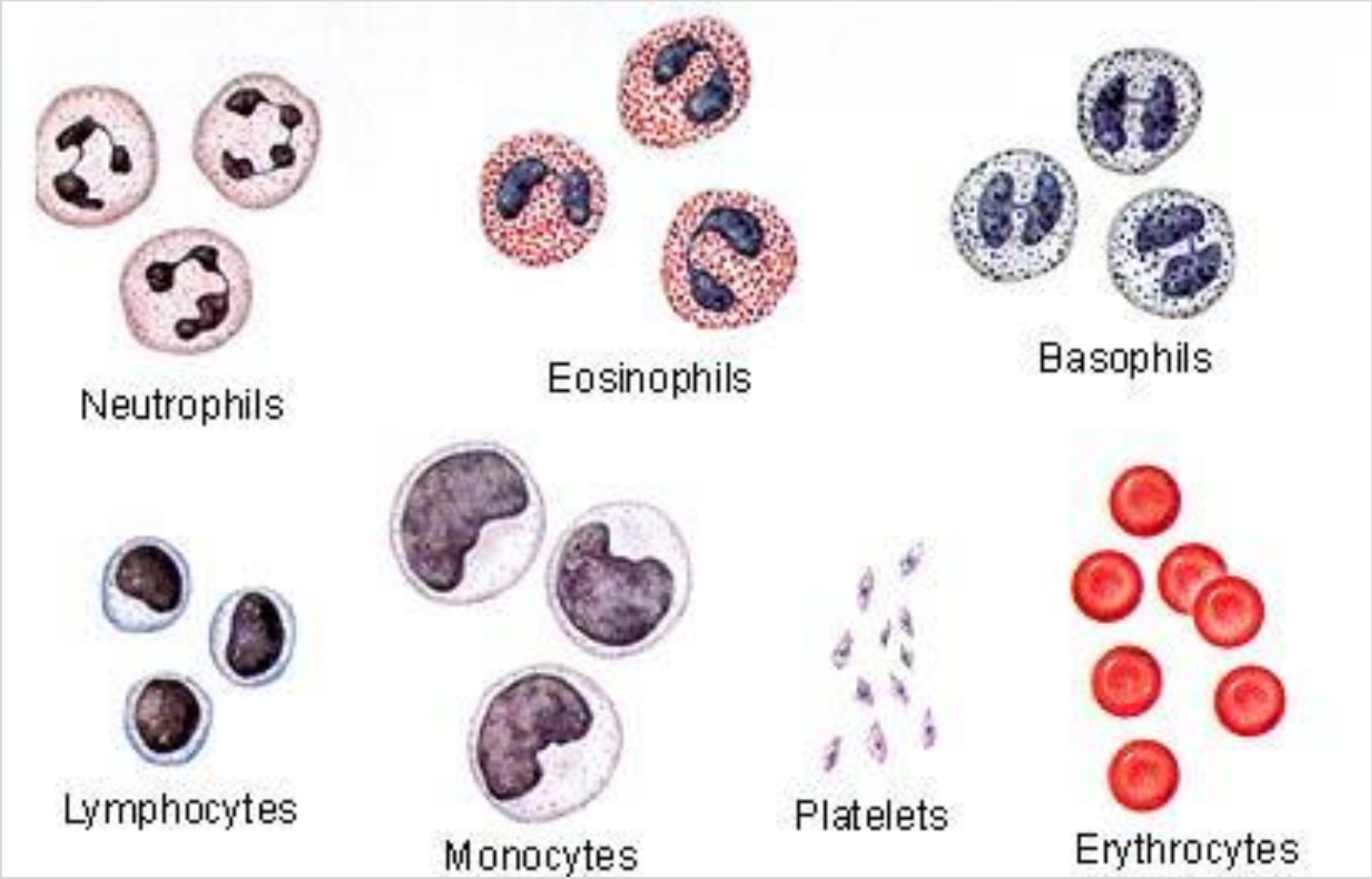
Platelets

- Helps to form clots to prevent blood loss
- Also involved in formation of clot fibers
- No nucleus
- Formed in Red Bone marrow

Formed element development in red bone marrow

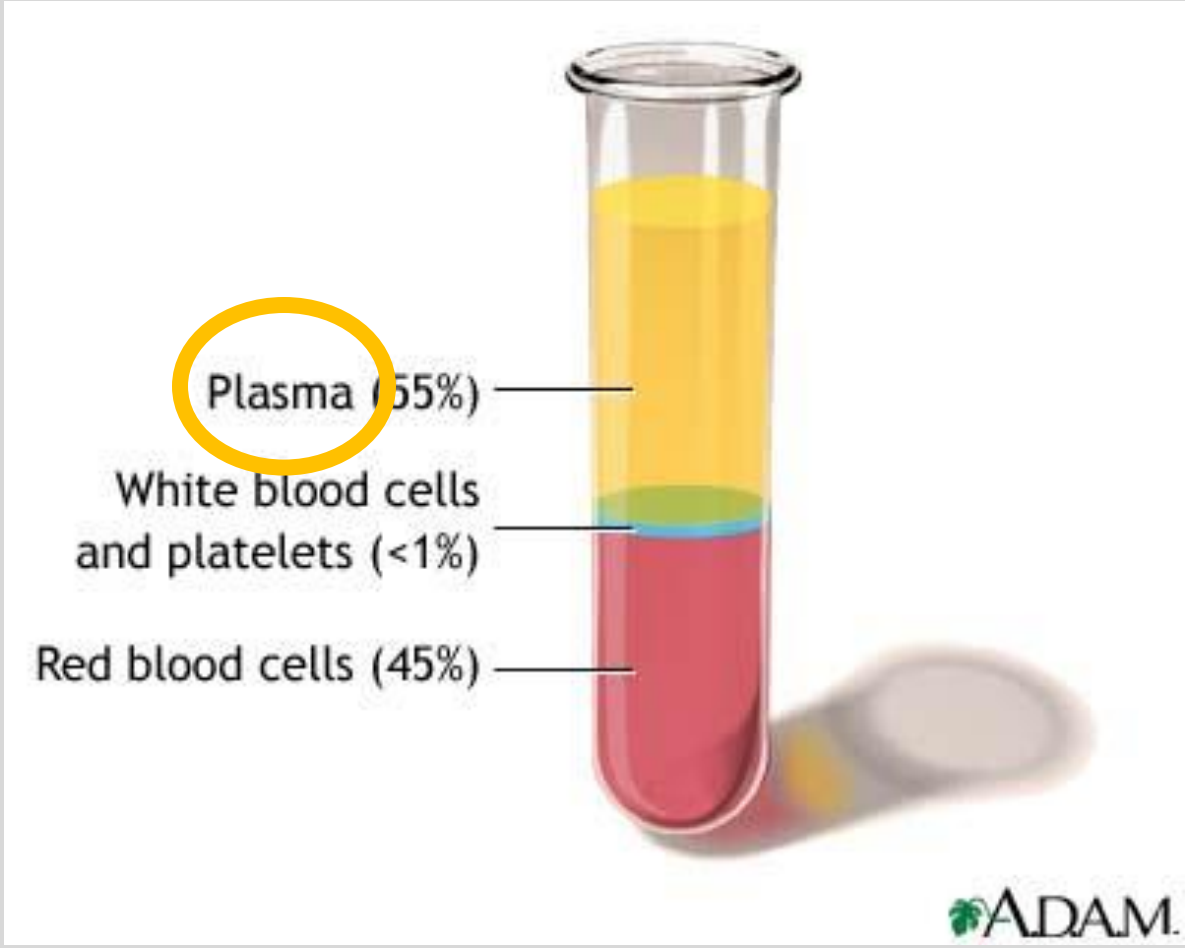


All of the different formed elements



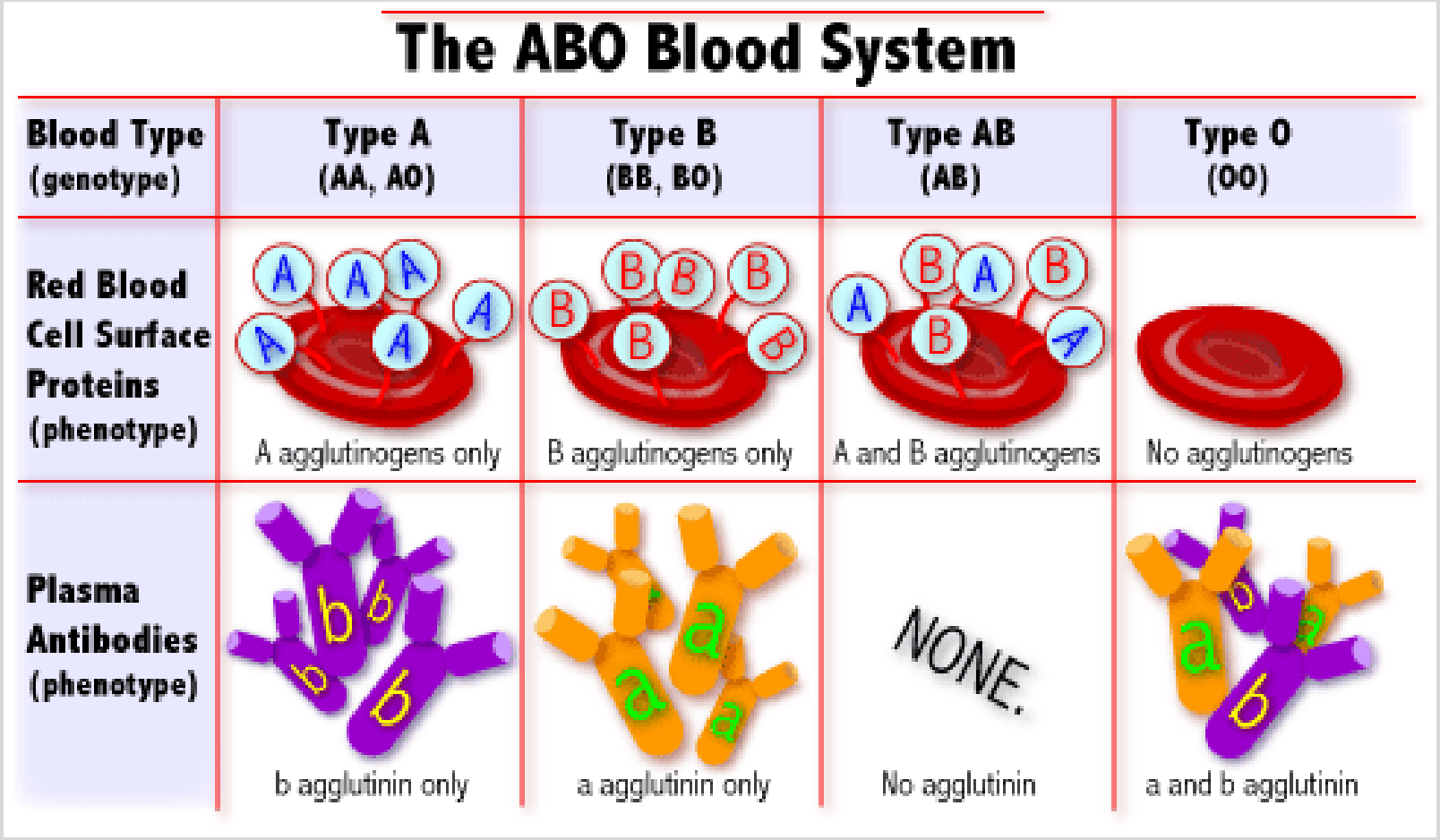
Plasma = 55% of blood

- Mostly water; ~92% absorbed from colon
- Nutrients = glucose, amino acids, lipids from SI
- Wastes = nitrogenous wastes like urea & uric acid from liver
- Salts from colon
- Gases = O2 from lungs and CO2 from tissues
- Plasma proteins = albumin & fibrinogen from liver and antibodies from WBCs
- Hormones from glands
- Vitamins from colon

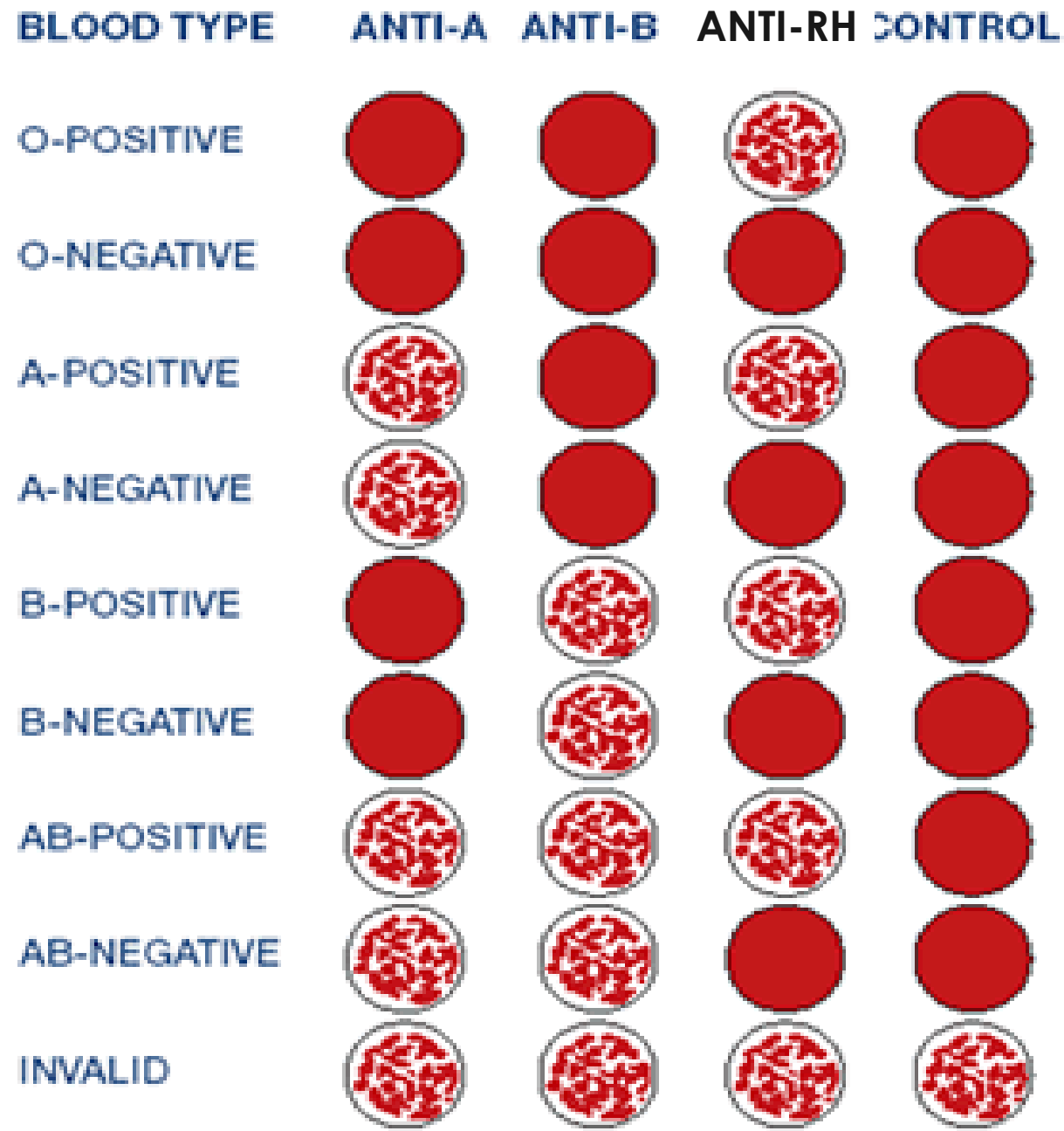


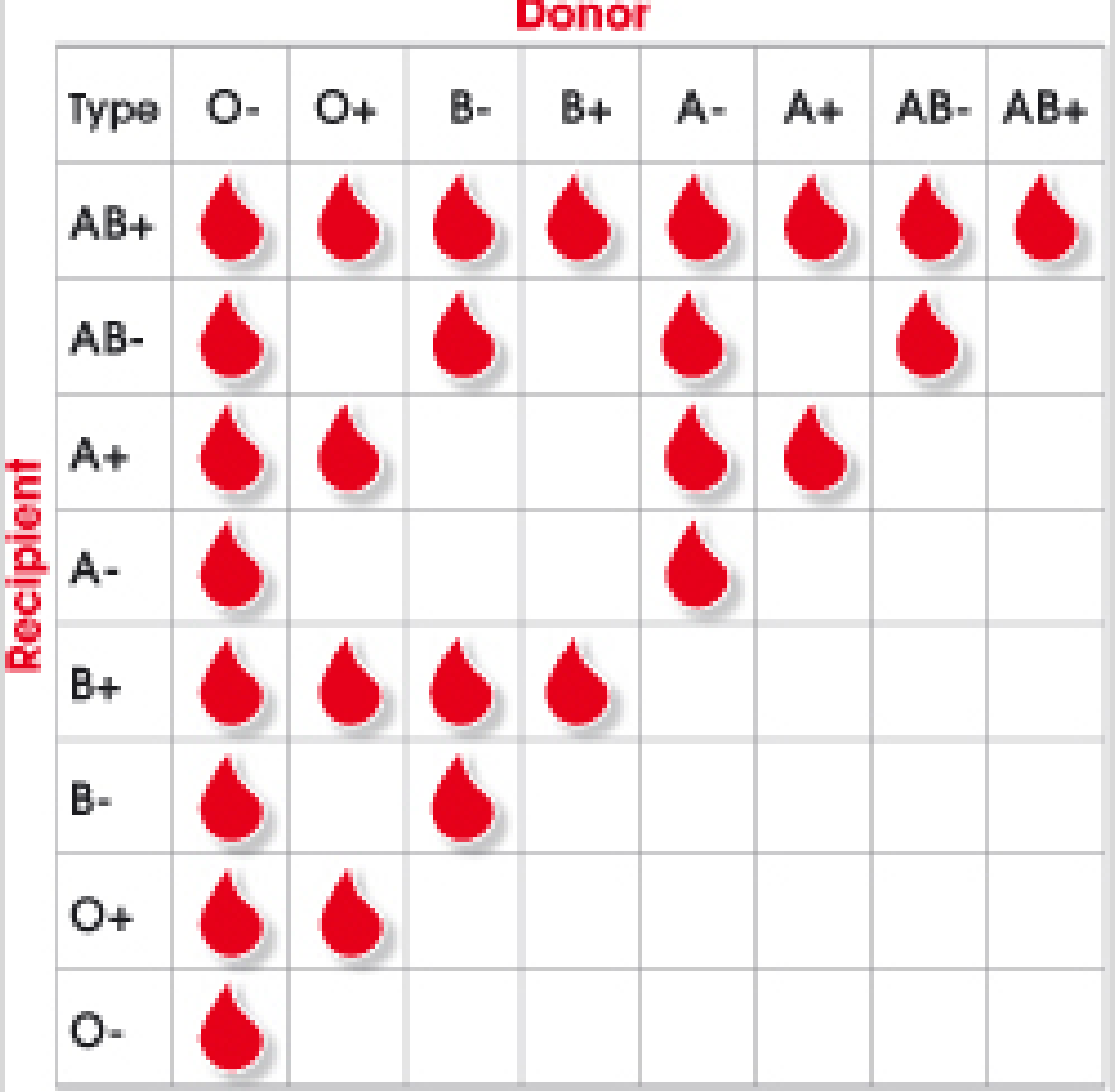
Blood Typing:

Antigens are the RBC surface fingerprints (glycolipids & glycoproteins
Antibodies are produced against a foreign antigen (or blood type)



HOW TO READ YOUR RESULTS




Donor
Recipient
Type
O-
O+
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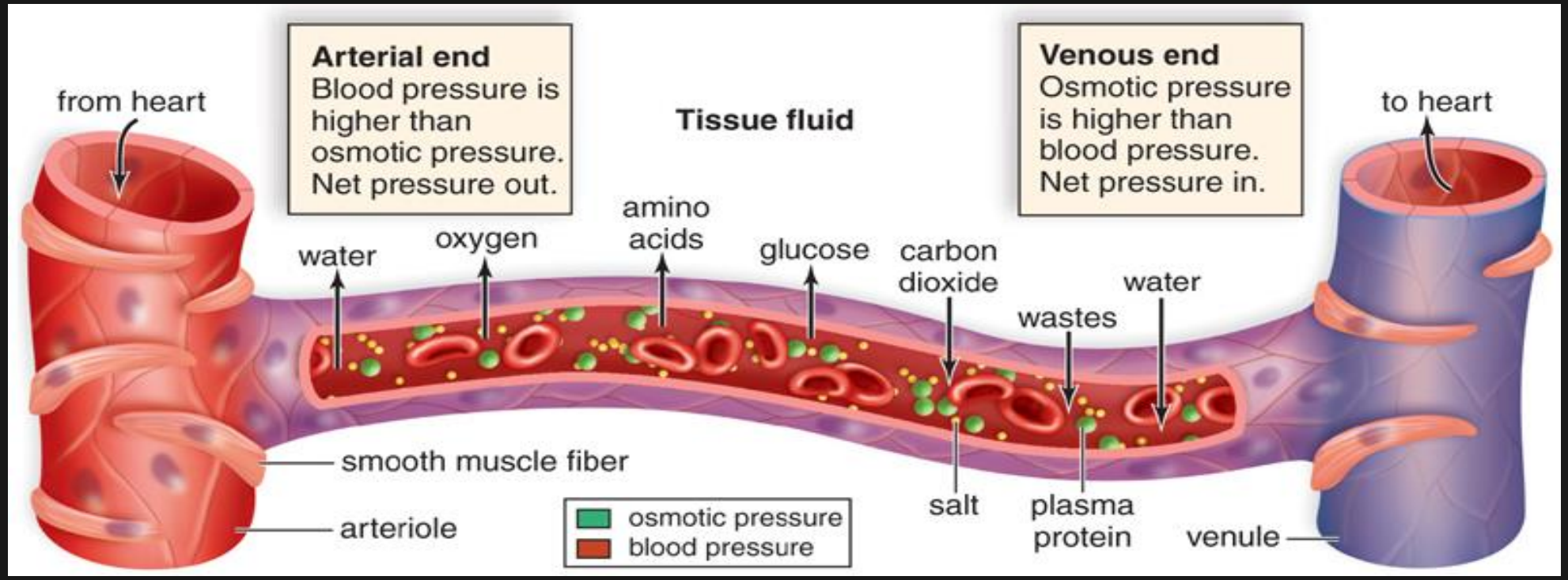
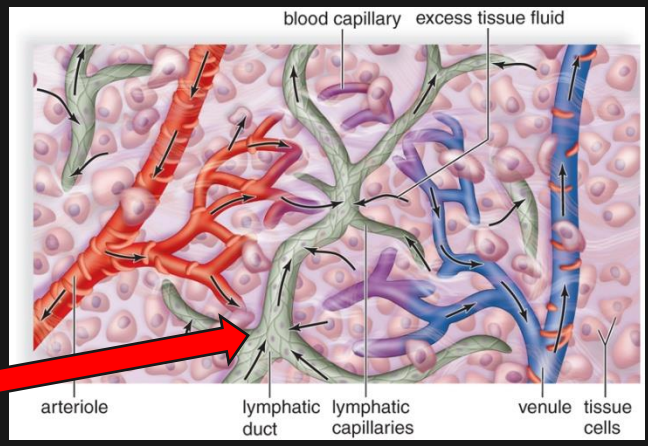
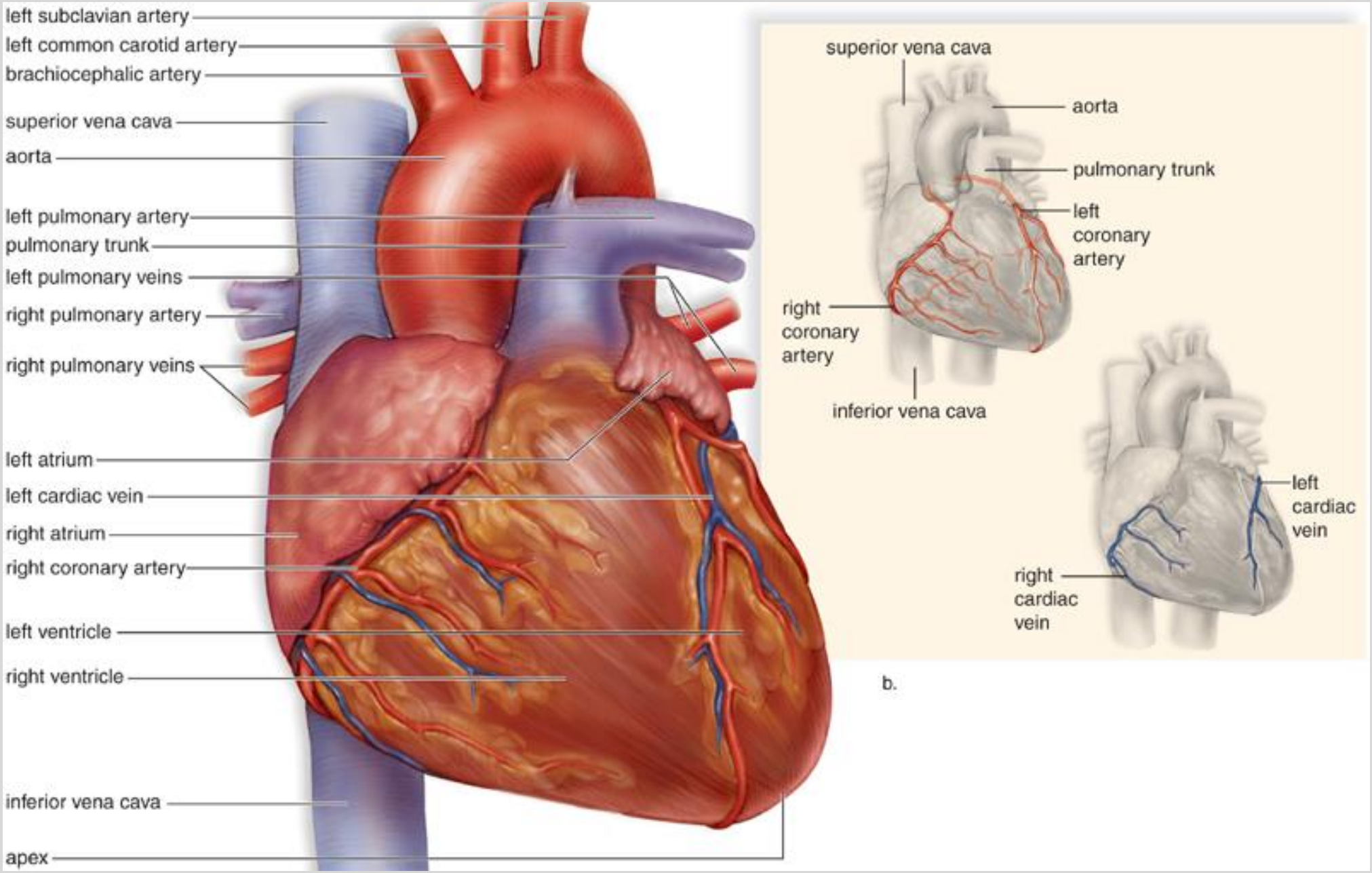
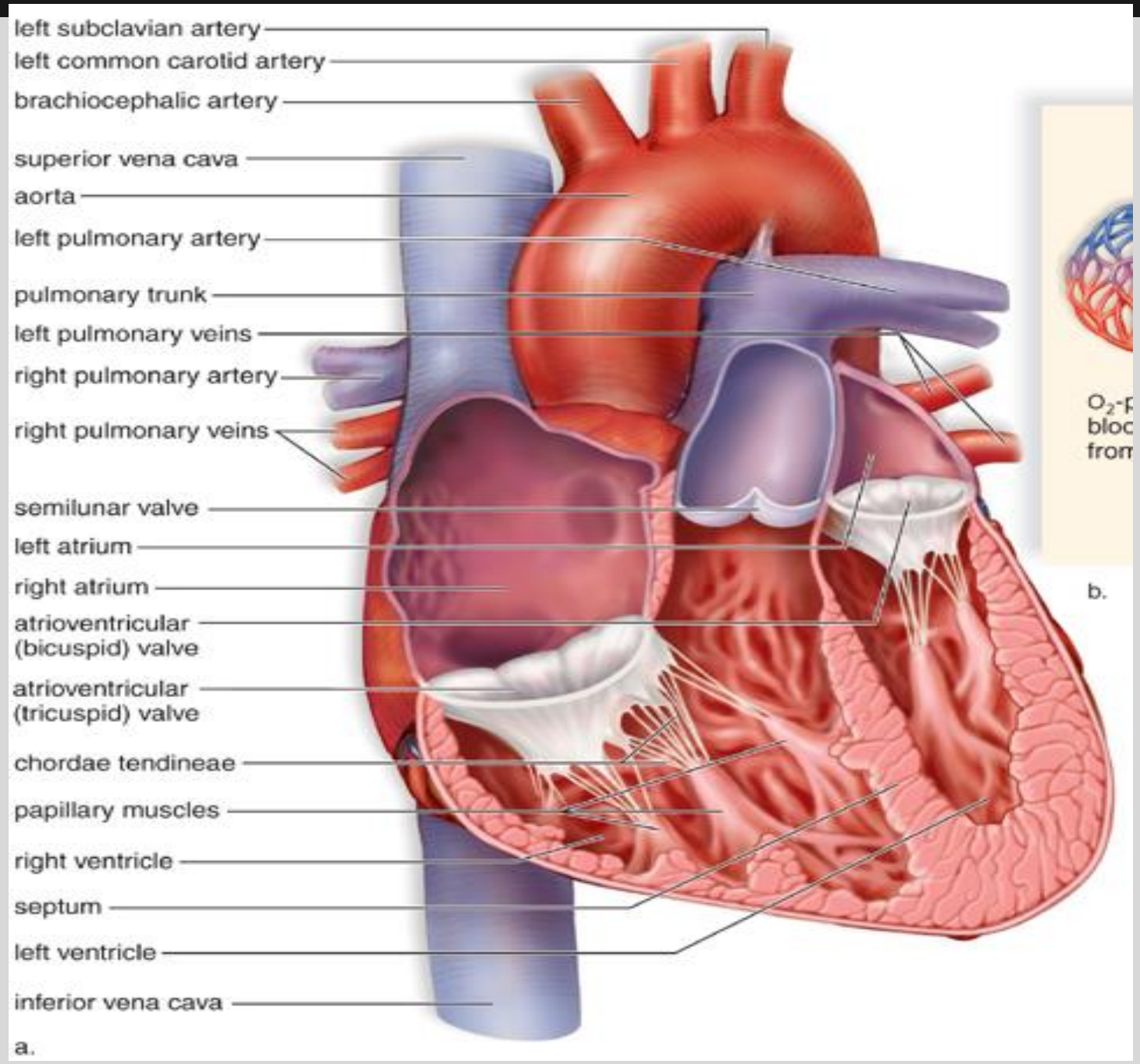


- BP higher than osmotic pressure at arterial end; therefore, fluid pushed out of capillary into tissue cells along with nutrients (glucose & aa) and O2.
- BP lower than osmotic pressure at venous end; therefore, fluid pushed into capillary along with wastes (urea) and CO2.
- Excess fluid in tissues is picked up by lymphatic capillaries which deliver the fluid to the blood at the subclavian veins.



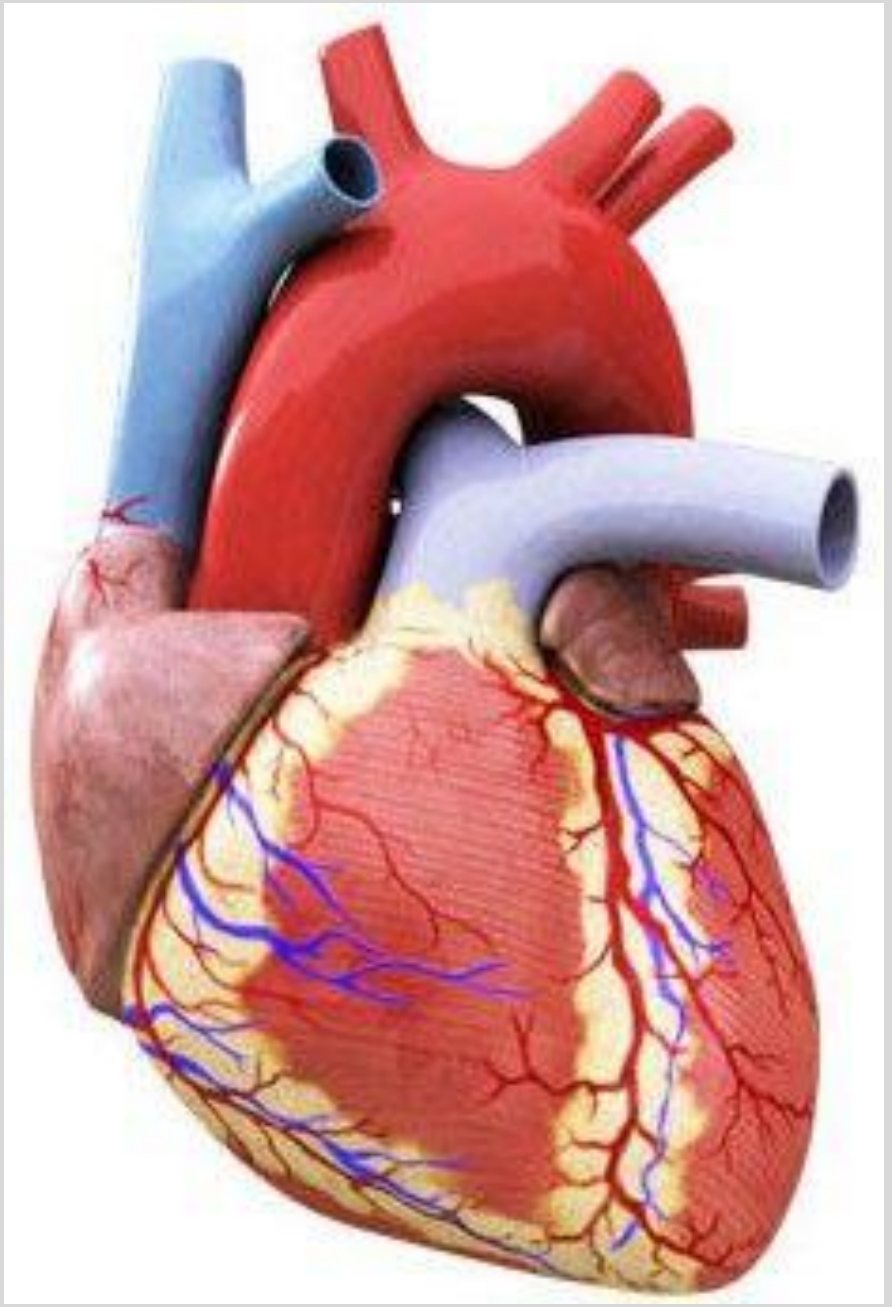
- http://highered.mcgraw-hill.com/sites/dl/free/0072464631/291136/Fluidexchange.swf


left subclavian artery
left common carotid artery
brachiocephalic artery
superior vena cava
aorta
left pulmonary artery
pulmonary trunk
left pulmonary veins
right pulmonary artery
right pulmonary veins
left atrium
left cardiac vein
right atrium
right coronary artery
left ventricle
right ventricle
inferior vena cava
apex
superior vena cava
aorta
pulmonary trunk
left coronary artery
right coronary artery
inferior vena cava
left cardiac vein
right cardiac vein
b.

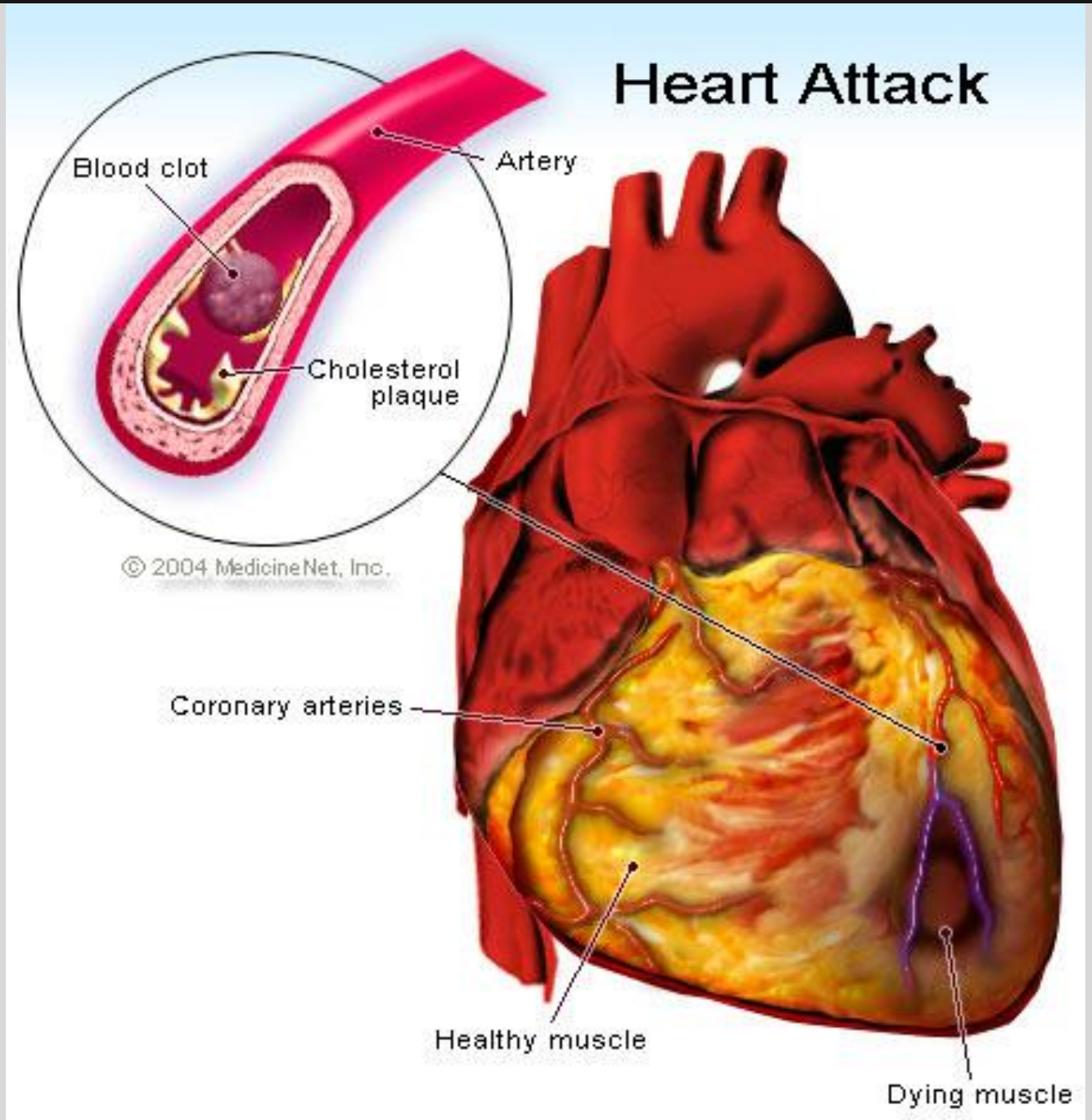

left subclavian artery
left common carotid artery
brachiocephalic artery
superior vena cava
aorta
left pulmonary artery
pulmonary trunk
left pulmonary veins
right pulmonary artery
right pulmonary veins
semilunar valve
left atrium
right atrium
atrioventricular (bicuspid) valve
atrioventricular (tricuspid) valve
chordae tendineae
papillary muscles
right ventricle
septum
left ventricle
inferior vena cava
a.
b.

The Heart

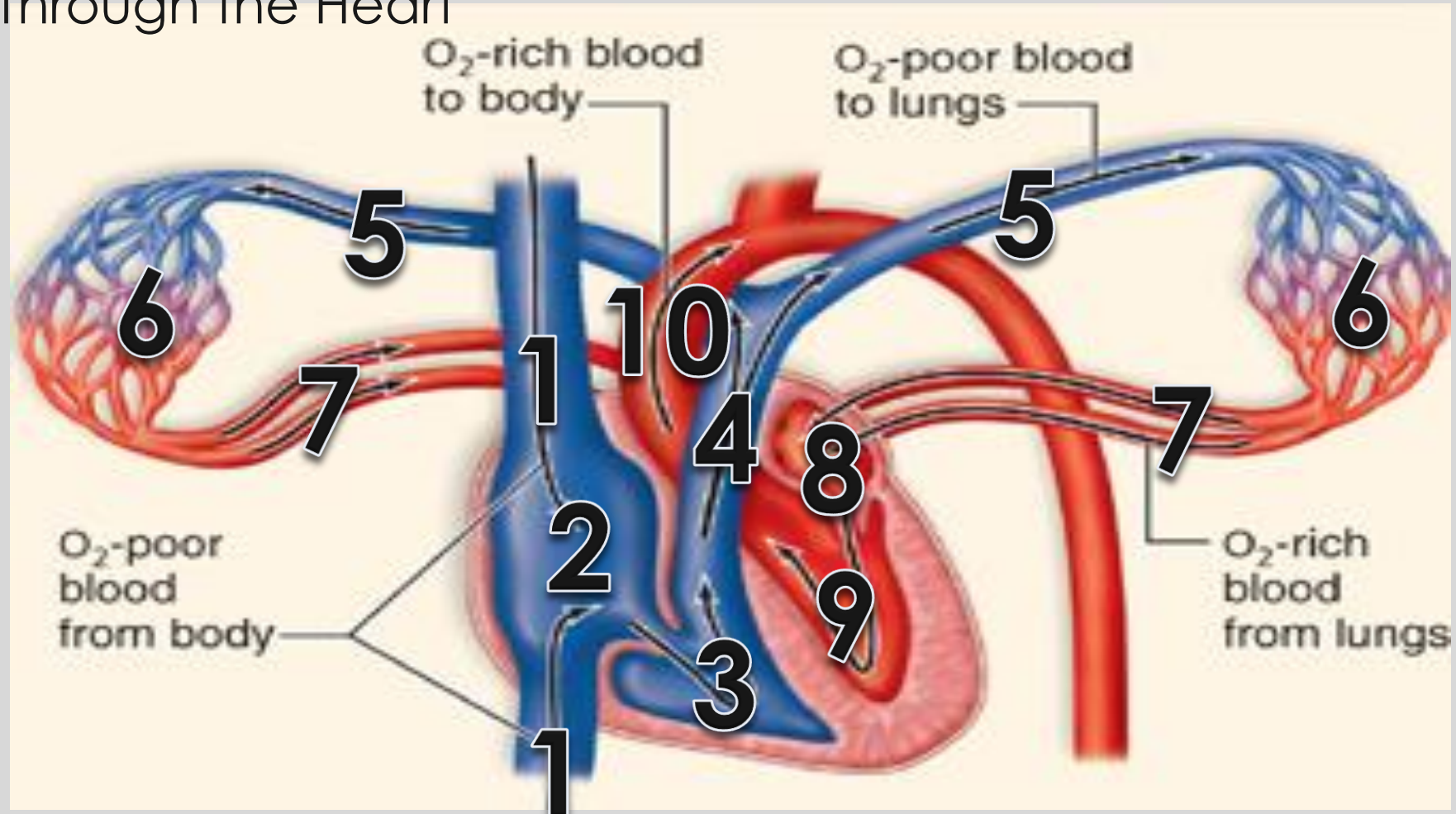
- Myocardium is a unique muscle that is controlled under the autonomic nervous system – an involuntary division.
- The wall of the left ventricle is thicker than the right because the left is pumping a greater distance the entire body while the right pumps to the lungs.
- Deoxygenated blood enters the right atrium and from the right ventricle is pumped to the lung where it is oxygenated.
- Oxygenated blood enters the left atrium and from the left ventricle is pumped to the rest of the body via the aorta
- Atrioventricular valves prevent backflow from the ventricles into the atria – chordae tendenae prevent these valves from inverting.
- Semilunar valves prevent backflow from the arteries (pulmonary artery and aorta) into the ventricles.
- The coronary artery supplies oxygen and nutrients to the my0cardium and the cardiac vein delivers carbon dioxide and wastes away from the muscles into the right atrium.



When the coronary artery becomes blocked, the myocardium that receives O2 and nutrients after the blockage will die due to a lack of O2 and nutrients.
This is a Heart Attack!



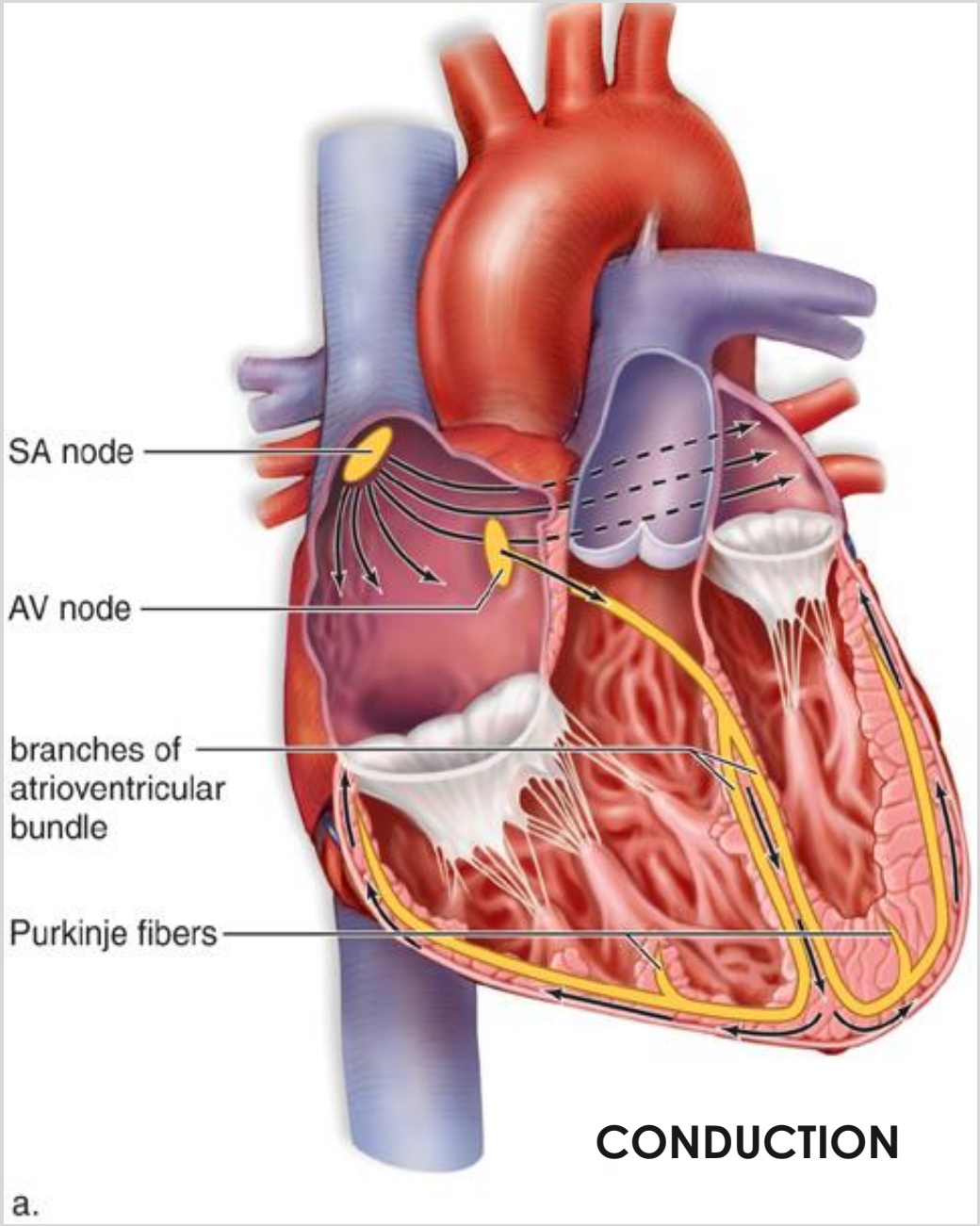
Blood Flow Through the Heart

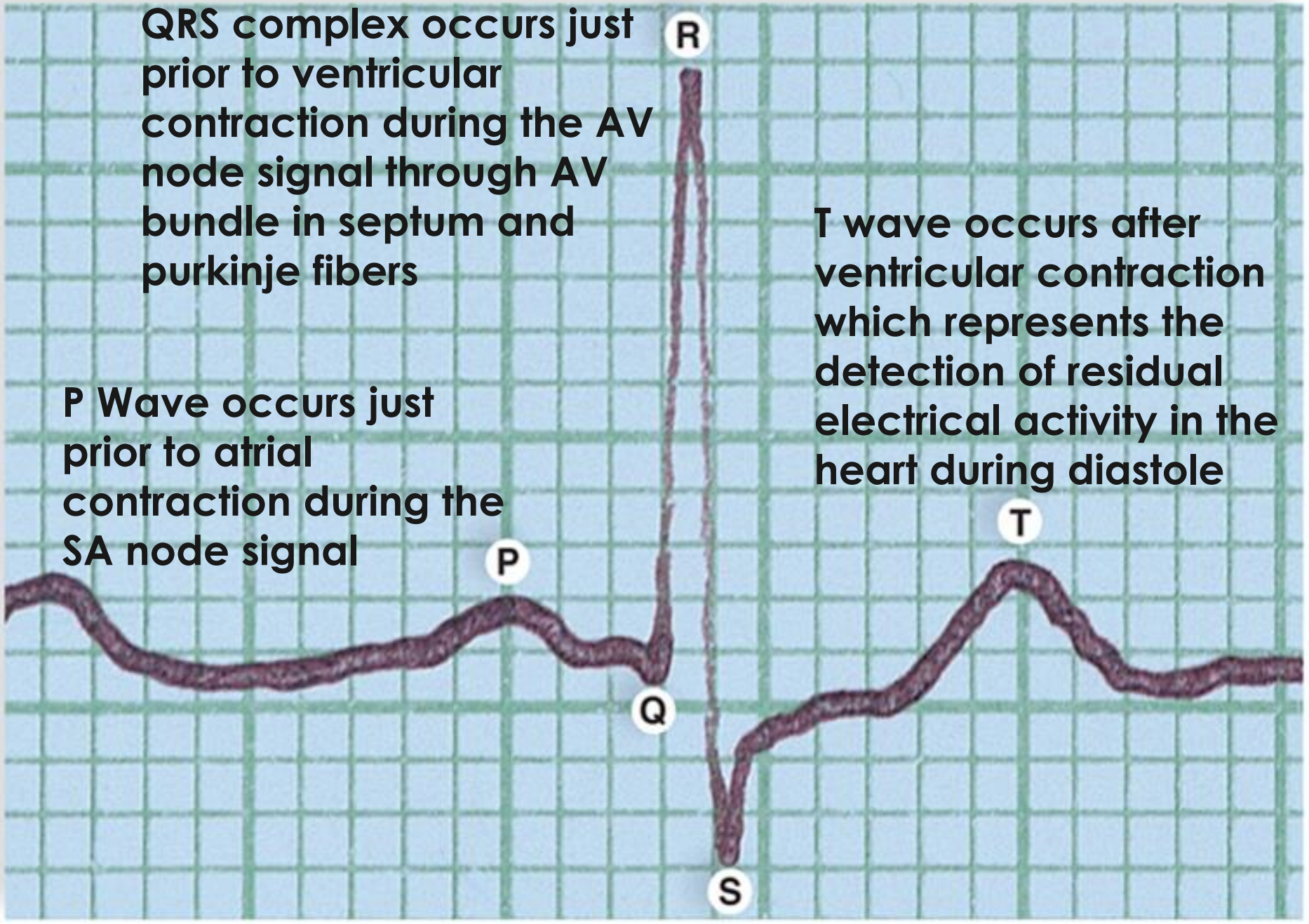


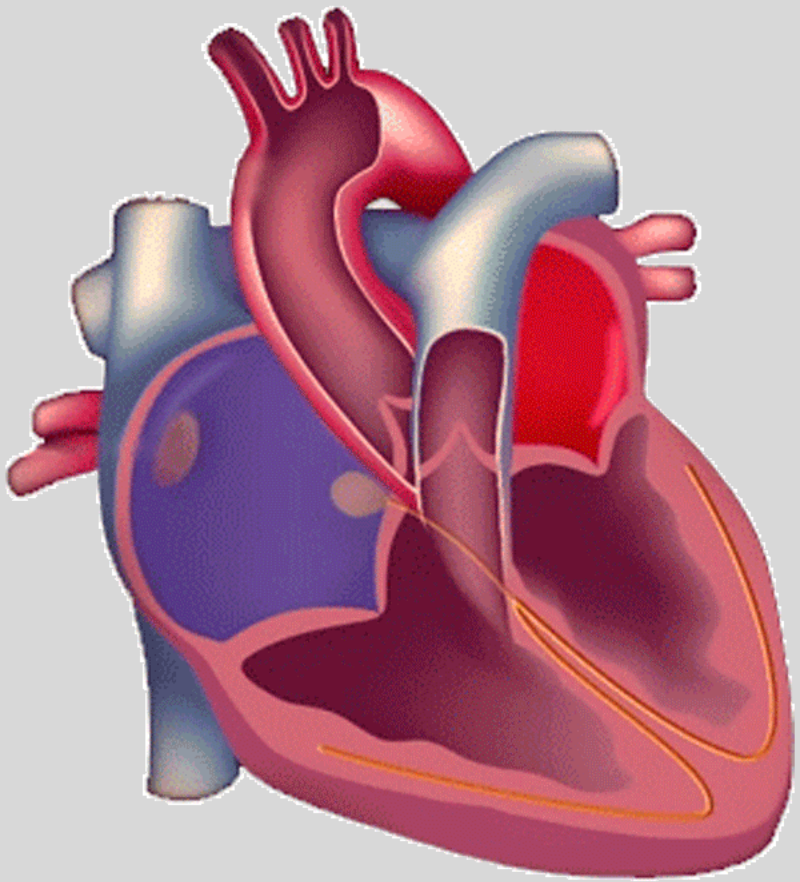
1. Superior & Inferior Vena Cava → 2. Right Atrium → Rt. Atrioventricular Valve → 3. Right Ventricle → Pulmonary Semilunar Valve → 4. Pulmonary trunk → 5. Pulmonary Arteries → 6. Pulmonary Capillaries (lungs) → 7. Pulmonary Veins → 8. Left Atrium → Left Atrioventricular Valve → 9. Left Ventricle → Aortic Semilunar Valve → 10. Aorta

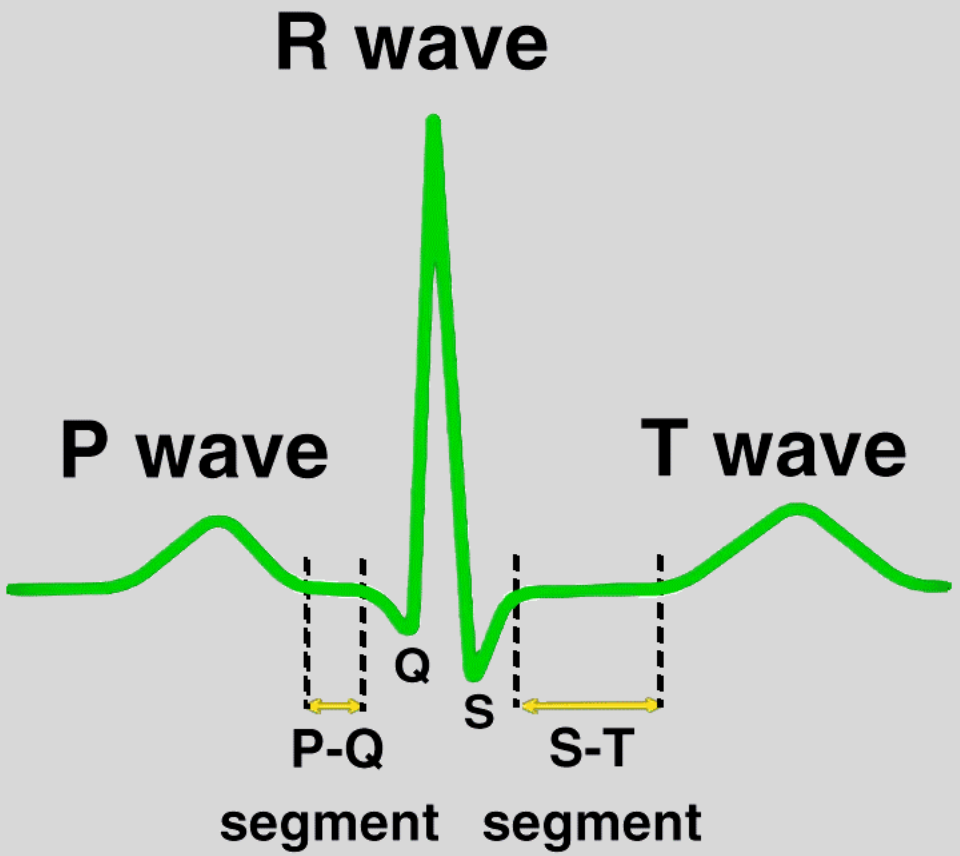
Intrinsic Heartbeat

1. The **SA node** sends a signal through the right and left atrium causing them to contract = **atrial systole**
2. The **AV node** receives the signal and sends an impulse through the **AV bundle** in the septum and the **purkinje fibers** in the ventricle walls causing them to contract = **ventricular systole**
3. The electrical signal dissipates leaving **residual electrical activity** after contraction during **heart diastole**



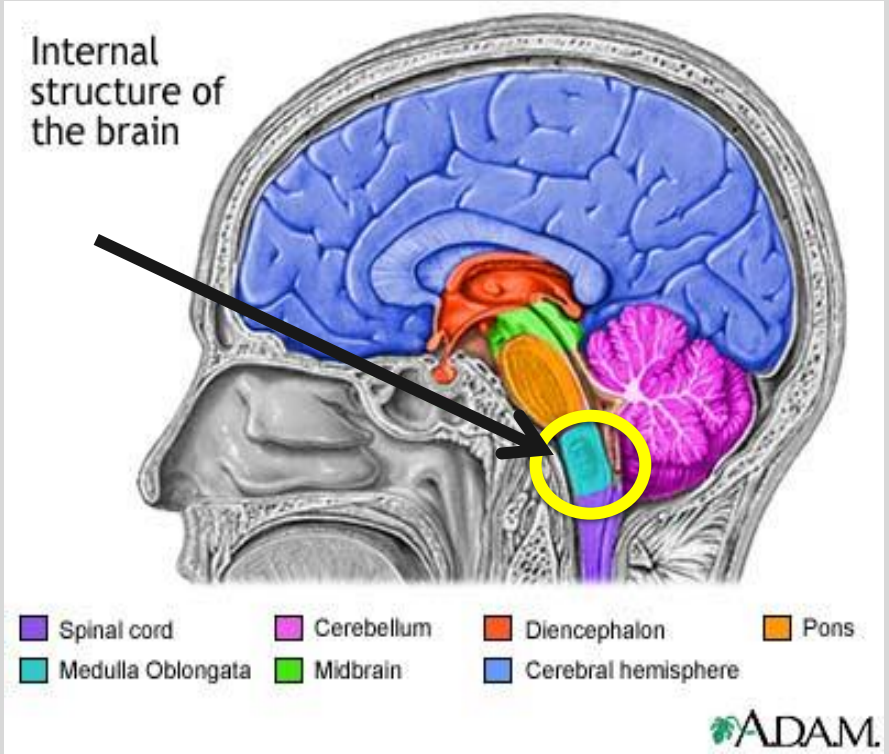

QRS complex occurs just prior to ventricular contraction during the AV node signal through AV bundle in septum and purkinje fibers
T wave occurs after ventricular contraction which represents the detection of residual electrical activity in the heart during diastole
P Wave occurs just prior to atrial contraction during the SA node signal
R
P
T
Q
S




R wave
P wave
T wave
Q
S
P-Q
segment
S-T
segment

Extrinsic Control of Heartbeat

Medulla Oblongata in the brain sends signals to the SA node of the heart to increase or decrease heart rate depending on the needs of the body.



Sympathetic = fight or flight
Epinephrine is released which increases SA node stimulation and therefore, increases heart rate (& blood velocity)

Parasympathetic = relaxed state
Acetylcholine is released which decreases SA node stimulation and therefore, decreases heart rate (& blood velocity)

Blood pressure is measured with a sphygmomanometer.

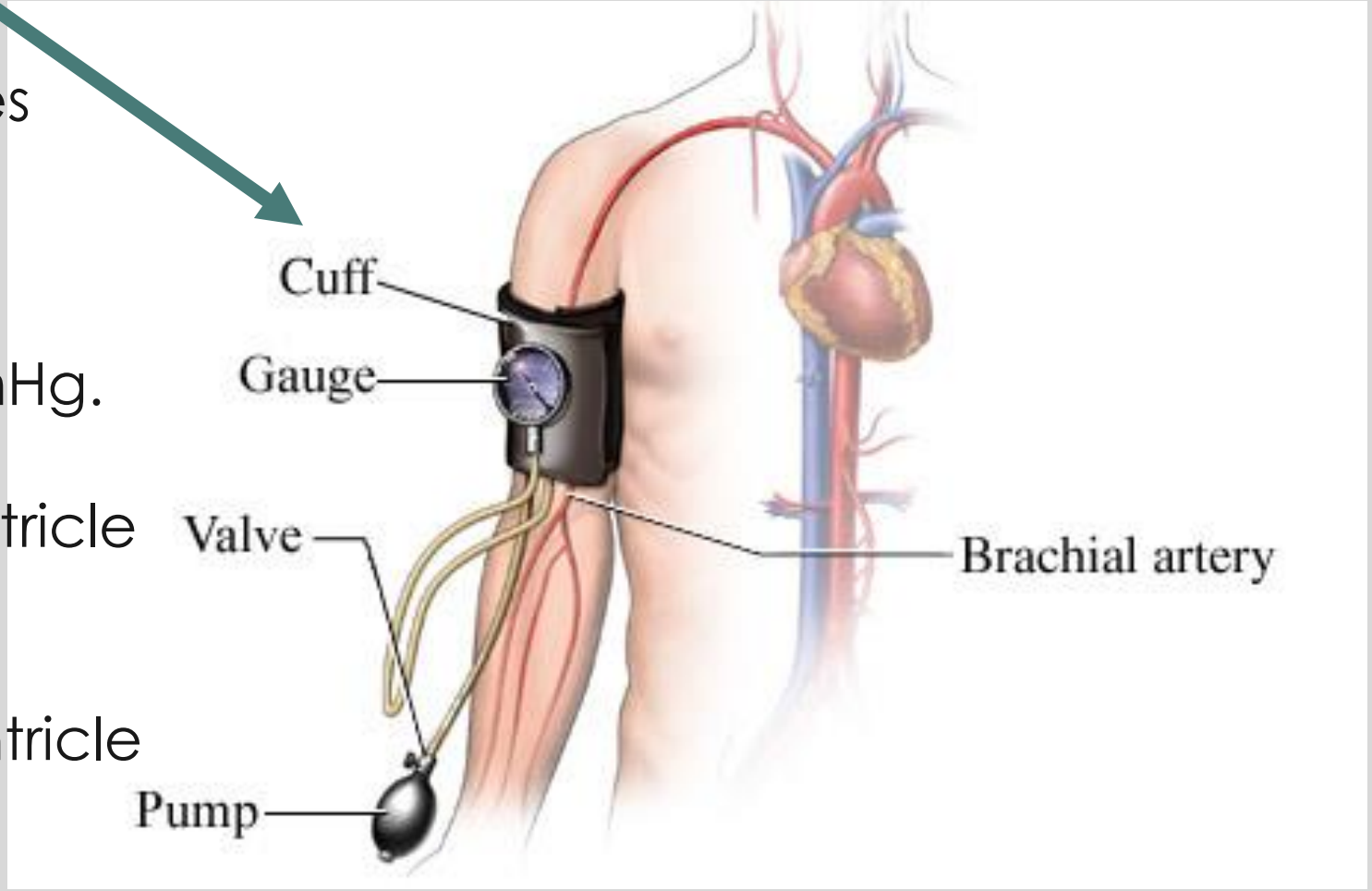
BP in systemic arteries indicates proper functioning of the left ventricle.

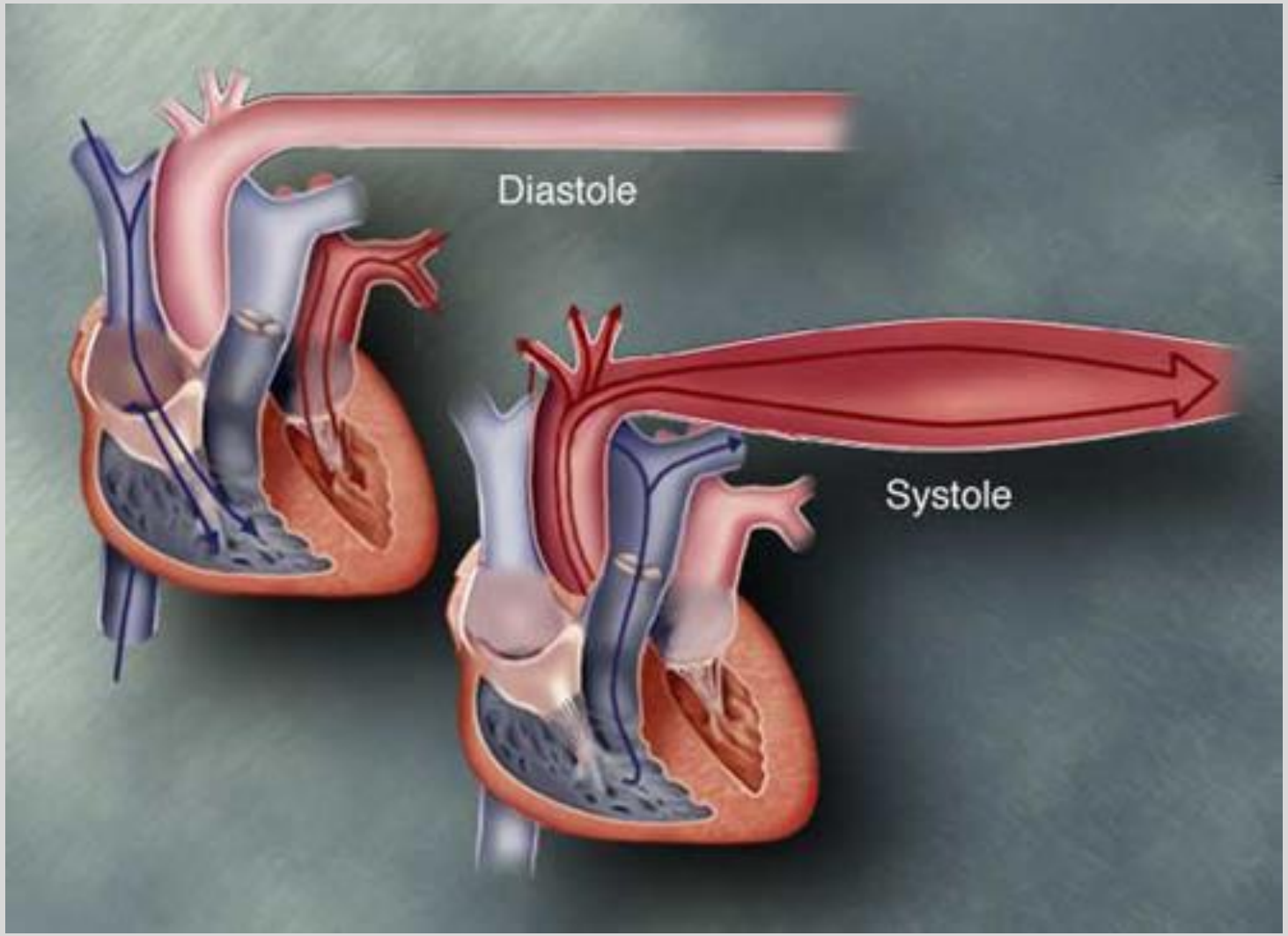
Normal BP is about 120/80 mmHg.

120 = systolic BP when the ventricle contracts

80 = diastolic BP when the ventricle relaxes

Hypertension is BP > 120/80
Hypotension is BP < 120/80





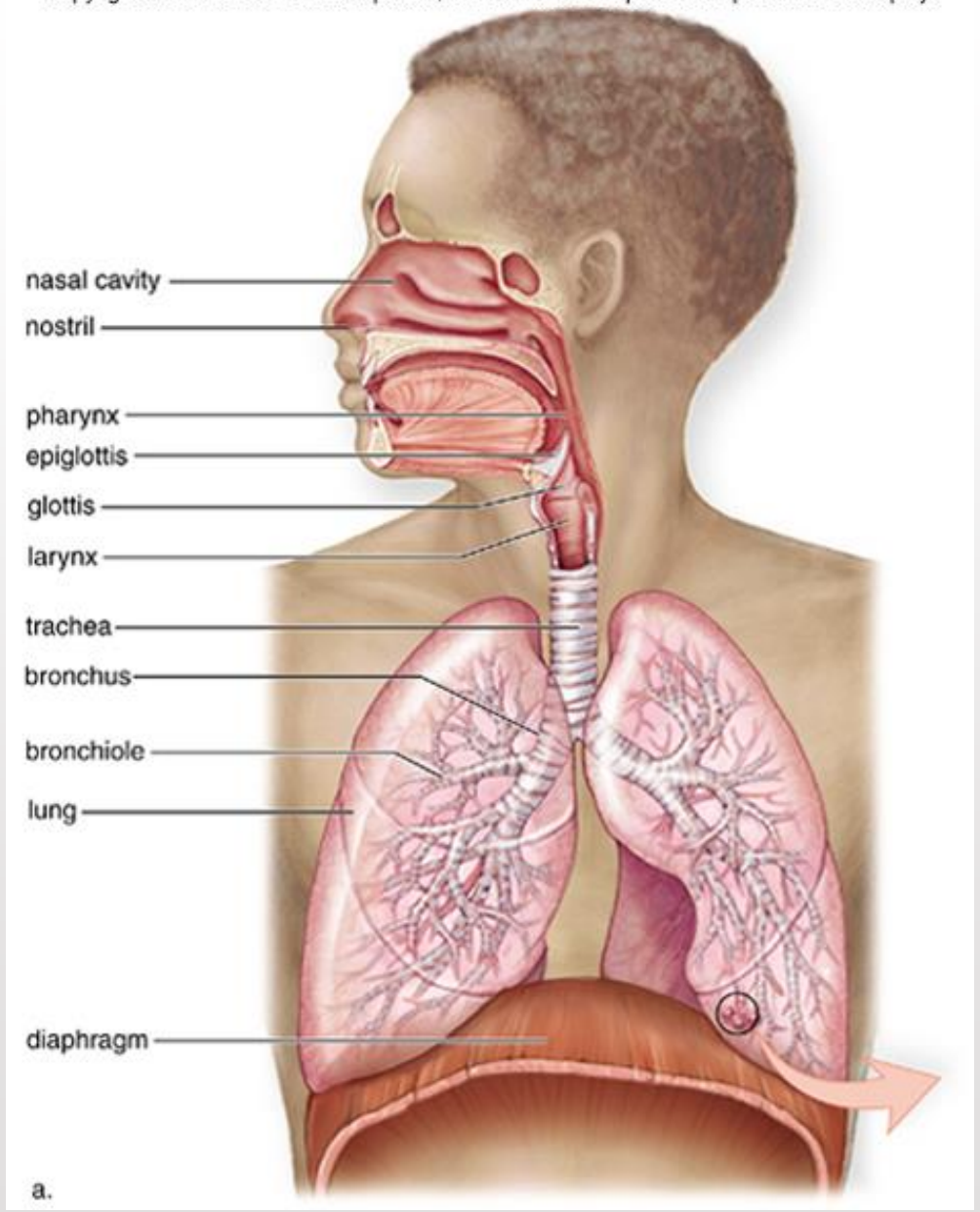
- When the left ventricle is in systole, there is an increase in pressure in the systemic arteries. This is systolic BP.
- When the left ventricle is in diastole, the arteries experience a resting blood pressure. This is diastolic BP.
- Pulse is felt in the systemic arteries with every heart beat and can indicate the heart rate and minimum BP.

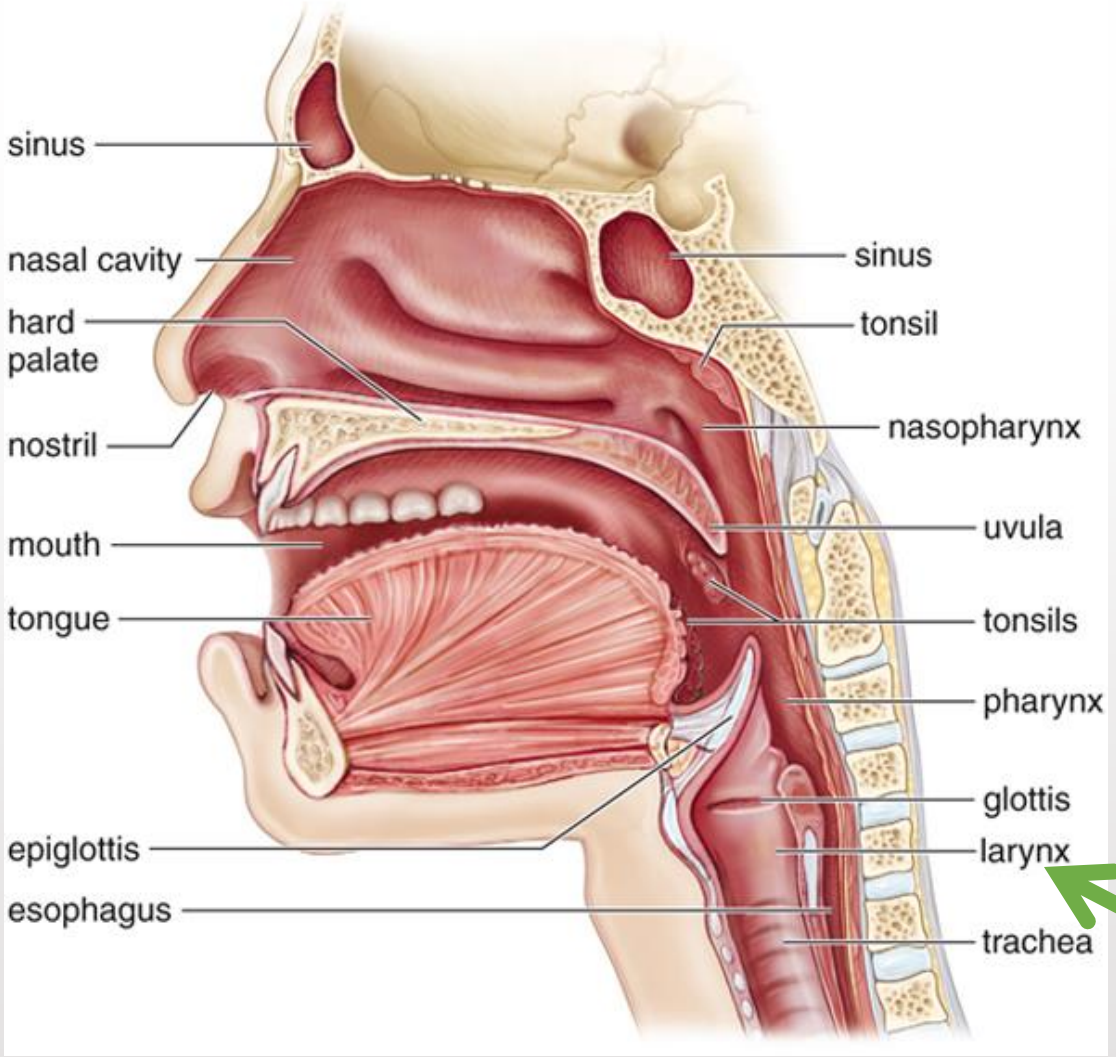
Chapter 11: Respiration

Structures of the Respiratory System

TABLE 15.1 Path of Air

Structure	Description	Function
Upper Respiratory Tract		
Nasal cavities	Hollow spaces in nose	Filter, warm; and moisten air
Pharynx	Chamber posterior to oral cavity; lies between nasal cavity and larynx	Connection to surrounding regions
Glottis	Opening into larynx	Passage of air into larynx
Larynx	Cartilaginous organ that houses the vocal cords; voice box	Sound production
Lower Respiratory Tract		
Trachea	Flexible tube that connects larynx with bronchi	Passage of air to bronchi
Bronchi	Paired tubes inferior to the trachea that enter the lungs	Passage of air to lungs
Bronchioles	Branched tubes that lead from bronchi to alveoli	Passage of air to each alveolus
Lungs	Soft, cone-shaped organs that occupy lateral portions of thoracic cavity	Contain alveoli and blood vessels
Alveoli	Thin-walled microscopic air sacs in lungs	Gas exchange between air and blood



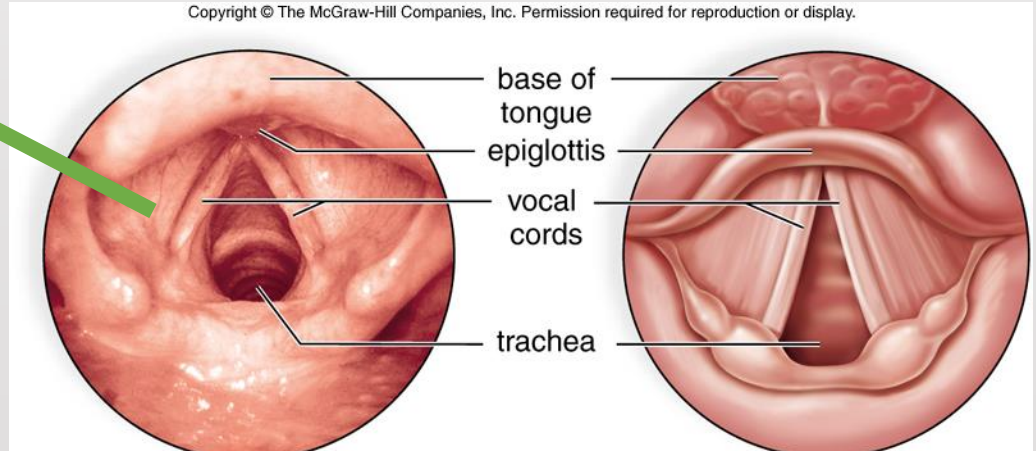


1. Nasal cavity has mucosal folds that warm and humidify the air, and cilia that help filter the air.

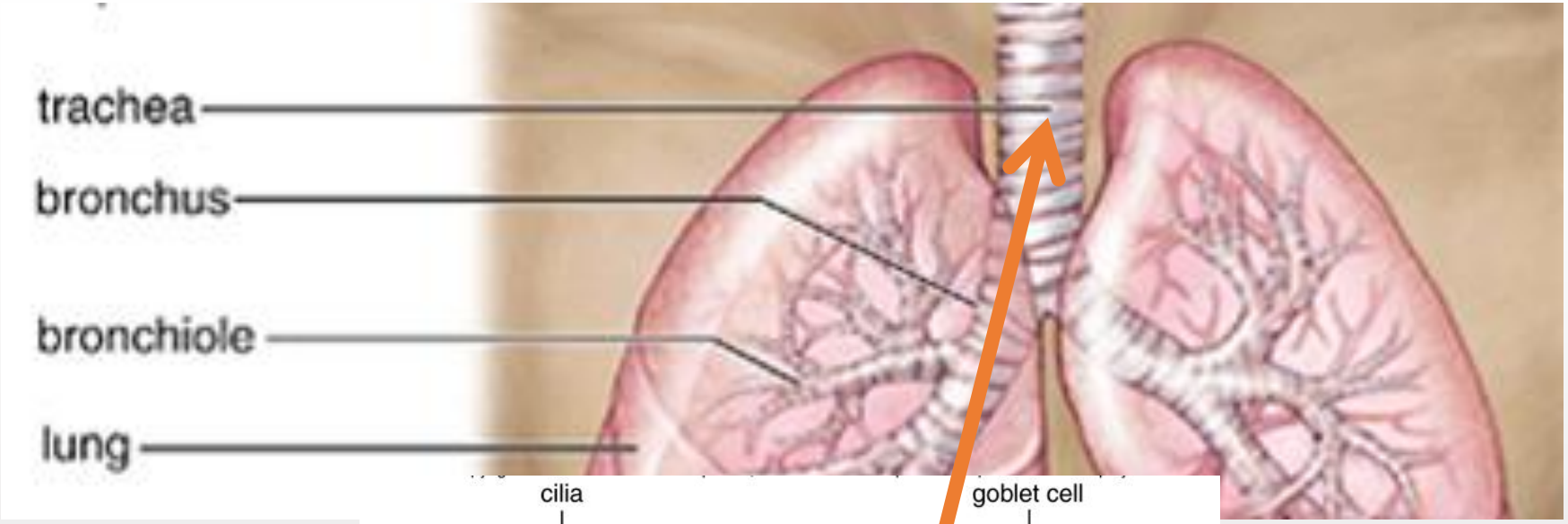
2. Pharynx is a common passage for air and food.

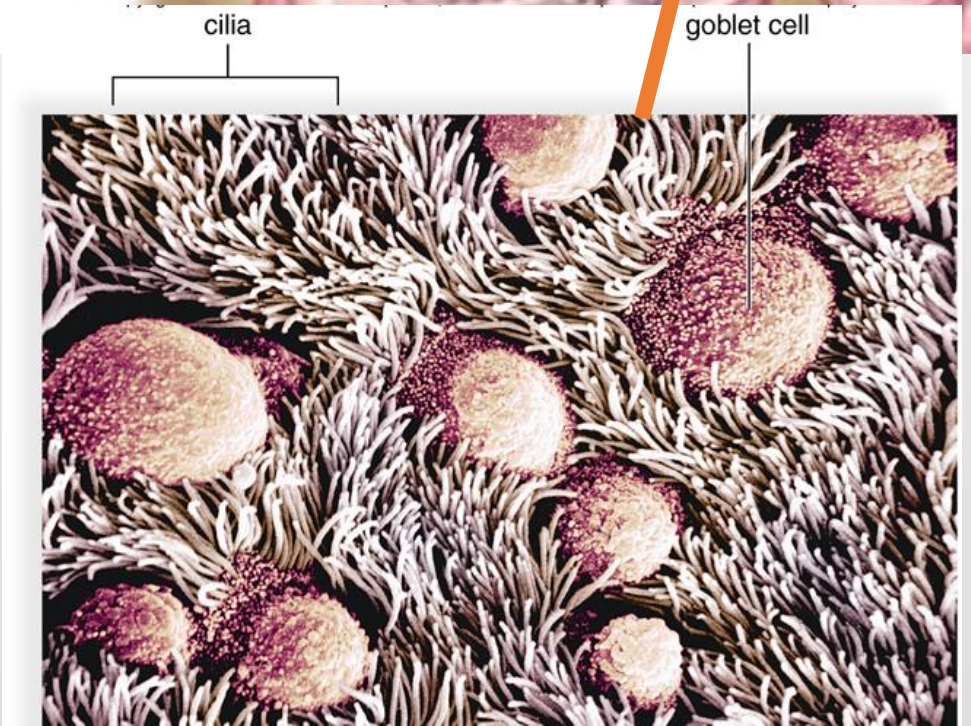
3. Epiglottis is open to allow air through the glottis

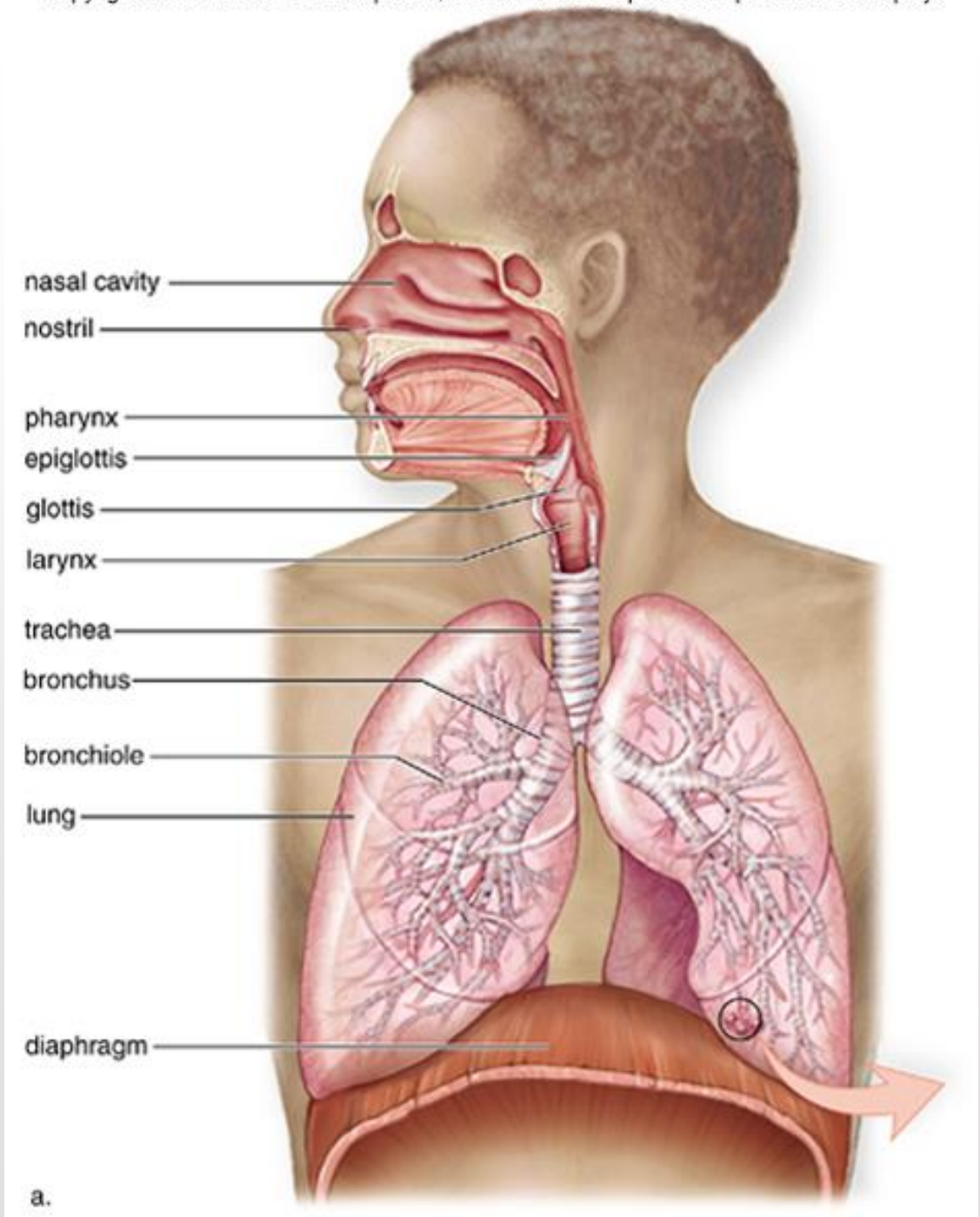
4. Air passes through the vocal cords in the larynx; they are mucosal folds that vibrate to form sounds as air passes



Air passes through trachea to lungs.


trachea
bronchus
bronchiole
lung

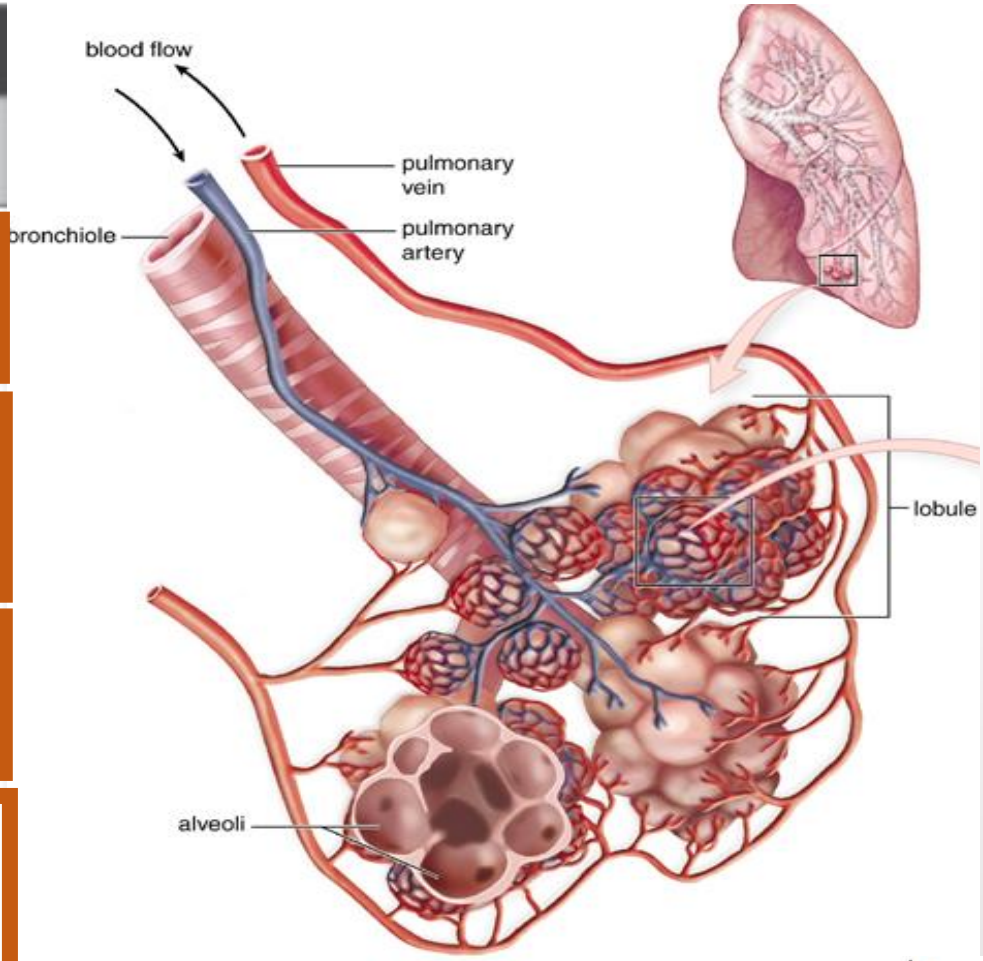

cilia
goblet cell



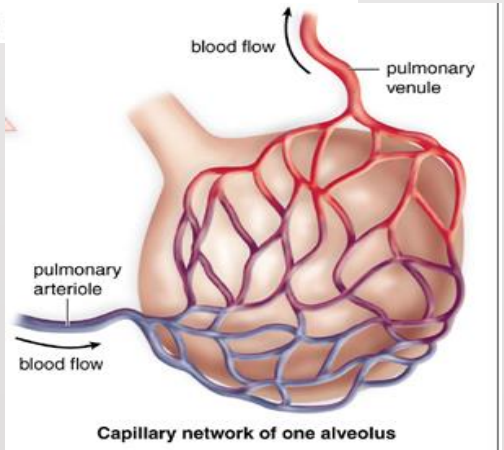
6. Trachea divides into two branches called the bronchi (singular = bronchus)

- 7. Bronchi further branch out throughout the lung into bronchioles
- Bronchioles are the smallest passages for air before the air sacs call alveoli
- Bronchioles contain smooth muscle which can contract or relax; ex. Asthma occurs when bronchioles contract and swell.

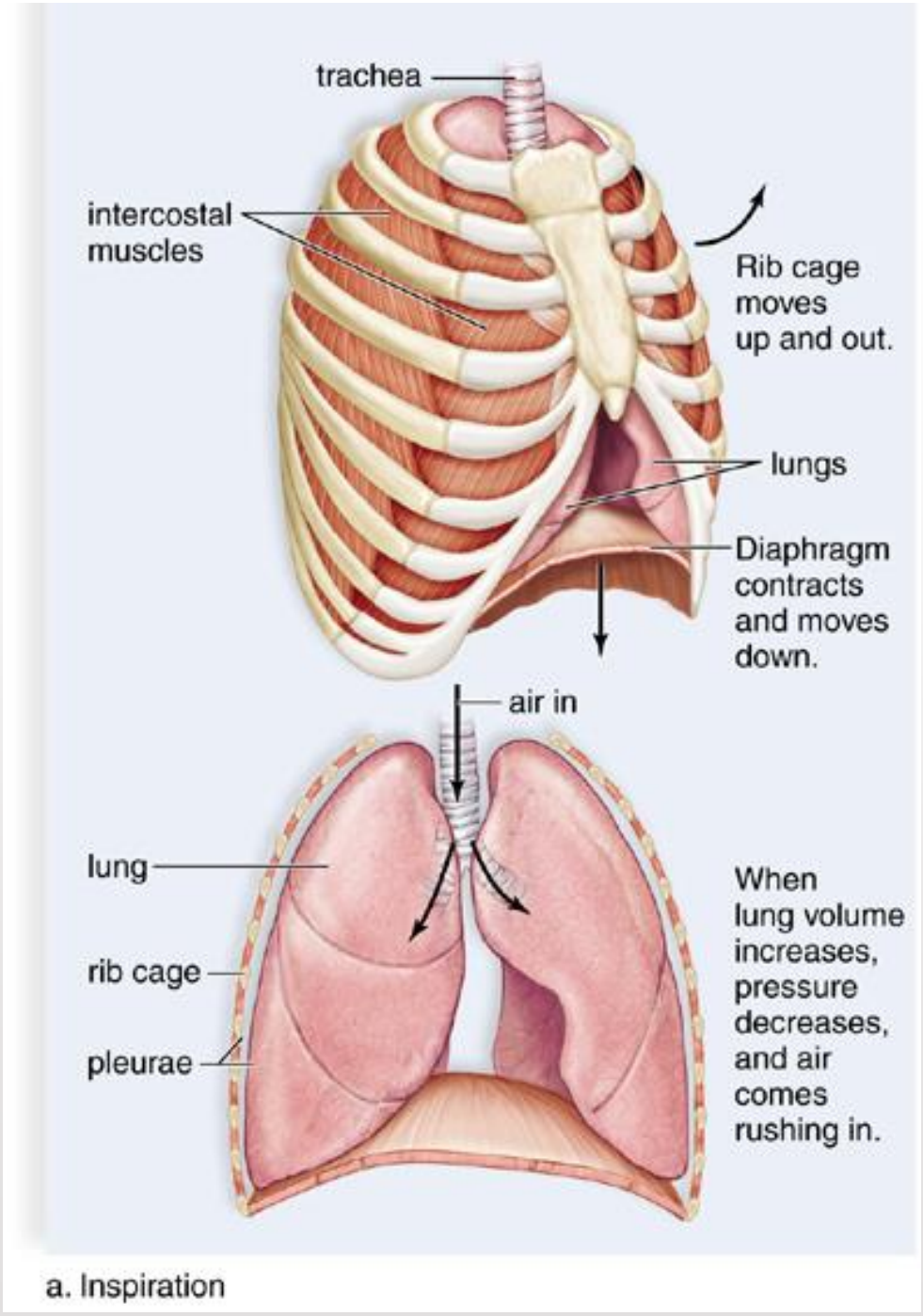
Alveoli Structure and Function Summary	
Structural Component	**Functional Benefit**
Alveoli are arranged in grape-like clusters	Greatly increases surface area for gas exchange
Thin walls—one cell thick	Increases rate of diffusion of oxygen and carbon dioxide between alveoli and blood
Densely covered with blood capillaries	Large contact area between alveoli and blood supply
Inner walls are lined with pulmonary surfactant	Lowers the surface tension within the alveoli and prevents them from collapsing
Walls of alveoli are moist	Aids rate of diffusion of gases
Alveoli contain stretch receptors	Prevents alveoli from over-filling with air and causing damage to the thin walls.



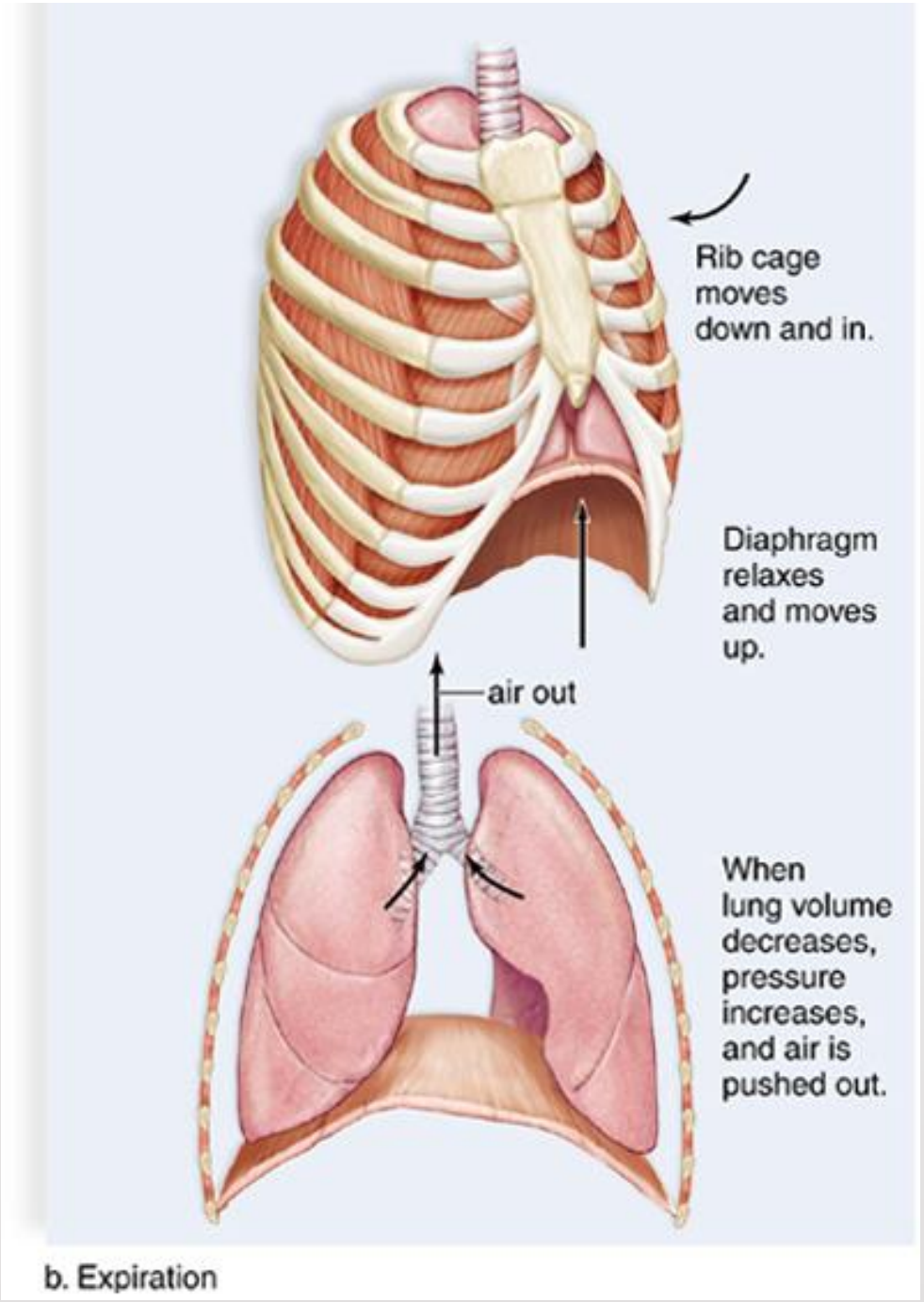
Blood supply of alveoli



Capillary network of one alveolus



a. Inspiration

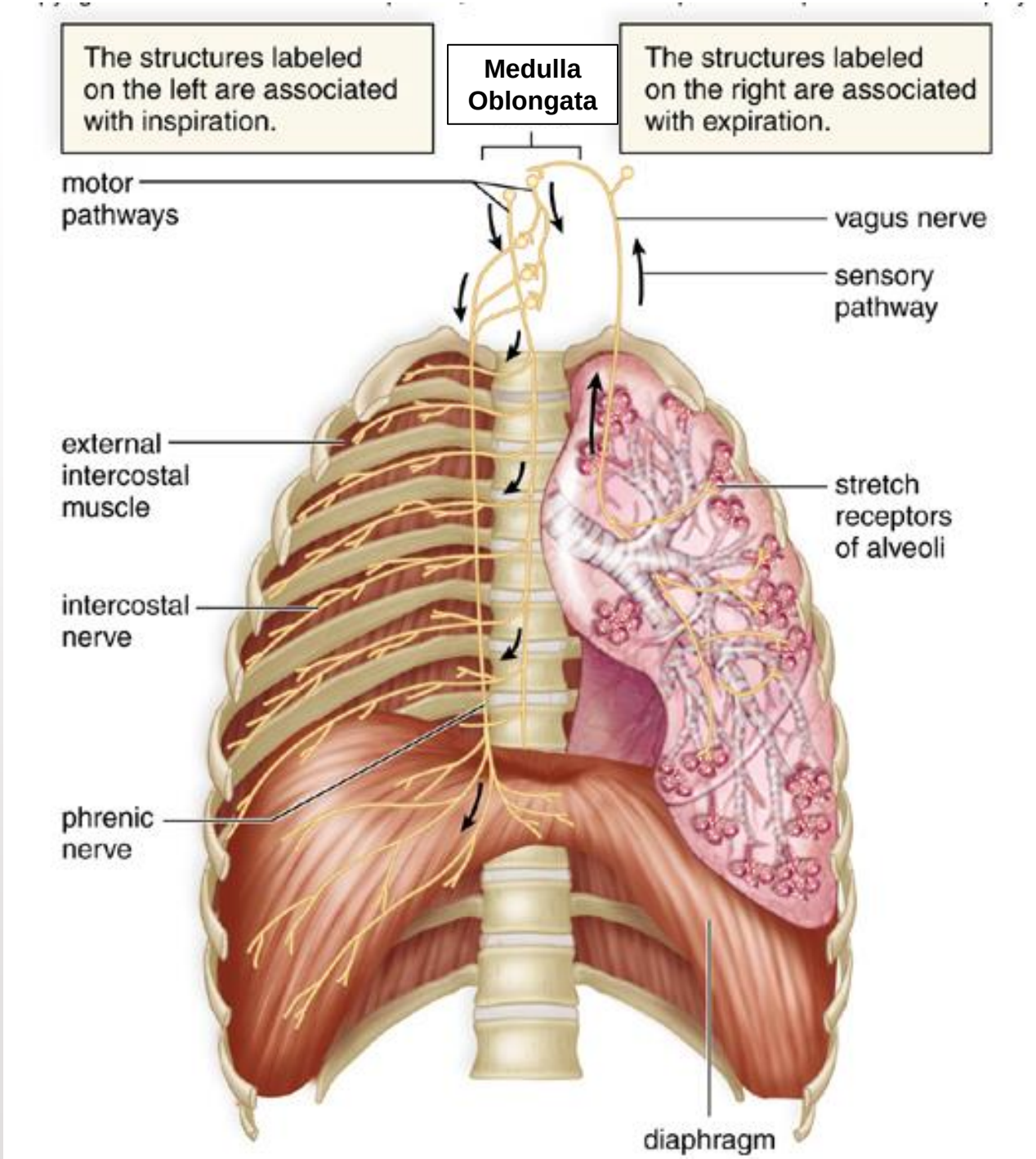


b. Expiration

Inhalation vs. Exhalation

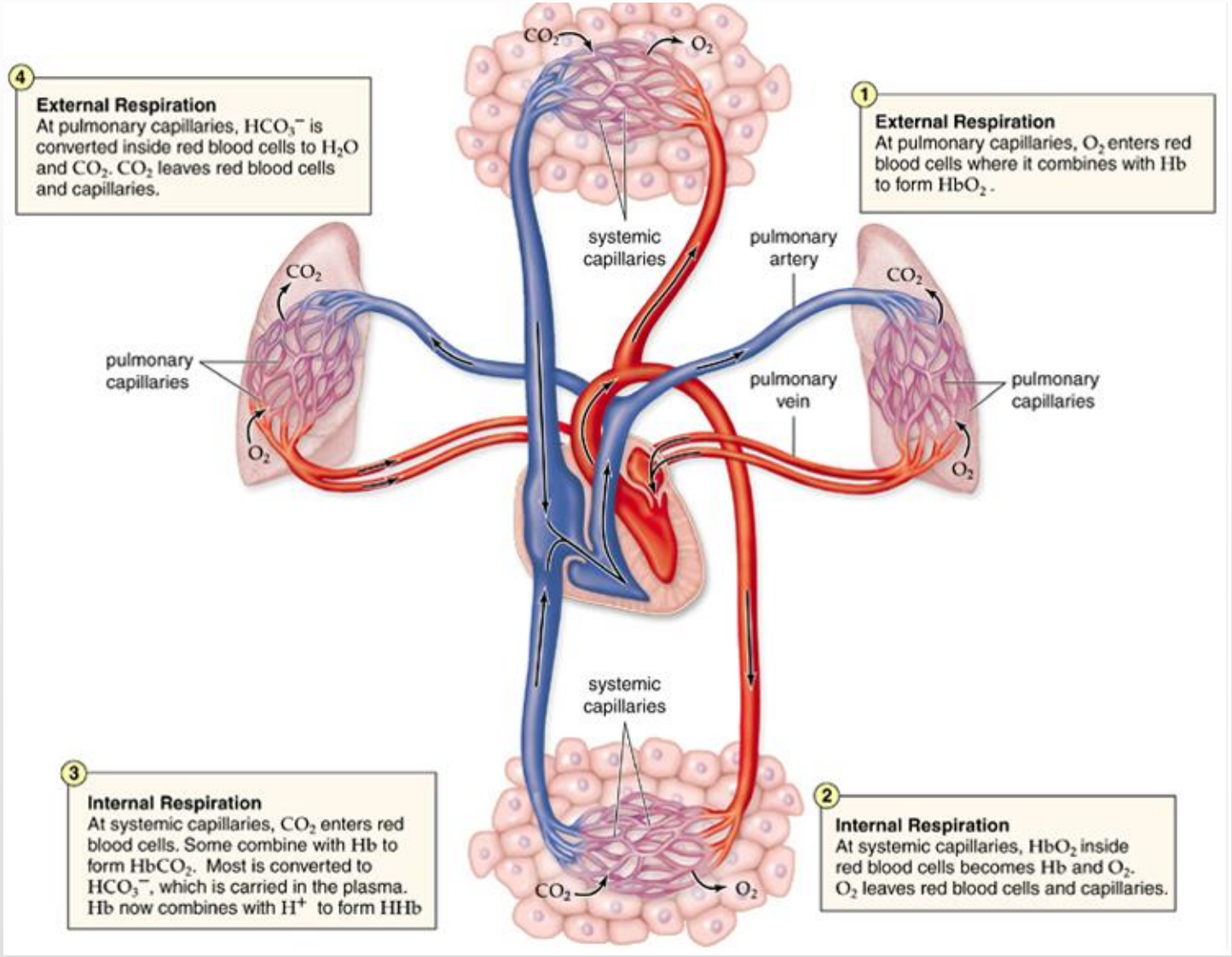
- The medulla oblongata detects an increase in CO_2 and H^+ in the blood and/or the carotid and aortic bodies detect a decrease in O_2 in the blood.
- A signal is sent to the intercostal muscles and diaphragm to contract.
- The ribs move up and out and the diaphragm flattens/lowers.
- The lungs are pulled open due to pleural membranes and a negative pressure is created inside the lungs.
- Air is pulled into the lungs for inhalation/inspiration.

- The stretch receptors in the alveoli detect overfilling of alveoli.
- A signal is sent to the medulla oblongata to stops signals to intercostals and diaphragm.
- The intercostal muscles and diaphragm relax.
- The ribs move down and in and the diaphragm moves up to dome shape.
- There is a positive pressure in the lungs as they are compressed.
- Air is pushed out of lungs for exhalation/expiration.


The structures labeled on the left are associated with inspiration.
Medulla Oblongata
The structures labeled on the right are associated with expiration.
motor pathways
vagus nerve
sensory pathway
external intercostal muscle
stretch receptors of alveoli
intercostal nerve
phrenic nerve
diaphragm

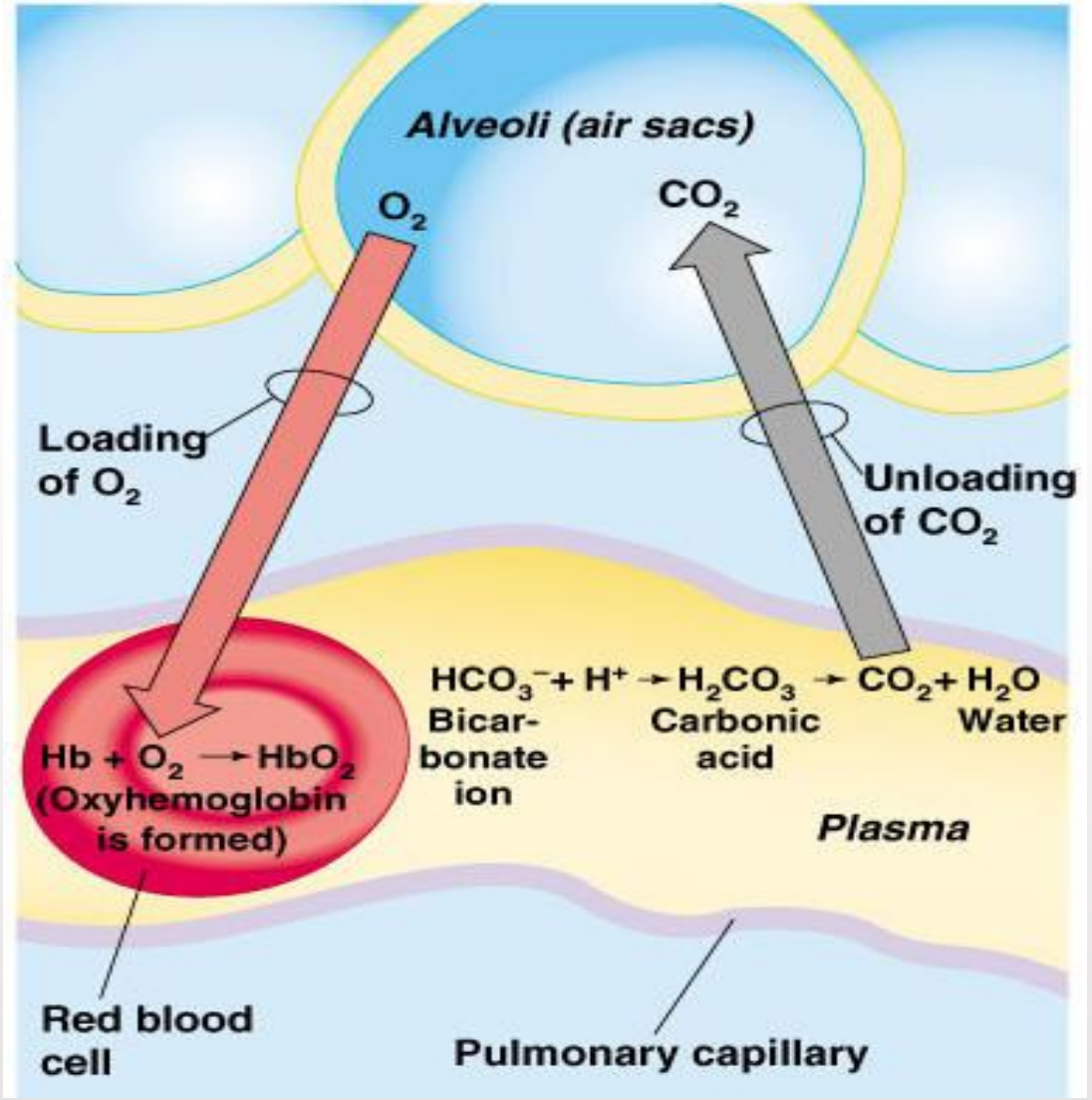
External and Internal Respiration

- ***External respiration*** consists of the reactions that occur in the ***pulmonary capillaries at the lungs***
- ***Internal respiration*** consists of the reactions that occur in the ***systemic capillaries at the tissues***



External Respiration

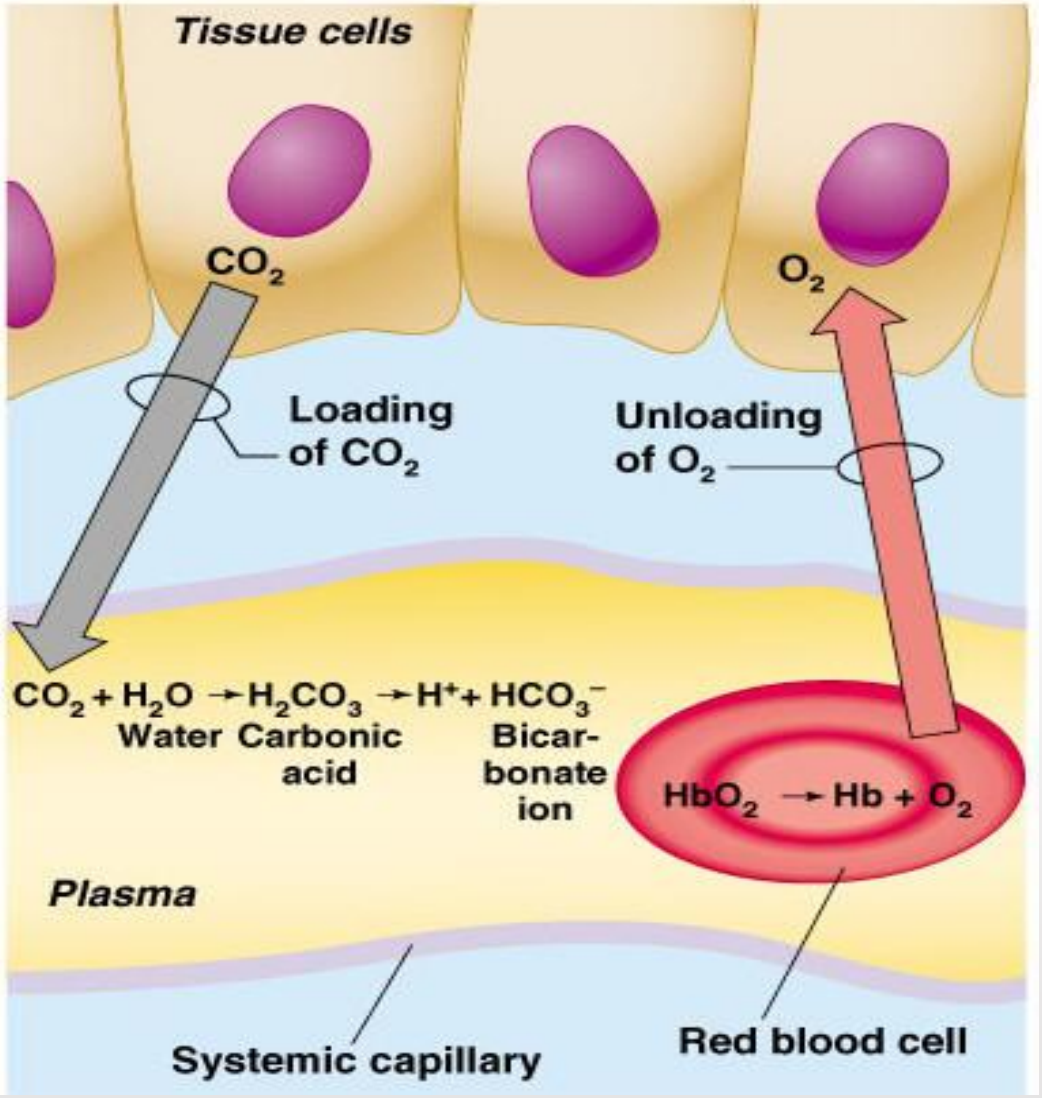
- O2 from the alveoli enters the blood capillary due to diffusion
- O2 then binds to hemoglobin forming oxyhemoglobin and blood becomes oxygenated and high in HbO2
- Hemoglobin has a high affinity for O2 in lungs where it is slightly cool and basic compared to tissues
- CO2 was carried in the form of bicarbonate ion ($HCO3^-$)
- $HCO3^-$ is converted to CO2 at the lungs and CO2 diffuses out of the blood and into the alveoli for exhalation
- Hemoglobin was also carrying CO2 and H^+ from the tissues and those are released in the lungs so CO2 is exhaled and hydrogen ion is use in bicarbonate reaction.



$$Hb + O_2 \rightarrow HbO_2$$
$$HCO_3^- + H^+ \rightarrow H_2CO_3 \rightarrow CO_2 + H_2O$$
$$HbCO_2 \rightarrow Hb + CO_2$$
$$HHb \rightarrow H^+ + Hb$$

Internal Respiration

- Oxyhemoglobin arrives at the tissues.
- The blood is slightly warm and acidic here at the tissues compared to the cool and basic lungs so hemoglobin has a low affinity for O2 and O2 detaches to diffuse into tissue cells
- CO2 produced by the tissues enters the blood by diffusion and is converted into bicarbonate ion by carbonic anhydrase enzyme.
- Hemoglobin also picks up CO2 and H^+ from the bicarbonate ion reaction to buffer the blood and prevent from becoming acidic.
- HHb is called reduced hemoglobin
- HbCO2 is called carbominohemoglobin

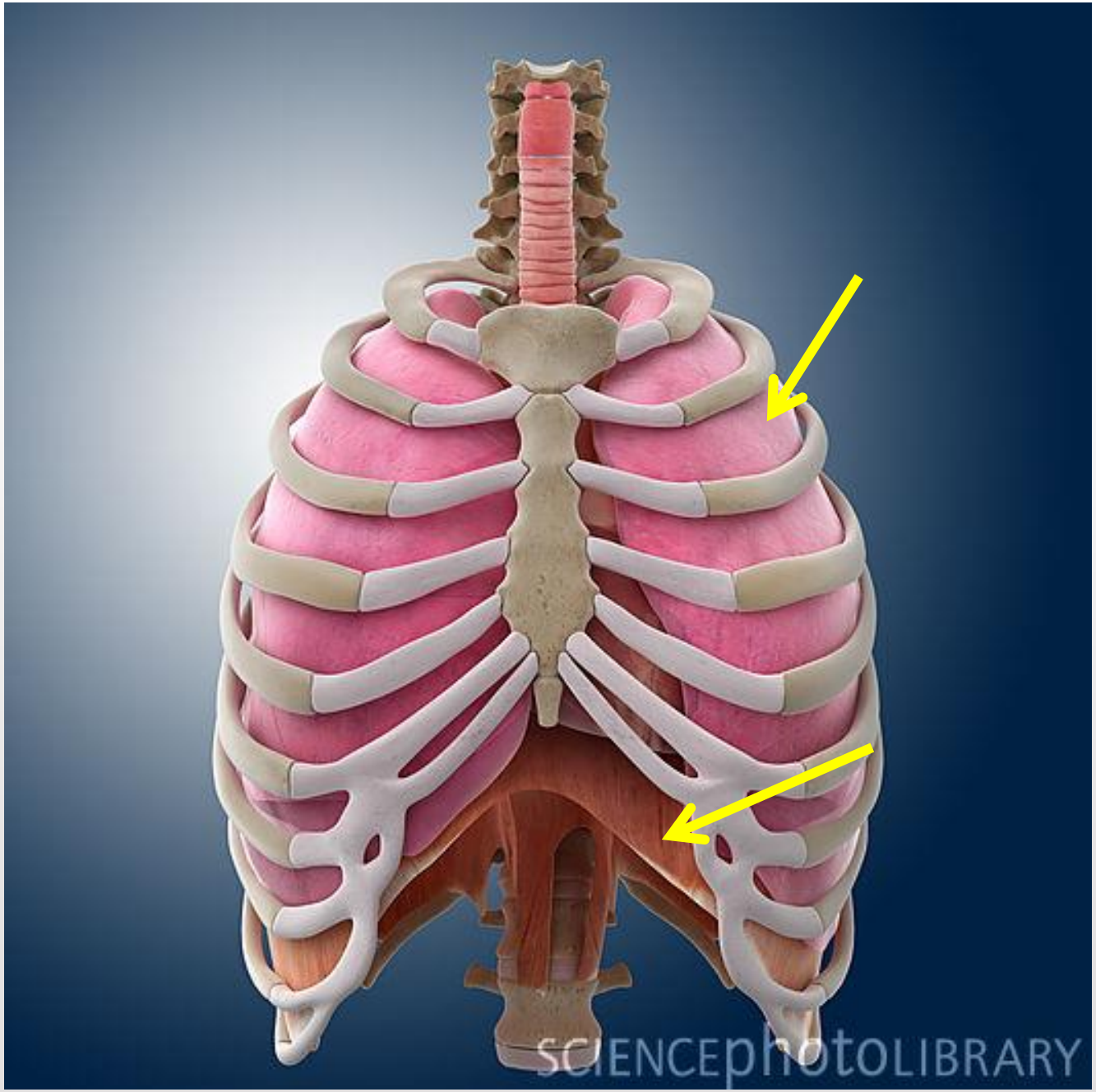


$$HbO_2 \rightarrow Hb + O_2$$

$$CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow HCO_3^- + H^+$$

$$Hb + CO_2 \rightarrow HbCO_2$$

$$H^+ + Hb \rightarrow HHb$$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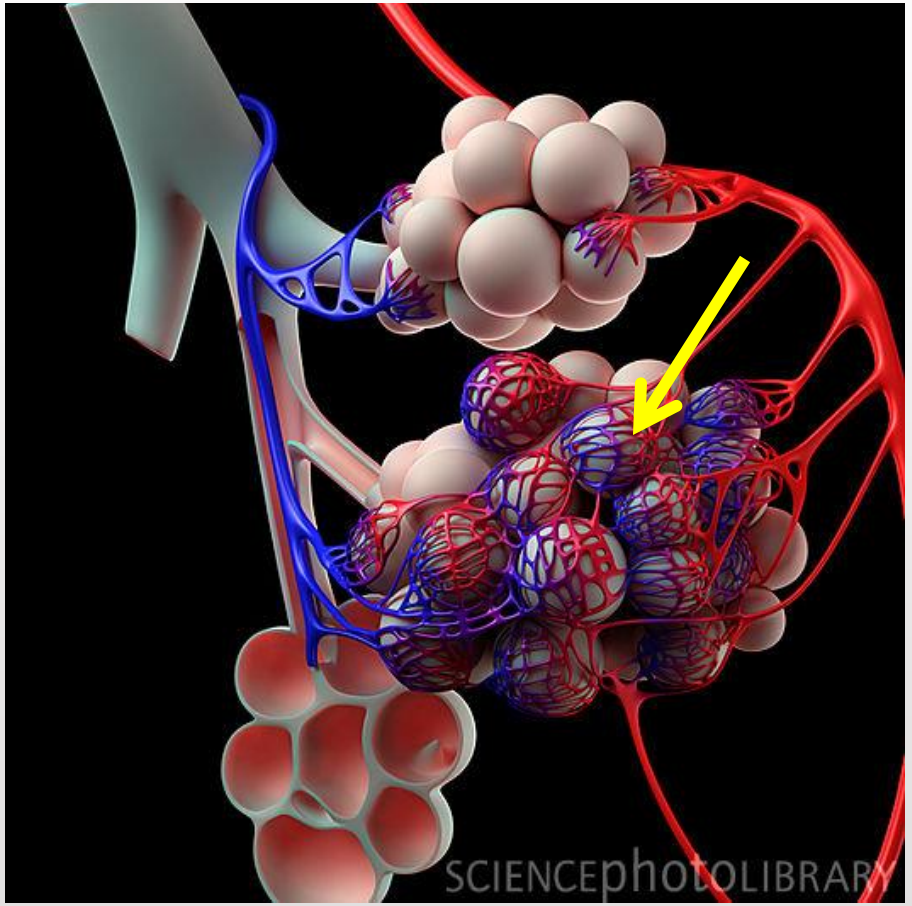
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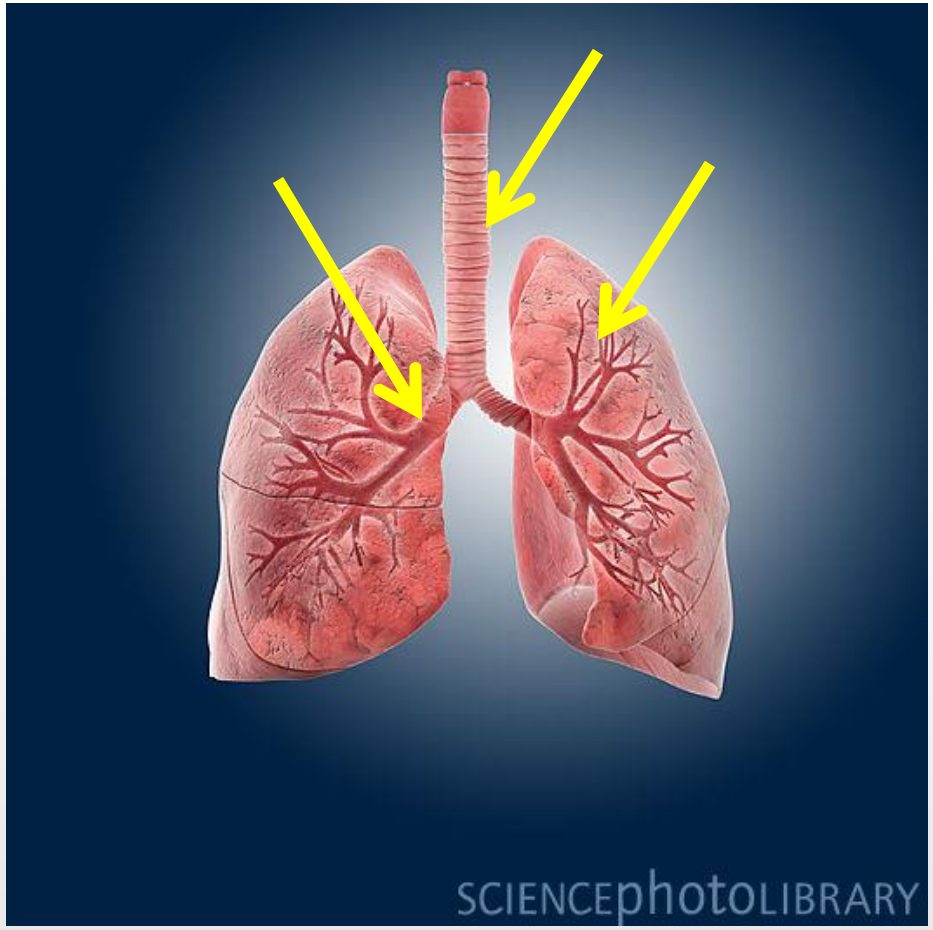
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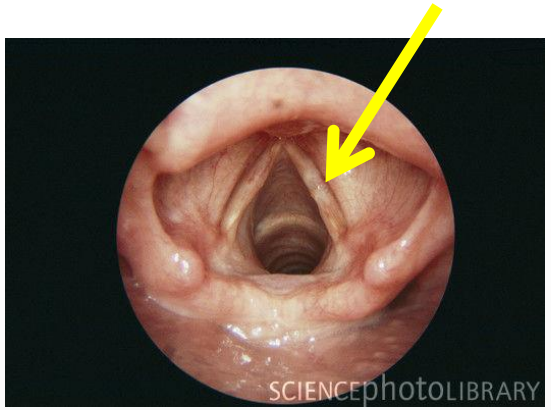
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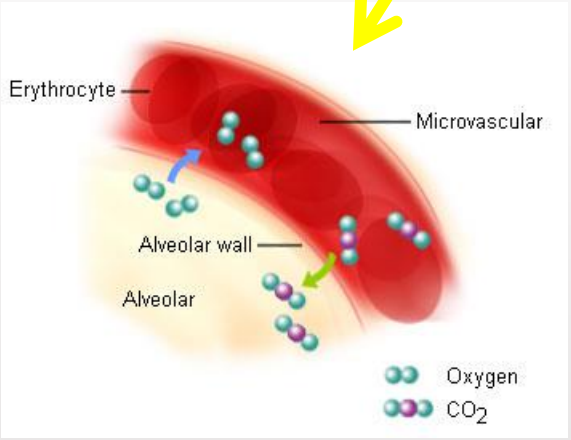
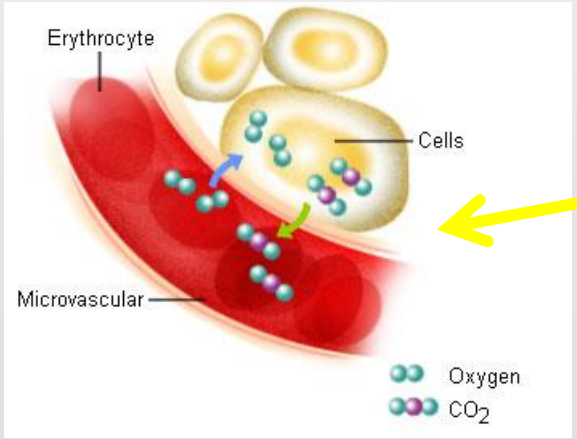

Erythrocyte
Microvascular
Alveolar wall
Alveolar
Oxygen
CO_2


Erythrocyte
Cells
Microvascular
Oxygen
CO_2