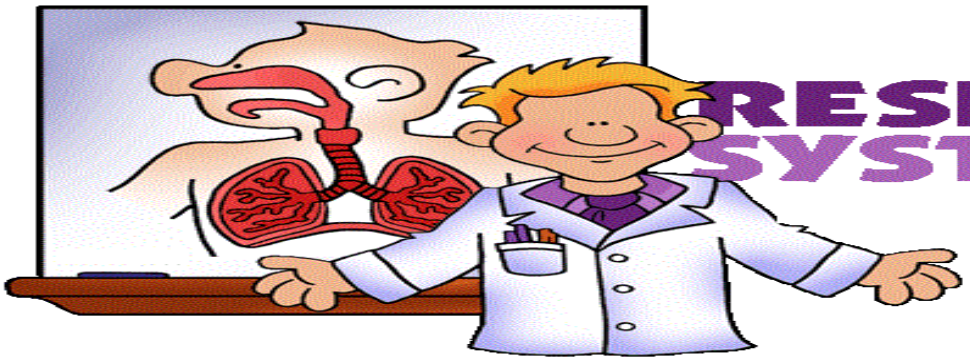
UNIT - III



RESPIRATORY SYSTEM

Presented By

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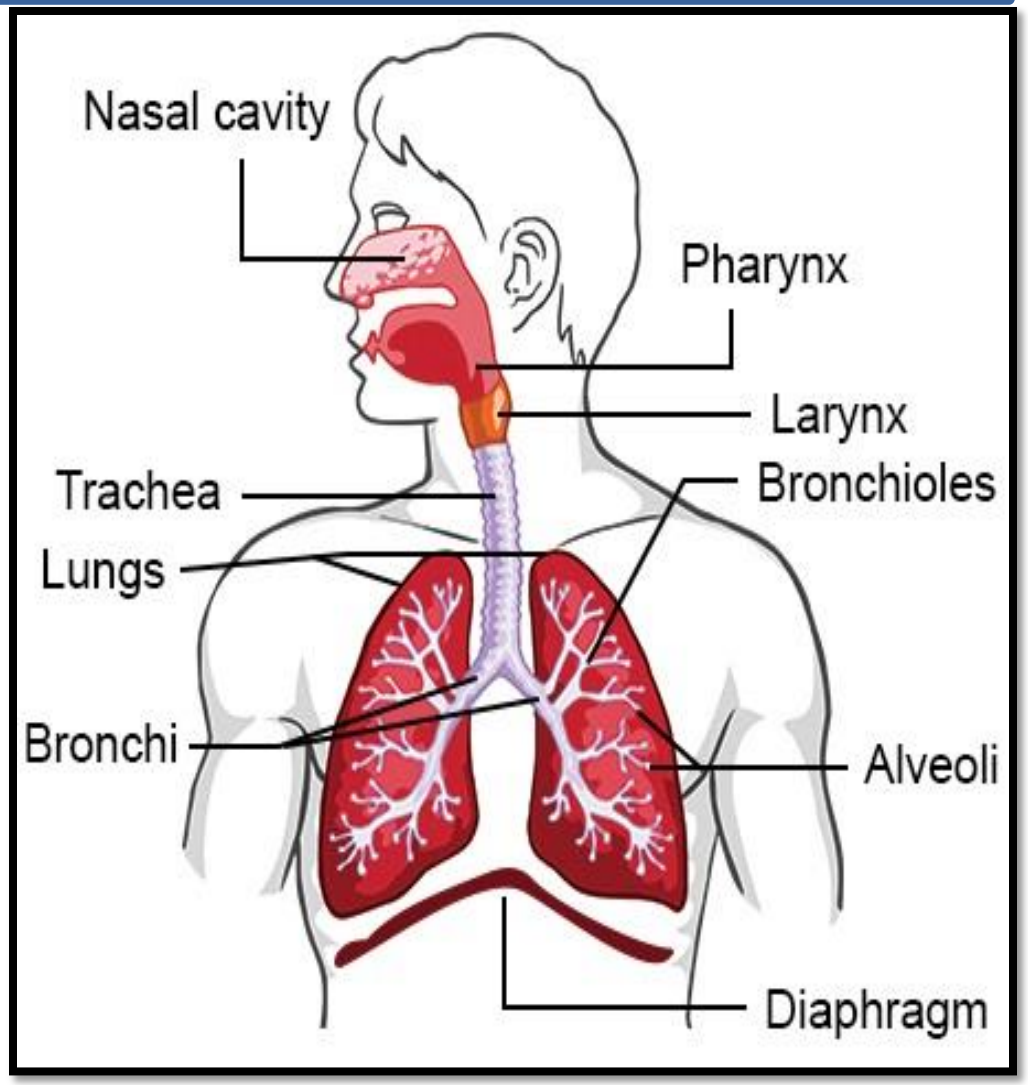
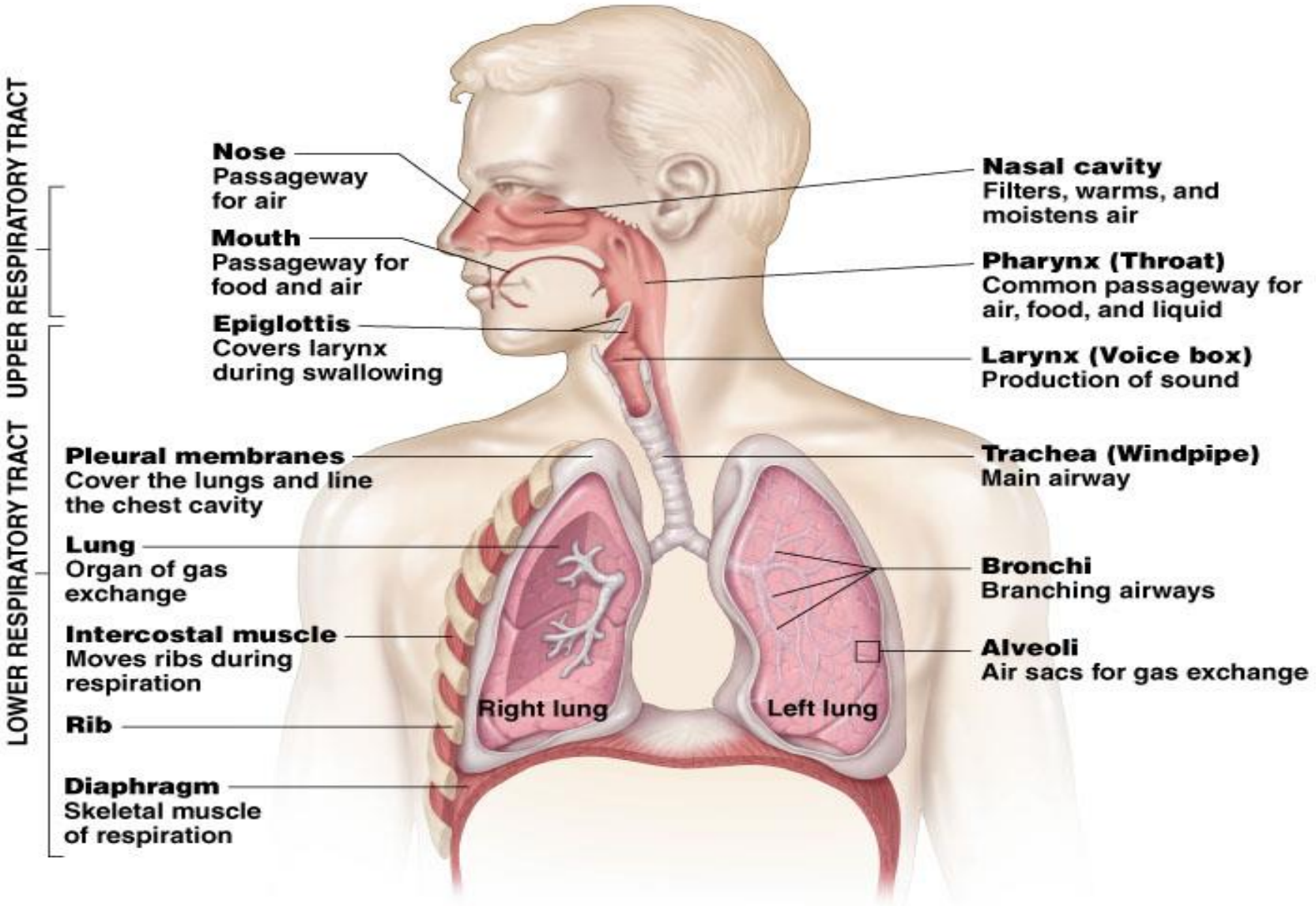
ORGANS OF RESPIRATORY SYSTEM

1. Nose & Nasal Cavity
2. Pharynx
3. Larynx
4. Trachea
5. Bronchi
6. Bronchioles
7. Lungs
8. Muscles of Respiration
    1. Intercostal muscle
    2. Diaphragm

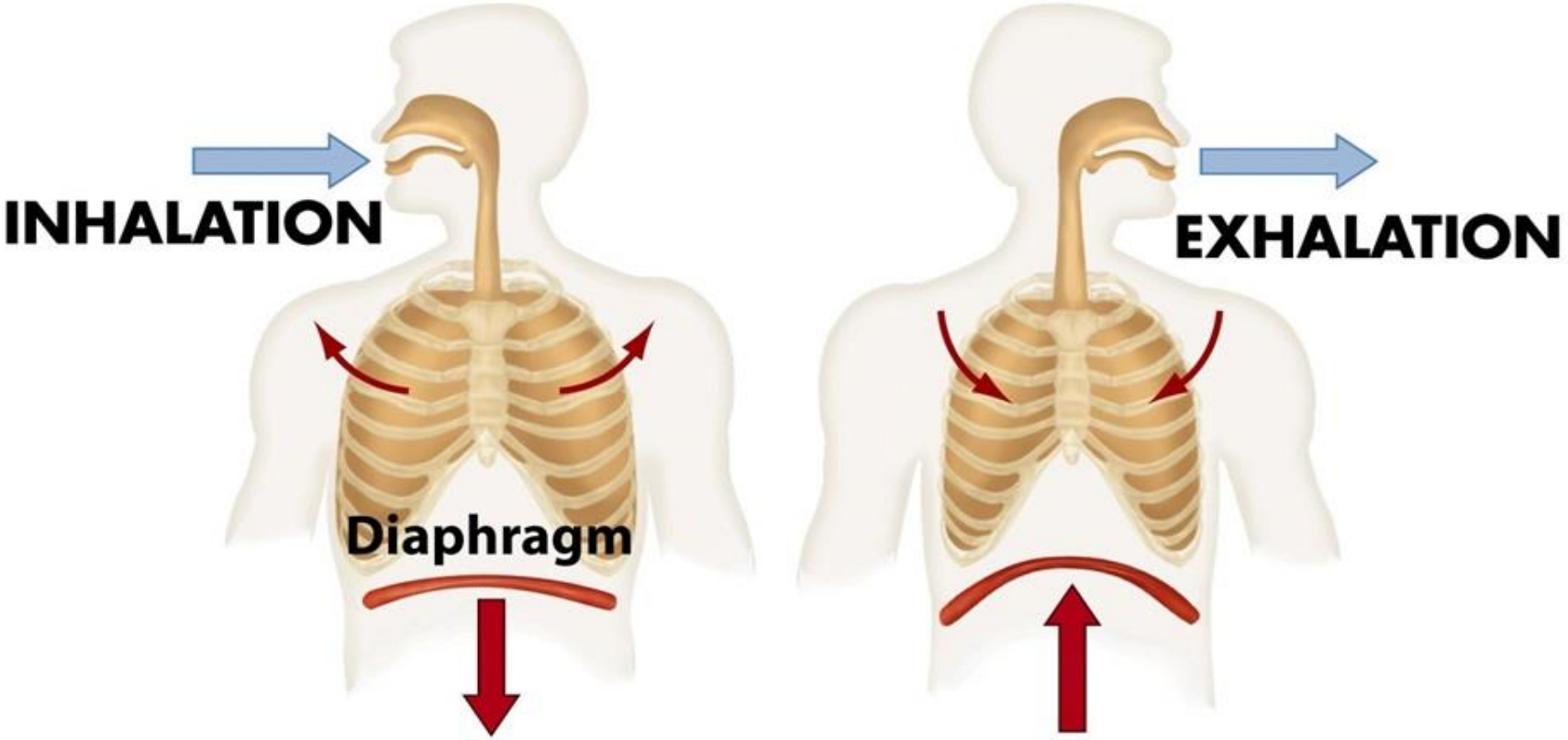


FUNCTIONS OF ORGANS



MECHANISM OF RESPIRATION

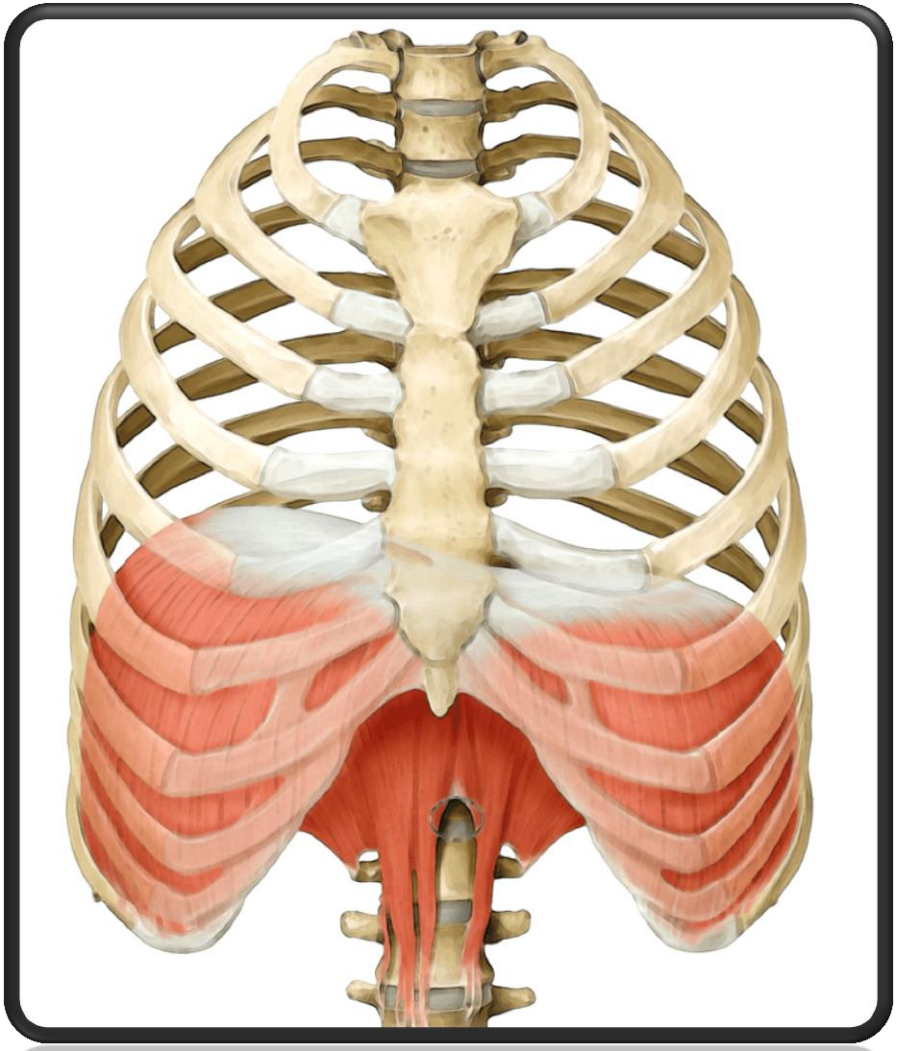
Lungs expand and contract in response to changes in pressure inside the chest cavity.



MECHANISM OF RESPIRATION

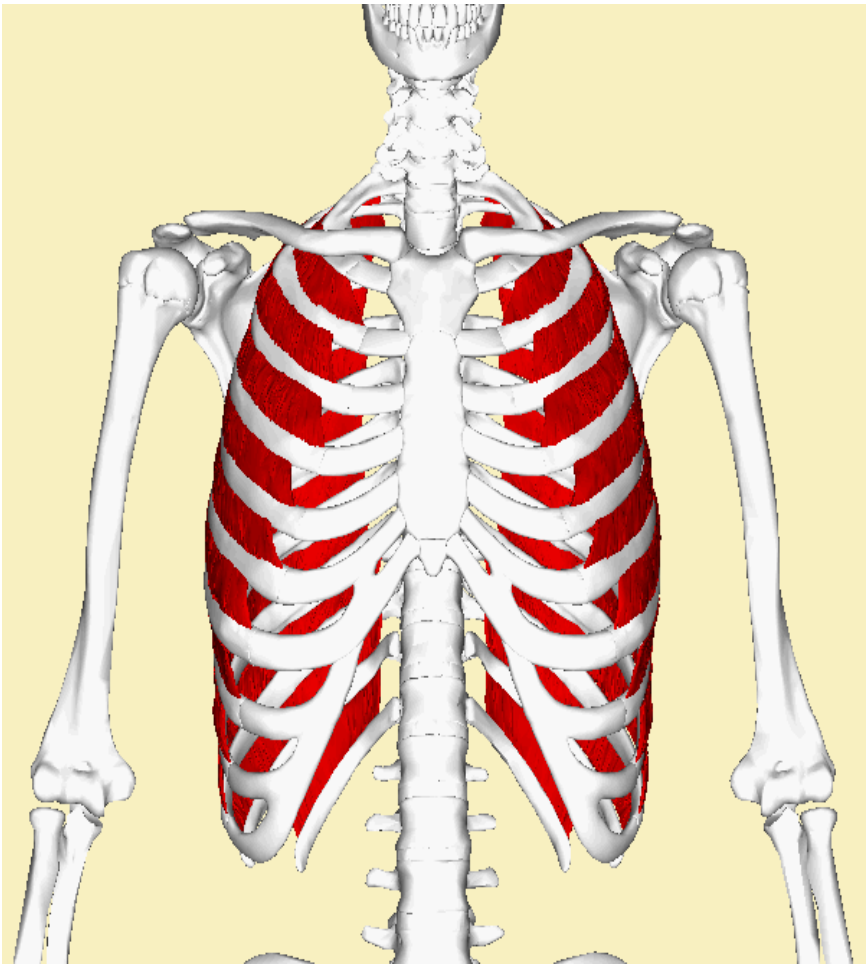
Muscles of Respiration

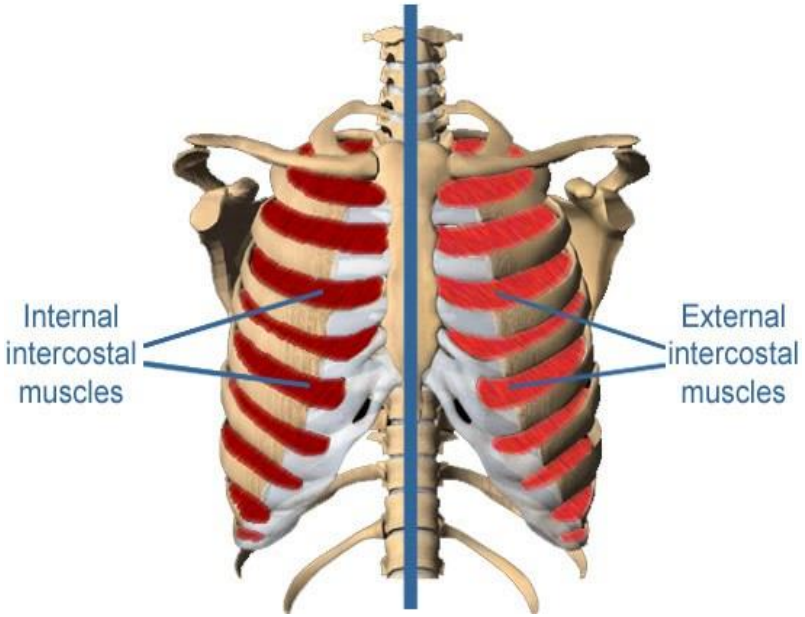
- Intercostal muscle
- Muscles of Diaphragm



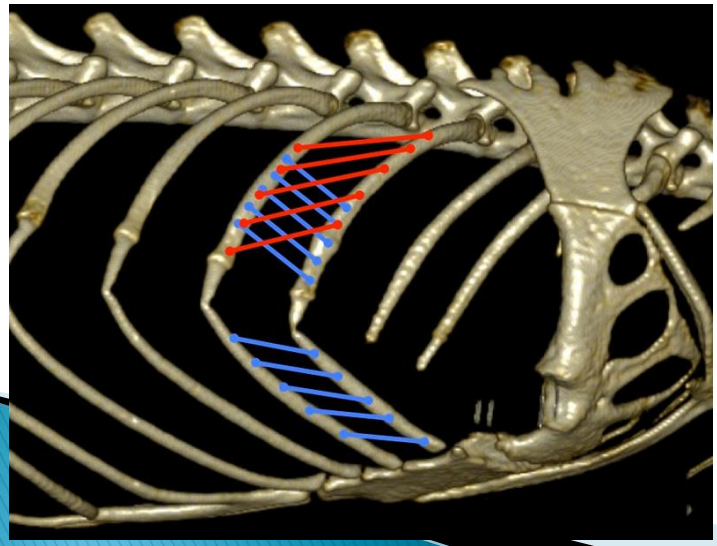
MECHANISM OF RESPIRATION

- Intercostals Muscles:
- 11 Pairs.
- Arranged in 2 layers
  - External
  - Internal

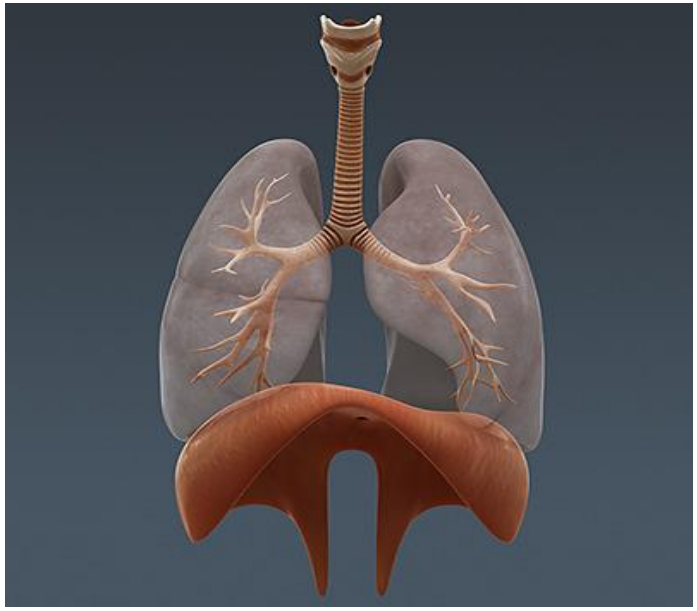


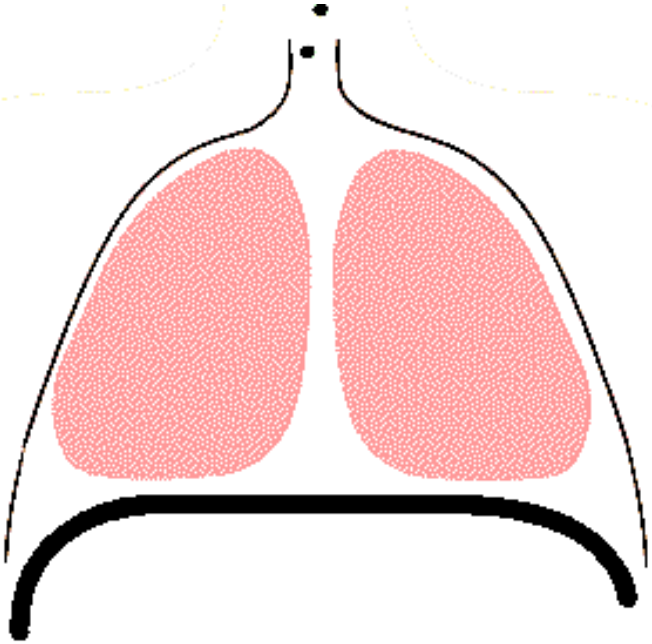


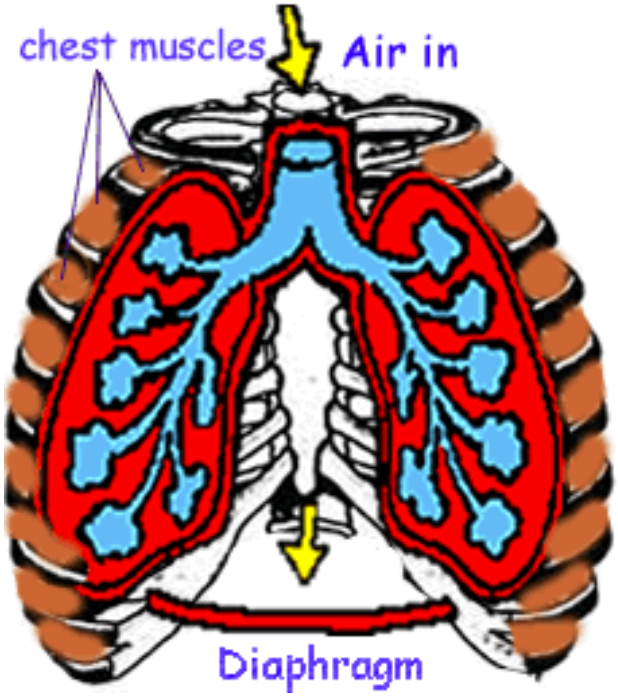
- External- Extend downward & forward.
- Internal- Extend downward & backward.



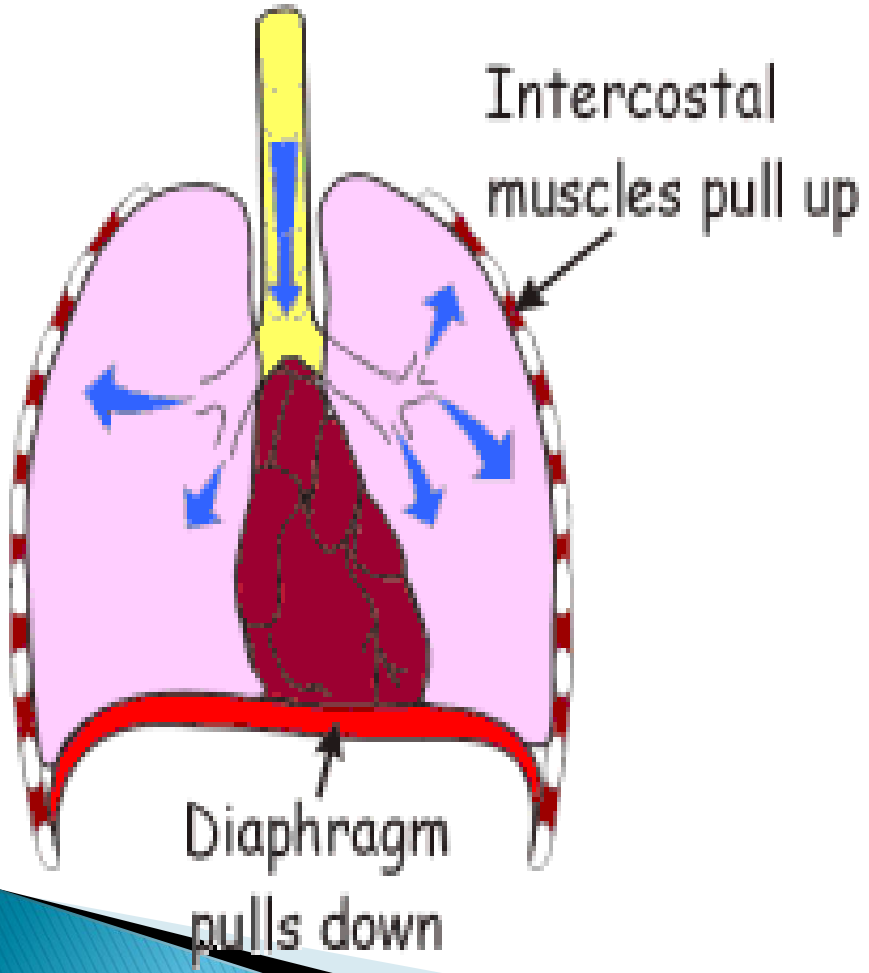
- **Diaphragm:**
  - Dome shaped (Parachute shaped).
  - Contraction leads to expansion of thoracic cavity.



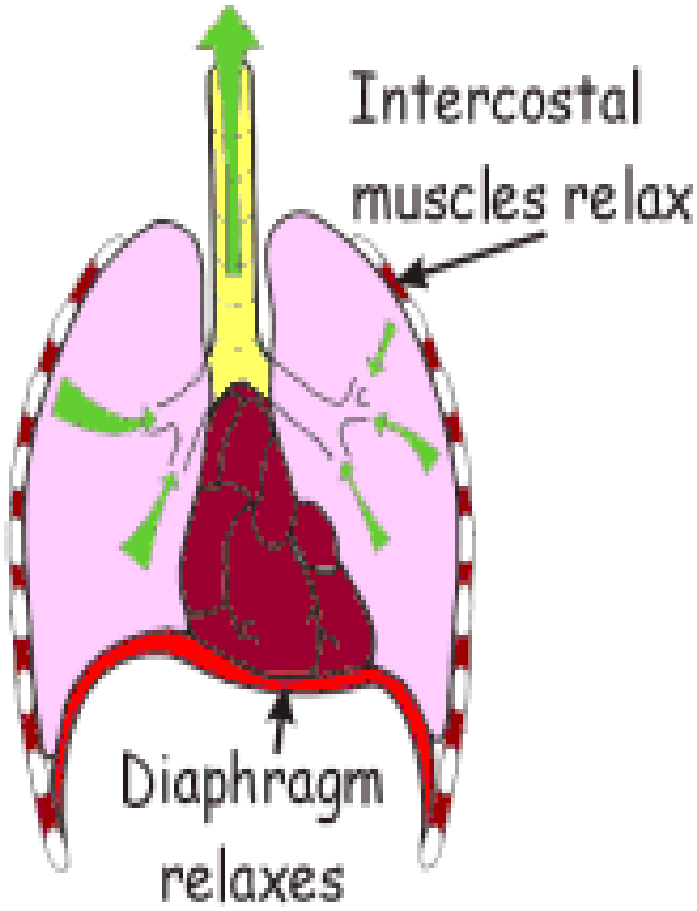


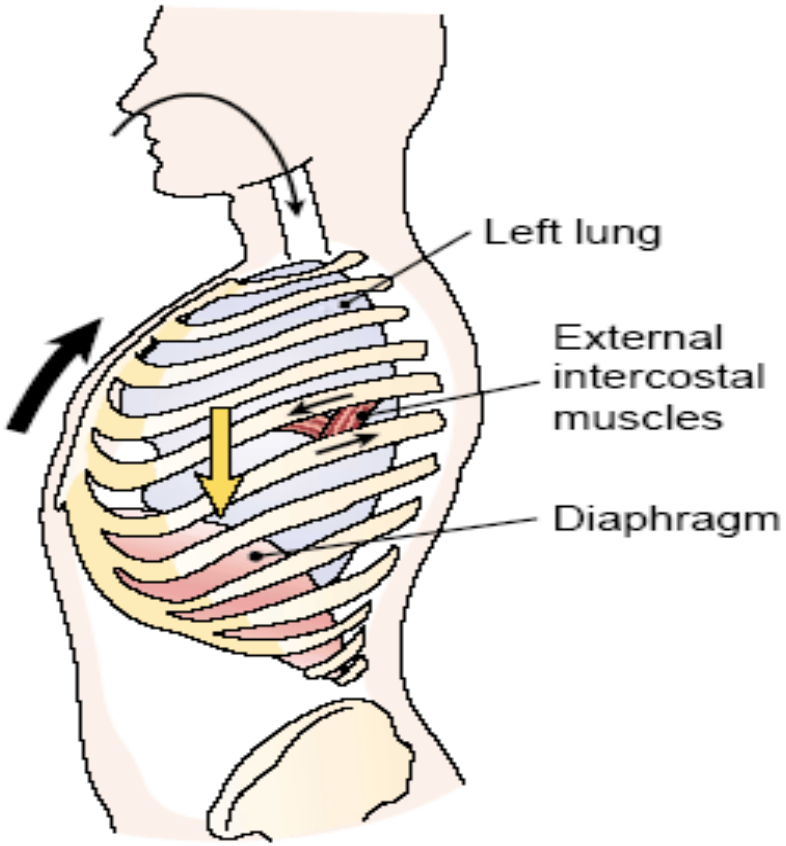


Inhalation



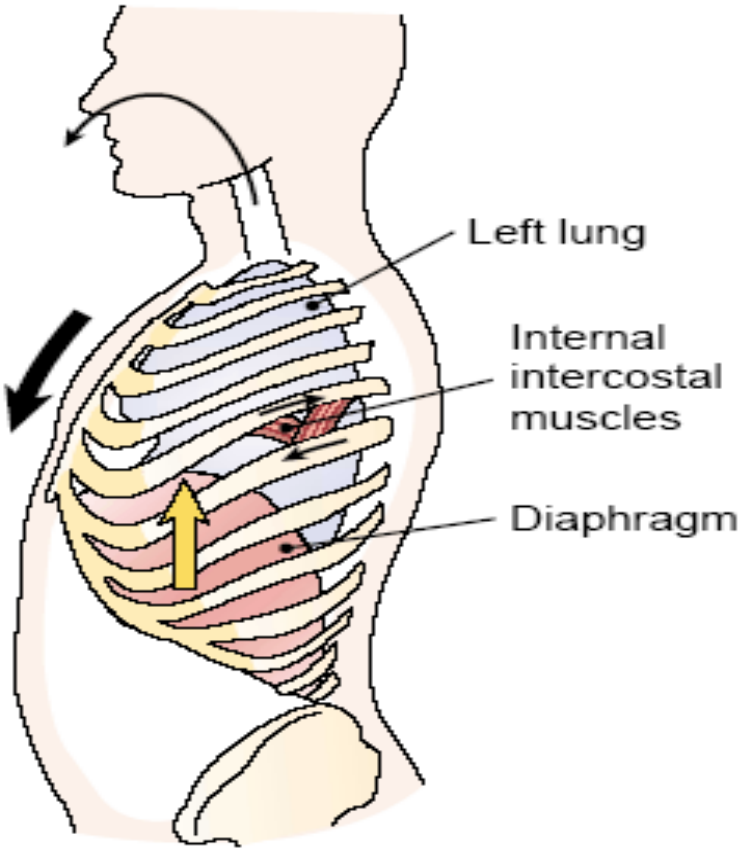
Exhalation





During inhalation, the diaphragm presses the abdominal organs downward and forward.

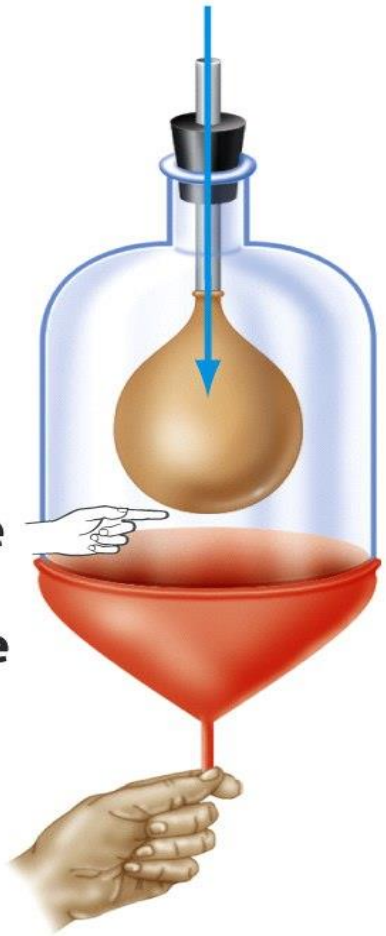
A Action of rib cage in inhalation



During exhalation, the diaphragm rises and recoils to the resting position.

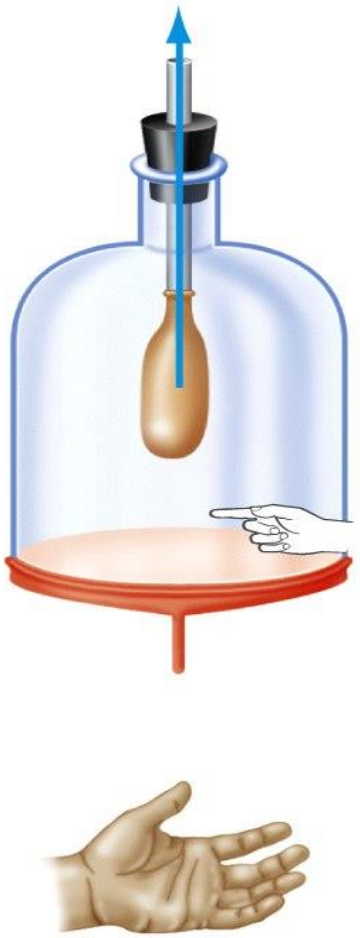
B Action of rib cage in exhalation

Ventilatory forces can be modeled by a balloon in a jar.



Pressure more negative

When the diaphragm is pulled down, the balloon inflates.



Pressure less negative

When the diaphragm is released, the balloon deflates.

Figure 44-9b Biological Science, 2/e

CYCLE OF RESPIRATION

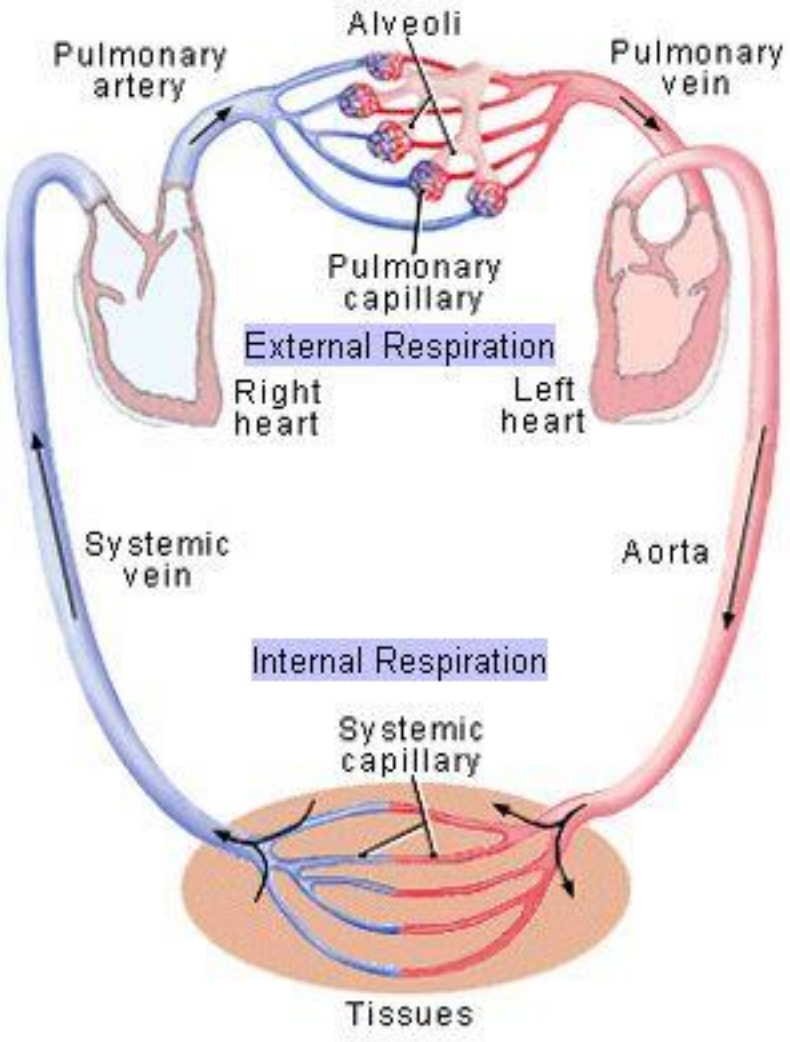
- 12-15 times per minute.

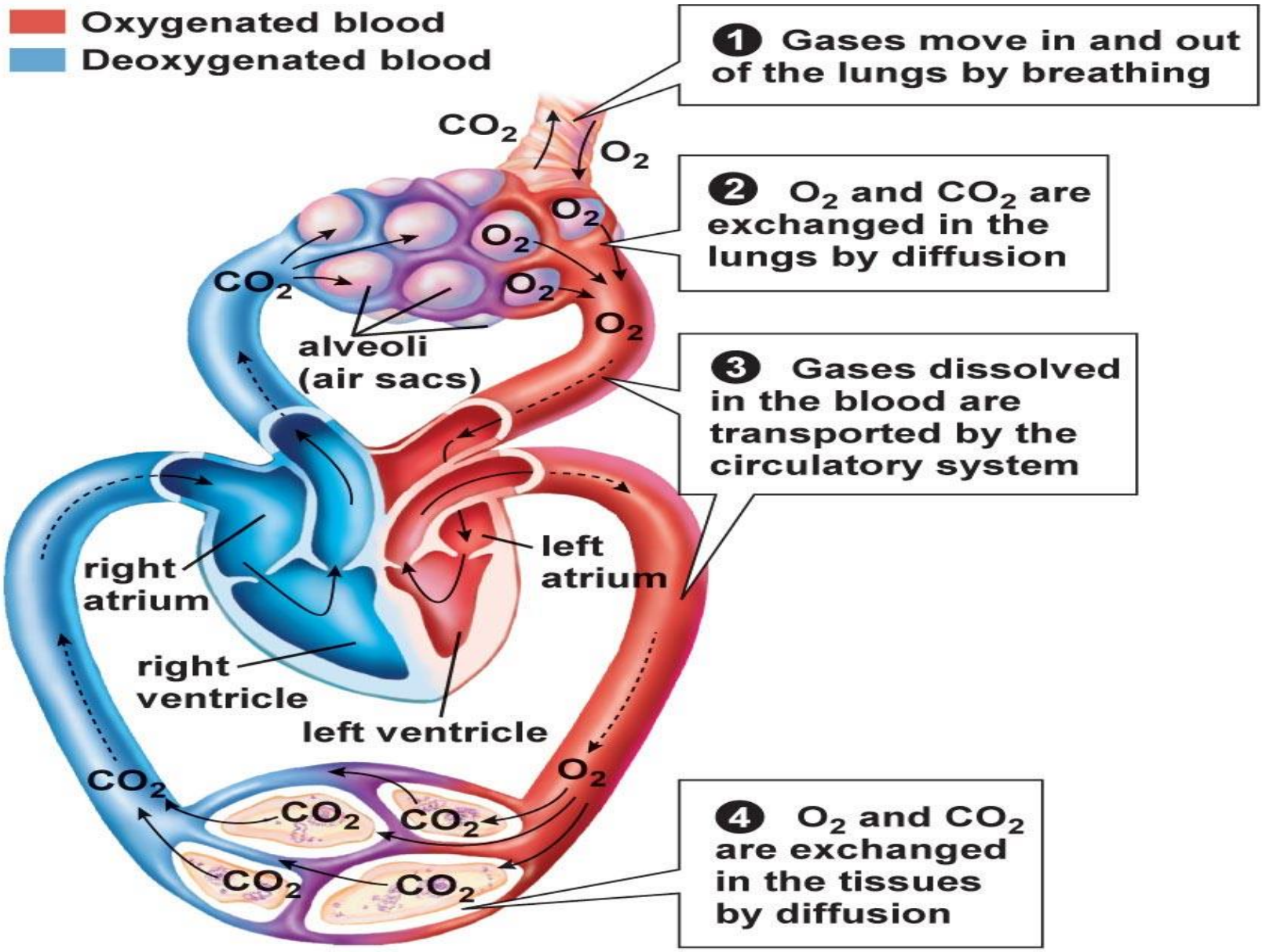
Atmospheric pressure= 760 mmHg.

- Phases….
  1. Inspiration- Pressure must be low.
  2. Expiration- Pressure is higher than atmospheric pressure.
  3. Pause- pressure equals to atmospheric pressure.

PHYSIOLOGY OF RESPIRATION

- External Respiration
- Internal Respiration




Oxygenated blood
Deoxygenated blood
1 Gases move in and out of the lungs by breathing
2 O_2 and CO_2 are exchanged in the lungs by diffusion
3 Gases dissolved in the blood are transported by the circulatory system
4 O_2 and CO_2 are exchanged in the tissues by diffusion
CO_2
O_2
alveoli (air sacs)
right atrium
left atrium
right ventricle
left ventricle
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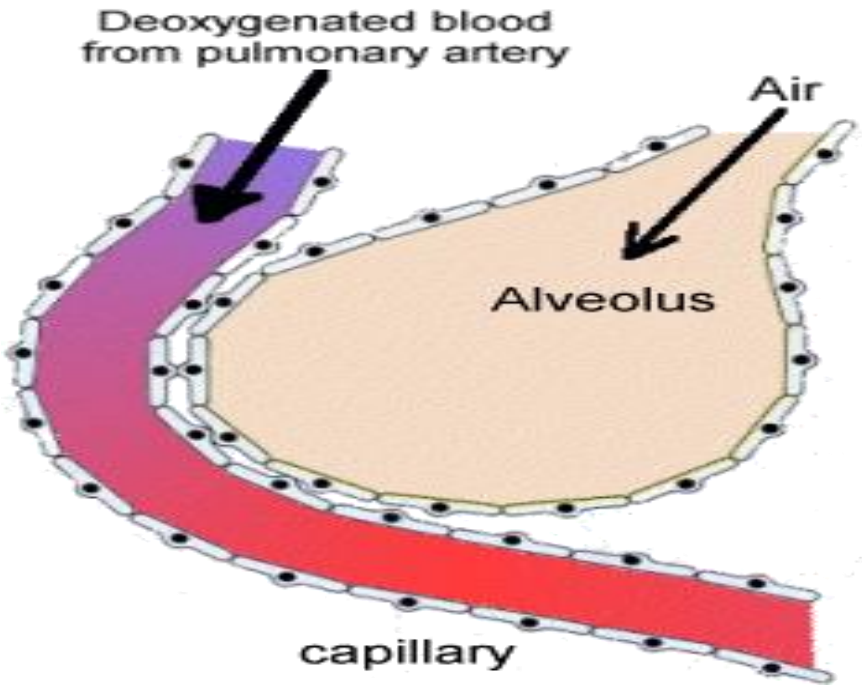
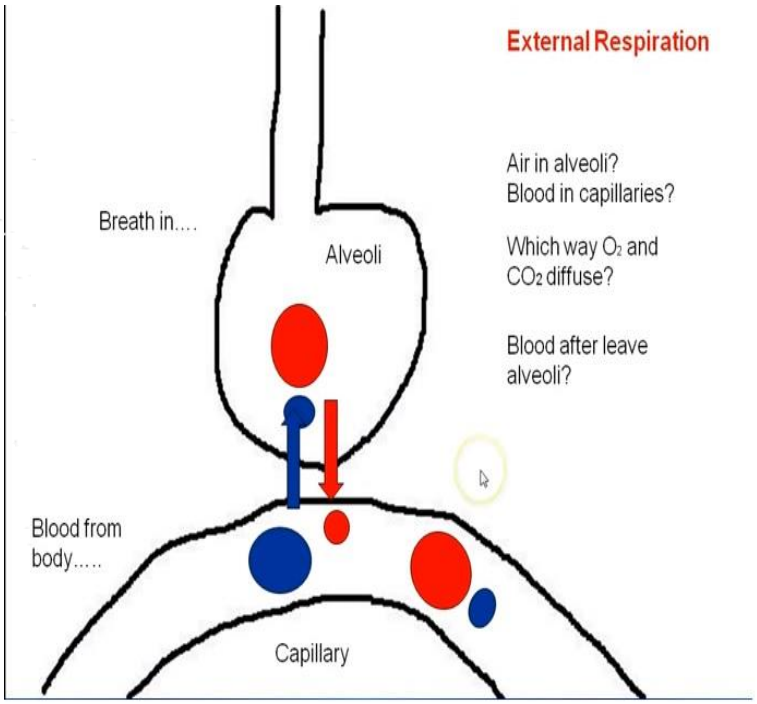
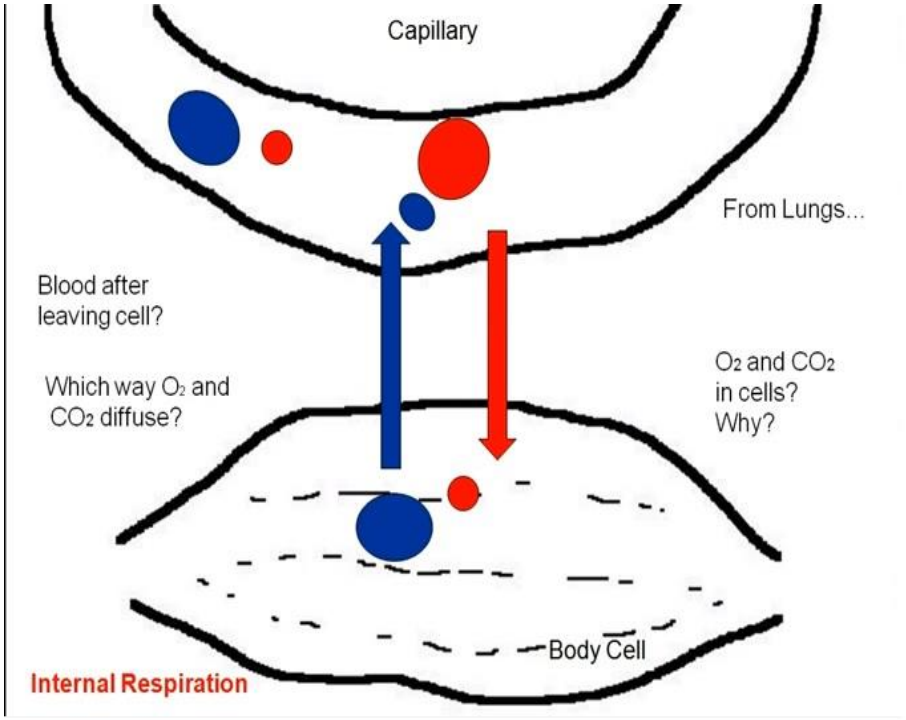
EXTERNAL RESPIRATION





Partial pressure of O_2 in Alveoli of lung= 105 mmHg.
Partial pressure of O_2 in Capillary blood = 40 mmHg.

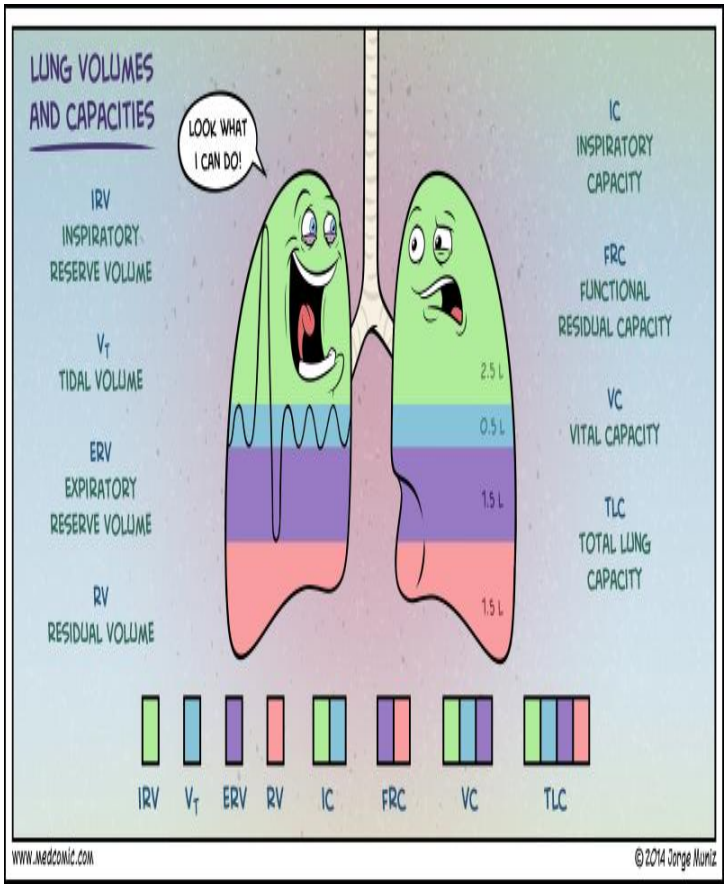
INTERNAL RESPIRATION



Partial pressure of O_2 in Blood = 105 mmHg.
Partial pressure of O_2 in Body cells = 40 mmHg

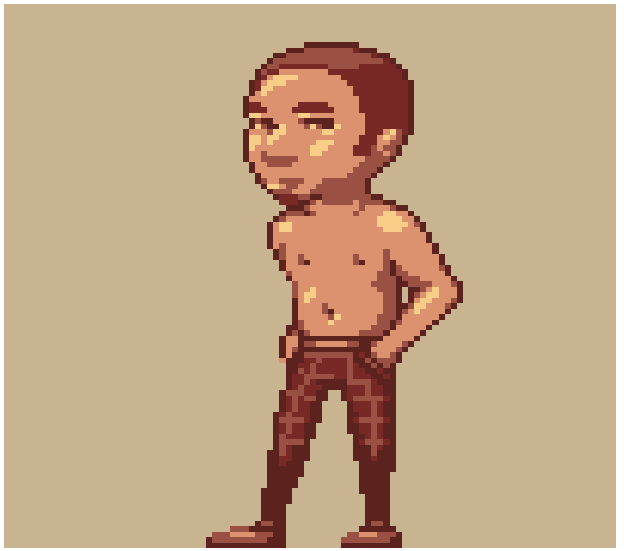
RESPIRATORY VOLUMES

1. Tidal volume
2. Vital Capacity
3. Inspiratory Reserve volume
4. Expiratory Reserve volume
5. Maximum breathing capacity
6. Residual volume



Tidal volume

- The volume of air taken in or given out during normal quiet breathing.
- Normal value - 500 ml

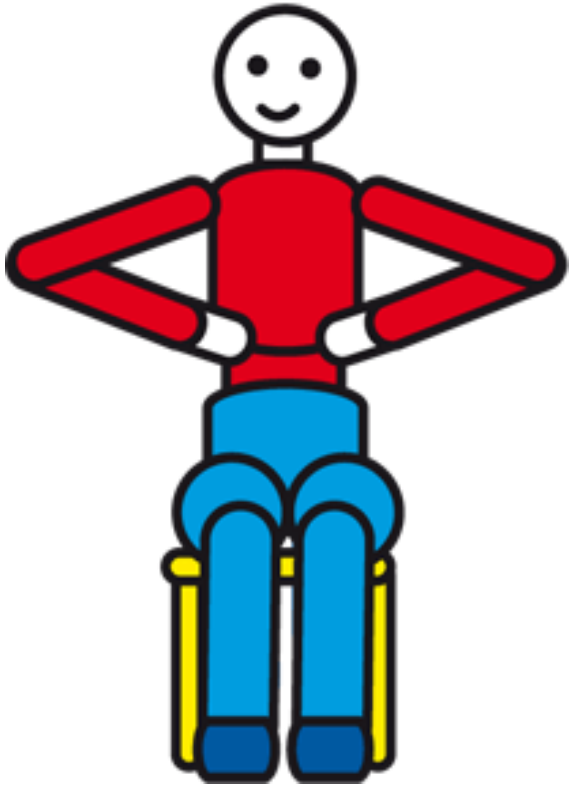


Vital Capacity

- The volume of air can be breathed out by forced expiration after taking forced inspiration.
- 4330 ml (Male)
- 3100 ml (Female)

Inspiratory Reserve volume

- The volume of air that can be taken in by forced inspiration over and above the tidal volume.
- 2000 – 3300 ml



Expiratory Reserve volume

- The volume of air that can be breathed out by forced expiration over & above the normal expiration.
- 1000 ml.

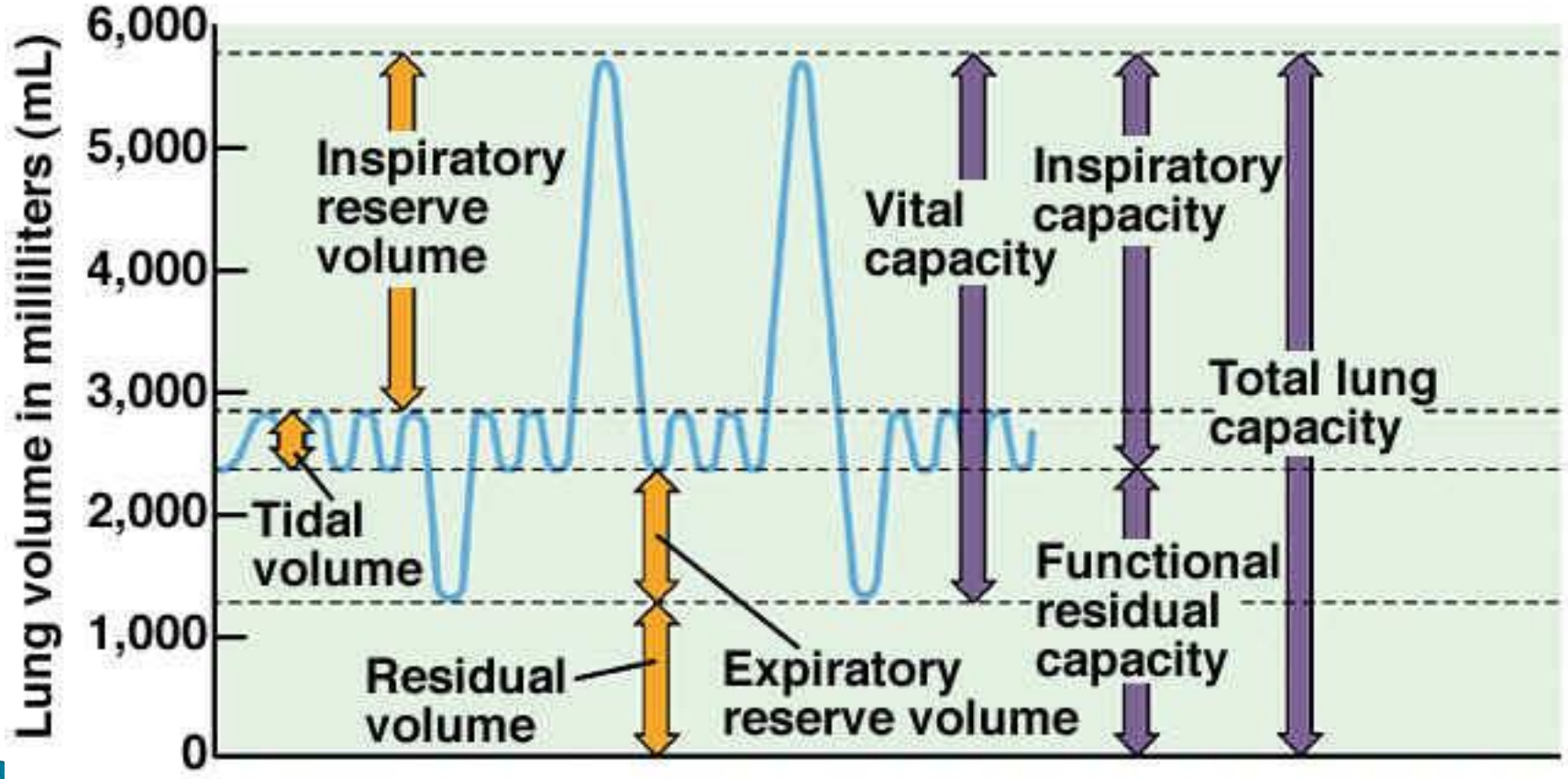
Maximum breathing capacity

- The volume of air that one can breathed with maximum efforts in one minute time.
- 80- 160 litres (Male)
- 60-120 litres (Female)

Residual volume

- The volume of air which remains in the lungs after maximum expiration.
- 1200 ml.

Respiratory Volumes and Capacities



ARTIFICIAL RESPIRATION AND RESUSCITATION METHODS

- Conditions when artificial respiration is required
- Artificial respiration is required whenever there is an arrest of breathing, without cardiac failure.
- Arrest of breathing occurs in the following conditions:

1. Accidents
2. Drowning
3. Gas poisoning
4. Electric shock
5. Anesthesia.

- Stoppage of oxygen supply for 5 minutes causes irreversible changes in tissues of brain, particularly tissues of cerebral cortex.

- So, artificial respiration (resuscitation) must be started quickly without any delay, before the development of cardiac failure.

- Purpose of artificial respiration is to ventilate the alveoli and to stimulate the respiratory centers.

METHODS OF ARTIFICIAL RESPIRATION

Methods of artificial respiration are of two types:

1. Manual methods
2. Mechanical methods

MANUAL METHODS

- Manual methods of resuscitation can be applied quickly without waiting for the availability of any mechanical aids.
- Affected person must be provided with clear air. Clothes around neck and chest regions must be loosened. Mouth, face and throat should be cleared of mucus, saliva, foreign particles, etc. Tongue must be drawn forward and it must be prevented from falling posteriorly, which may cause airway obstruction.

- Manual methods are of two types:
- i. Mouth-to-mouth method
- ii. Holger-Nielsen method.

1) Mouth-to-mouth Method

- The subject is kept in supine position and the resuscitator (person who give resuscitation) kneels at the side of the subject. By keeping the thumb on subject's mouth, the lower jaw is pulled downwards.

- Nostrils of the subject are closed with thumb and index finger of the other hand.

- Resuscitator then takes a deep breath and exhales into the subject's mouth forcefully. Volume of exhaled air must be twice the normal tidal volume.
- This expands the subject's lungs.
- Then, the resuscitator removes his mouth from that of the subject. Now, a passive expiration occurs in the subject due to elastic recoil of the lungs.
- This procedure is repeated at a rate of 12 to 14 times a minute, till normal respiration is restored.

- Mouth-to-mouth method is the most effective manual method because, carbon dioxide in expired air of the resuscitator can directly stimulate the respiratory centers and facilitate the onset of respiration.

- Only disadvantage is that the close contact between the mouths of resuscitator and subject may not be acceptable for various reasons.

2. Holger Nielsen Method or Back Pressure Arm Lift Method

- Subject is placed in prone position with head turned to one side. Hands are placed under the cheeks with flexion at elbow joint and abduction of arms at the shoulders.

- Resuscitator kneels beside the head of the subject. By placing the palm of the hands over the back of the subject, the resuscitator bends forward with straight arms (without flexion at elbow) and applies pressure on the back of the subject.

- Weight of the resuscitator and pressure on back of the subject compresses his chest and expels air from the lungs.
- Later, the resuscitator leans back. At the same time, he draws the subject's arm forward by holding it just above elbow.
- This procedure causes expansion of thoracic cage and flow of air into the lungs.
- The movements are repeated at the rate of 12 per minute, till the normal respiration is restored.

MECHANICAL METHODS

- Mechanical methods of artificial respiration become necessary when the subject needs artificial respiration for long periods. It is essential during the respiratory failure due to paralysis of respiratory muscles or any other cause.

- Mechanical methods are of two types:

i. Drinker method
ii. Ventilation method

1. Drinker Method

- The machine used in this method is called iron lung chamber or tank respirator.
- The equipment has an airtight chamber, made of iron or steel.
- Subject is placed inside this chamber with the head outside the chamber.

2. Ventilation Method

- A rubber tube is introduced into the trachea of the patient through the mouth. By using a pump, air or oxygen is pumped into the lungs with pressure intermittently.
- When air is pumped, inflation of lungs and inspiration occur.
- When it is stopped, expiration occurs and the cycle is repeated.
- Apparatus used for ventilation is called ventilator and it is mostly used to treat acute respiratory failure.

- Ventilator is of two types:
- a. Volume ventilator
- b. Pressure ventilator.

a. Volume ventilator

- By volume ventilator, a constant volume of air is pumped into the lungs of patients intermittently with minimum pressure.

b. Pressure ventilator

- By pressure ventilator, air is pumped into the lungs of subject with constant high pressure.


THANK YOU

UNIT – III
URINARY SYSTEM

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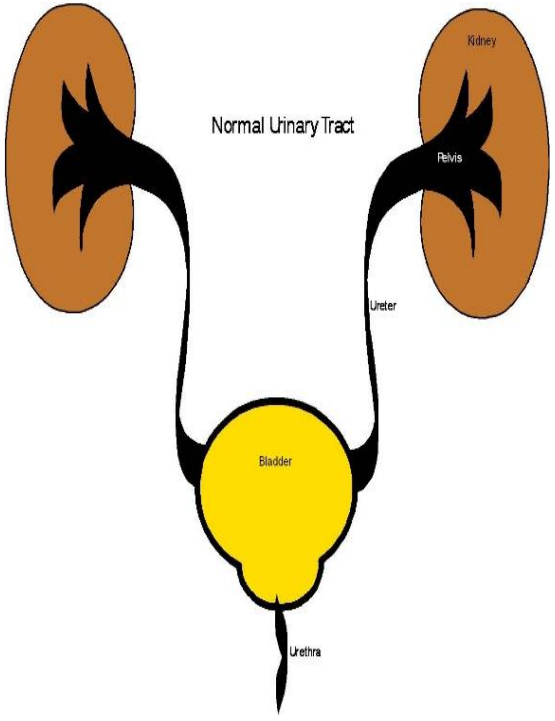
INTRODUCTION

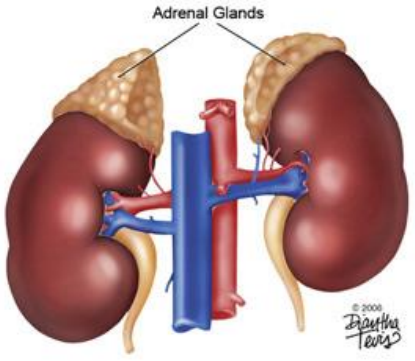
Urinary System Organs

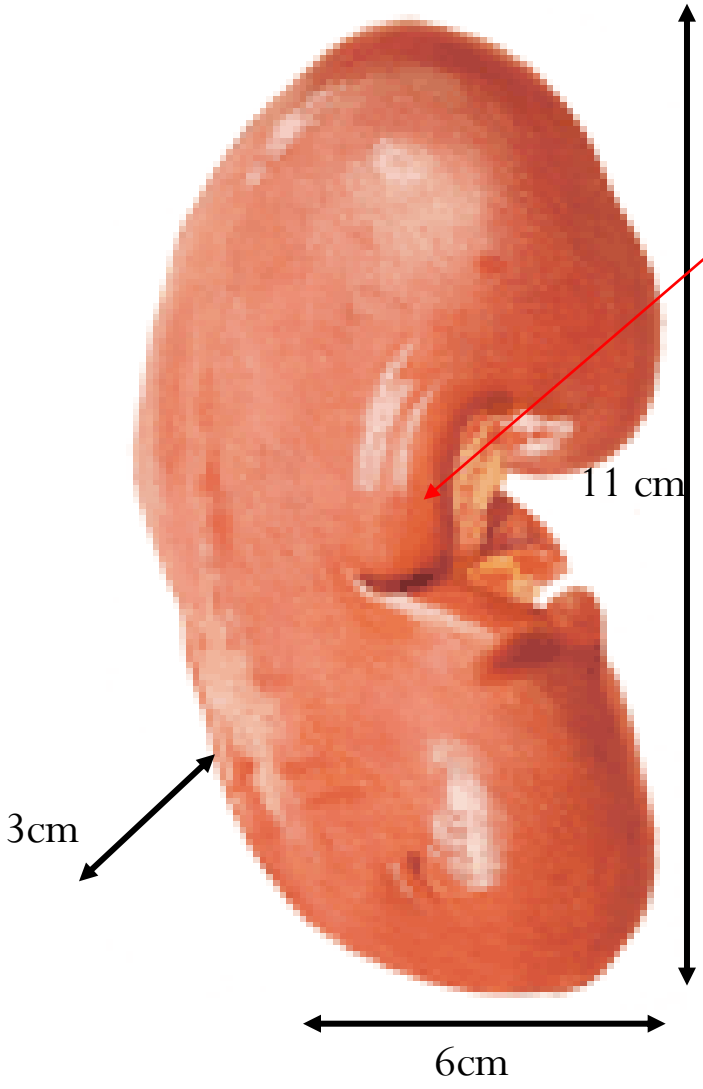
- Kidneys
- Ureters
- Bladder
- Urethra



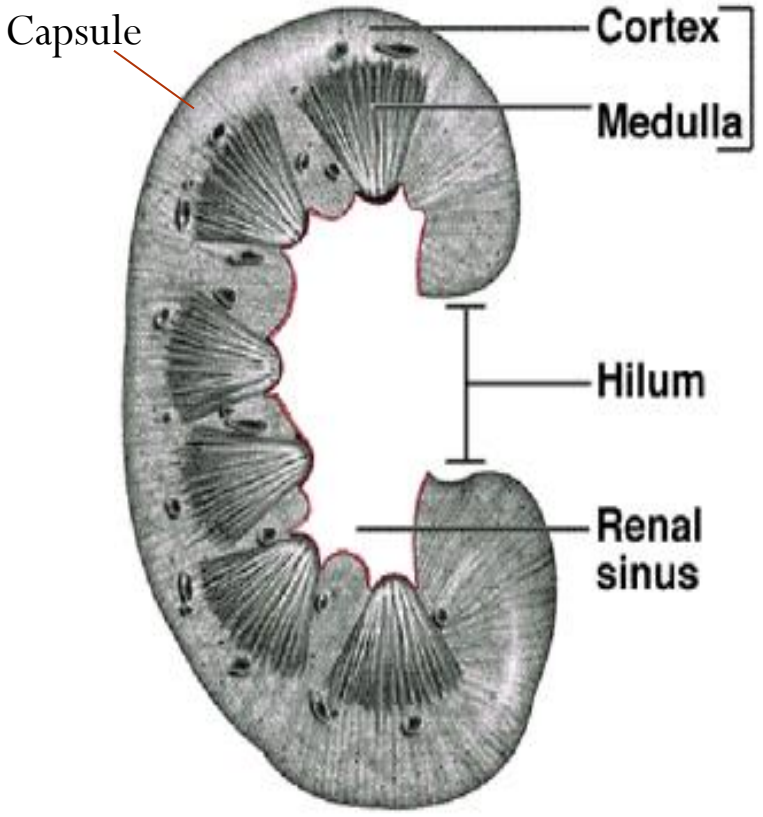
Surface anatomy of the Kidney

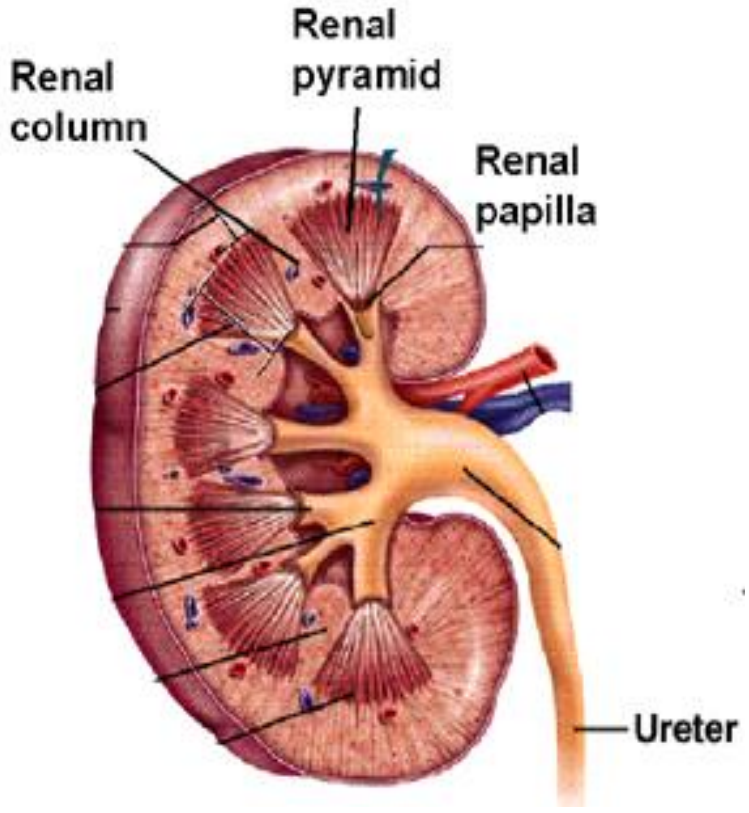
Figure 1: Kidneys and Adrenal Glands

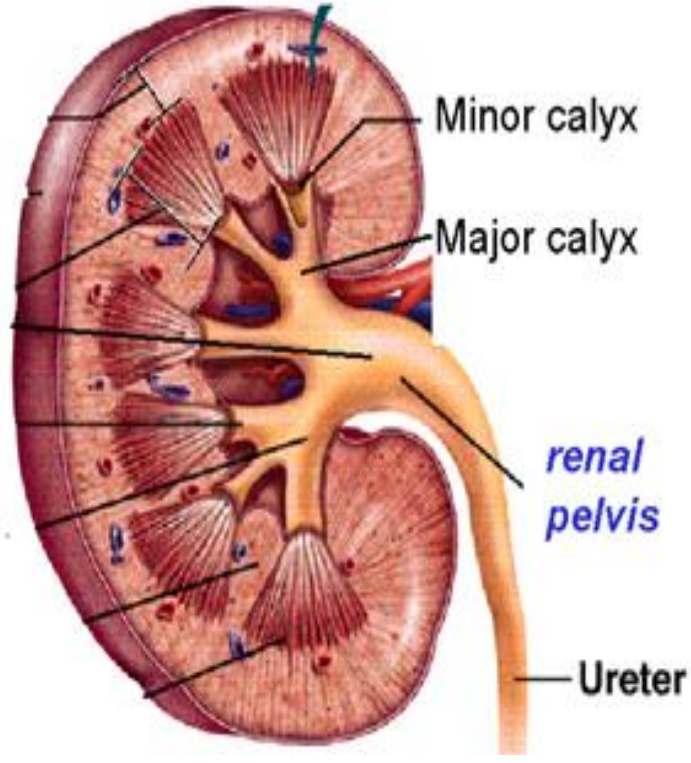




- Bean shaped.
- Length – 11 cm.
- Width – 6 cm.
- Thickness – about 3 cm.
- Weight – about 150 g.
- Colour – Reddish brown.
- Hilum is located on the medial surface



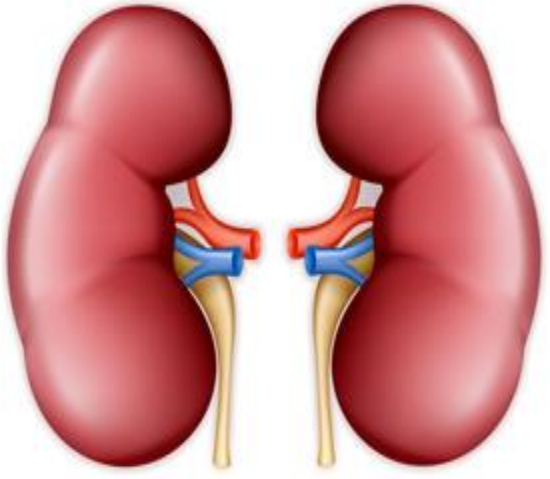




The papilla is nestled into a cup called a *minor calyx*, which collects its urine. Two or three minor calyces merge to form a *major calyx*. The major calyces merge to form the *renal pelvis*.

Functions of Kidney

1. Formation of urine.
2. Removes metabolic waste products from the blood & excrete them in urine.
3. Regulate the balance of water and various inorganic ions.
4. Remove many chemicals and drugs from the blood and excrete them in urine.
5. Hormone secretion –
    1. Renin
    2. Erythropoietin
6. Maintain Blood Pressure.
7. Maintain pH of body fluids.

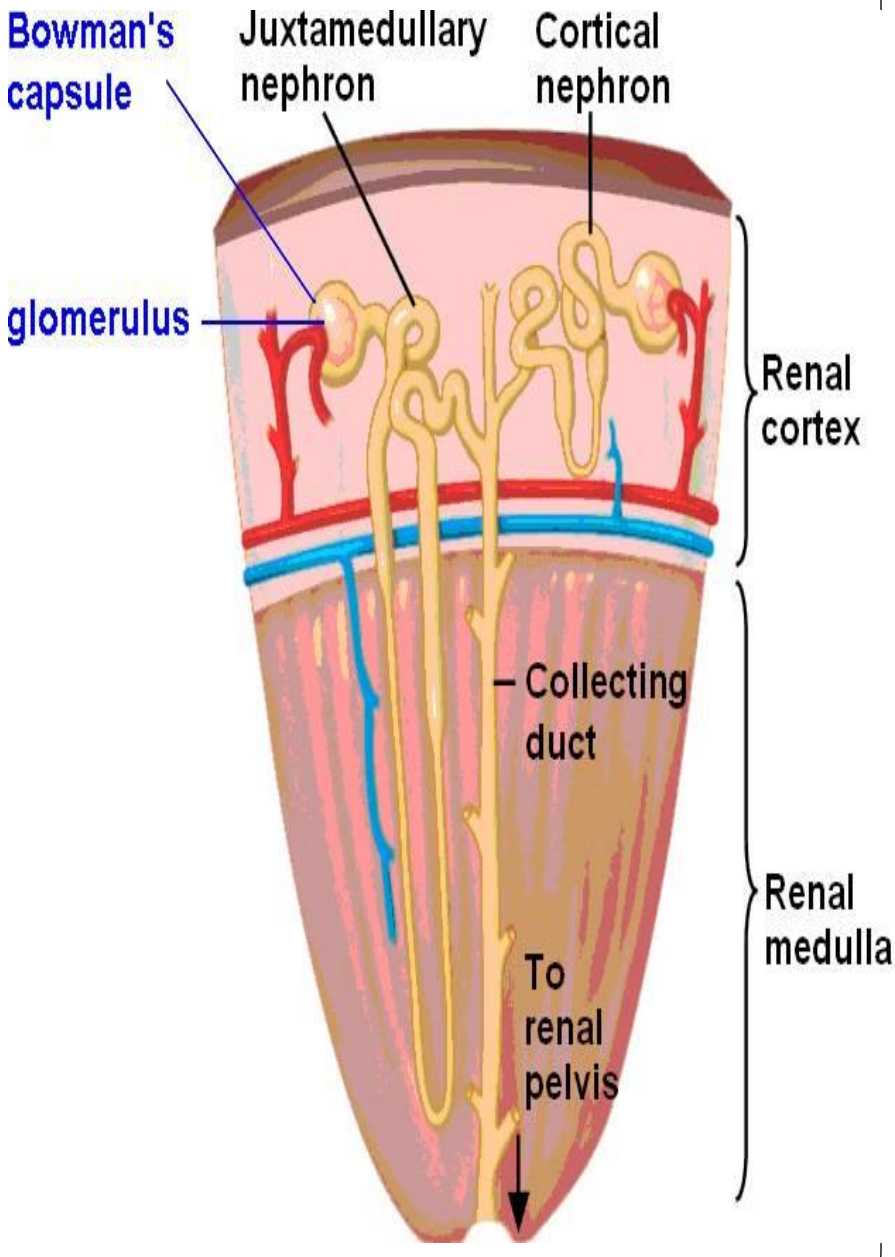


Nephrons

- **Structural and functional unit of kidney.**
- **About 6 cm in length.**
- **Types –**

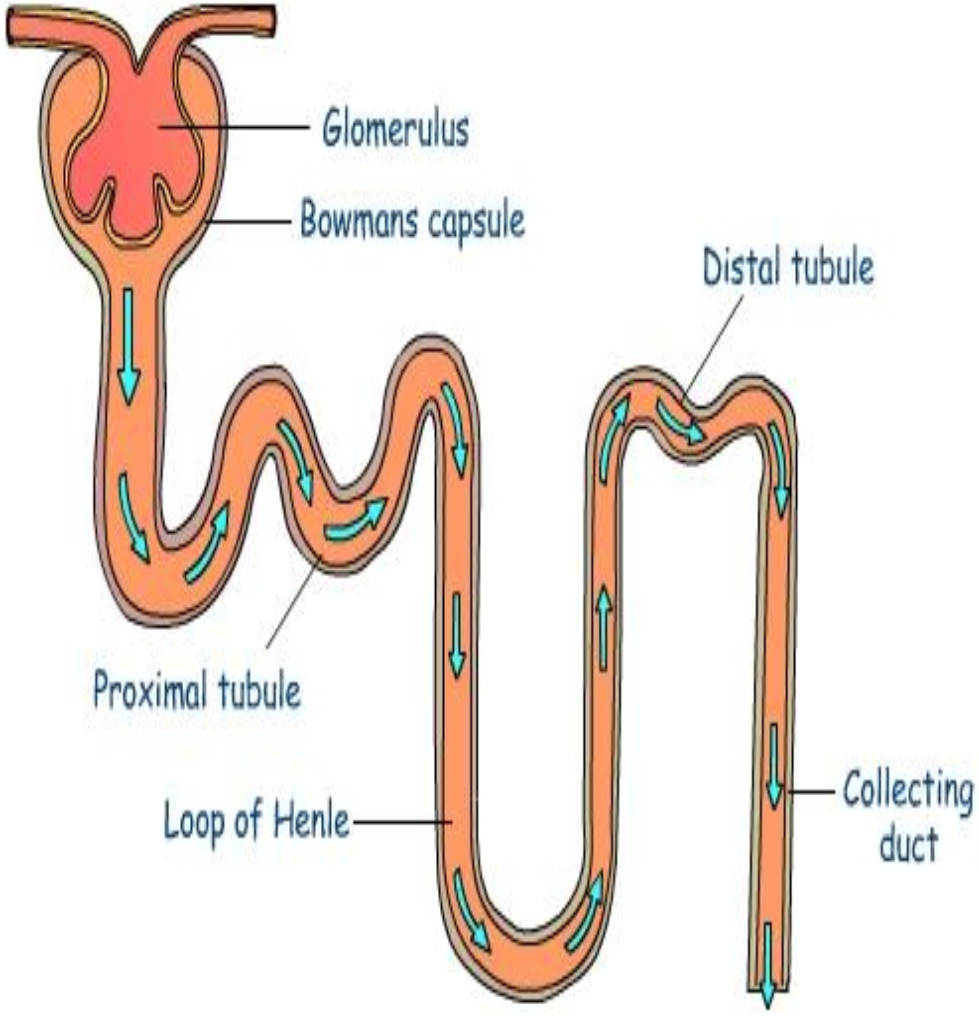
1. **Cortical nephrons**

2. **Juxtamedullary nephrons**



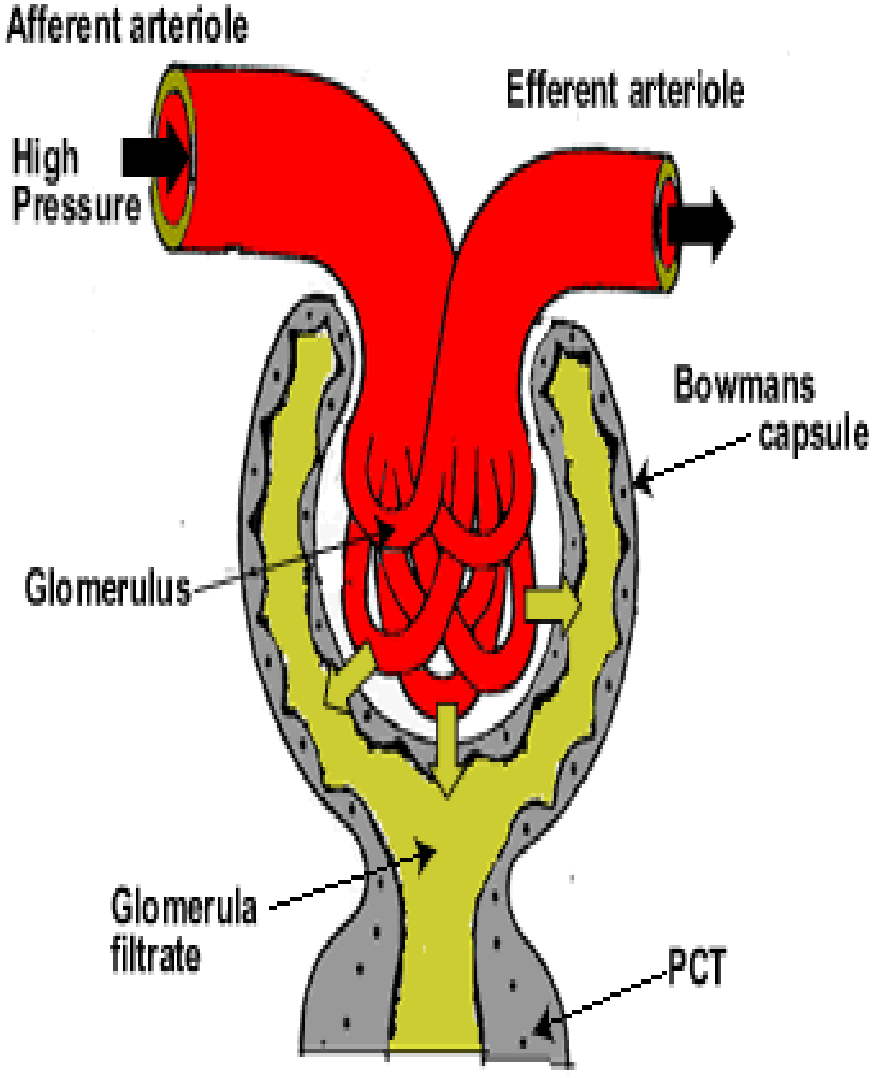
NEPHRON

1. Malphigian body.
    1. Bowman's capsule.
    2. Glomerulus.
2. Renal tubule.
    1. Proximal convoluted tubule.
    2. Loop of Henle.
    3. Distal convoluted tubule
3. Collecting tubules.



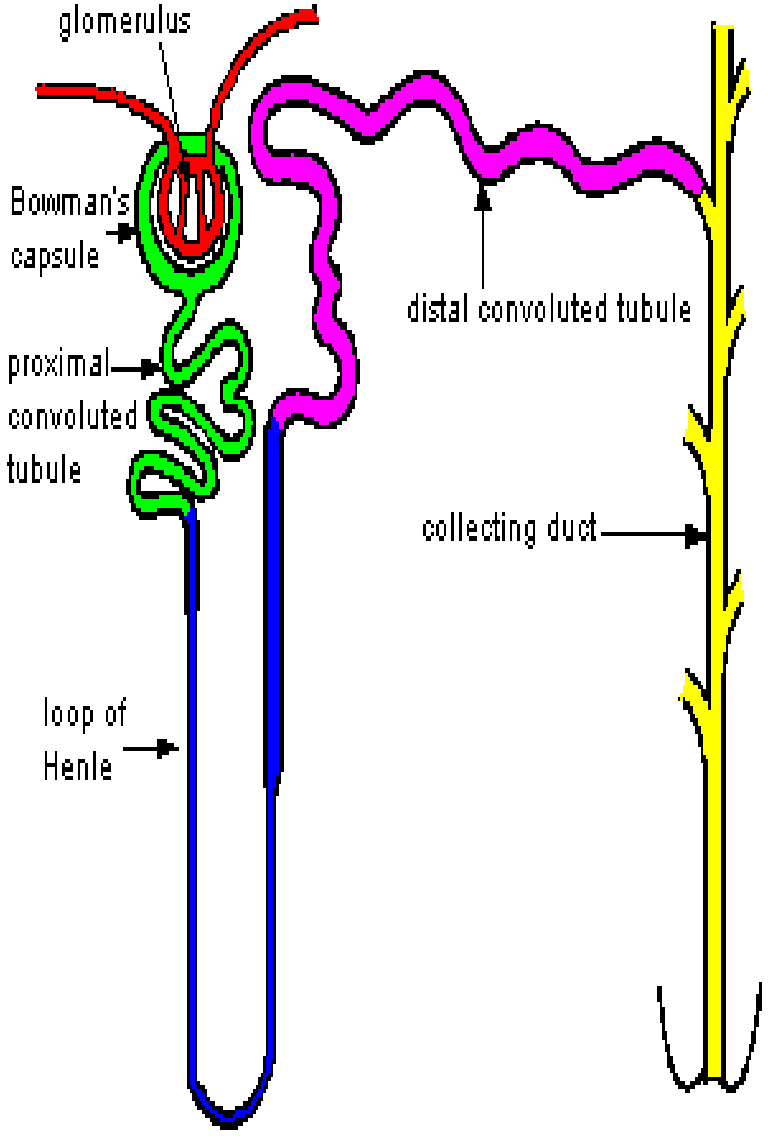
Malphigian body.

1. **Bowman's capsule.**
   - Thin , double walled, cup shaped structure.
   - Outer – squamous epithelium
   - Inner – Modified simple squamous epithelium.
   - Urinary space- between two layers.
2. **Glomerulus.**
   - Network of blood capillaries.
   - Formed due to branching of afferent arteriole.
   - Capsular space – between glomerulus and Bowman's capsule.
   - Function – Ultrafiltration.



Renal tubule

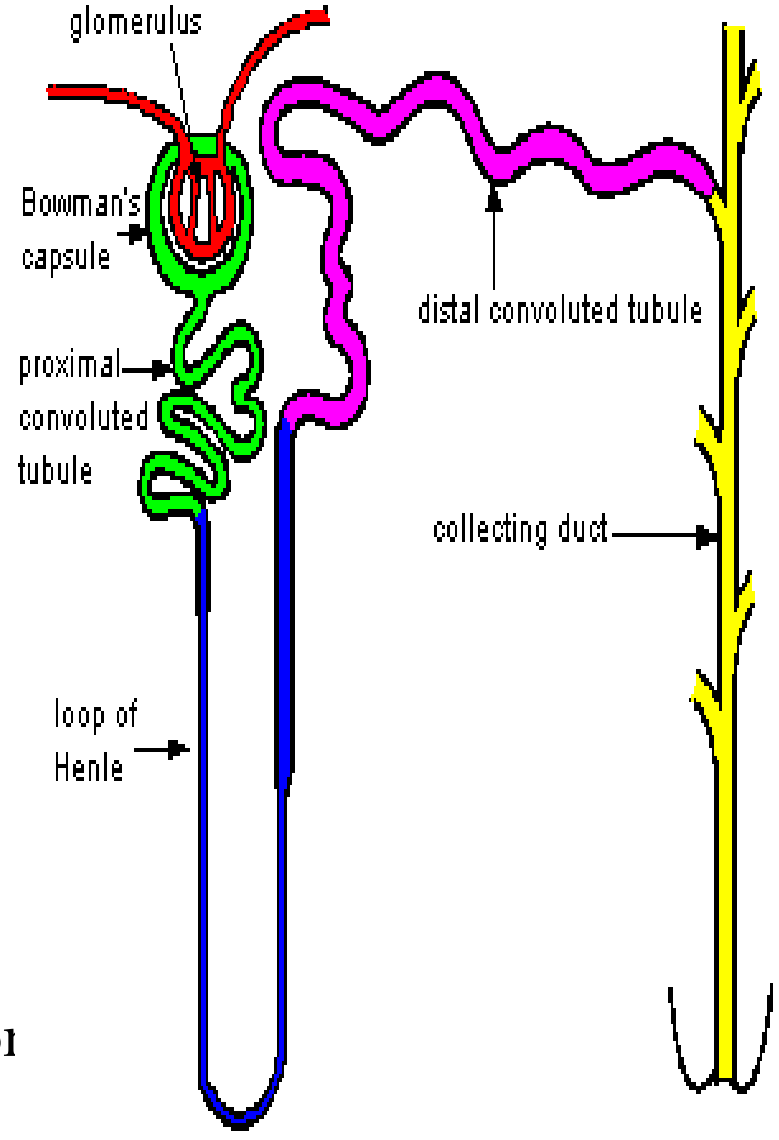
1. **Proximal convoluted tubule:**
   - Highly convoluted.
   - Arises from neck of Bowman's capsule.
   - Internally lined by glandular & ciliated cells.
   - Function- Active reabsorption of amino acids, glucose, K^+, Na^+, Ca^{+2} and vitamins.



Renal tubule

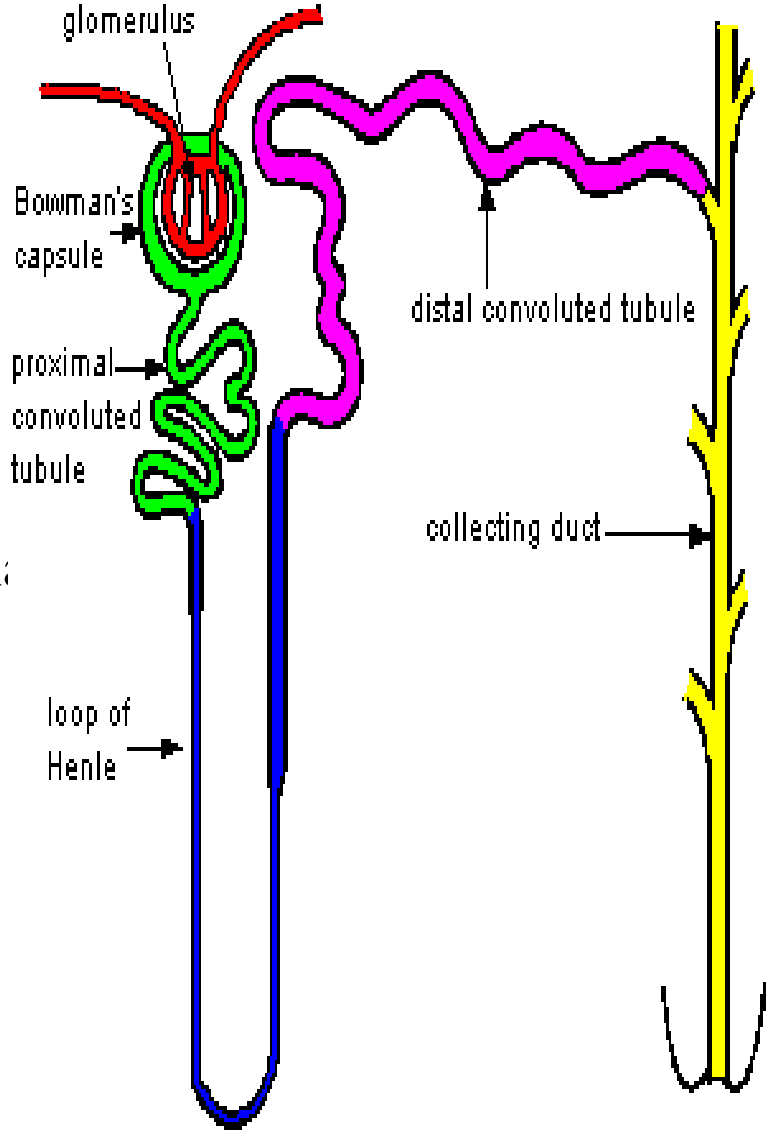
2. **Loop of Henle:**

- U shaped.
- Connect PCT and DCT.
- Ascending & descending limbs.
- Descending- thin & permeable to water (flat epithelial cells).
- Ascending - thick & impermeable (Cuboidal cells).
- Function- Osmoregulation



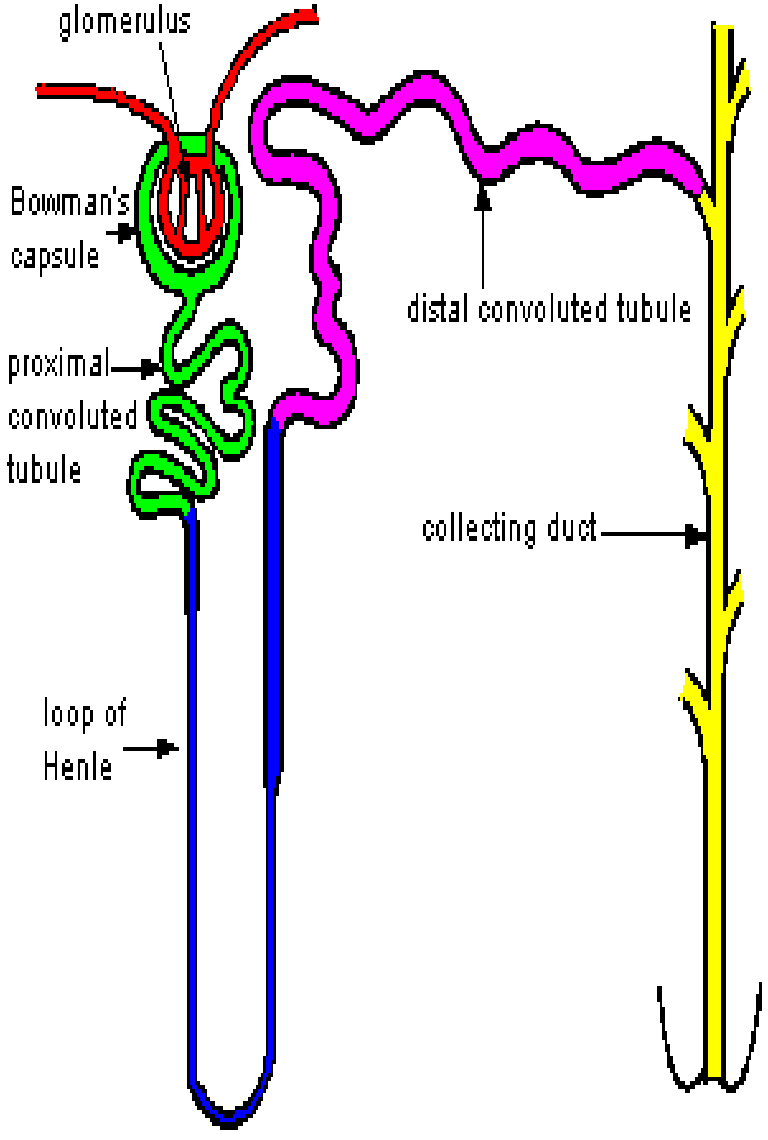
Renal tubule

3. **Distal convoluted tubule:**
   - Less convoluted.
   - Connects LOH & Collecting tubule.
   - Lumen is wider.
   - Internally lined by cuboid epithelium.
   - Function- Absorption of Na^+, H_2O and chlorides.



Collecting tubule

- **Terminal end of DCT opens into CT.**
- **Collecting duct- Collecting tubules of number of nephrons opens into a large duct called Collecting duct.**
- **Cells are highly columnar.**



Functions of Nephrons

1. Ultrafiltration
2. Selective reabsorption.
3. Excretion.
4. Osmoregulation.
5. Maintainance of pH and homeostasis of body fluids.

Blood Flow Through Nephron

Afferent Arteriole

↓

Glomerulus

↓

Efferent Arteriole

↓

Peritubular Capillaries

↓

Veins of the Kidney

- Afferent arterioles deliver blood to the glomeruli
- Efferent arterioles carry blood from the glomeruli to peritubular capillaries

Urine

- Urine is clear and amber in colour.
- pH is around 6 (4.5 to 8).
- Healthy adult passes 1000 – 1500 ml urine per day.
- Urine production decreases during sleep and exercise.
- **Composition –**
  - Water – 96 %
  - Urea – 2 %

Uric acid
Creatinine
Ammonia
Sodium
Potassium
Chlorides
Phosphates
Sulphates
Oxalates

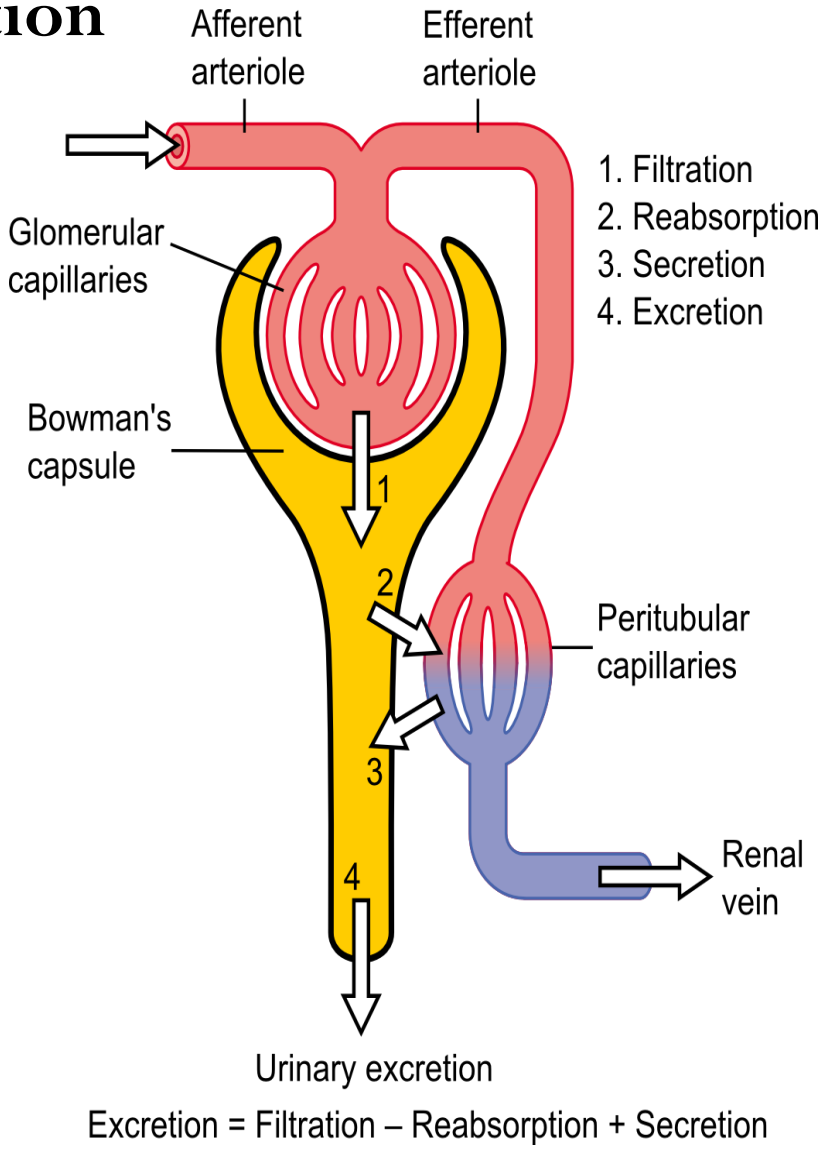
2 %

Abnormal constituents of urine

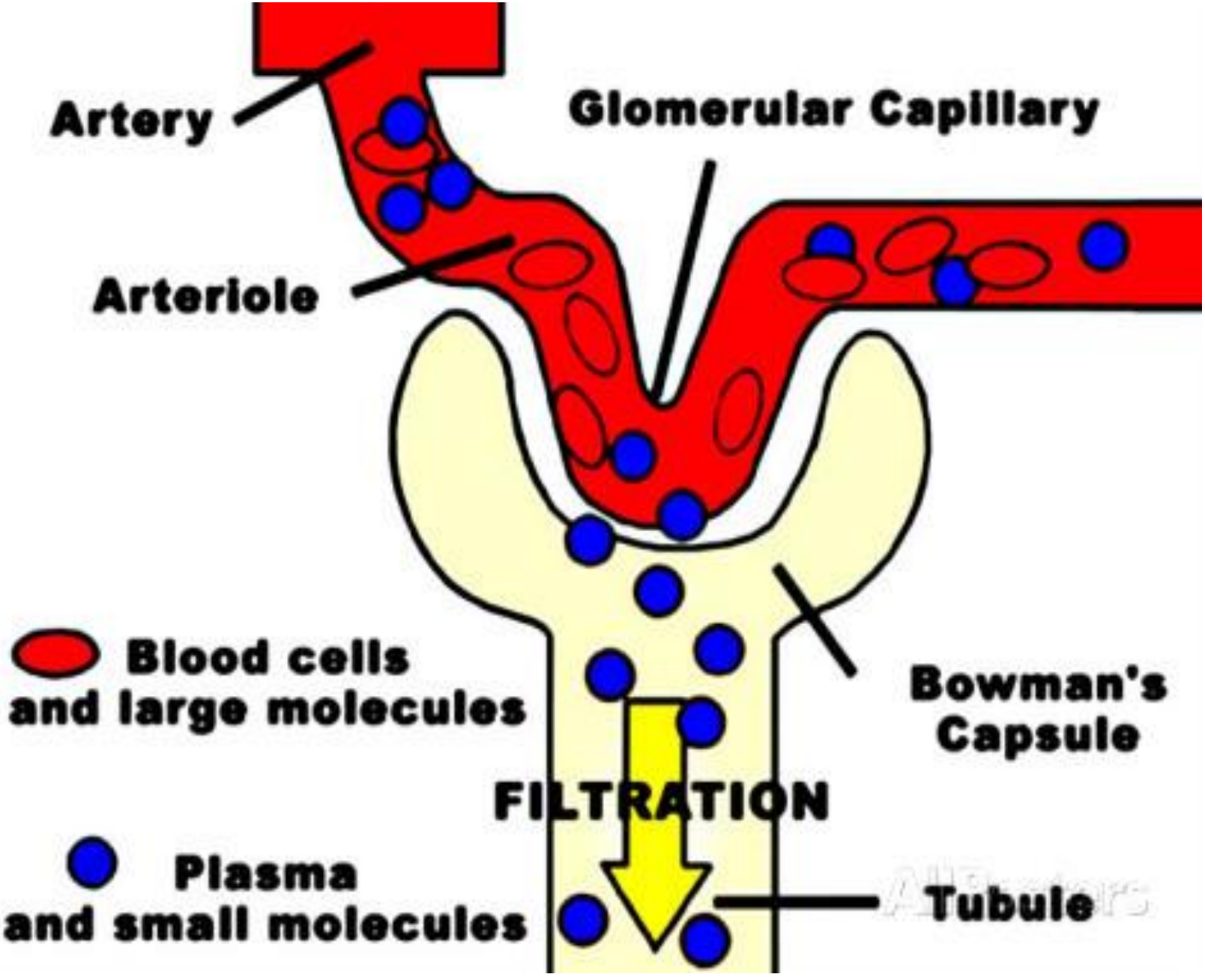
1. Proteins.
2. Sugar.
3. Ketone bodies
4. Bile
5. Blood.

FORMATION OF URINE

- **Glomerular filtration OR Ultrafiltration**
- **Selective Reabsorption**
- **Tubular secretion**



GLOMERULAR FILTRATION



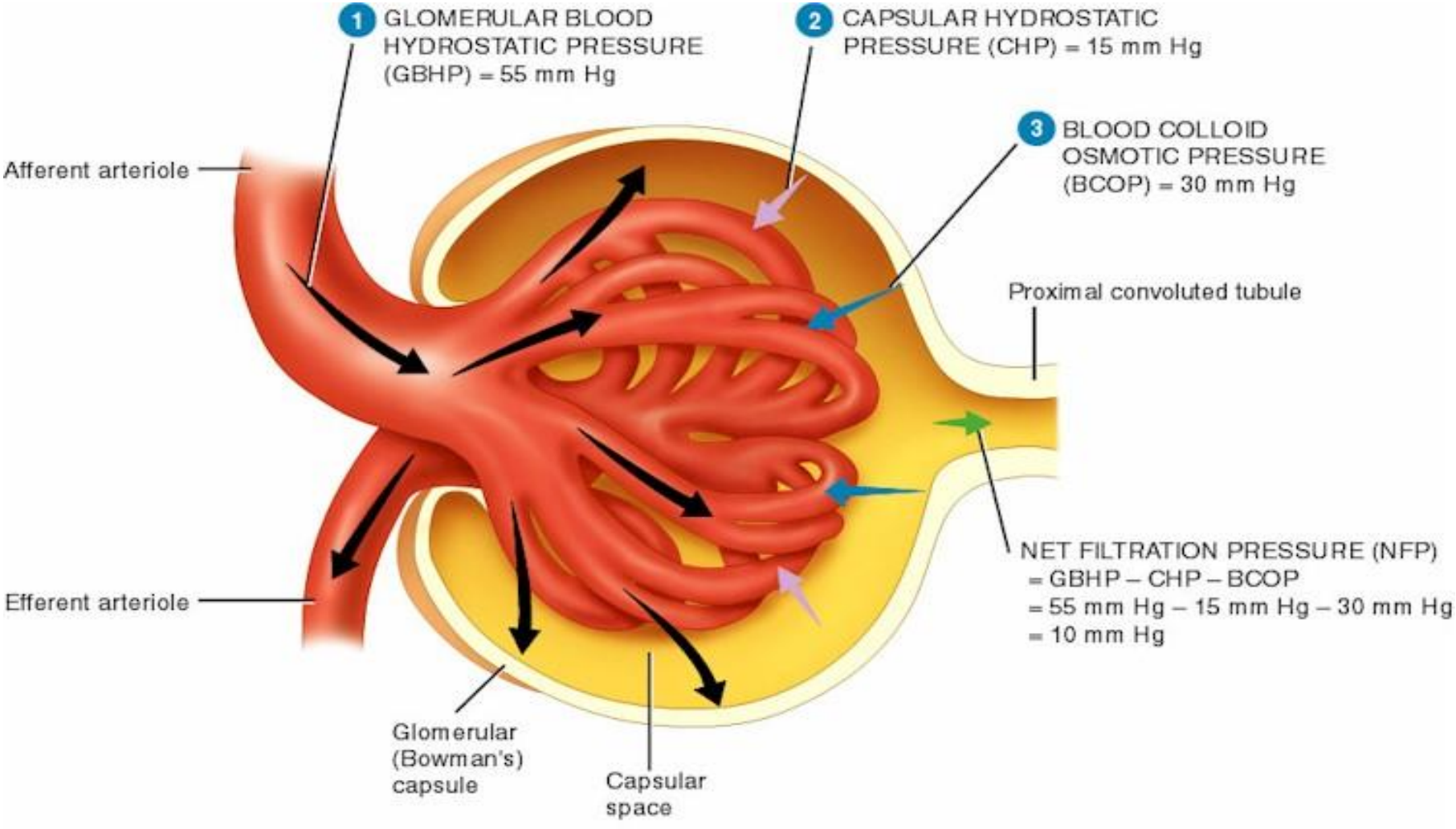
GLOMERULAR FILTRATION CONTINUES.....

CONSTITUENTS REMAIN IN.....

	Glomerular filtrate	In capillaries
01	Water	Erythrocytes
02	Mineral salts	Leucocytes
03	Amino acids	Platelets
04	Ketoacids	Plasma proteins
05	Glucose	Some drugs
06	Some hormones	
07	Creatinine	
08	Urea	
09	Uric acid	
10	Some toxins	
11	Some drugs	

GLOMERULAR FILTRATION CONTINUES.....

- Glomerular blood hydrostatic pressure
- Capsular hydrostatic pressure
- Blood osmotic pressure



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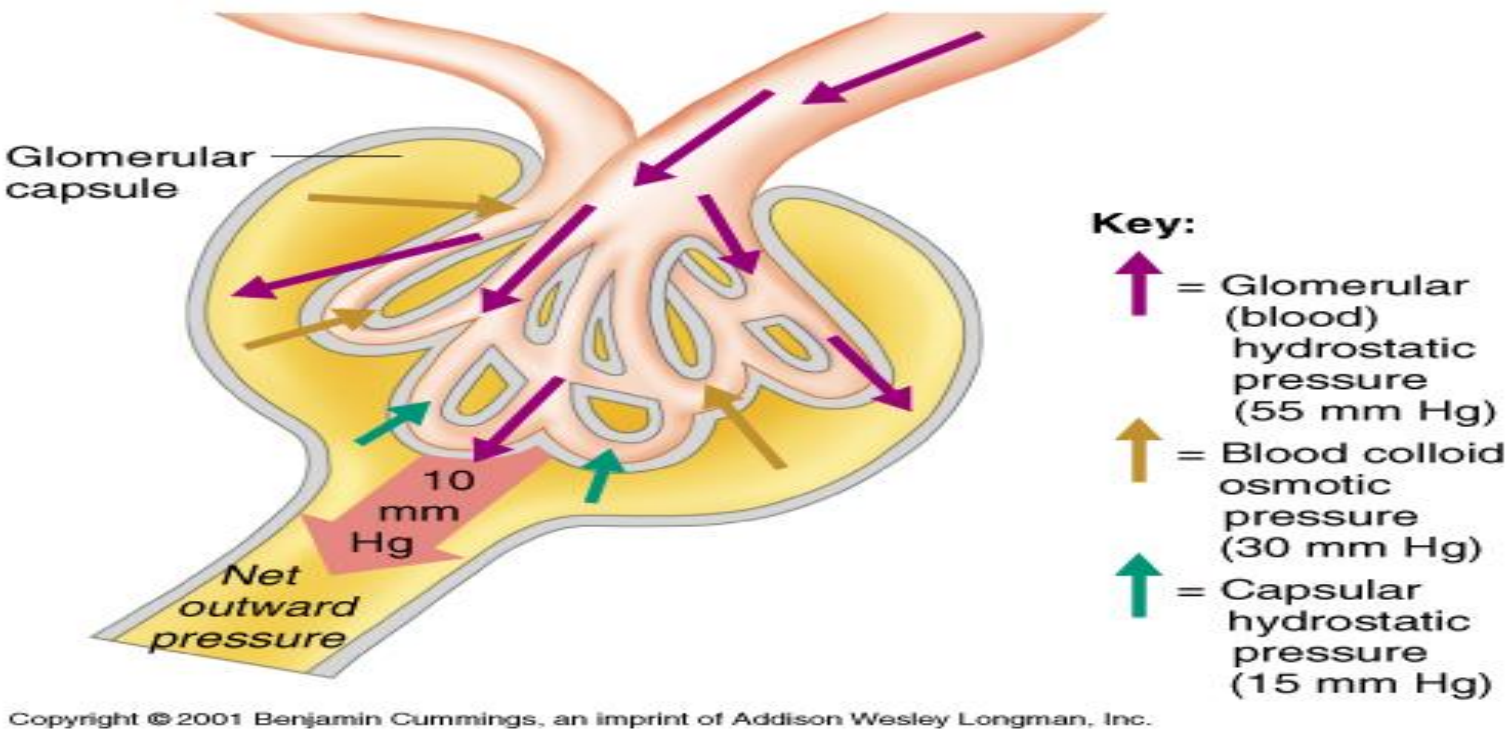
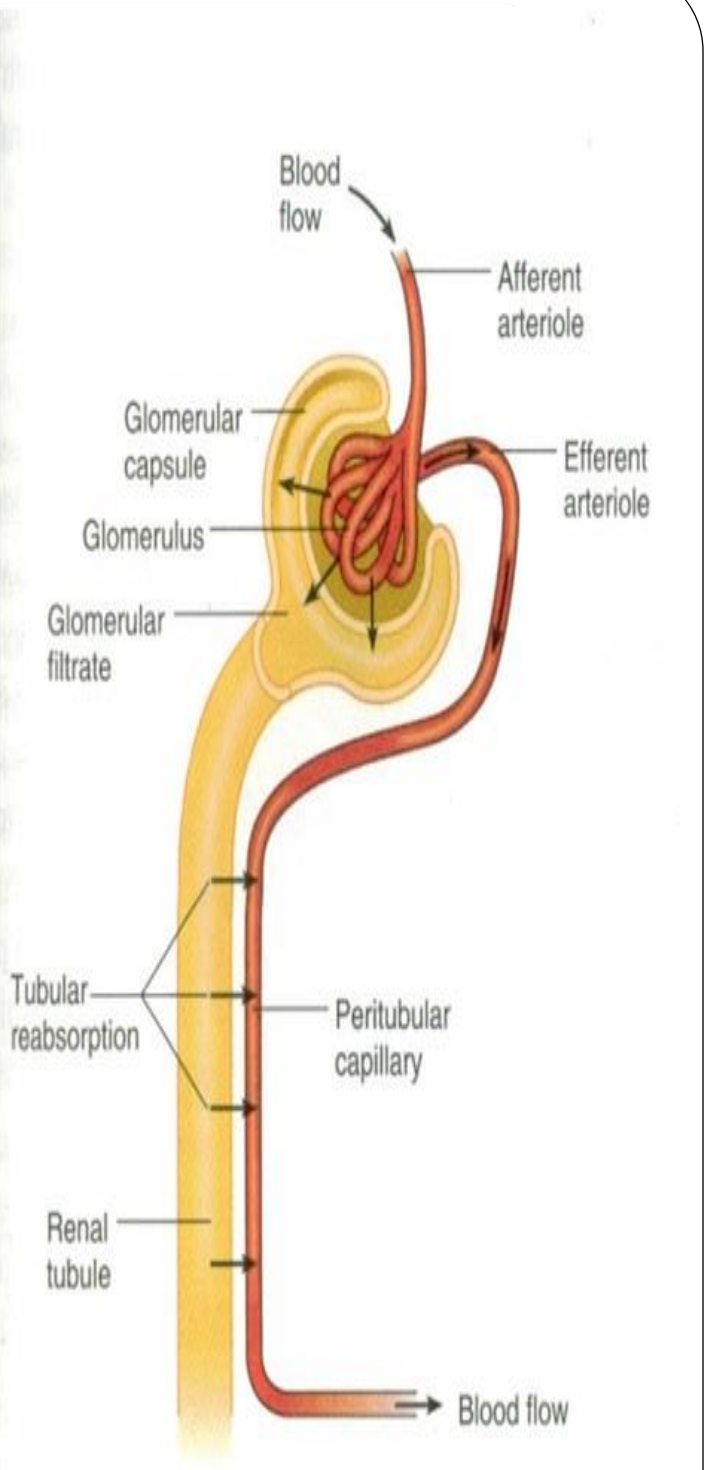
GLOMERULAR FILTRATION CONTINUES.....



- As a result of this pressure (10 mm Hg), certain substances of blood are filtered from glomerulus into the Bowman's capsule called Glomerular filtrate OR Primary urine.
- GFR (Glomerular Filtration Rate): The volume of filtrate formed by both kidneys each minute is called GFR.
- In healthy adult, GFR is about 125ml/min i.e. 180 litres/day.

SELECTIVE REABSORPTION

- About 99 % filtrate is reabsorbed.
- Selective reabsorption means?
- Where it takes place?
- Why reabsorption occurs?



Tubular Reabsorption

SELECTIVE REABSORPTION CONTI.....

REABSORPTION IN PCT

- Almost all amino acids
- Glucose
- Vitamins
- Sodium
- Potassium
- Calcium
- Water
- Chloride ions

REABSORPTION IN LOOP OF HENLE

Descending Limb

- Water

Ascending Limb

- Sodium
- Potassium
- Chloride

REABSORPTION IN DCT

- Sodium
- Water
- Chloride ions

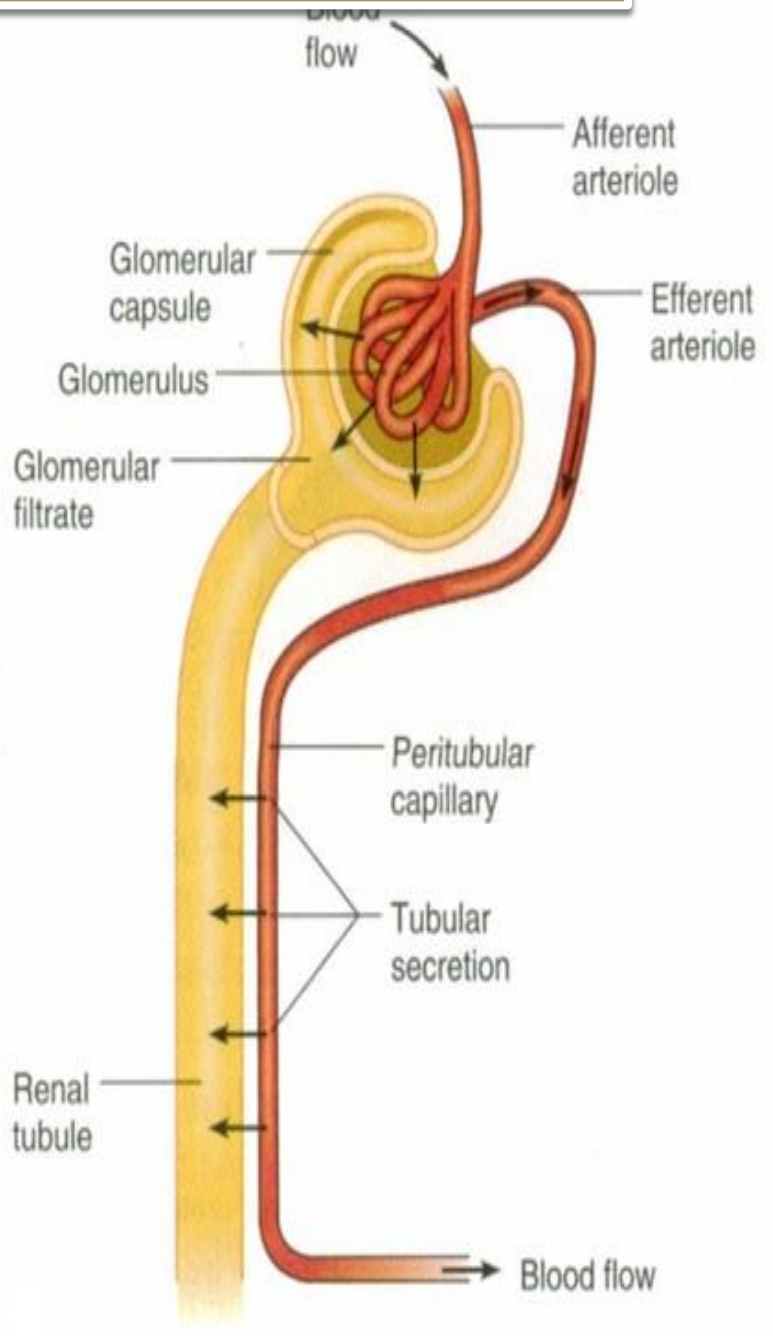
REABSORPTION IN COLLECTING TUBULE

- Additional Water

TUBULAR SECRETION

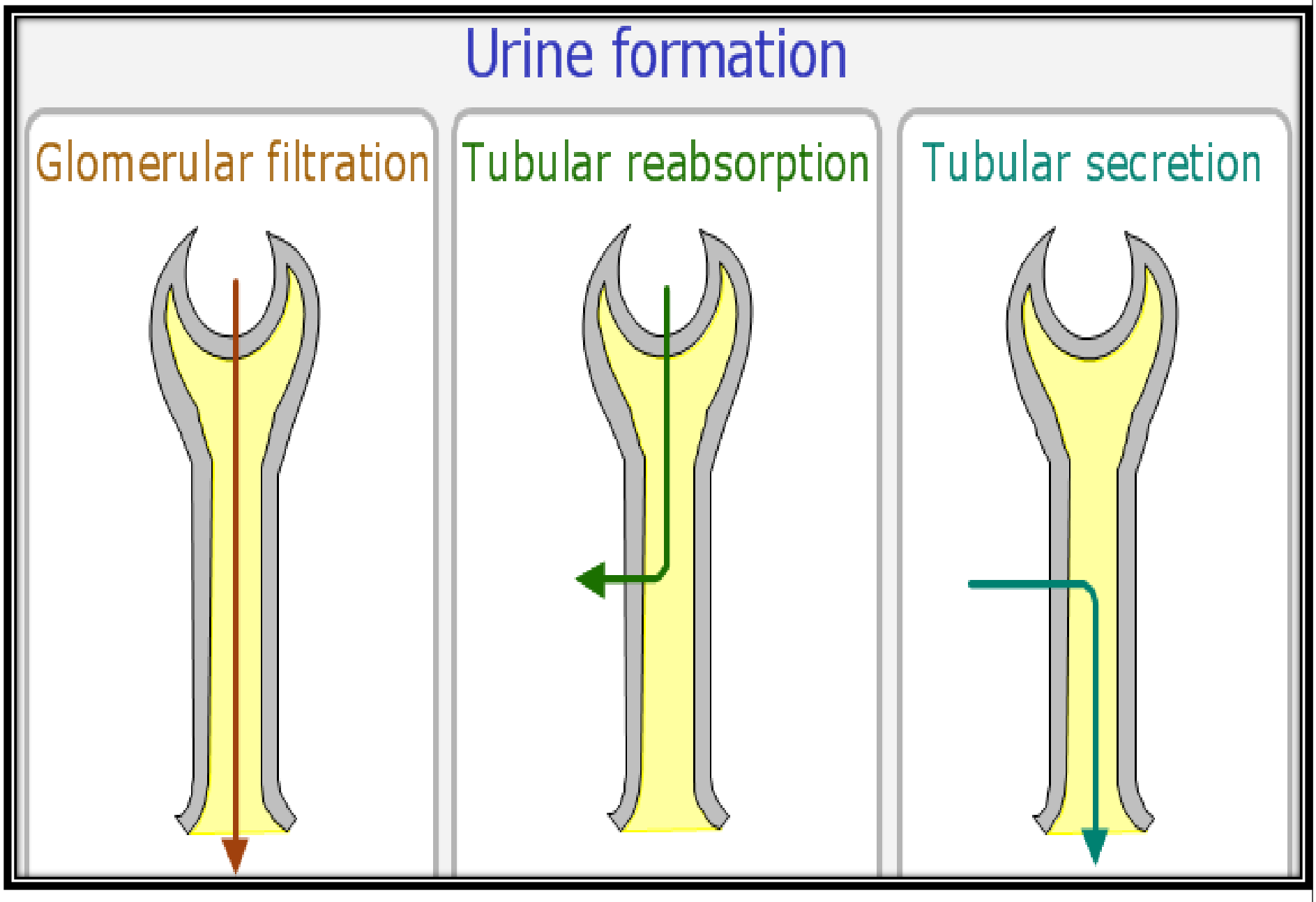
- What is tubular secretion?
- Where it takes place?
- What is the necessity?
- Which components secreted?

(Hydrogen, creatinine, and drugs)

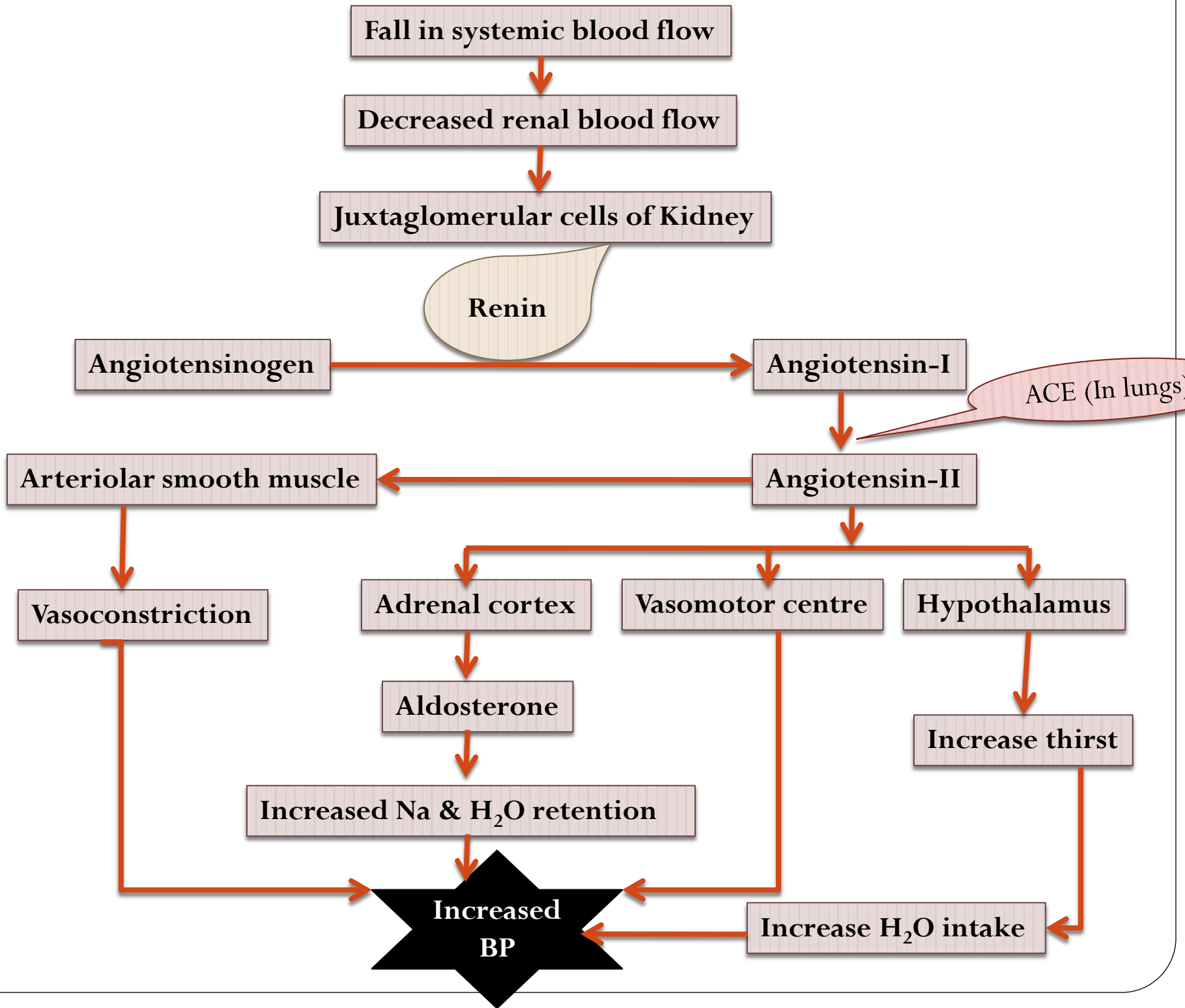


Tubular Secretion

SUMMARY OF URINE FORMATION



Renin Angiotensin Aldosterone System




MAYO
CLINIC
THANK YOU