ENERGY

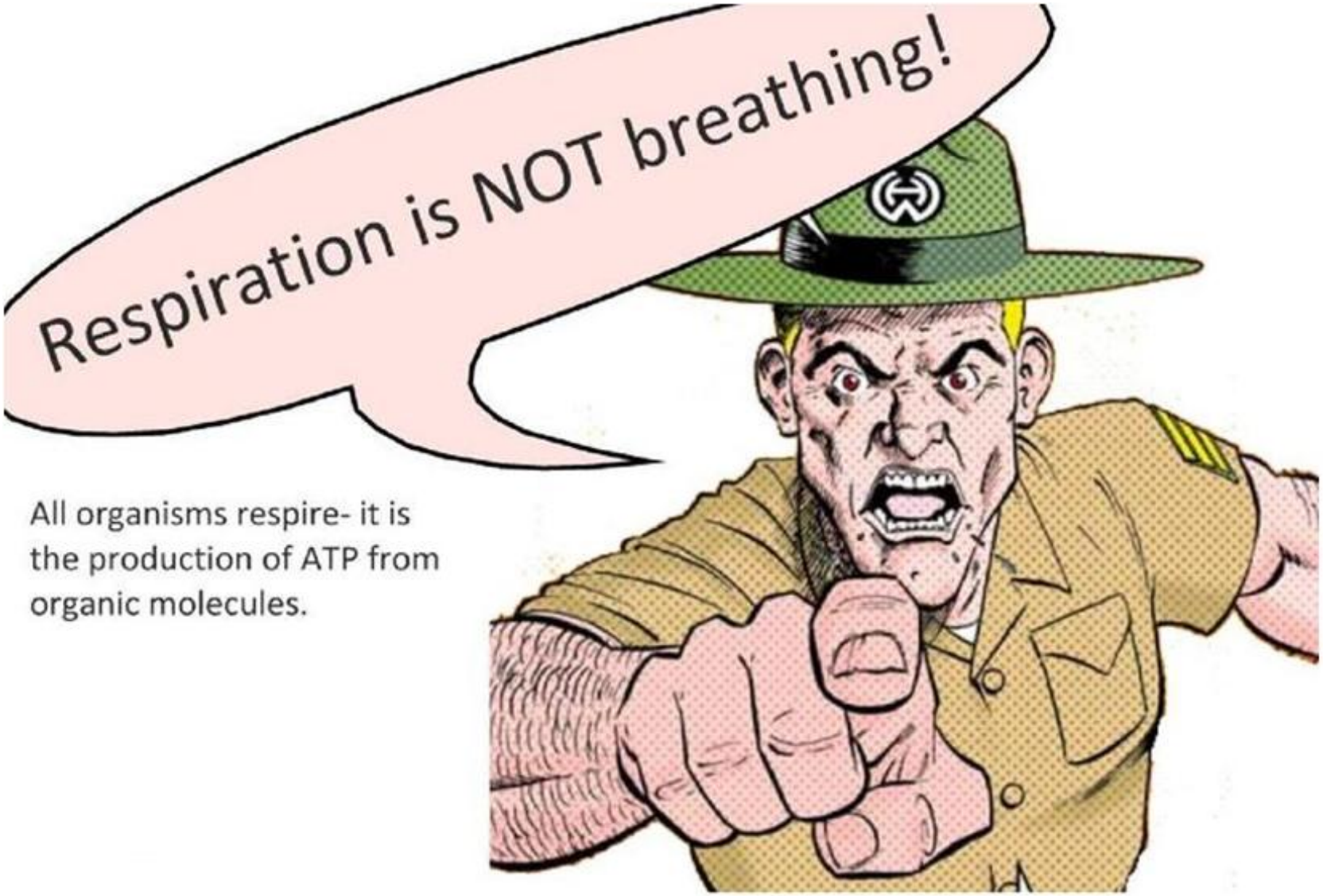
- *All living organisms need energy to perform different processes.*
- *Energy can be defines as the 'capacity for doing work'.*
- *What is the main source of energy for all organisms?*
- *How does body convert energy stored in food?*
- *In what forms does this chemical energy present?*
- *Name the process by which organisms gain energy from these chemicals.*

State the uses of energy in the body of humans

In what life processes does my body need energy ……?

1. Growth
2. Muscle contraction
3. Protein synthesis
4. Cell division
5. Active transport
6. Passage of nerve impulses and
7. Maintenance of a constant body temperature

WHAT IS CELLULAR RESPIRATION…?



All organisms respire- it is the production of ATP from organic molecules.

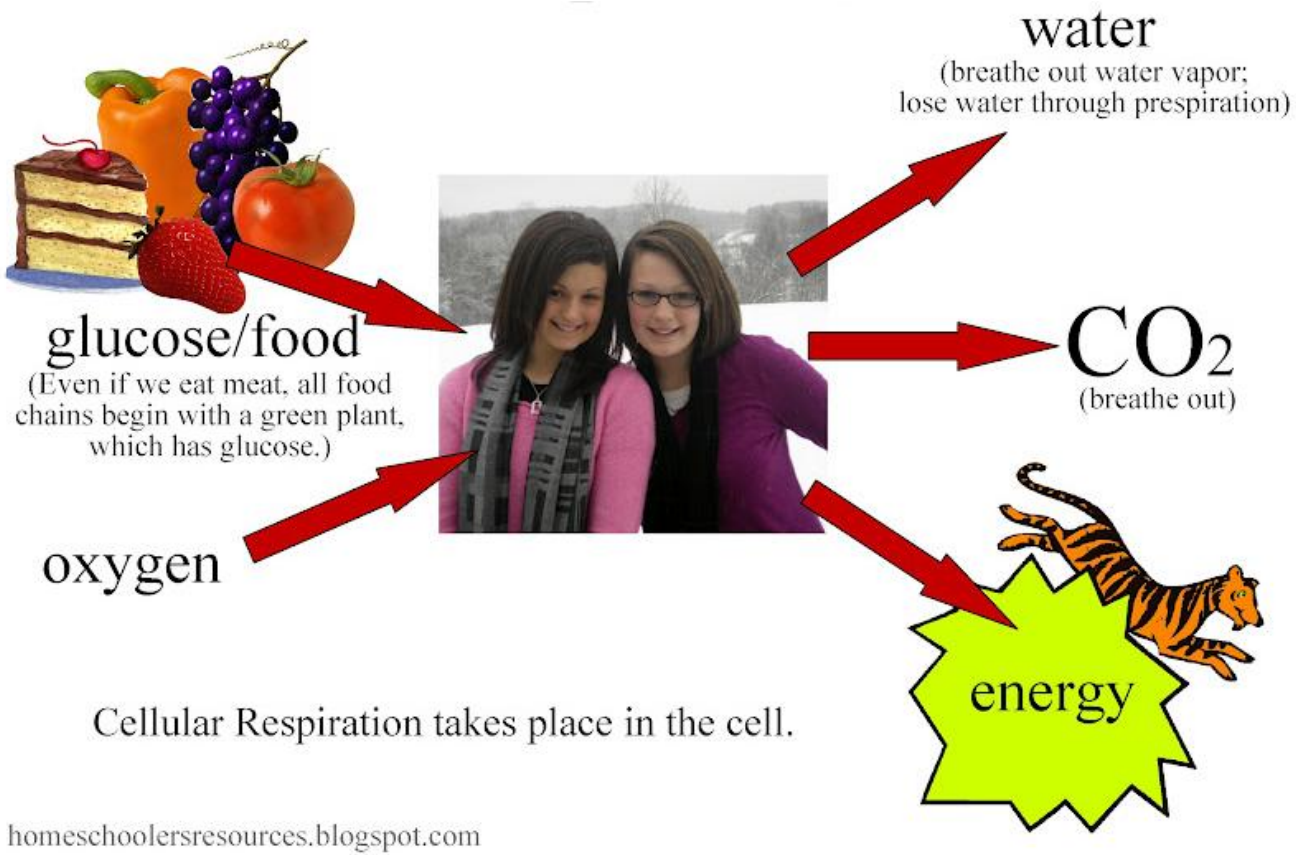
Respiration: definition

- Respiration as the chemical reactions that break down nutrient molecules in living cells to release energy.

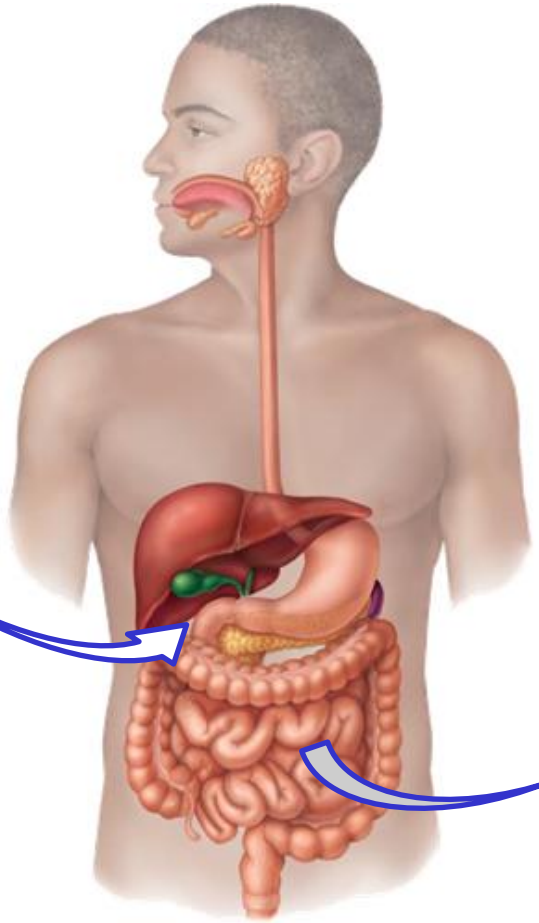
- Types:
- Aerobic respiration
- Anaerobic respiration

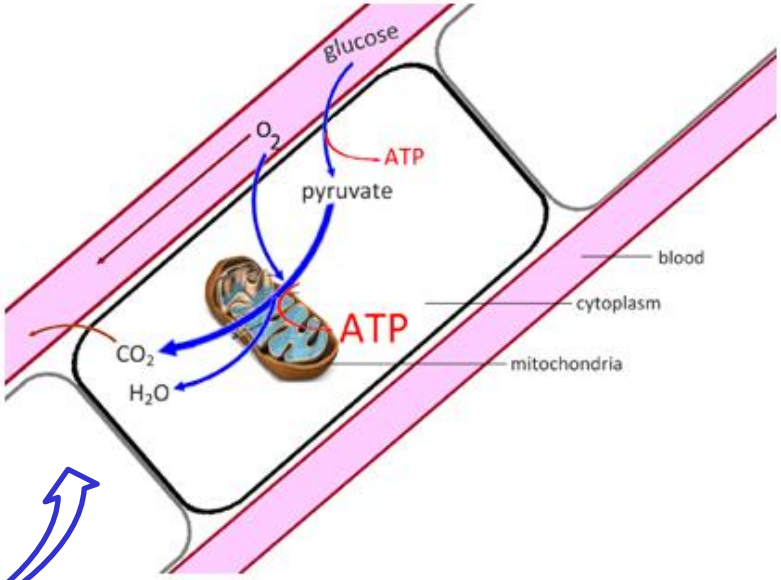
Aerobic respiration

- A process in which the *breakdown of food* substances takes place *in cells* in the *presence of oxygen* and produce relatively *large* amount of energy.



Respiration:

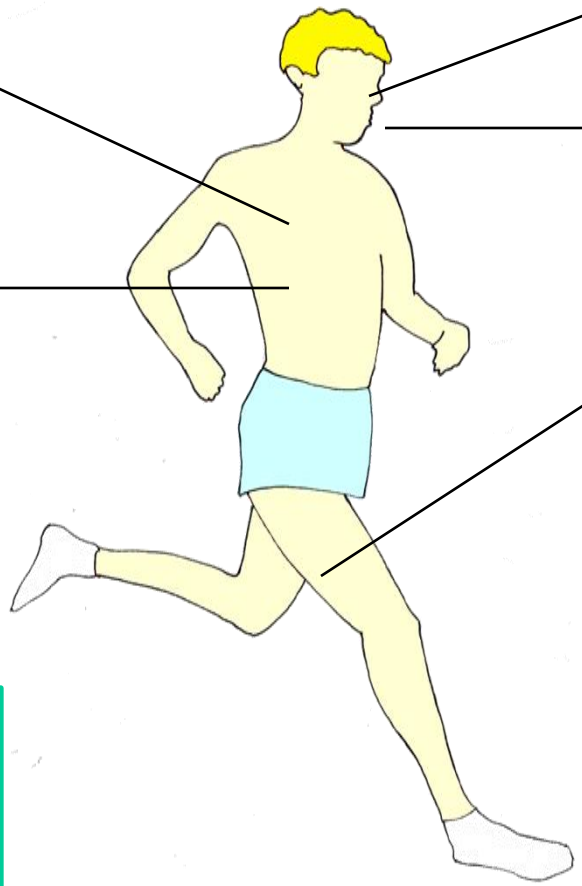




Respiration:

2. The lungs absorb oxygen from the air

2.The stomach and intestine digest food. One of the products is glucose



1. Air taken in

1.Food taken in

3.The blood stream carries glucose and oxygen to the muscles

5 Carbon dioxide is carried to the lungs by the blood

4 **RESPIRATION**

Glucose and oxygen react to produce energy.

Aerobic respiration : Equation

Glucose + Oxygen ⟶ Carbon dioxide + Water + Energy

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 2900\ kJ/mol$

1. The molecule are combined with oxygen so the process is called oxidation..
2. Is this large amount of energy released at once.....? (combustion)
3. Respiration is a multistep process in which each step produce little energy.

Anaerobic respiration:

- Anaerobic: absence of oxygen.
- It is possible to release energy from food without using oxygen in cells.
- ***A process in which the breakdown of food substances in cell takes place in the absence of oxygen and release of a relatively small amount of energy.***
- Examples:

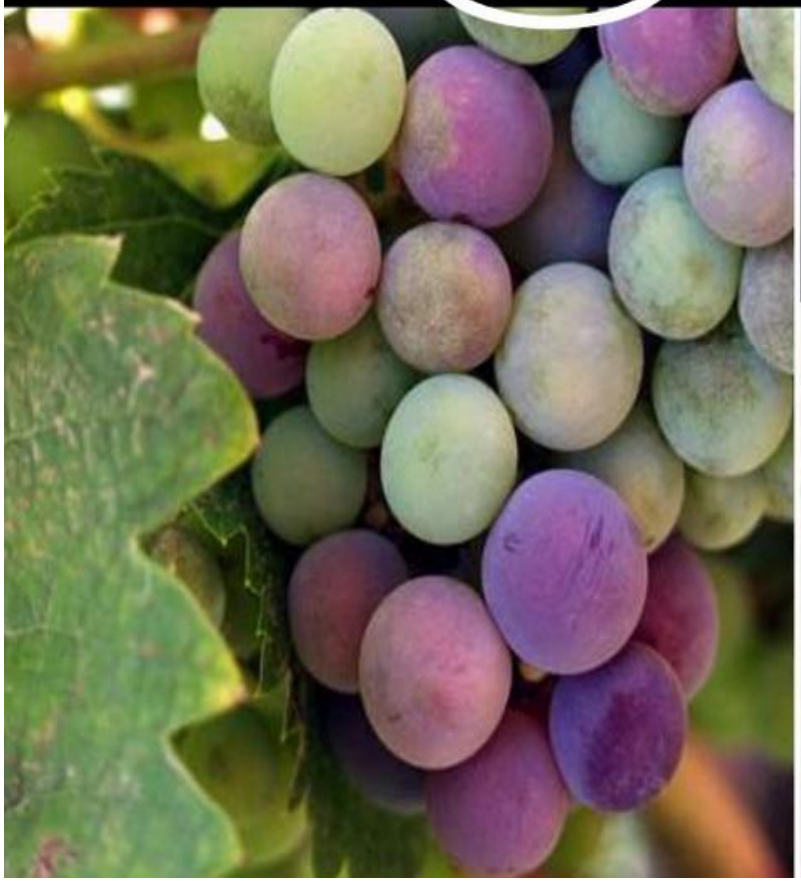
1. Action of yeast on sugar solution to produce alcohol.
2. In brewing and bread-making.
3. In Muscles cells during hard, strenuous exercise.

1. Action of yeast on sugar solution to produce alcohol.

Anaerobic respiration

Glucose (with yeast)

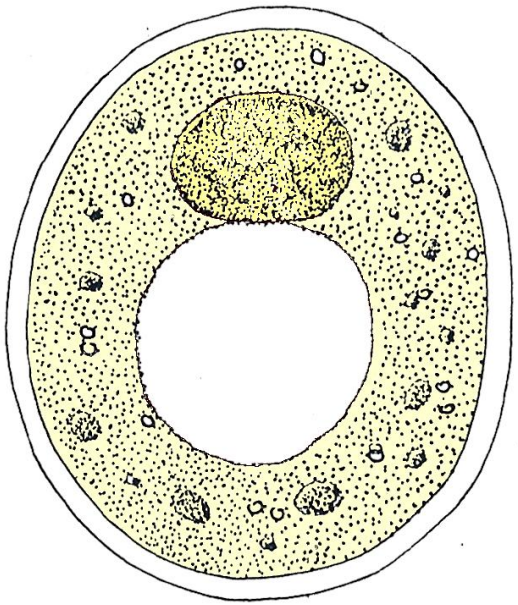
→ Carbon dioxide + ethanol + little energy



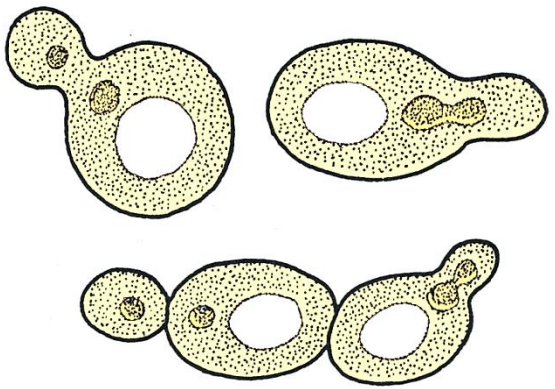
1. Action of yeast on sugar solution to produce alcohol.

Glucose → Ethanol + Carbon dioxide + Energy

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + Energy$

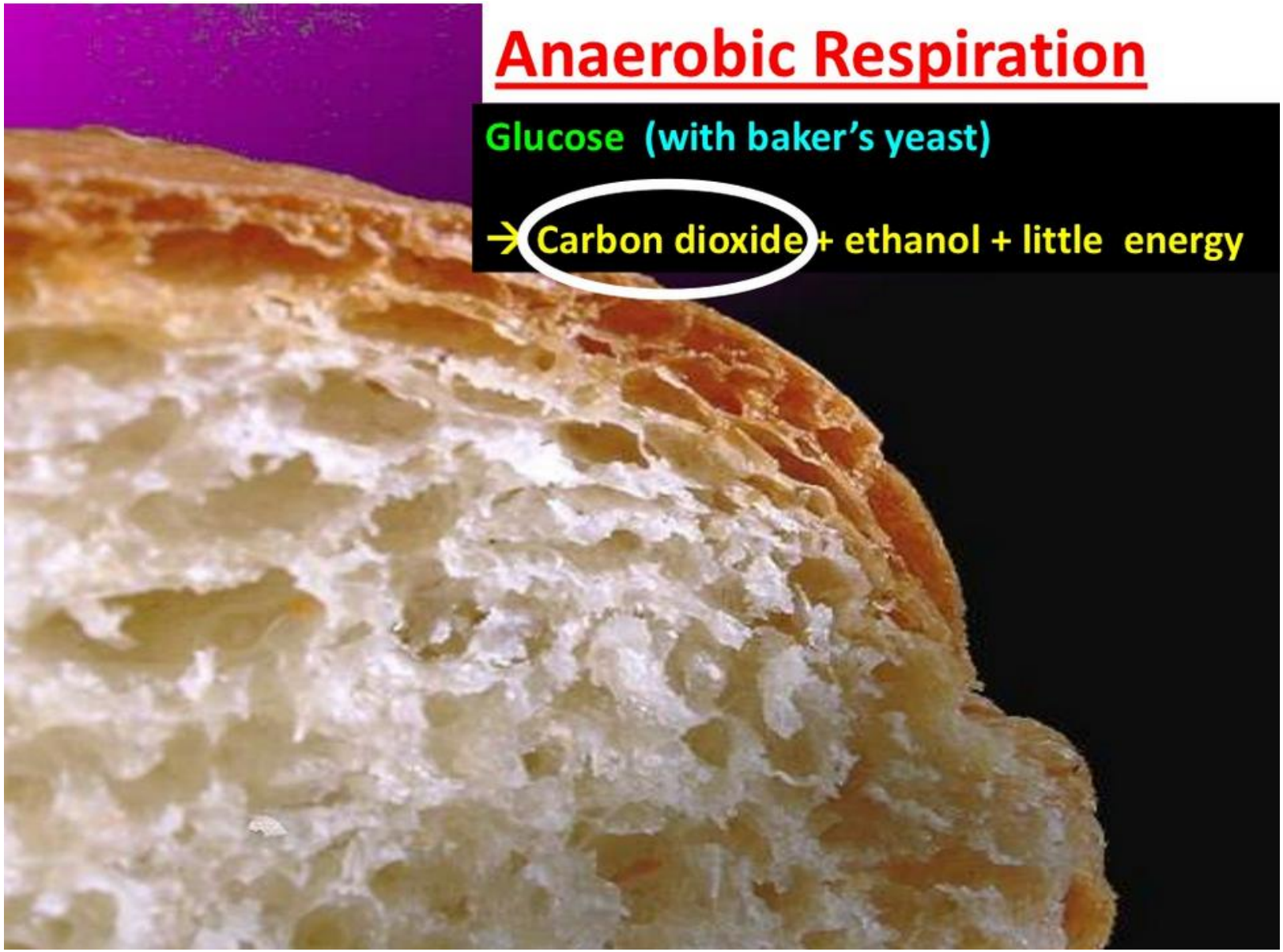


single yeast cell



Yeast cells dividing

2. Action of yeast on sugar solution to produce CO_2.



3. In Muscles cells during hard, strenuous exercise.

FAST

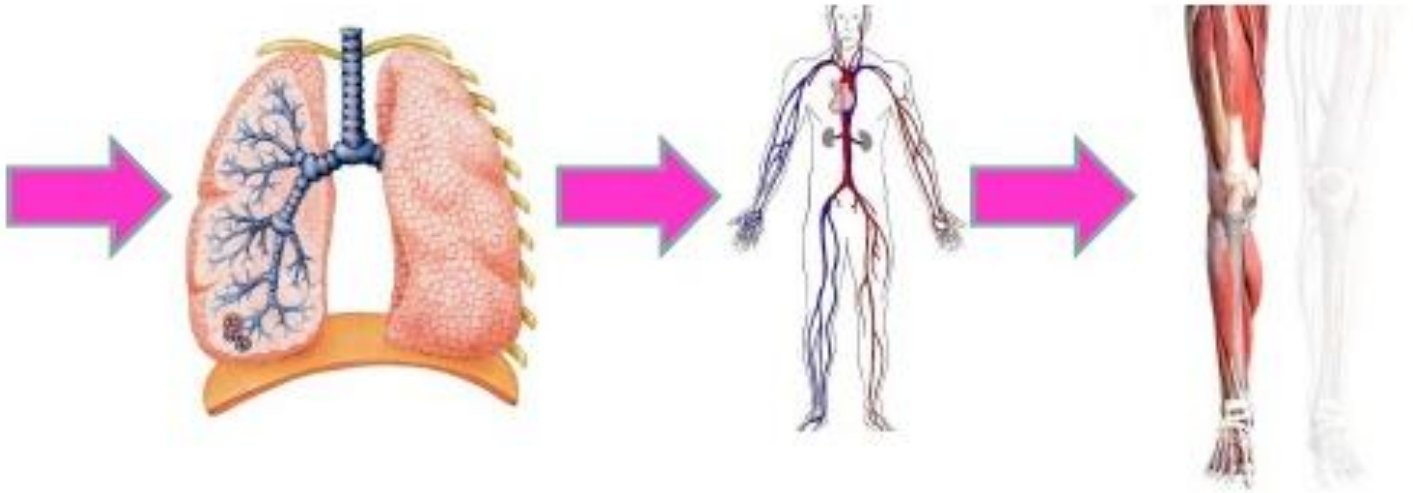
EXPLOSIVE

QUICK

3. In Muscles cells during hard, strenuous exercise.

Sport/Exercise

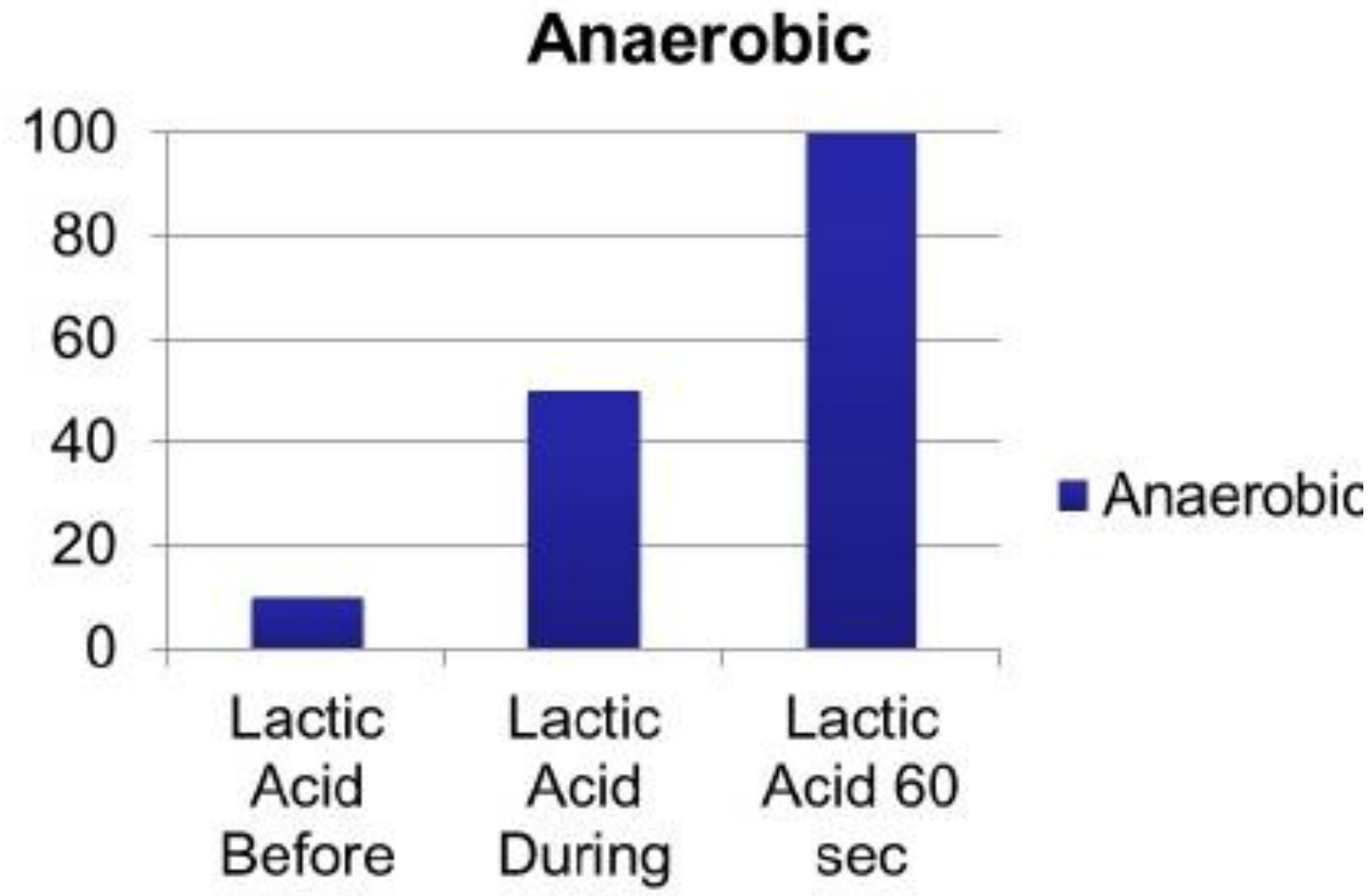
Increased need for O_2



Not enough time Aerobically

Can't supply O_2 quick enough

3. In Muscles cells during hard, strenuous exercise.



Anaerobic respiration:

Glucose → Lactic acid + Energy

$C_6H_{12}O_6 \rightarrow 2C_3H_6O_3 + 120\ kJ/mol$

Glucose → Ethanol + Carbon dioxide + Energy

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + Energy$

Remember (Exams questions)

Explain the role of yeast in bread making.

1. yeast respires glucose / sugar (in dough);
2. produces carbon dioxide (bubbles)
3. causes dough to rise;
4. on baking bubbles expand;
5. form air spaces in bread / make bread porous / light;

Explain the role of yeast in brewing.

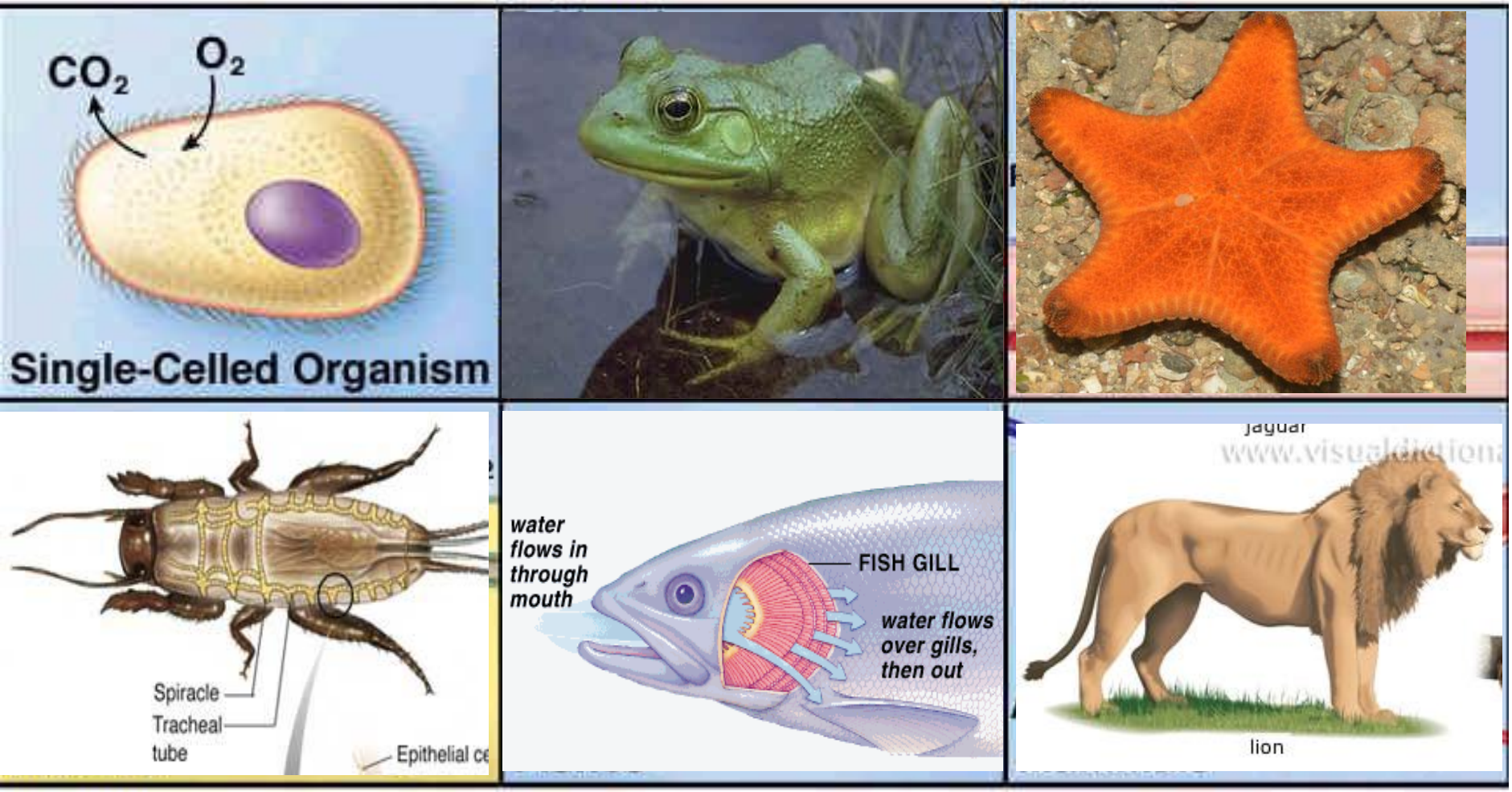
1. in little / no oxygen conditions;
2. yeast respires anaerobically;
3. ethanol / alcohol produced;
4. releases carbon dioxide / adds “gas” to product

Differences between aerobic and anaerobic respiration

	aerobic respiration	anaerobic respiration
1	oxygen used	no oxygen used;
2	lots of energy released	little energy released;
3	no lactic acid produced	lactic acid produced;
4	carbon dioxide formed	no carbon dioxide formed;

List the features of gas exchange surfaces in animals.

- Respiratory surface:



List the features of gas exchange surfaces in animals.

1. A very large surface area:

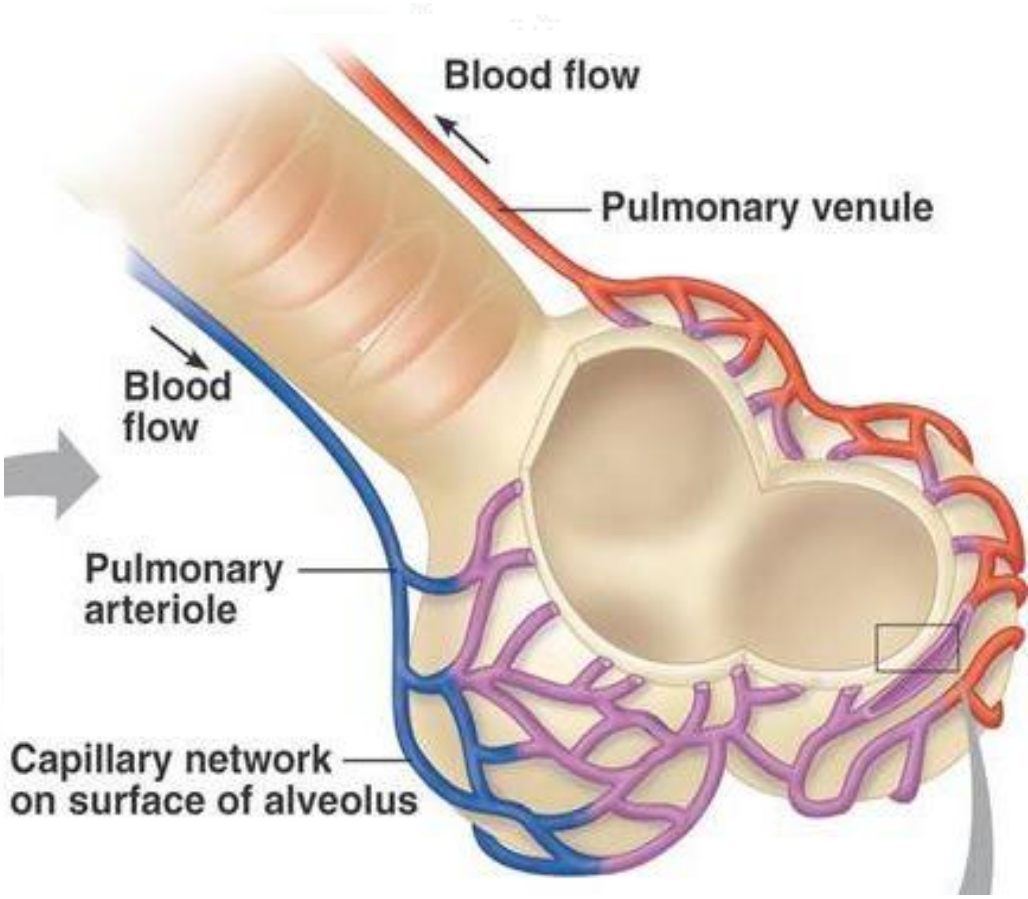
   Diffusion of gases

2. Moist surfaces: gases can dissolve before diffusion.

3. Thin walls (one cell thick):

   Gases do not have to diffuse very far. Ensure faster rate of diffusion

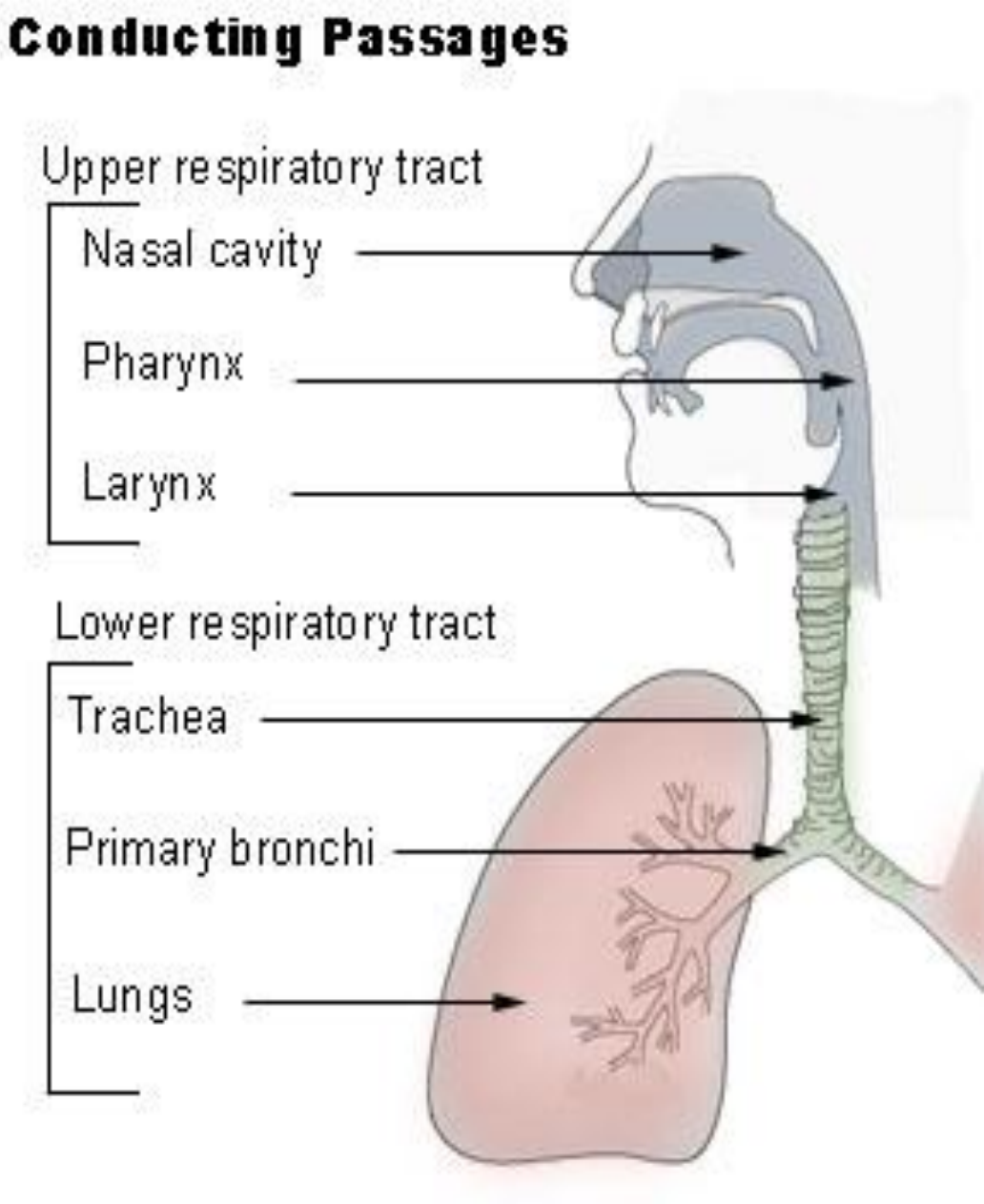
4. Rich blood supply: Maintains exchange of gases quickly.

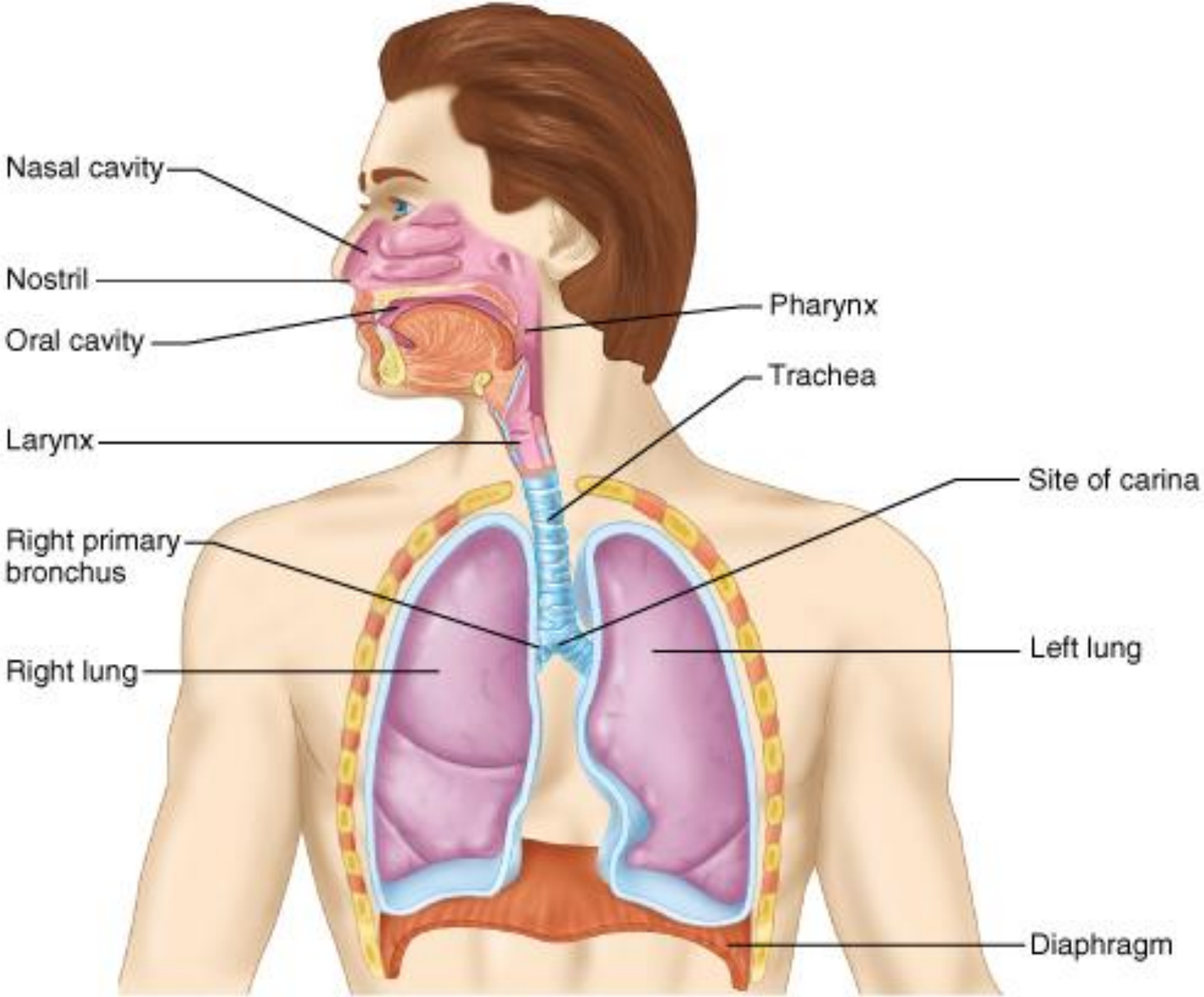


HUMAN RESPIRATORY SYSTEM

Two main components:

- Respiratory tract
- Respiratory organ



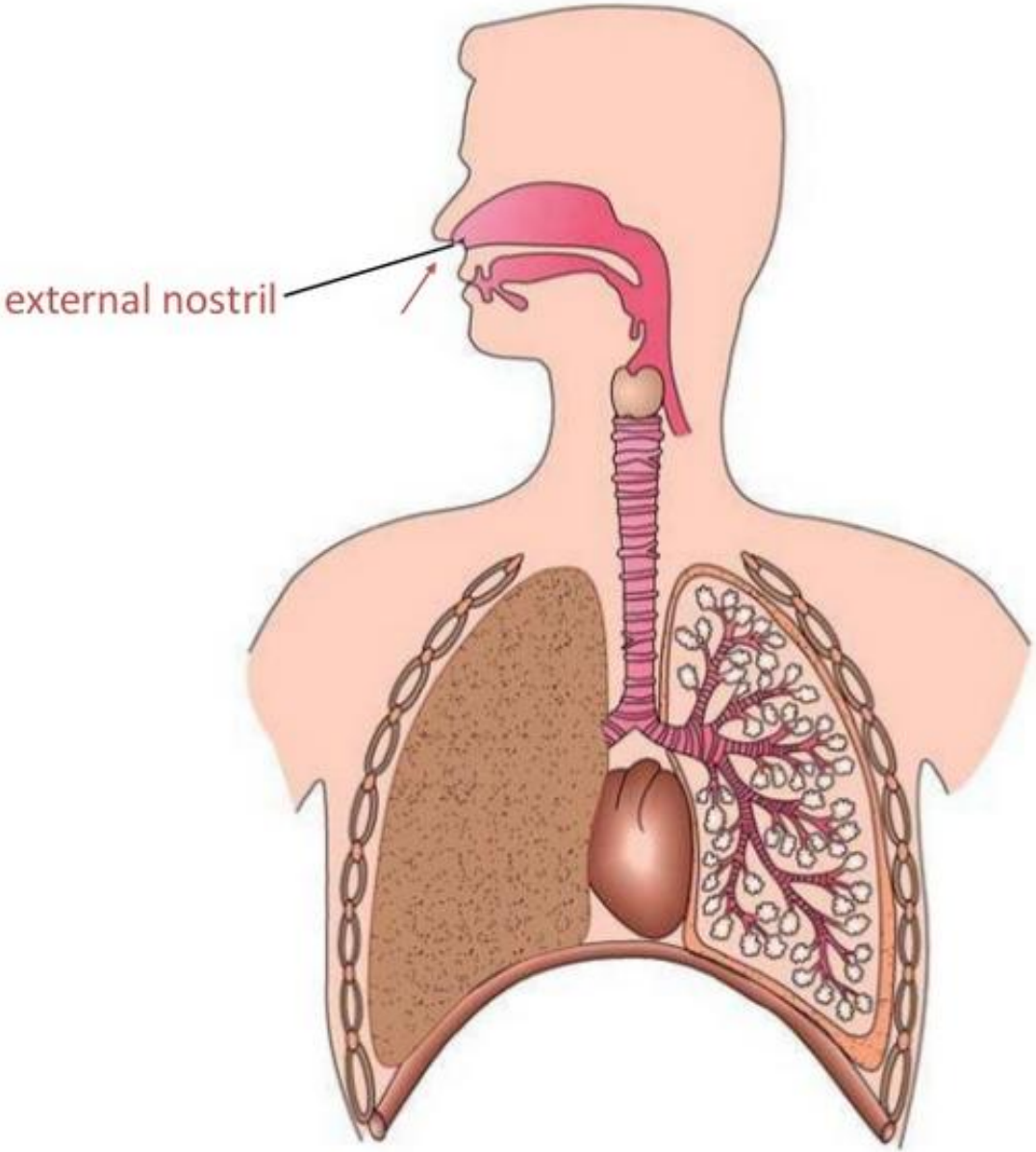

Nasal cavity
Nostril
Oral cavity
Larynx
Right primary bronchus
Right lung
Pharynx
Trachea
Site of carina
Left lung
Diaphragm

Path of Air Through the Respiratory System

atmosphere

↓

external nostril



Path of Air Through the Respiratory System

atmosphere

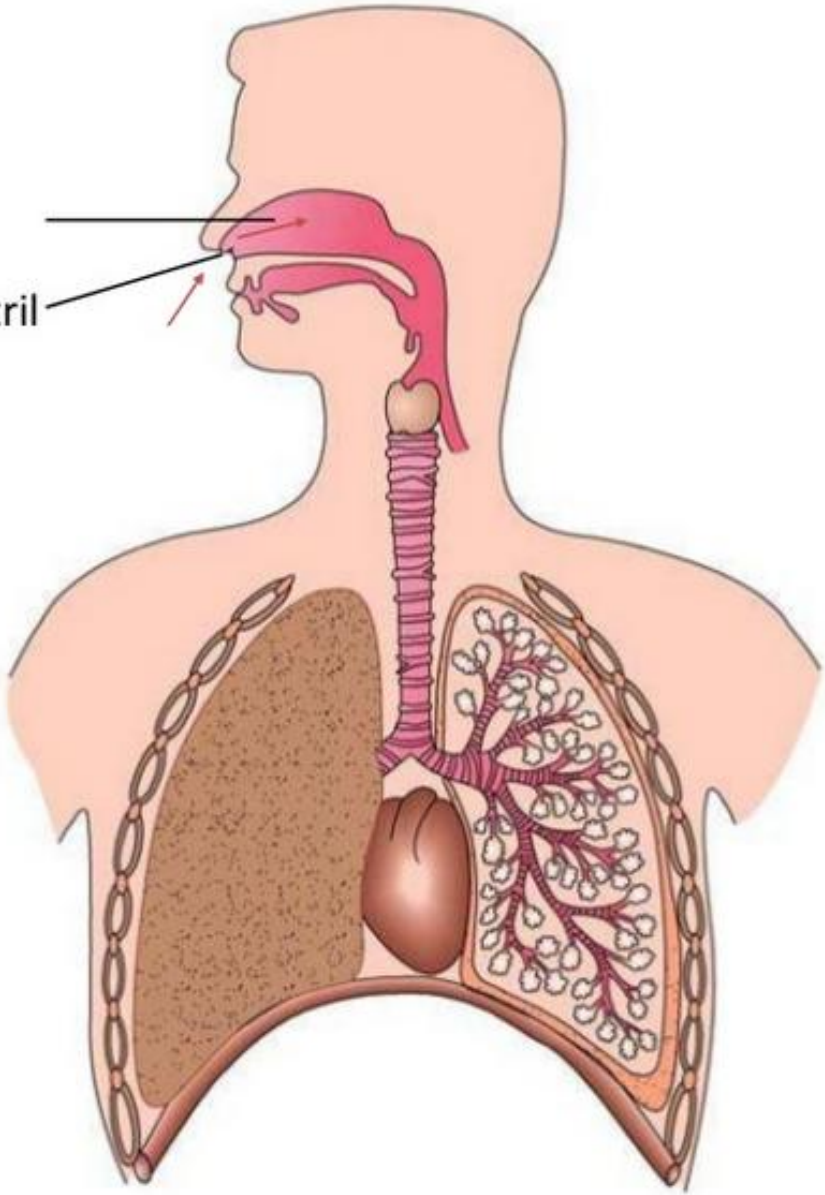
↓

external nostril

↓

nasal passages

(lined with moist mucus membrane)



Nasal passage or nasal cavity

Lined with moist mucus membrane.

Advantages of breathing through nose:

1. **Hairs** and **moist mucous membrane** lining alls of external nostrils filter air, trap dust and foreign particles
2. **Blood capillaries** and **mucus** warm and moisten air respectively before entry into lungs.
3. Sensory cells(small receptor cells) in mucous membrane may detect harmful chemicals in the air (sense of smell)

Path of Air Through the Respiratory System

atmosphere

↓

external nostril

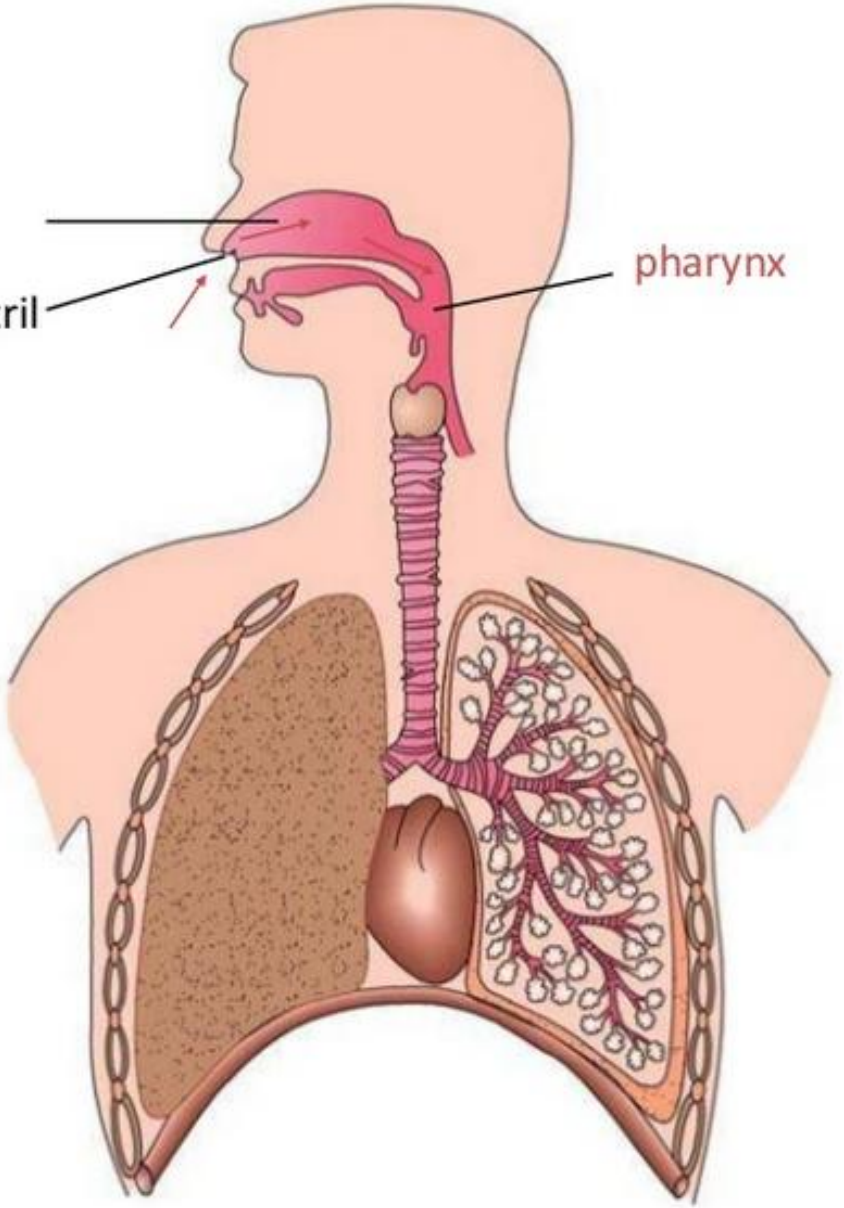
↓

nasal passages

↓

Pharynx
(throat)

→ Located behind the mouth cavity, air passes through it on the way to glottis



Path of Air Through the Respiratory System

atmosphere

↓

external nostril

↓

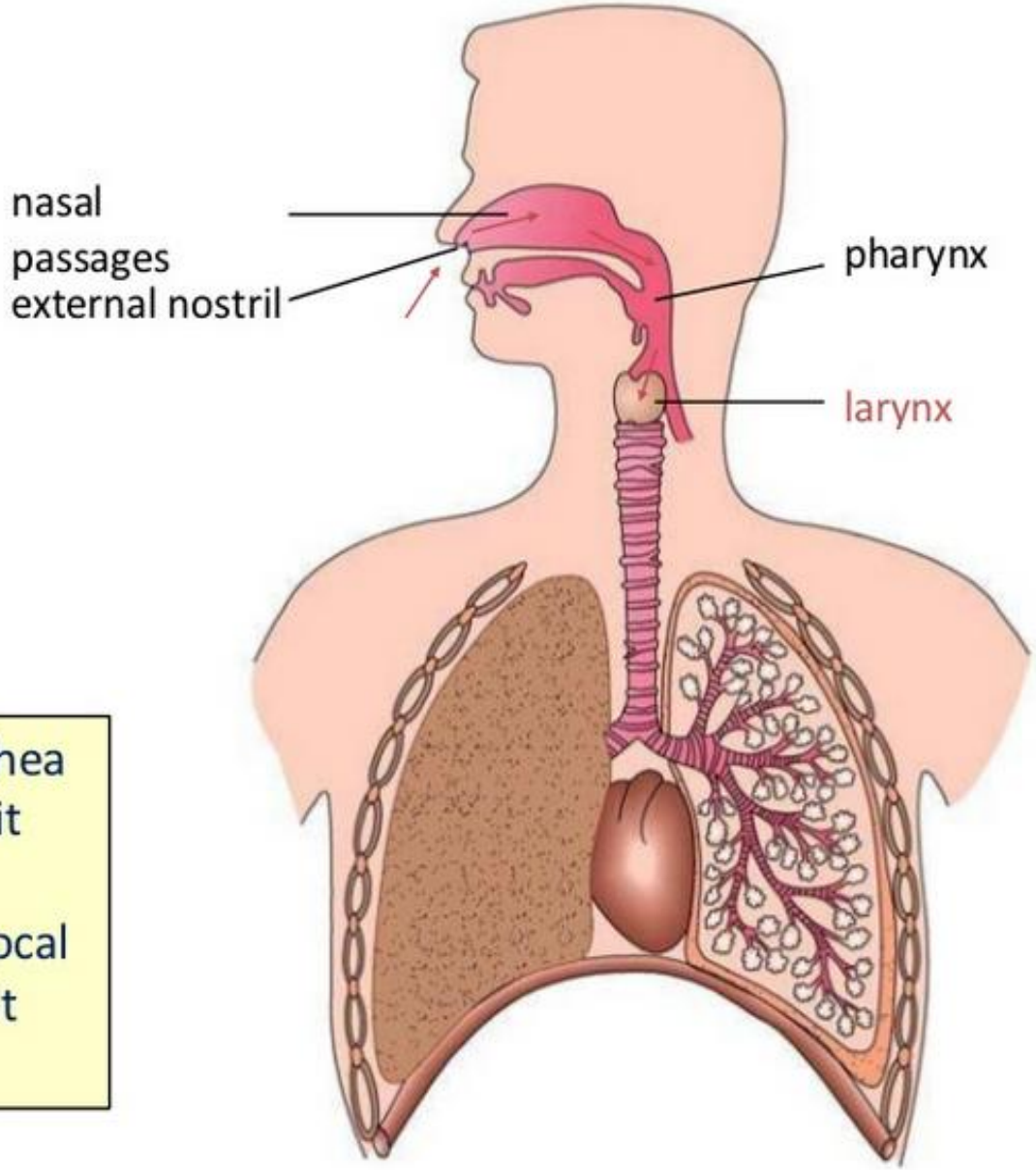
nasal passages

↓

pharynx

↓

Larynx (Adam's Apple)



→Situated at top of trachea
→ Has cartilage to keep it open
→Is the voicebox with vocal chords stretched across it

Path of Air Through the Respiratory System

atmosphere

↓

external nostril

↓

nasal passages

↓

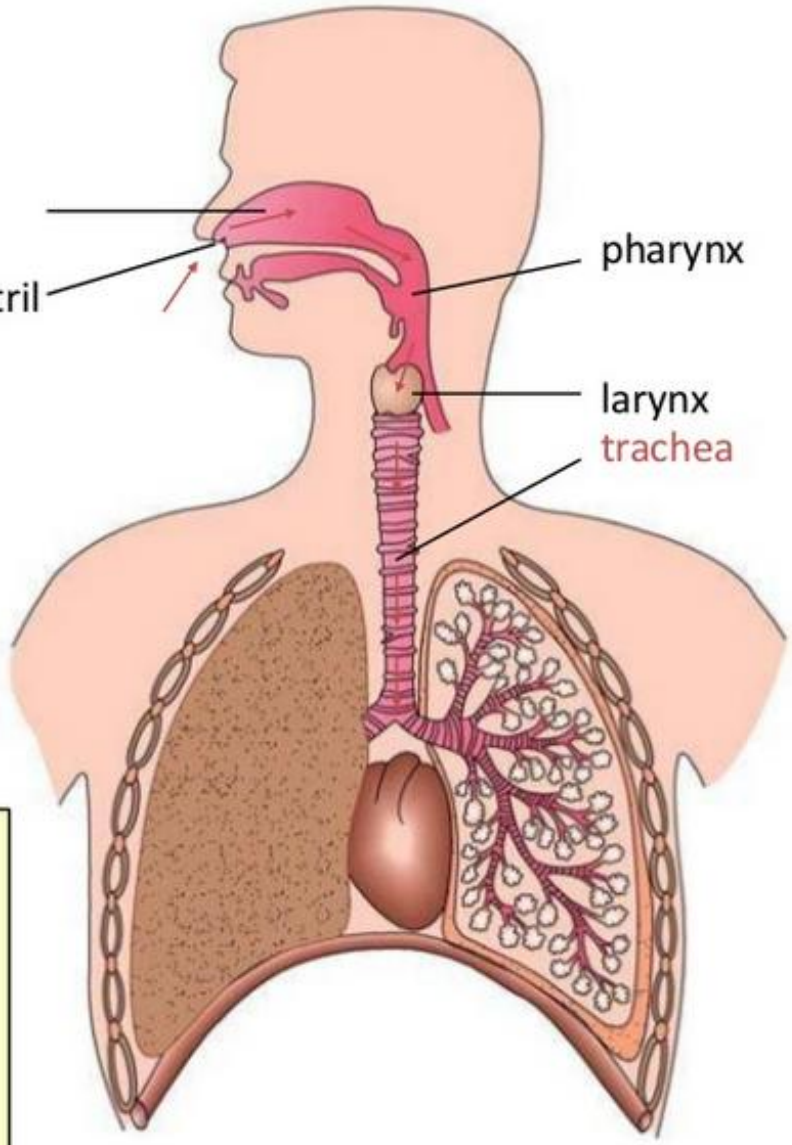
pharynx

↓

larynx

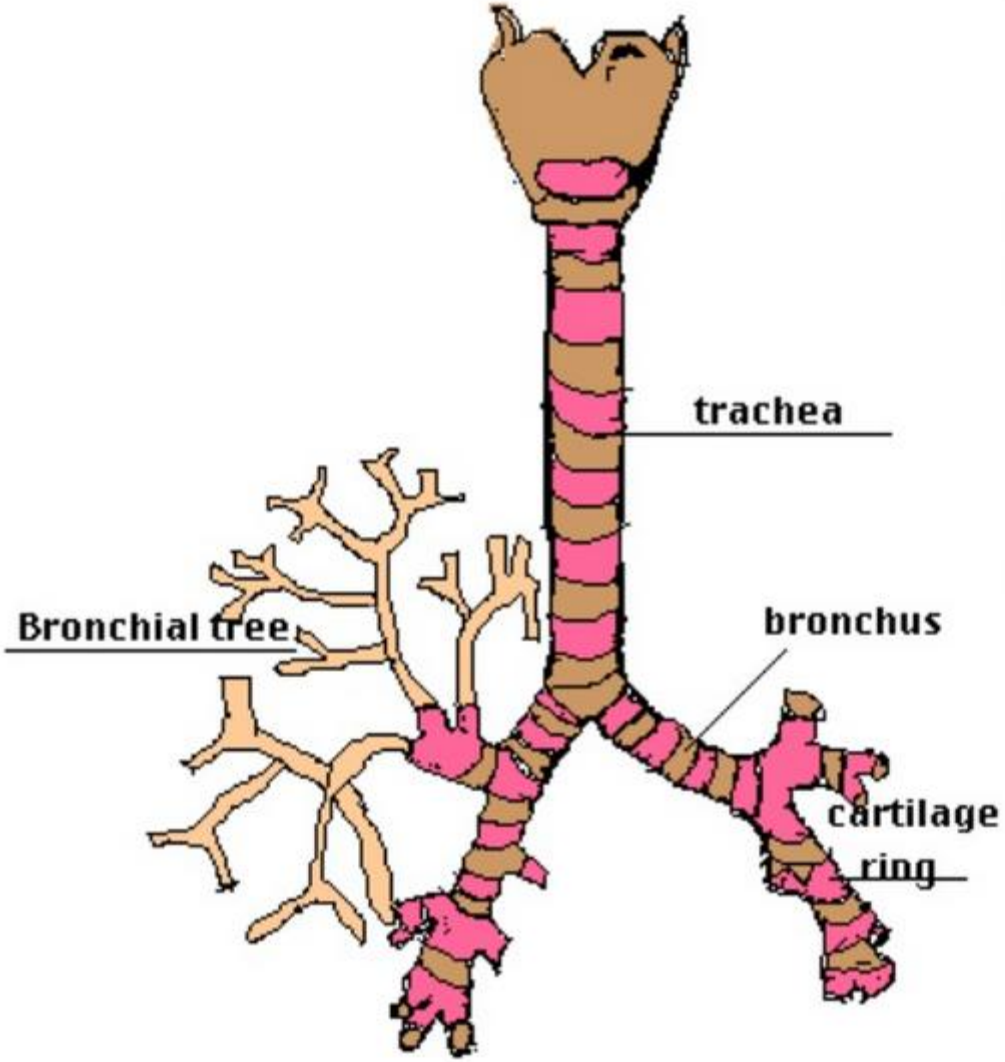
↓

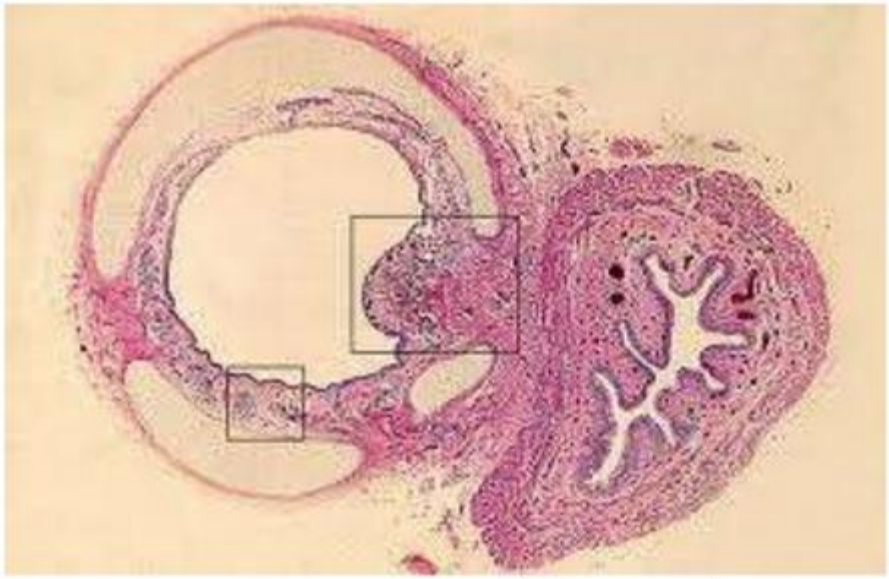
Trachea
(Windpipe)



-A long tube supported by C-shaped rings of cartilage to keep it open.
- Inner wall lined with cilia and mucous membrane
- Cilia beat rhythmically and move particles away from lungs

Trachea





- Contains C-shaped cartilage
- Keeps airways opened and prevent it from collapsing

Path of Air Through the Respiratory System

atmosphere

↓

external nostril

↓

nasal passages

↓

pharynx

↓

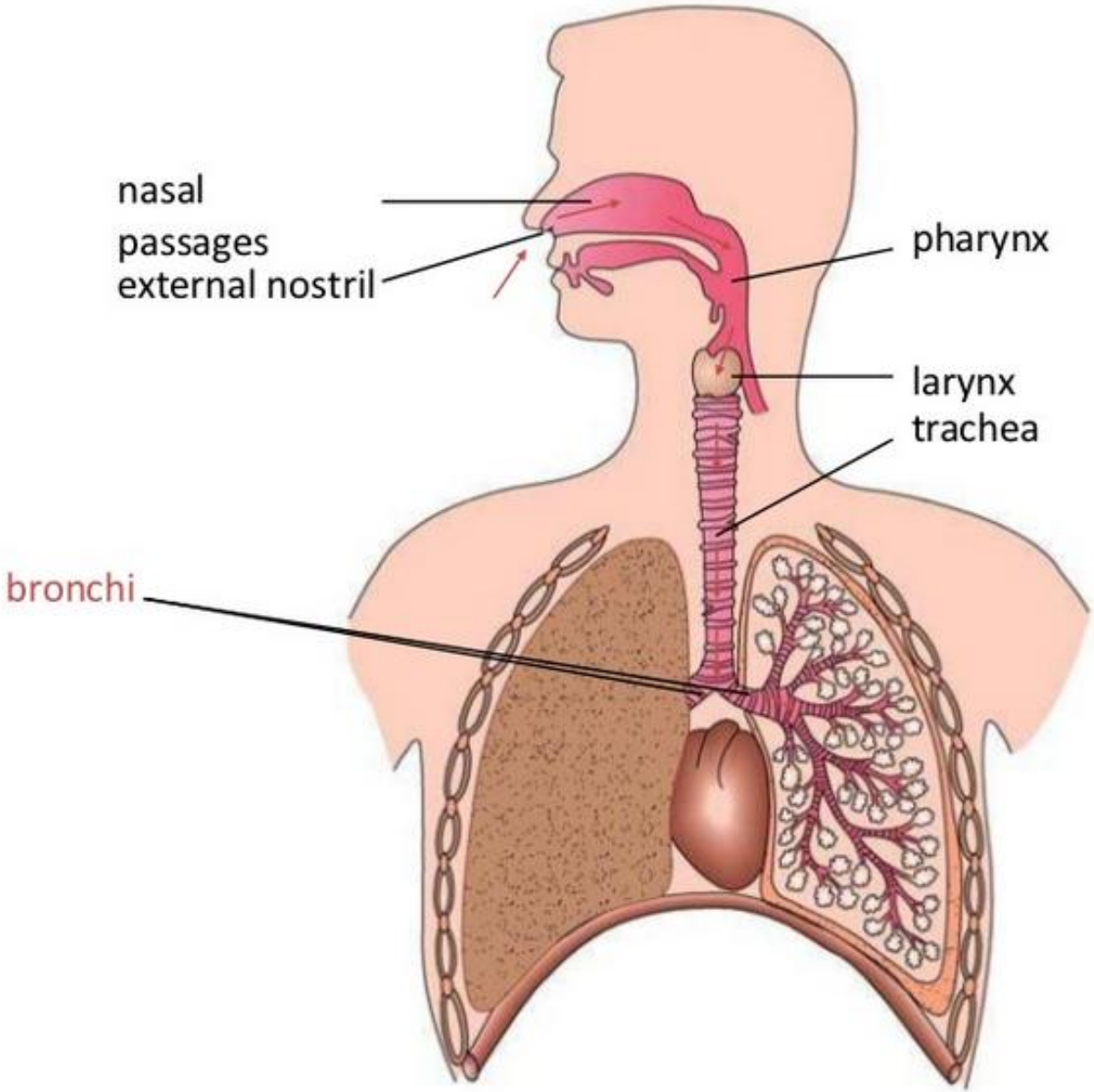
larynx

↓

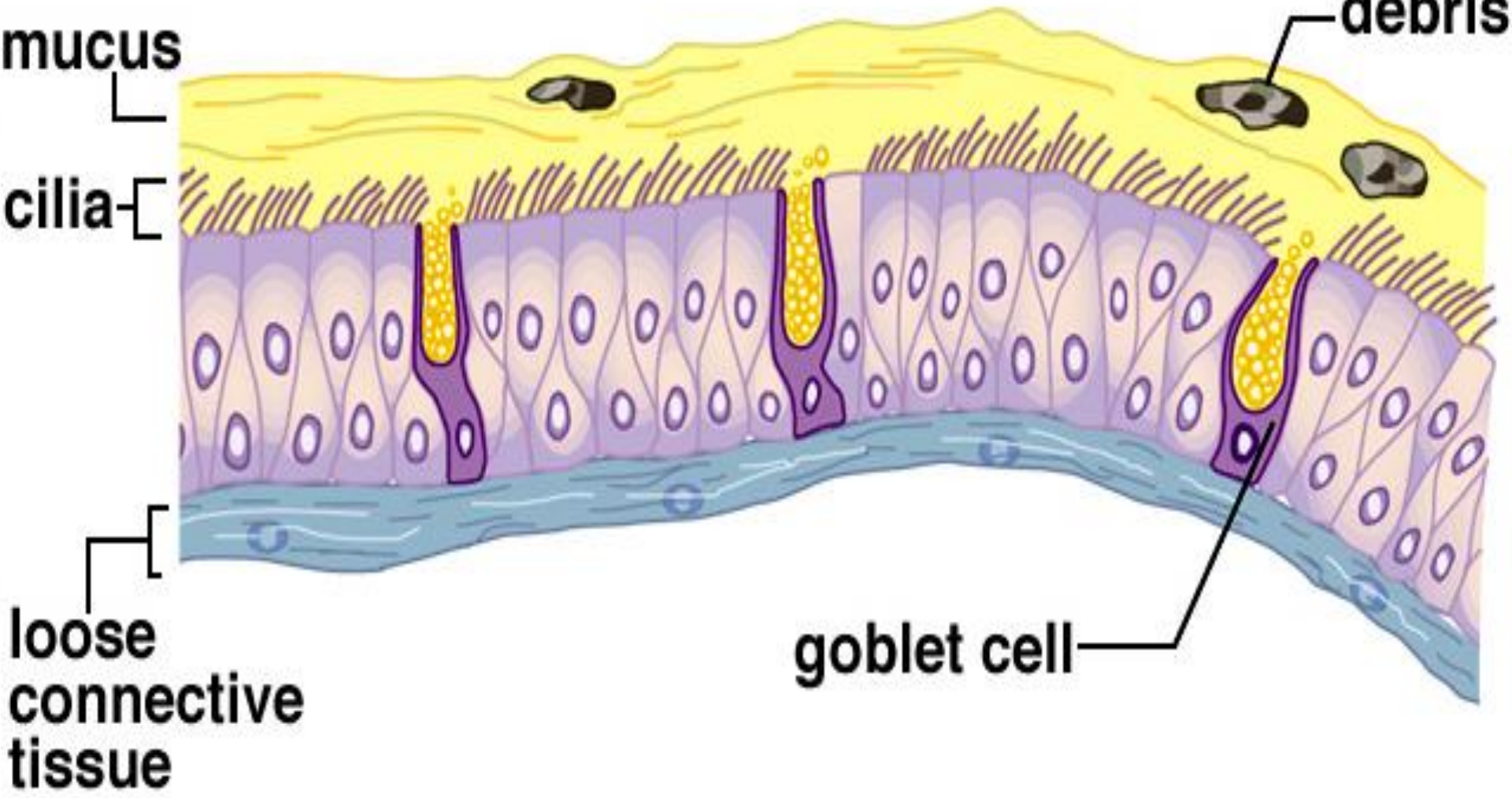
trachea

↓

bronchi



Trachea Cross Section



Path of Air Through the Respiratory System

atmosphere

↓

external nostril

↓

nasal passages

↓

pharynx

↓

larynx

↓

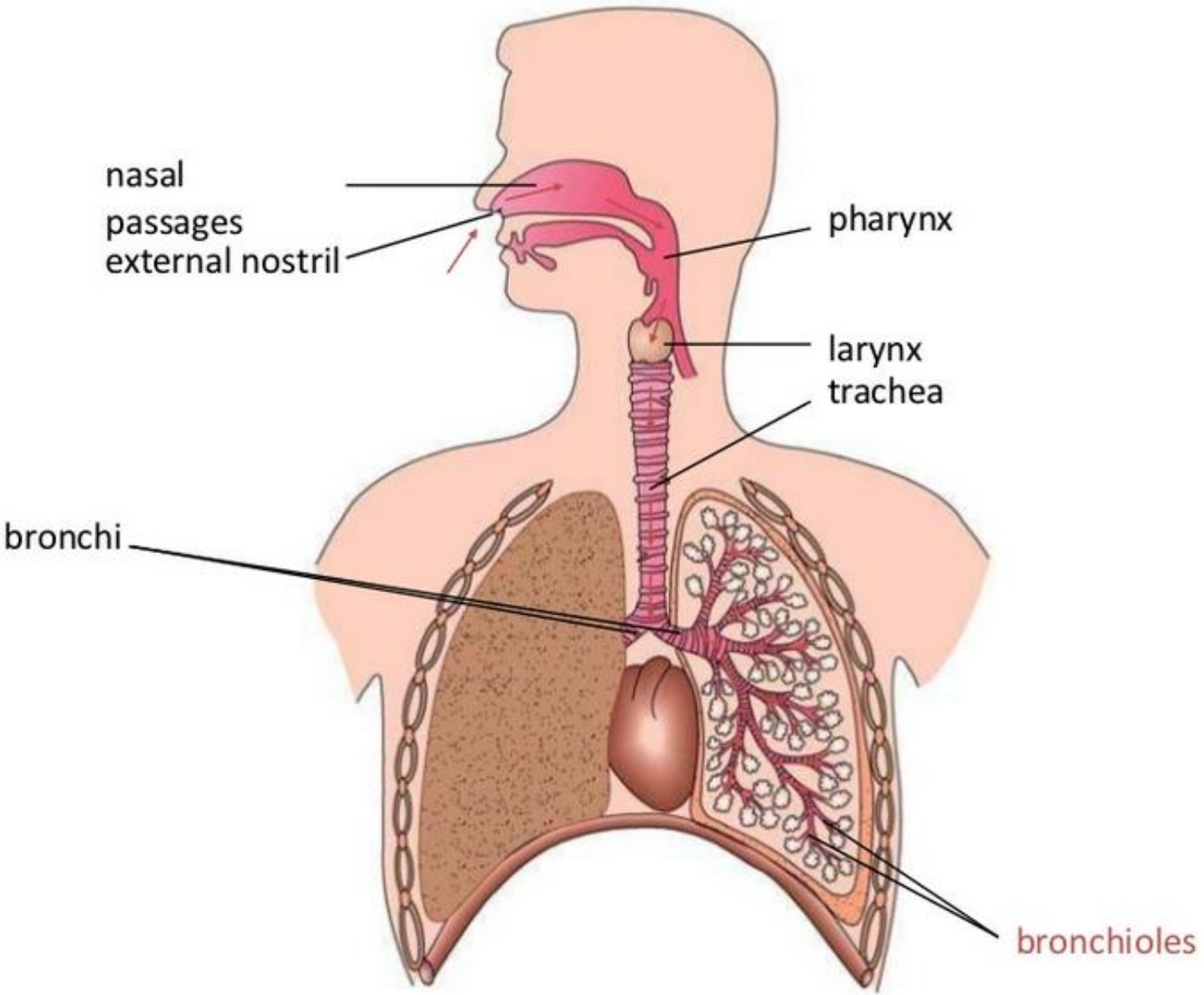
trachea

↓

bronchi

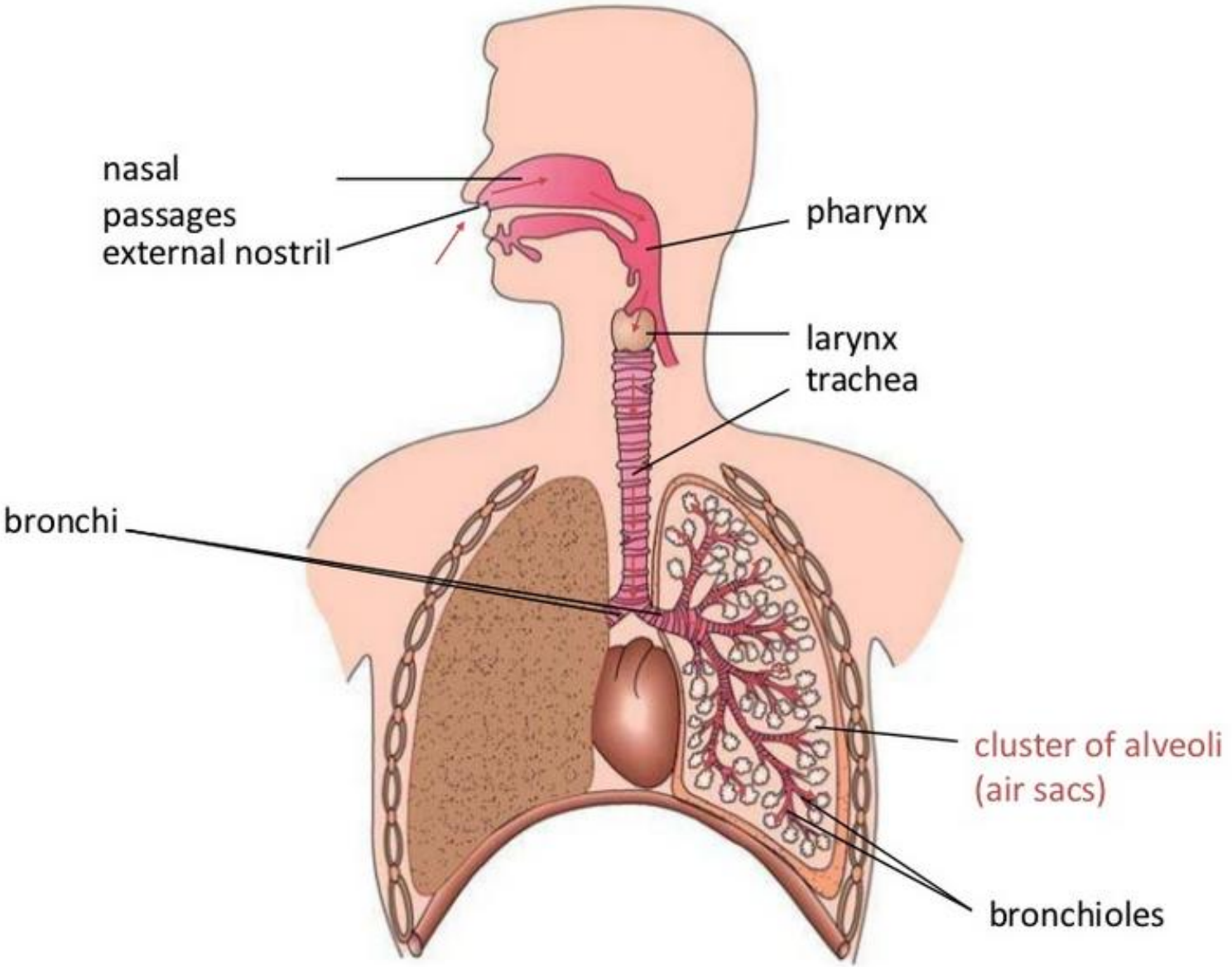
↓

Bronchioles
(Not supported
by cartilage)

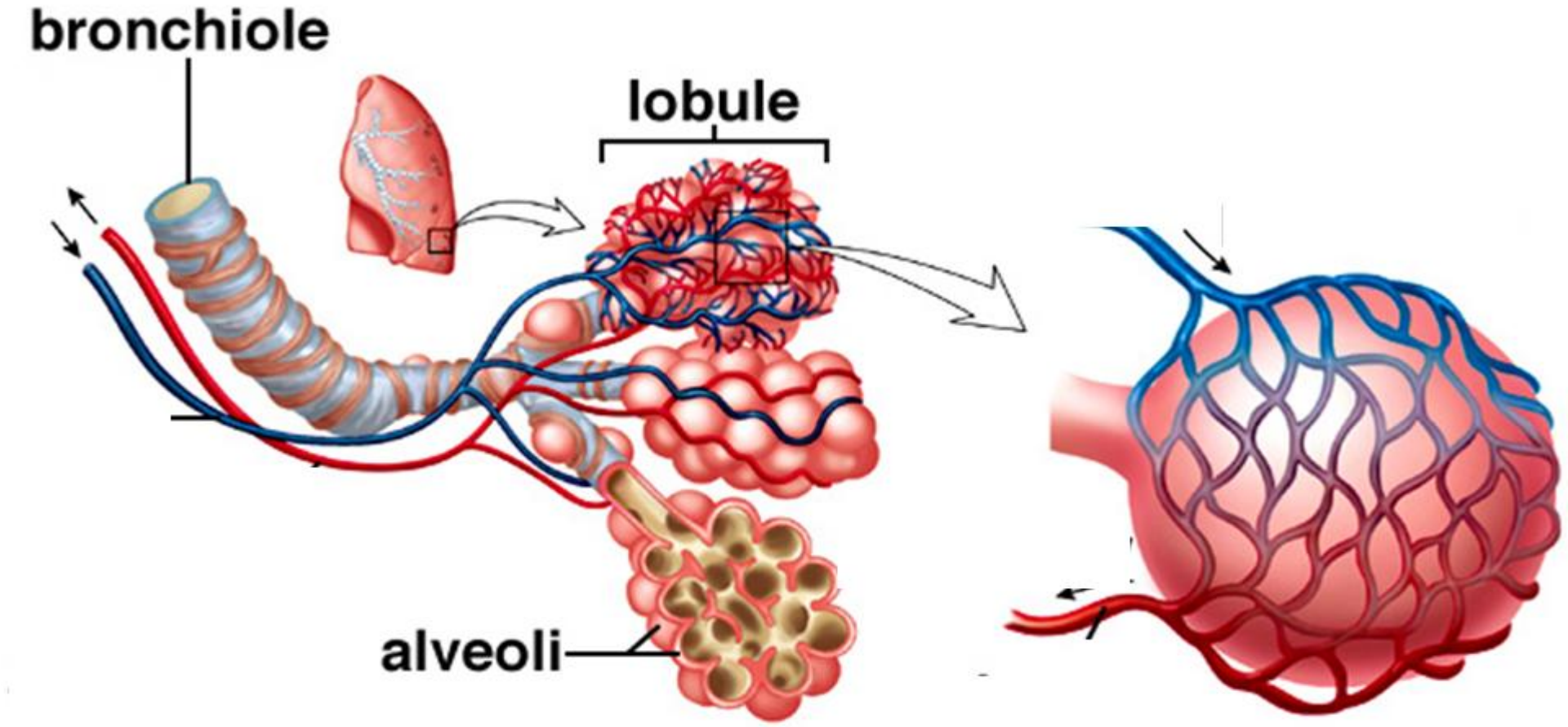


Path of Air Through the Respiratory System

atmosphere
↓
external nostril
↓
nasal passages
↓
pharynx
↓
larynx
↓
trachea
↓
bronchi
↓
bronchioles
↓
Alveoli (For gaseous exchange)



ALVEOLI

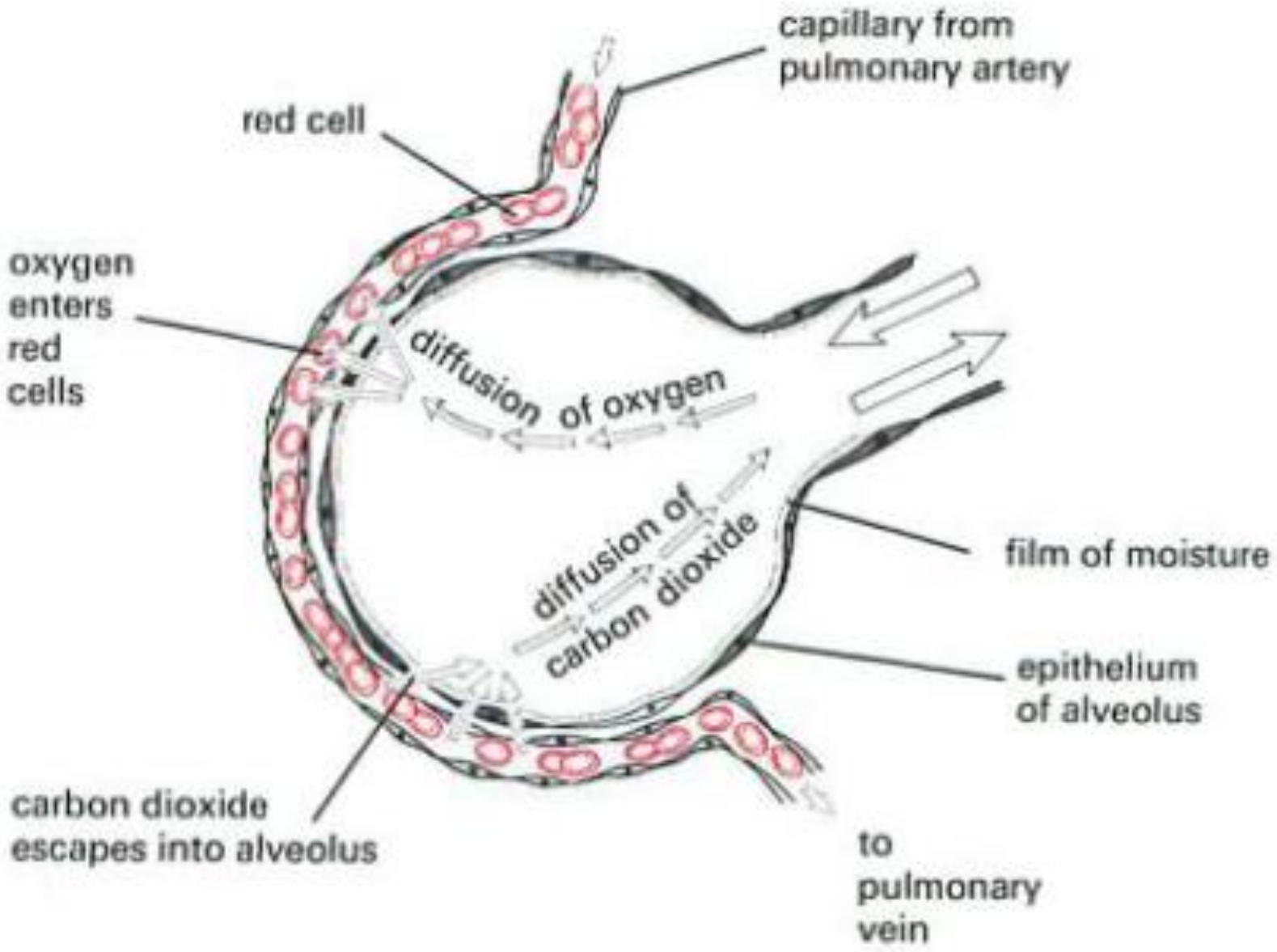


Blood supply of alveoli

Capillary network of one alveolus

http://vimeo.com/25969150

GAS EXCHANGE

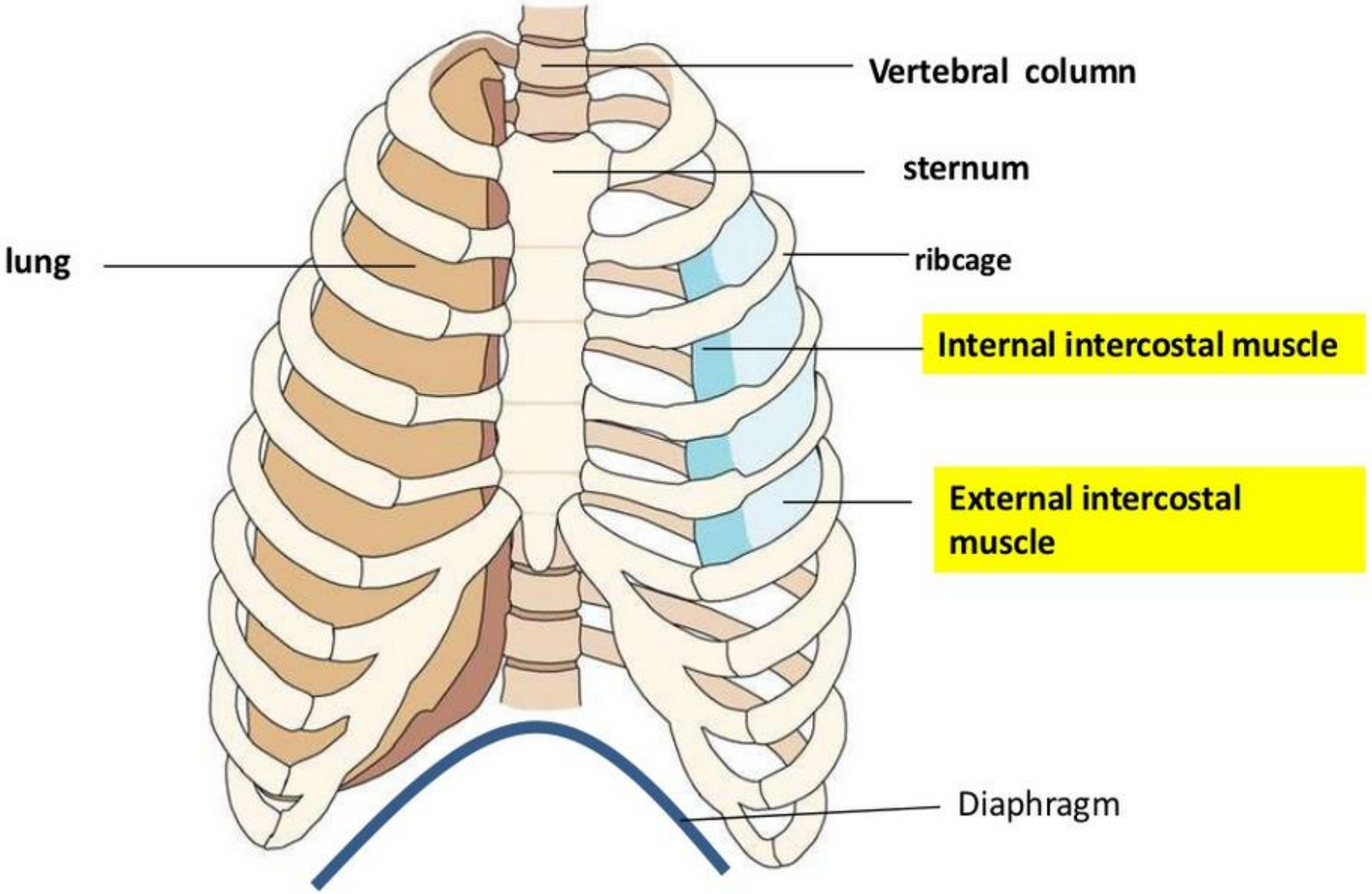


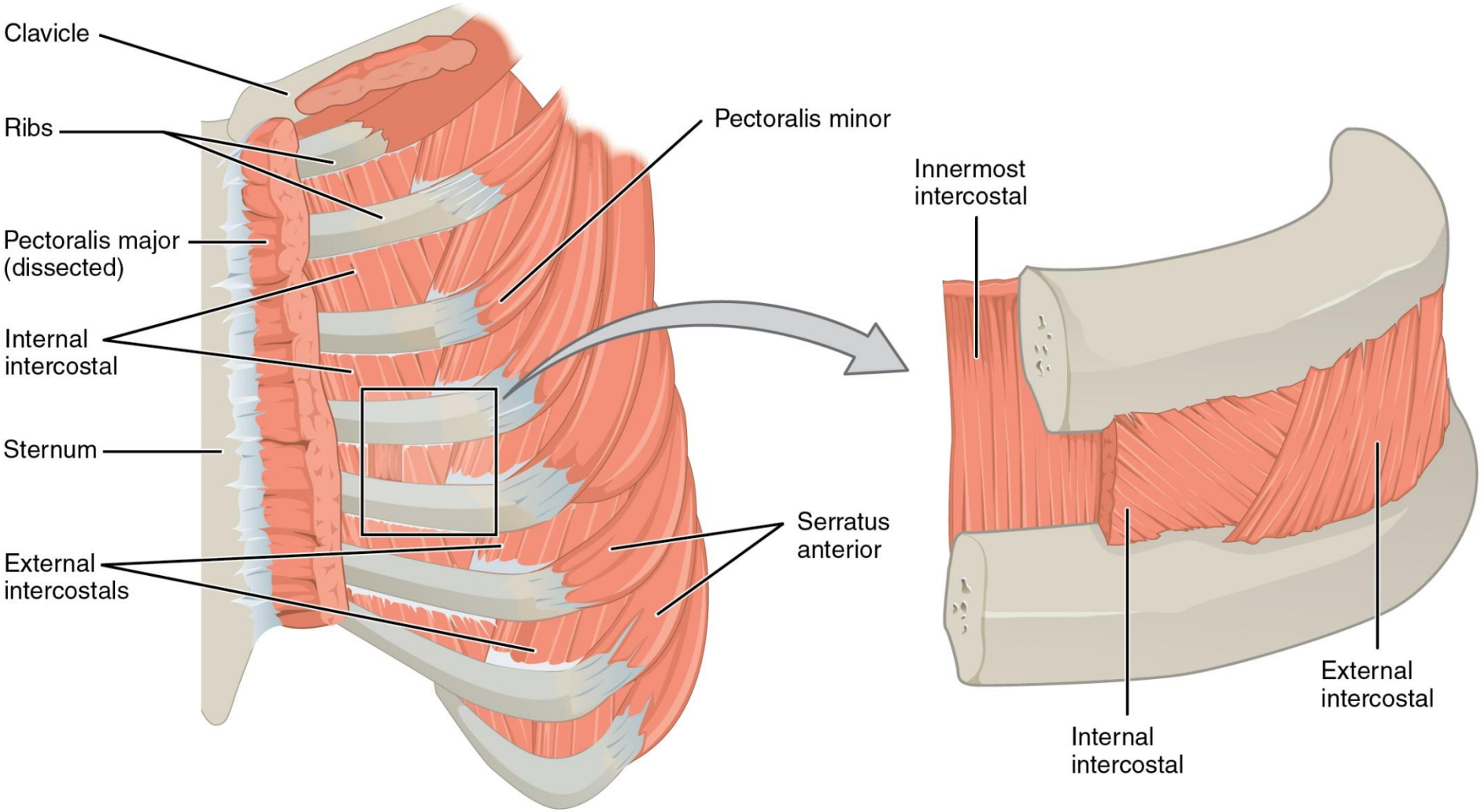
Adaptations of alveoli

Feature	Function
Numerous alveoli	To increase the surface area for gaseous exchange
Wall of alveoli is one-cell thick	To ensure rapid diffusion of gases, between alveolus and capillary
A thin film of moisture on surface of alveolus	To allow oxygen to dissolve and diffuse into the capillary bloodstream
Rich supply of blood capillaries	Ensure constant flow of blood to maintain a steep concentration gradient for efficient gaseous exchange

What causes air movement into the lungs?

PG 205




Clavicle
Ribs
Pectoralis major (dissected)
Internal intercostal
Sternum
External intercostals
Pectoralis minor
Serratus anterior
Innermost intercostal
Internal intercostal
External intercostal

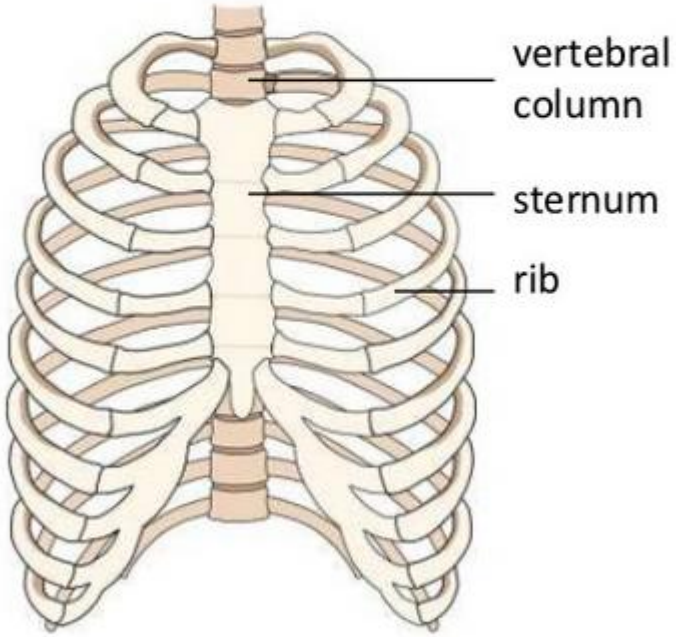
PG 206

Mechanism of Breathing - Inhalation

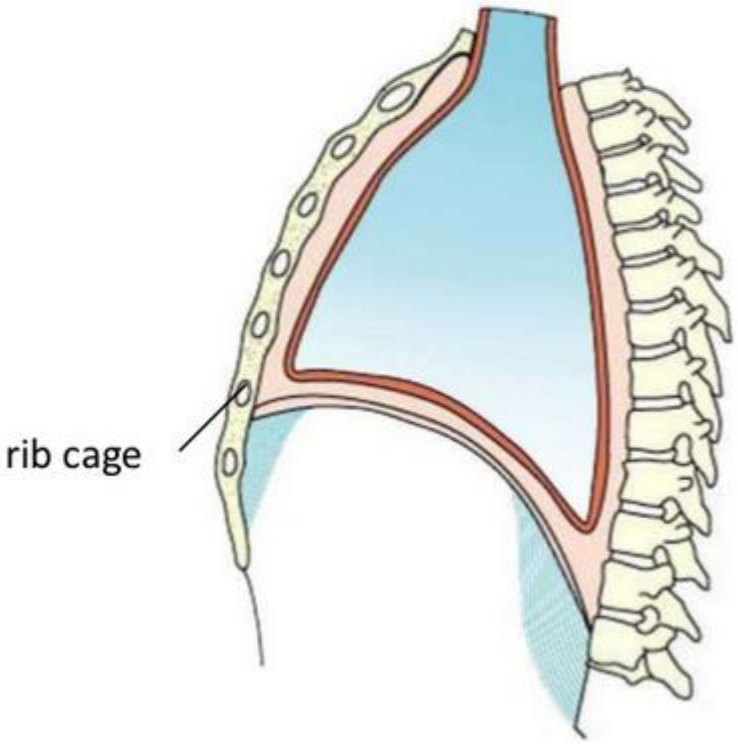
When you breathe in or inhale, the following events take place

Movement of rib cage during inhalation

Front view



Side view

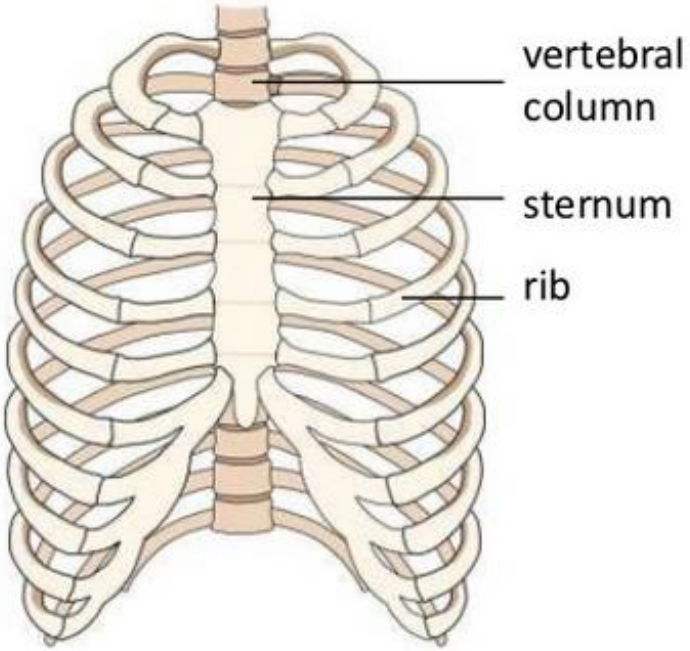


Mechanism of Breathing - Inhalation

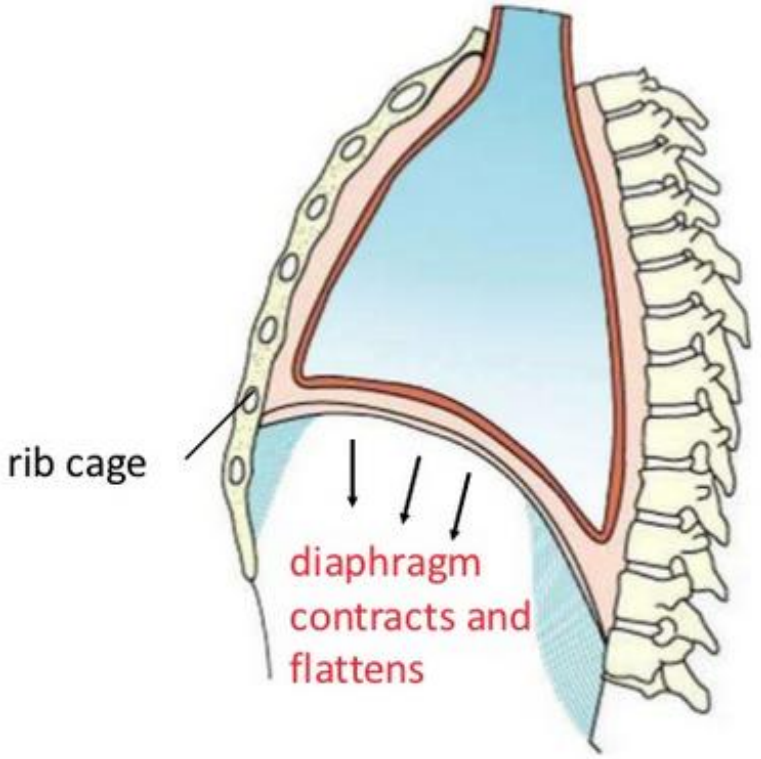
- **Your diaphragm contracts and flattens.**

Movement of rib cage during exhalation

Front view



Side view



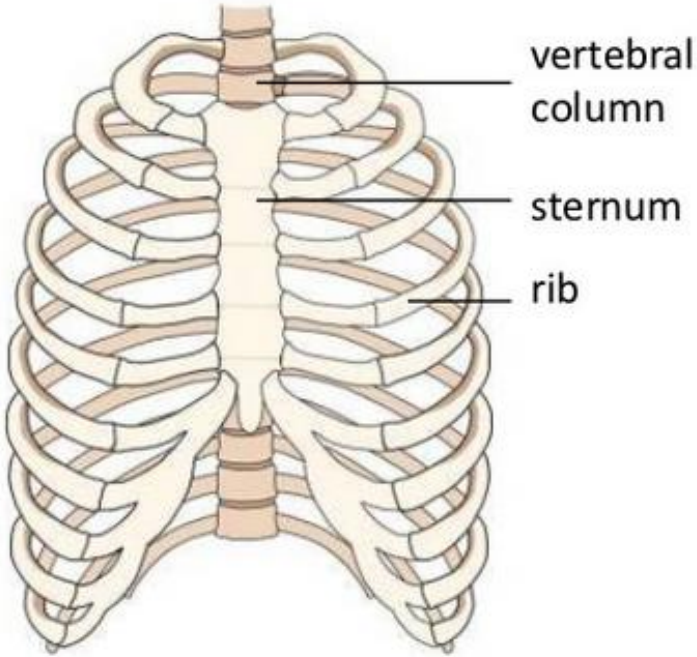
G 206

Mechanism of Breathing - Inhalation

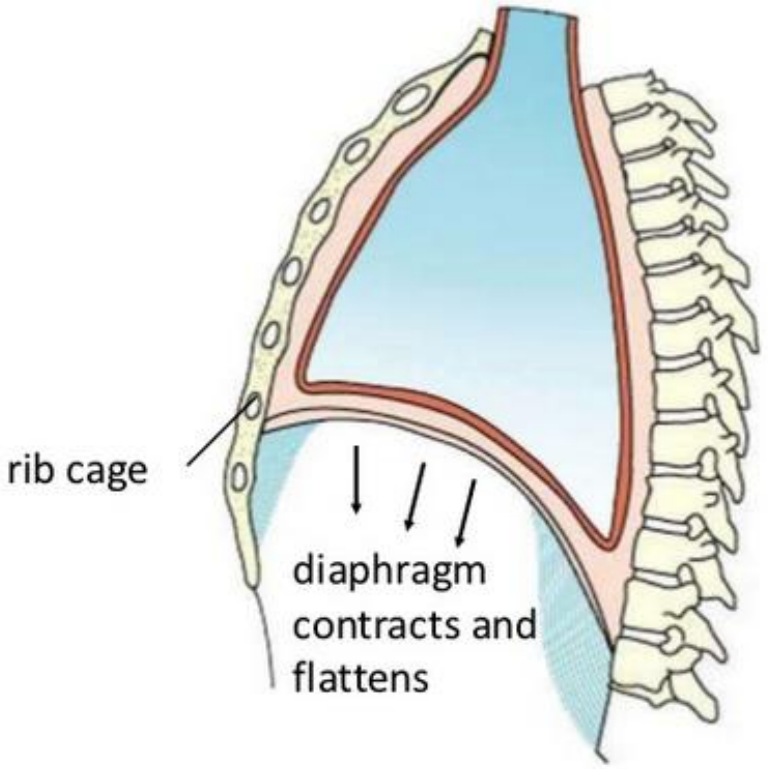
- **Your external intercostal muscles contract while your internal intercostal muscles relax.**

Movement of rib cage during inspiration

Front view



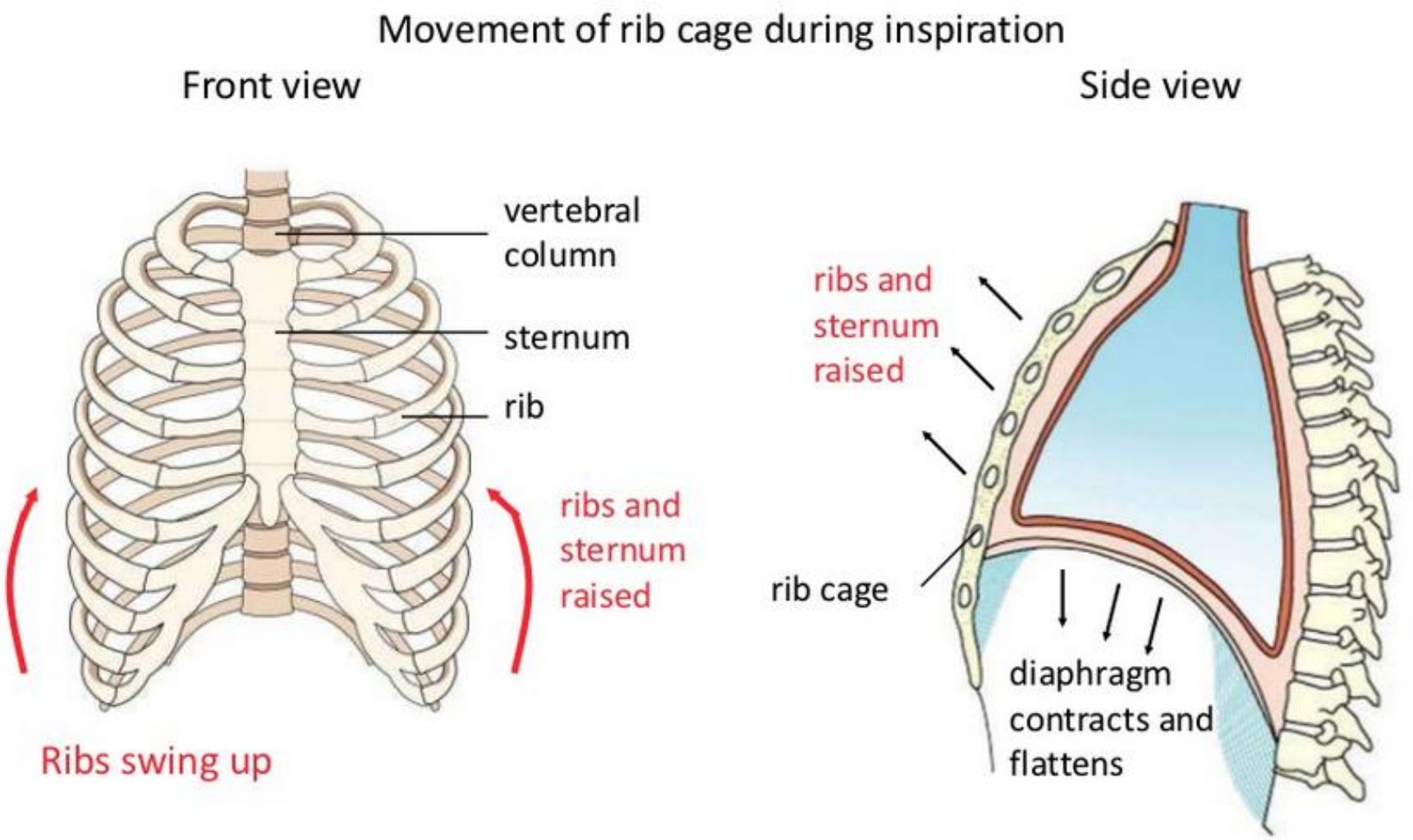
Side view



Mechanism of Breathing - Inhalation

- **Your ribs move upwards and outwards. Your sternum also moves up and forward.**

Movement of rib cage during inspiration



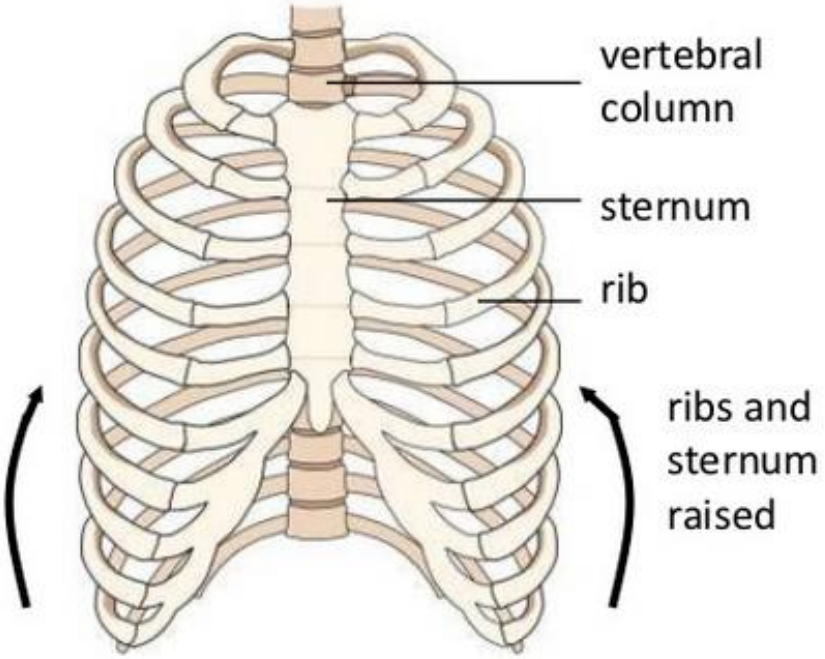
G 206

Mechanism of Breathing - Inhalation

- **The volume of your thoracic cavity increases.**

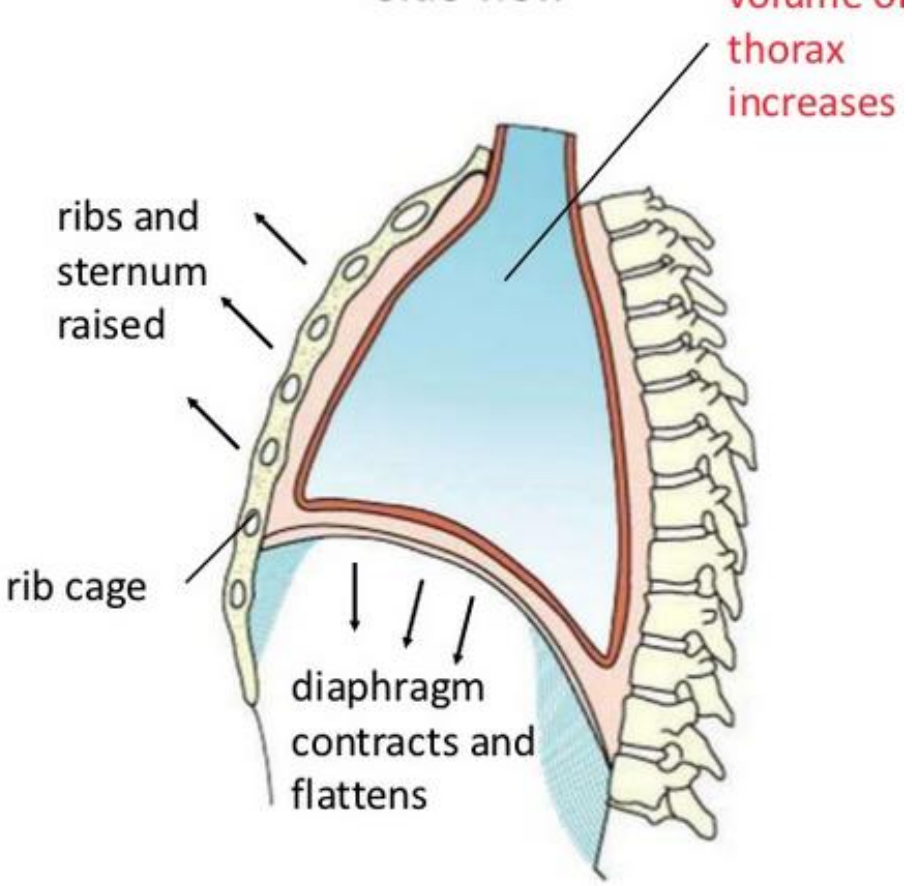
Movement of rib cage during inspiration

Front view



Ribs swing up and increase volume of thorax

Side view



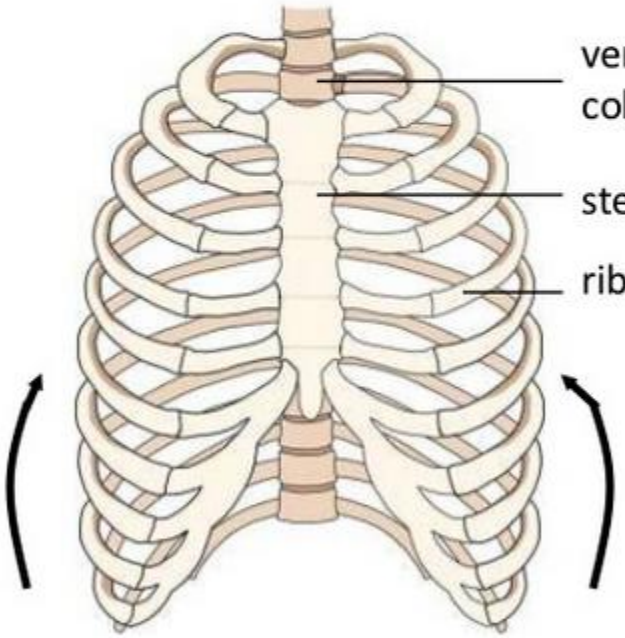
PG 206

Mechanism of Breathing - Inhalation

- **Air pressure in your lungs causes them to expand to fill up the enlarged space in your thorax.**

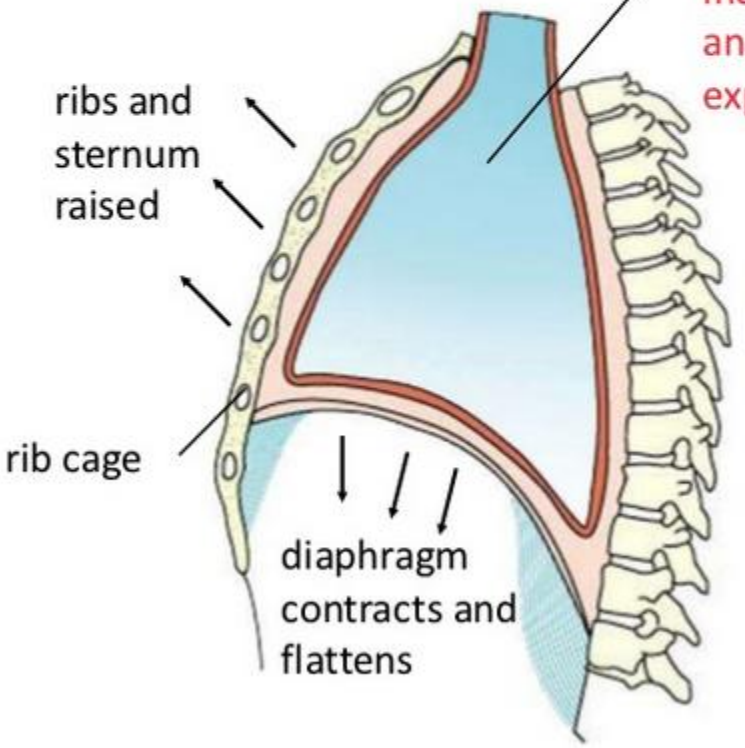
Movement of rib cage during inspiration

Front view



Ribs swing up and increase volume of thorax

Side view



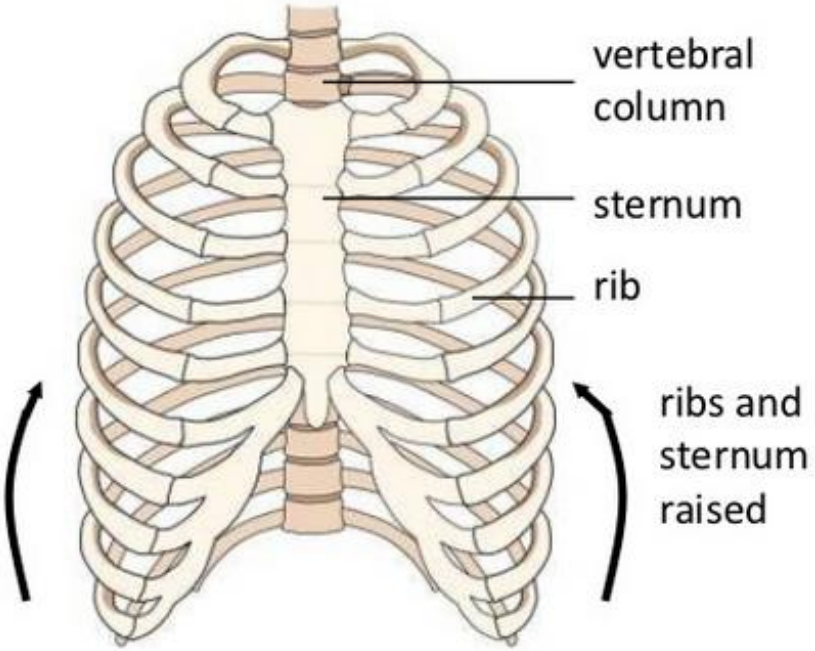
PG 206

Mechanism of Breathing - Inhalation

- **Expansion of your lungs causes the air pressure inside them to decrease.**

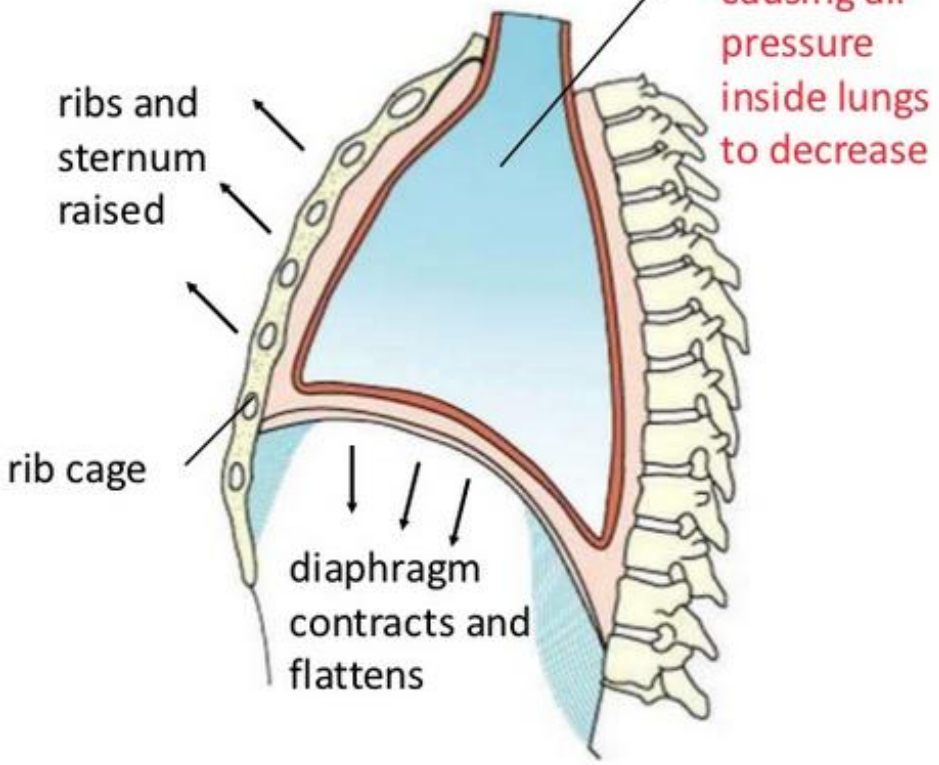
Movement of rib cage during inspiration

Front view



Ribs swing up and increase volume of thorax

Side view



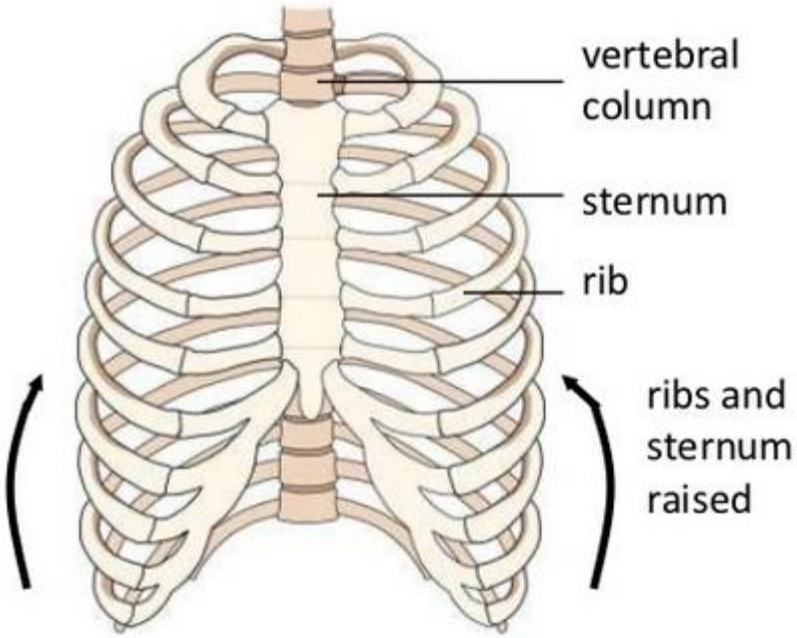
G 206

Mechanism of Breathing - Inhalation

- **Atmospheric pressure is now higher than the pressure within your lungs. This causes air to rush into your lungs.**

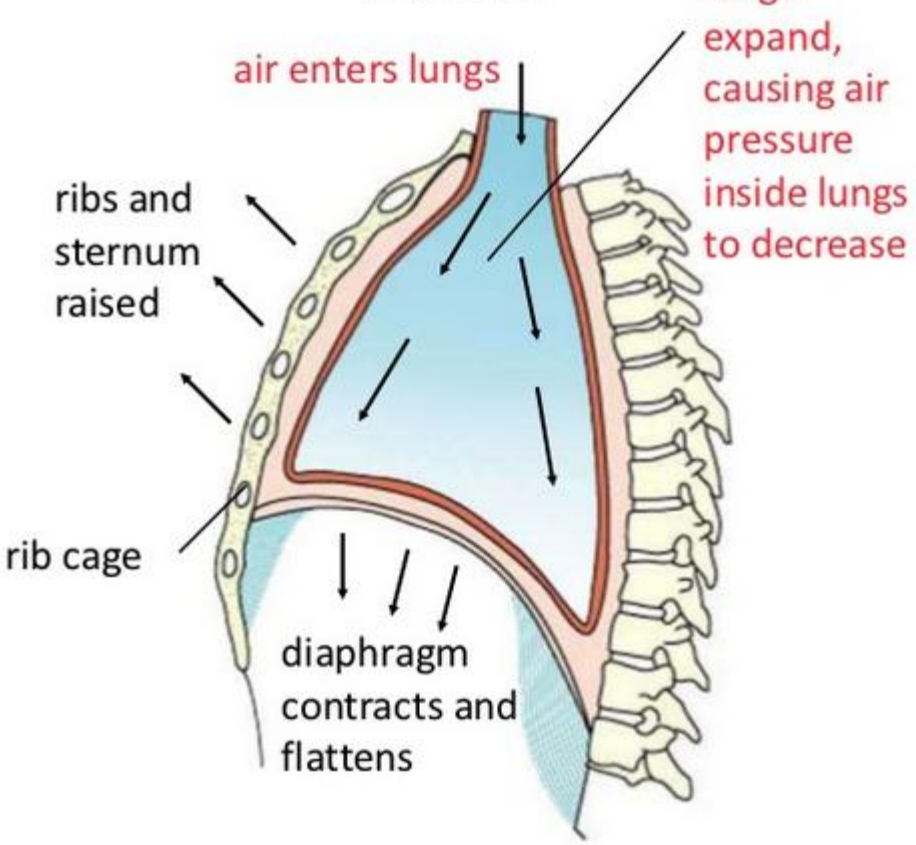
Movement of rib cage during inspiration

Front view



Ribs swing up and increase volume of thorax

Side view



PG 206

Mechanism of Breathing - Inhalation

What causes air movement into the lungs?

Biomechanical

1. Diaphragm contracts
2. External Intercostal Muscles contract
3. Internal Intercostal Muscles Relax
4. Rib cage and sternum move upwards and forward

Physical Parameters

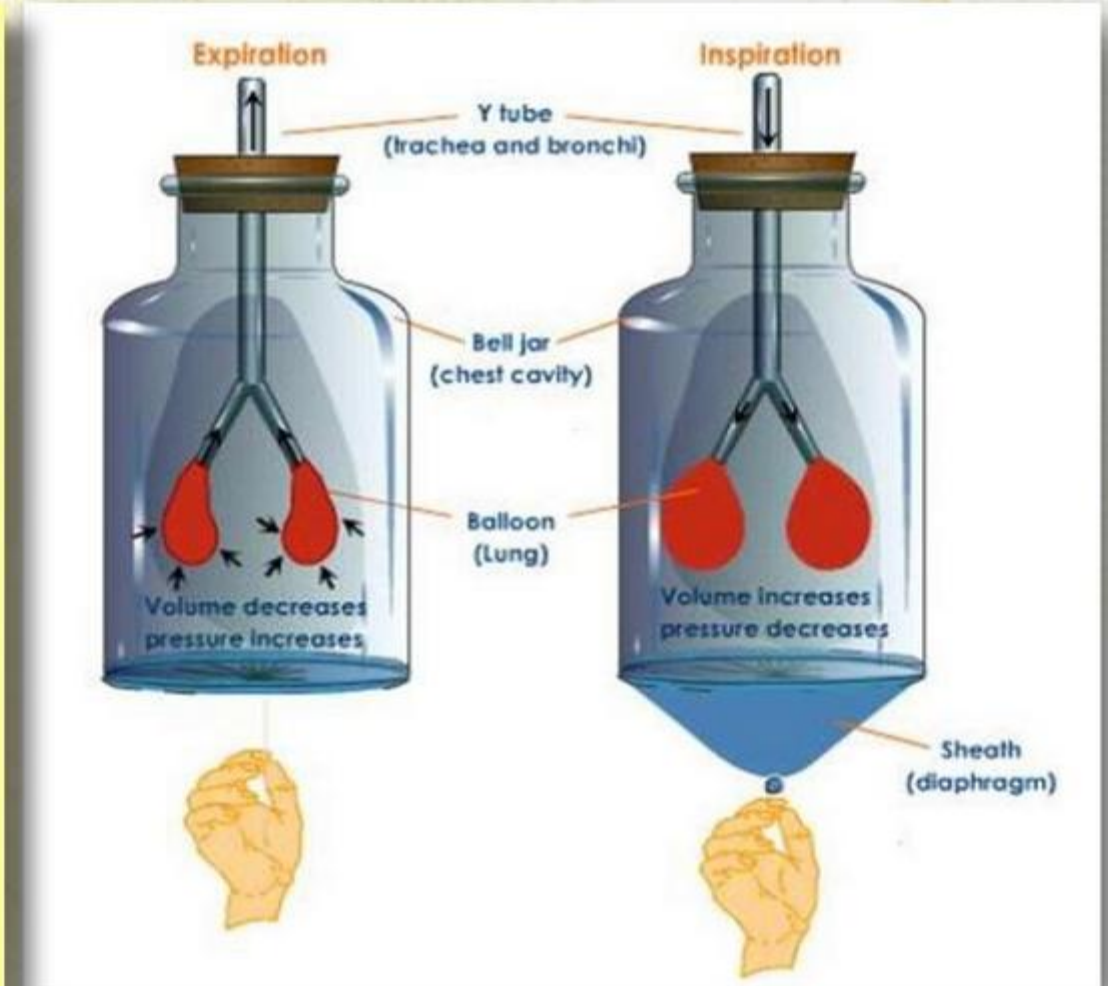
5. Volume of thoracic cavity increase
6. Pressure of thoracic cavity decrease
7. Lungs expand and air pressure in lungs lower than atmospheric air pressure
8. Air rush in from atmosphere to lungs

PG 206

Mechanism of Breathing - Inhalation

Demonstration of Changes in Physical Parameters

1. Volume in thoracic cavity **increase**
2. Pressure in thoracic cavity **decrease**
3. Pressure in Lungs > Pressure in thoracic cavity
4. Lungs expand
5. Pressure in lungs drop
6. Atmospheric pressure > Pressure in lungs
7. Air rushes in

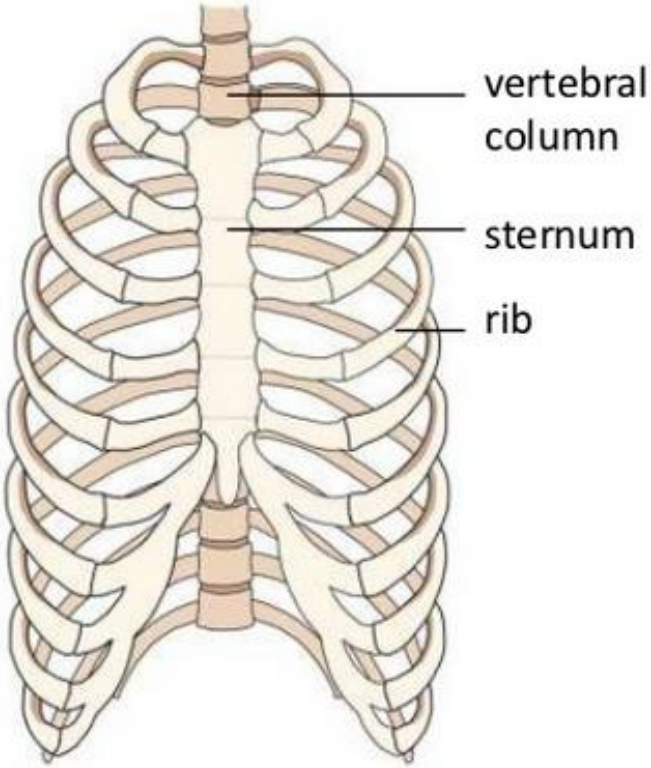


Mechanism of Breathing -Exhalation

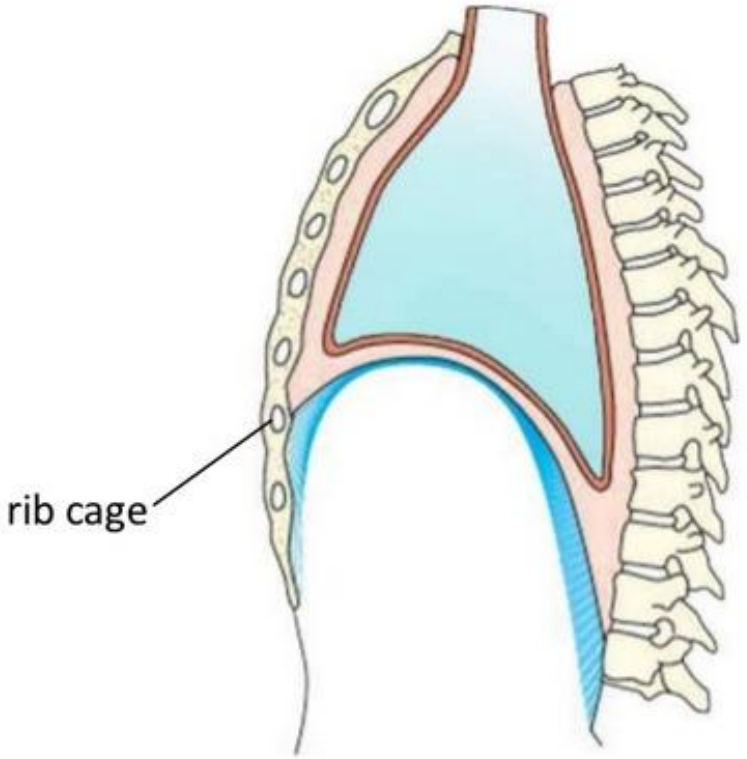
When you breathe out or exhale, the following events take place:

Movement of rib cage during expiration

Front view

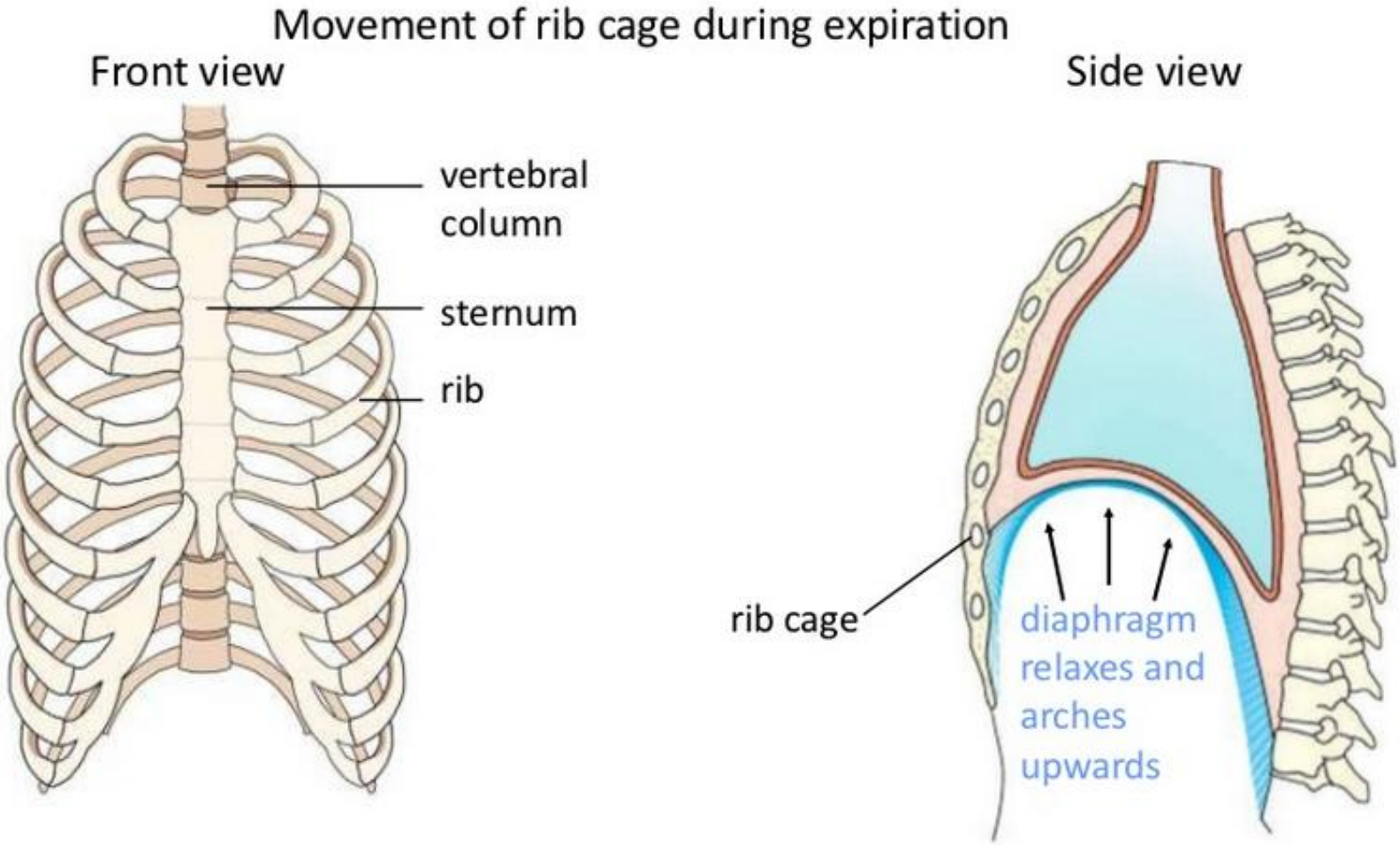


Side view



Mechanism of Breathing - Exhalation

- **Your diaphragm relaxes and arches upwards.**

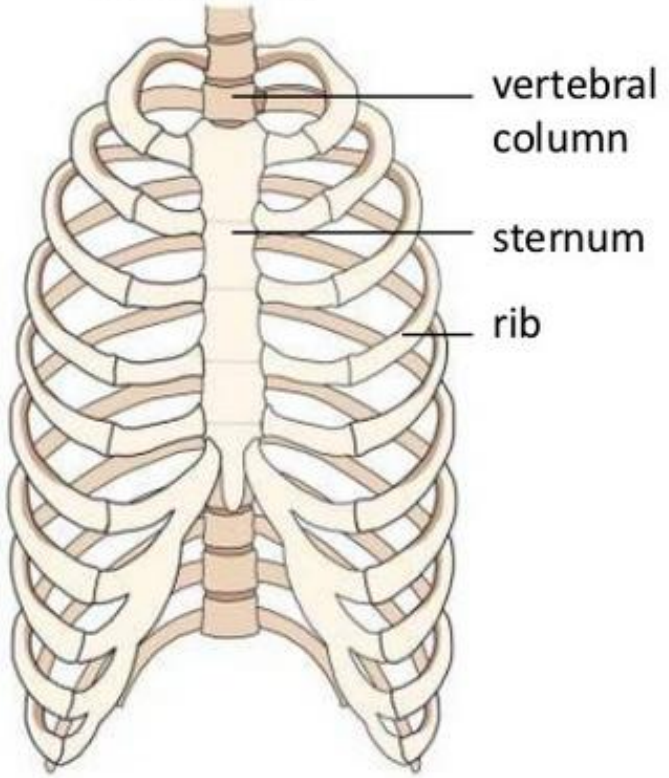


Mechanism of Breathing- Exhalation

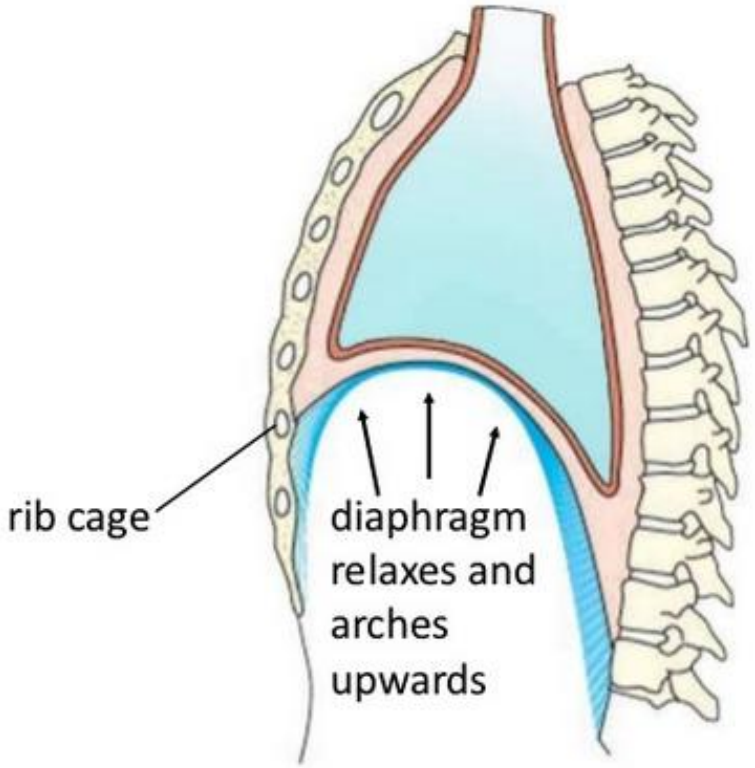
- **Your internal intercostal muscles contract while your external intercostal muscles relax.**

Movement of rib cage during expiration

Front view



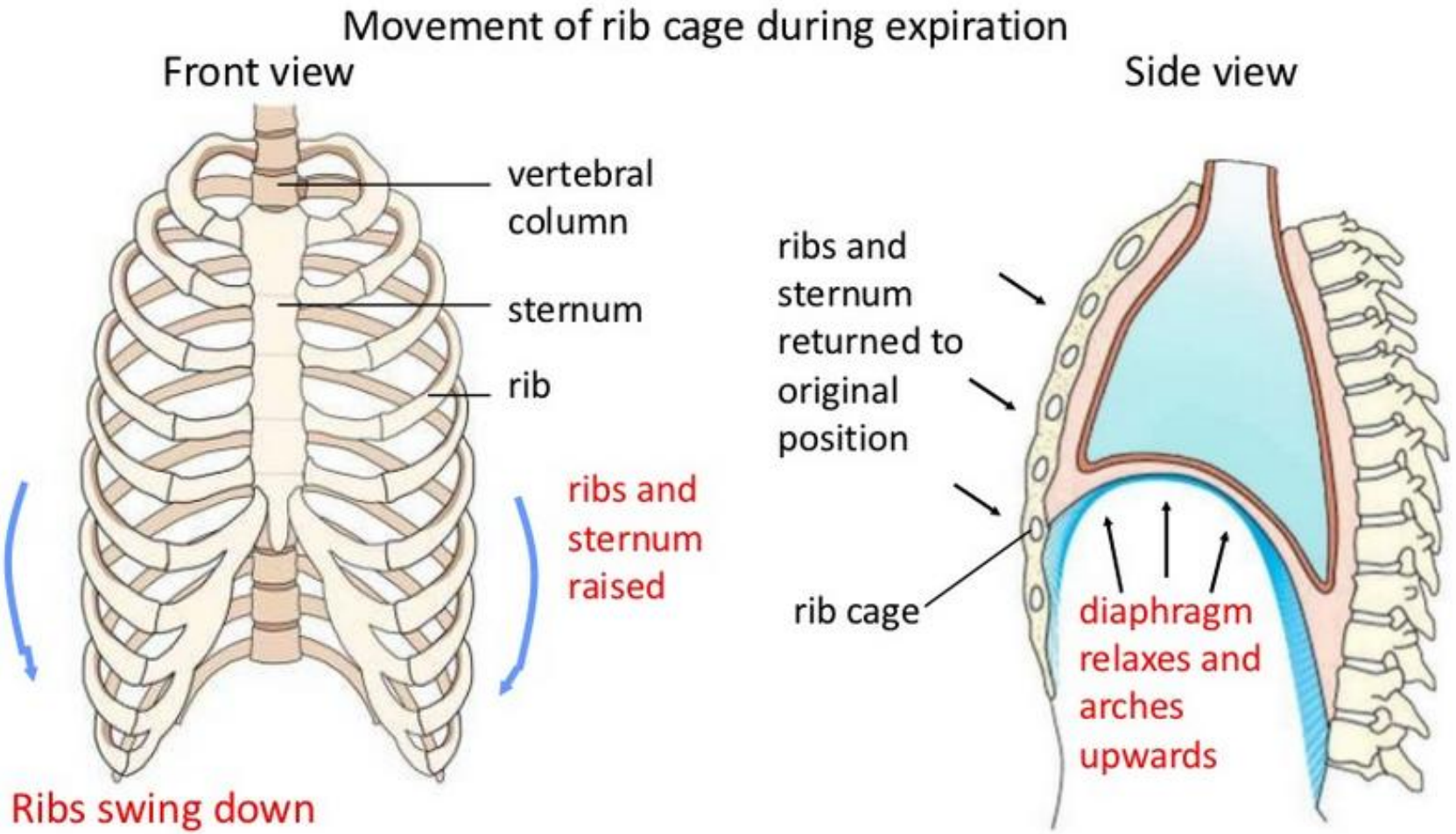
Side view



G 207

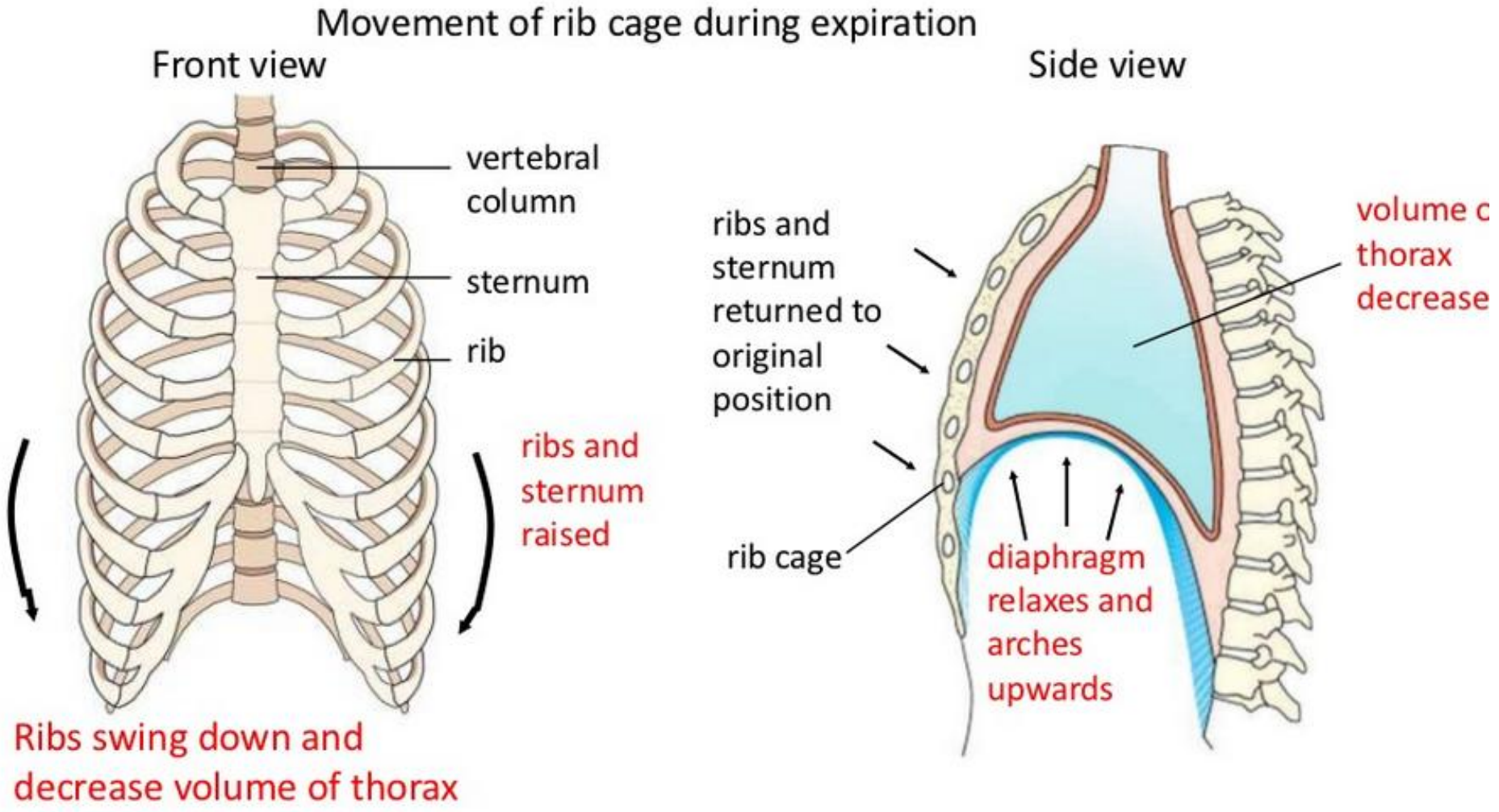
Mechanism of Breathing - Exhalation

- **Your ribs move downwards and inwards. Your sternum also moves down to its original position.**



Mechanism of Breathing - Exhalation

- **The volume of your thoracic cavity decreases.**

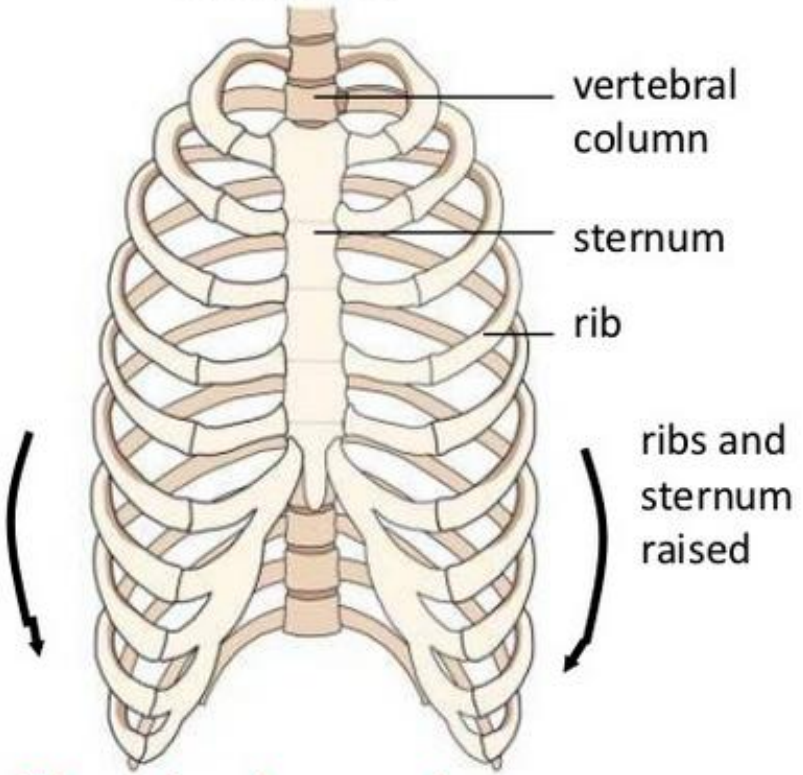


Mechanism of Breathing - Exhalation

- **Your lungs are compressed and air pressure inside them increases as the volume decreases.**

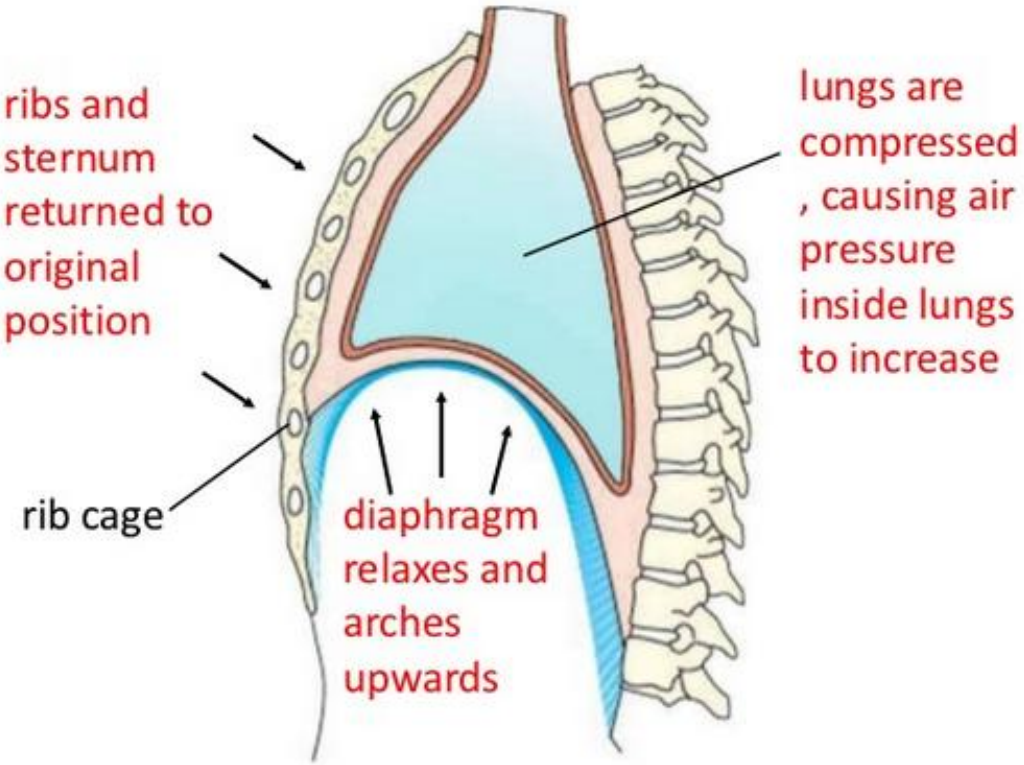
Movement of rib cage during expiration

Front view



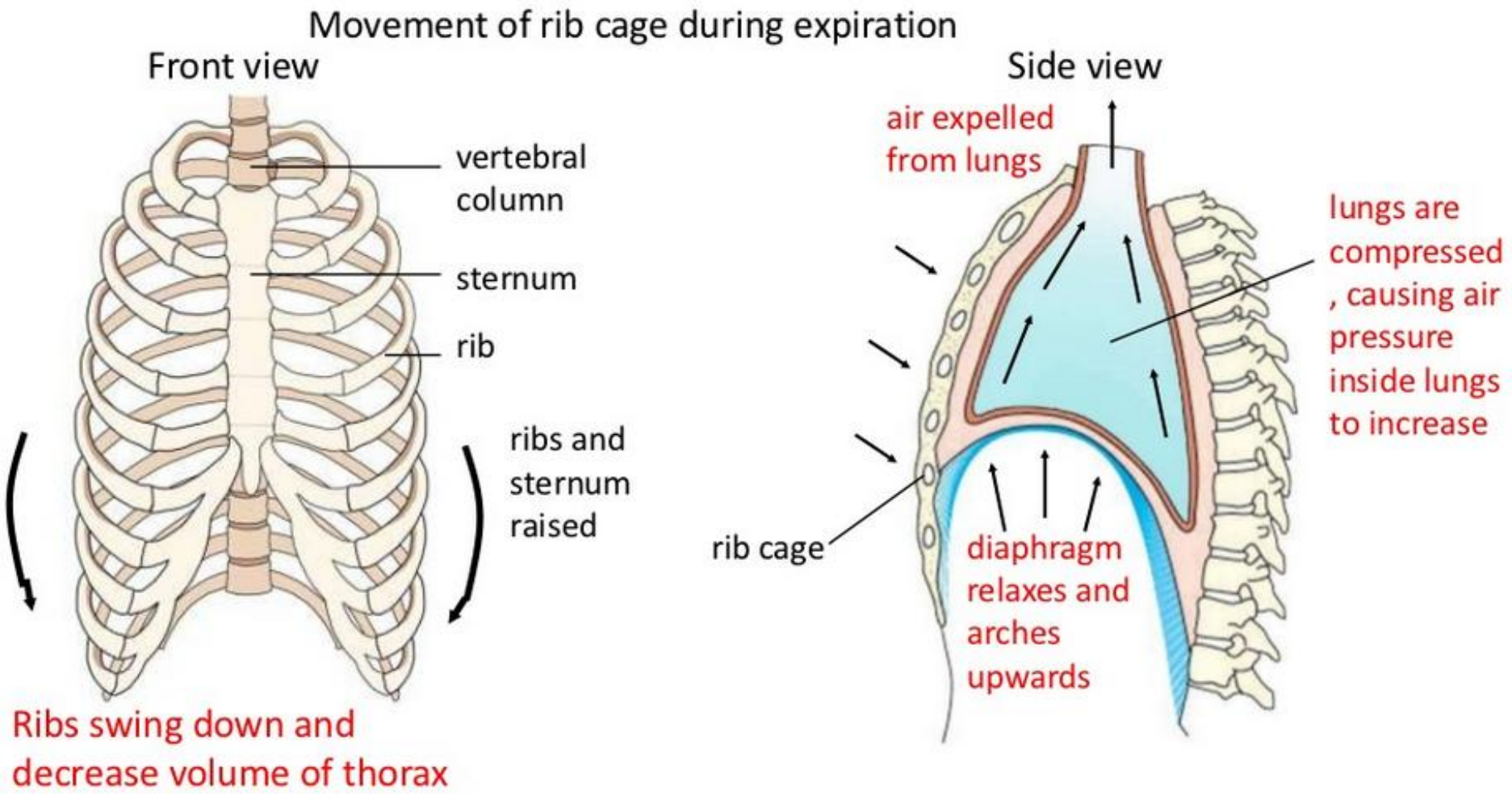
Ribs swing down and decrease volume of thorax

Side view



Mechanism of Breathing - Exhalation

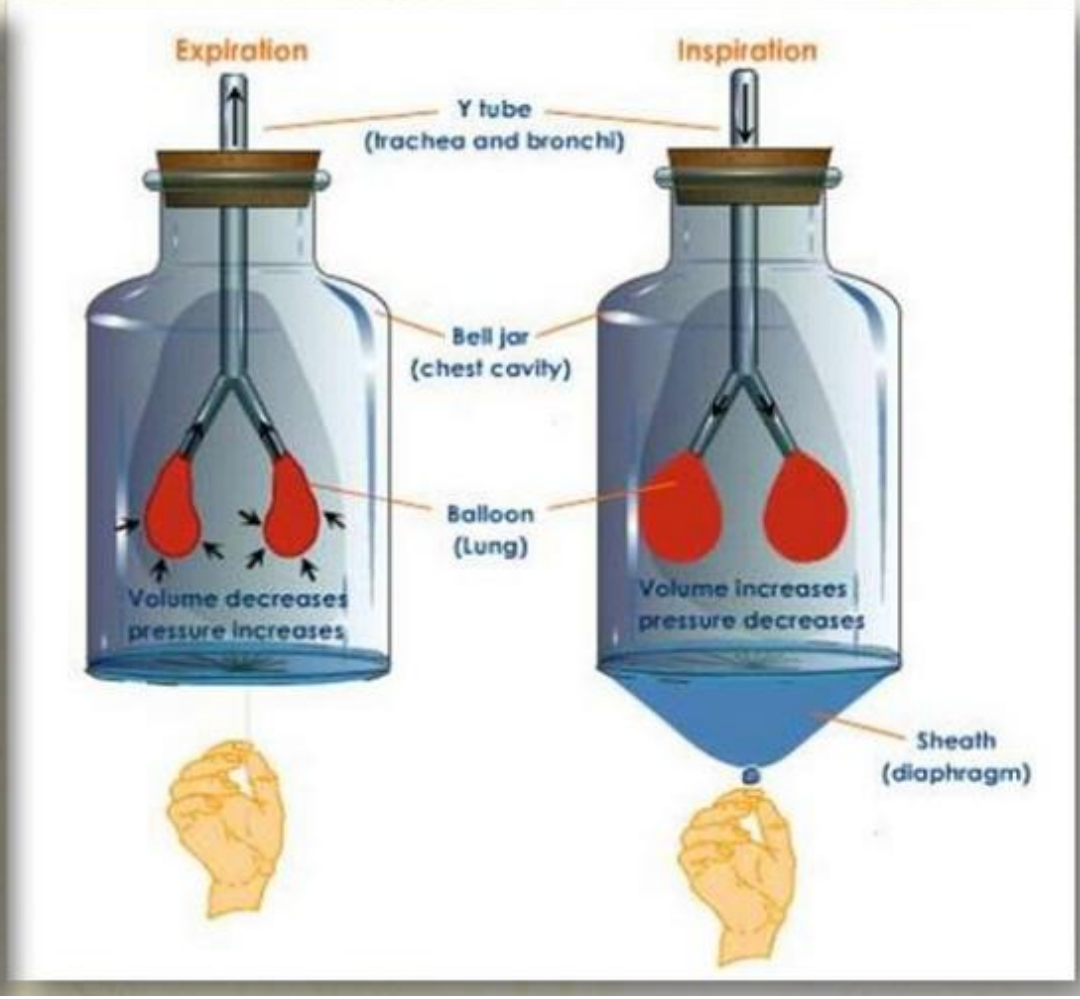
- **Air pressure within the lungs is now higher than atmospheric pressure. The air is forced out of your lungs to the exterior.**



Mechanism of Breathing - Exhalation

Demonstration of Changes in Physical Parameters

1. Volume in thoracic cavity **decrease**
2. Pressure in thoracic cavity **increase**
3. Pressure in Lungs < Pressure in thoracic cavity
4. Lungs contract
5. Pressure in lungs drop
6. Atmospheric pressure < Pressure in lungs
7. Air rushes out



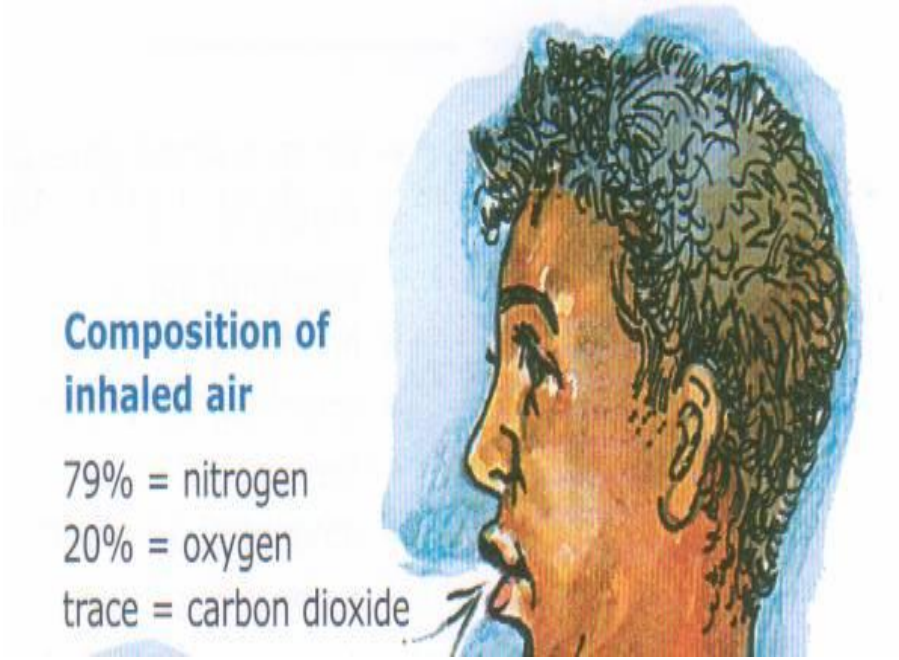
Summary of Breathing Mechanism

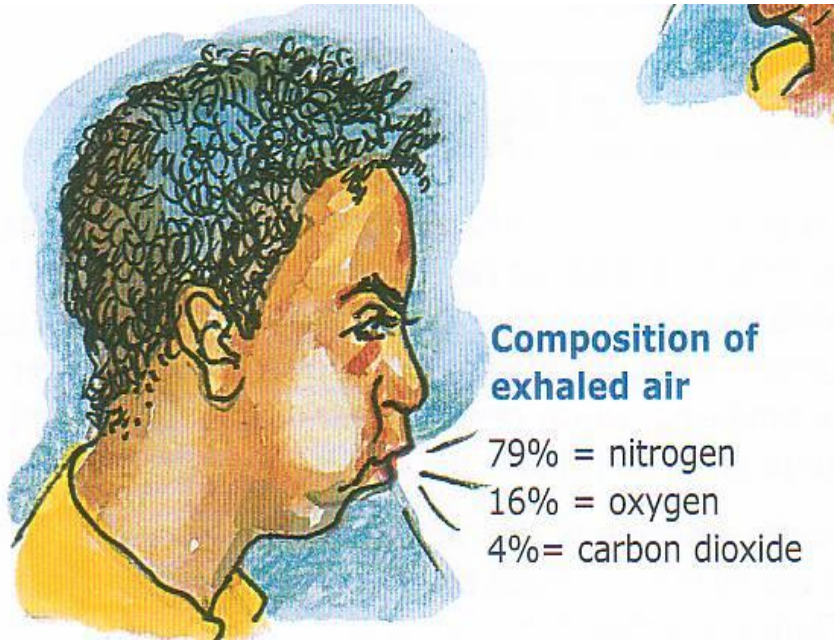
Inhalation/Inspiration	Exhalation/Expiration
Diaphragm contracts and flattens (move down)	Diaphragm relaxes and moves up
Externa l intercostal muscles contract	External intercostal muscles relax
Internal intercostal muscles relax	External intercostal muscles contract
Ribcage expands	Internal intercostal muscles contract
Thoracic volume and lung volume increase	Ribcage contracts
Air pressure in lungs decrease	Air pressure in lungs increase
Higher external air pressure force air to flow into the lungs	Higher air pressure in lungs forces air to flow out to the exterior

COMPOSITION OF INSPIRED & EXPIRED AIR

- State the differences in composition between inspired and expired air.
- Use lime water as a test for carbon dioxide to investigate the differences in composition between inspired and expired air

COMPOSITION OF INSPIRED & EXPIRED AIR

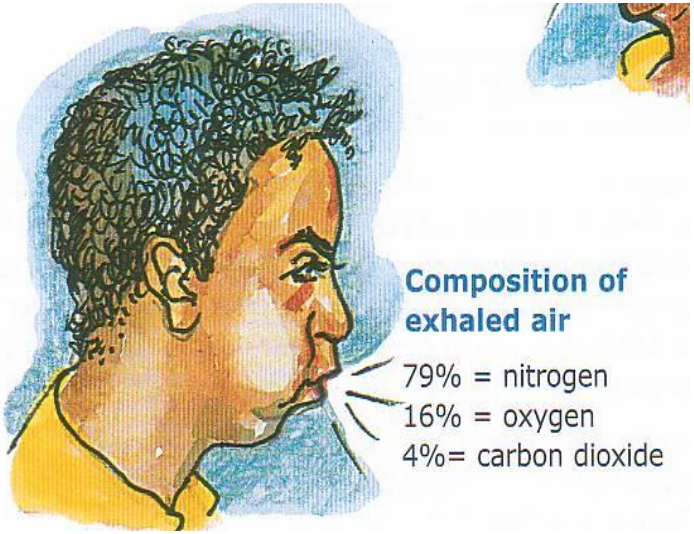




Water vapour:

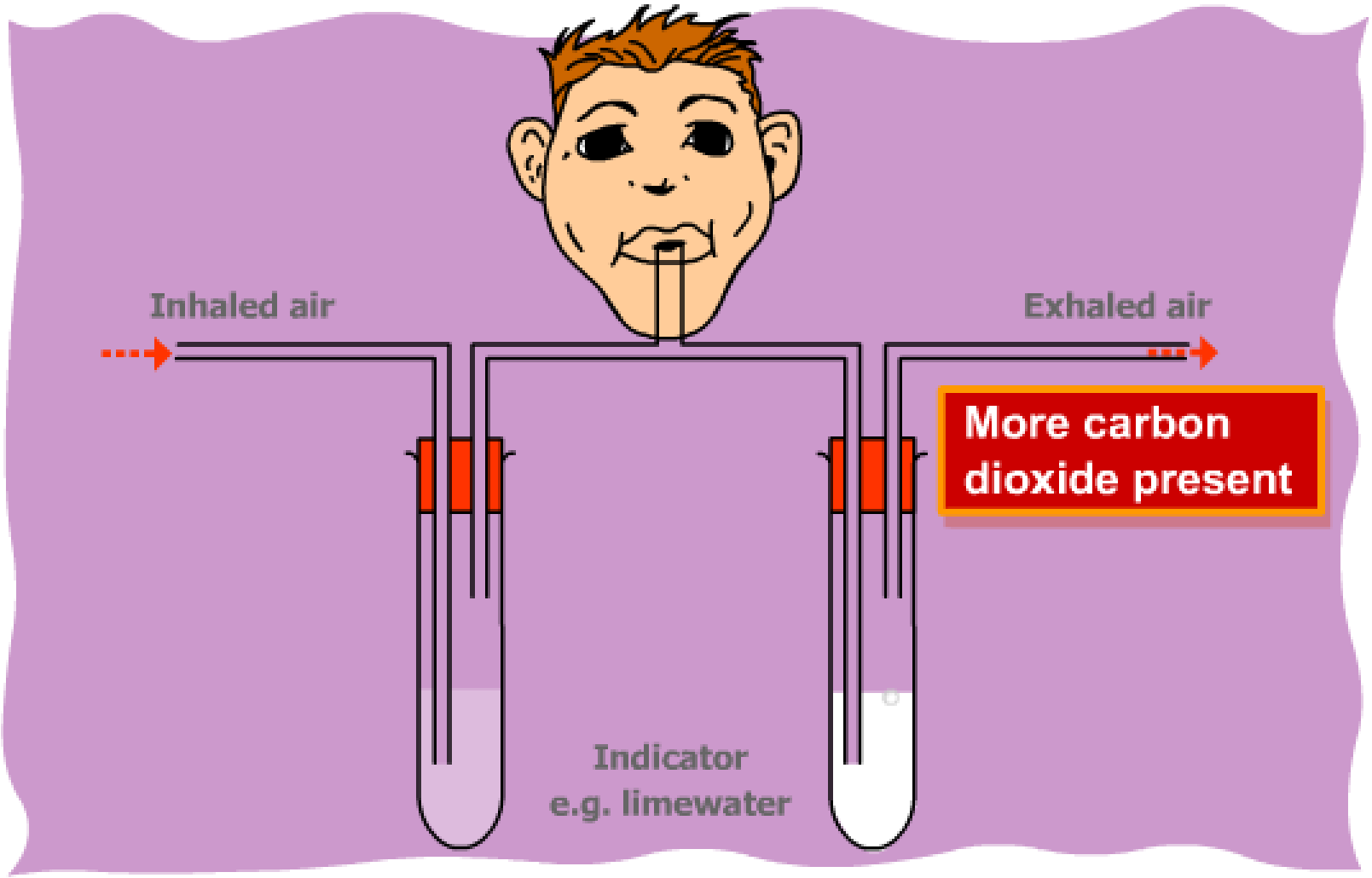
- Inspired air: variable
- Expired air: Saturated

How does mouth to mouth resuscitation help to save in case of drowning..?



Amount of oxygen is.....%

Use lime water as a test for carbon dioxide to investigate the differences in composition between inspired and expired air



http://lgfl.skoool.co.uk/content/keystage3/biology/pc/learningsteps/EIELC/launch.html

PHYSICAL ACTIVITY AND BREATHING

- Investigate and describe the effects of physical activity on rate and depth of breathing.
- Explain the link between physical activity and rate and depth of breathing in terms of changes in the rate at which tissues respire and therefore of carbon dioxide concentration and pH in tissues and in the blood.

1 During exercise, cell respiration in your muscles increases. So the level of carbon dioxide in your blood rises.

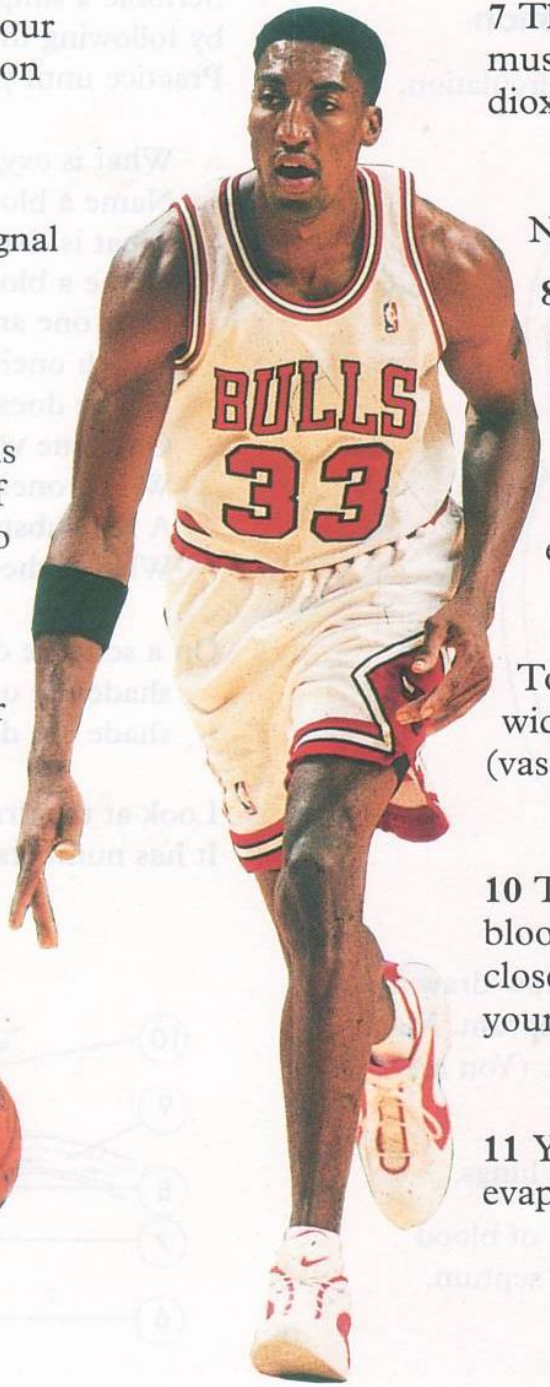
2 Your brain detects this. It sends a signal to your lungs to breathe faster and deeper.

3 So gas exchange in your lungs speeds up. More carbon dioxide passes out of the blood and more oxygen passes into it.

4 The brain also sends a signal to your heart to beat faster. Your **heart rate** goes up.

5 Your muscles squeeze on veins, sending more blood back to the heart. This makes **stroke volume** rise.

6 So **cardiac output** rises too. More blood gets pumped to the muscles each minute.



7 This means more oxygen reaches the muscles each minute and more carbon dioxide is carried away.

Note these changes too:

8 Arterioles widen so that your blood pressure won't get too high.

9 Blood gets shunted from where it is less needed to where the action is. For example from your gut to your legs.

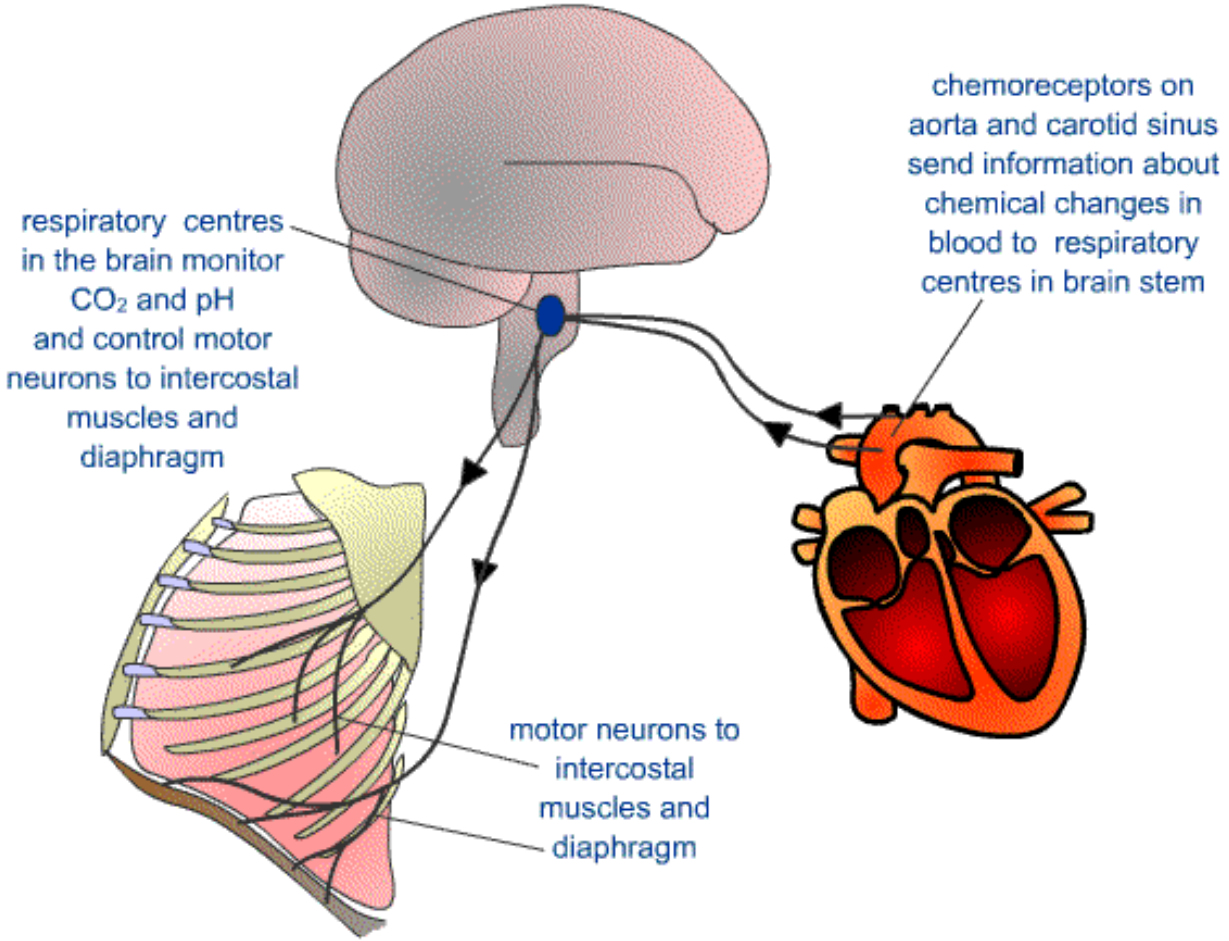
To make this happen, blood vessels widen and constrict at different points (vasodilation and vasoconstriction).

10 The exercise generates heat. So your blood gets hotter. More blood is shunted close to the skin to cool down. This makes your skin redden.

11 You sweat, which cools you by evaporation.

Control of respiration rate

- The normal respiratory rate in adults is between 14 and 18 breaths per minute.



Control of respiration rate

1. During exercise tissues respire more quickly and make more carbon dioxide.
2. This lowers the pH in the tissues and the blood.
3. Our brain detects this rise in CO_2 and low pH of the blood.
4. In response, brain sends nerve impulses to the diaphragm & to the intercostals muscles.
5. These contract faster and increase the rate and depth of breathing.
6. Deeper breathing lowers the concentration of CO2 and this raise the blood pH back to normal.