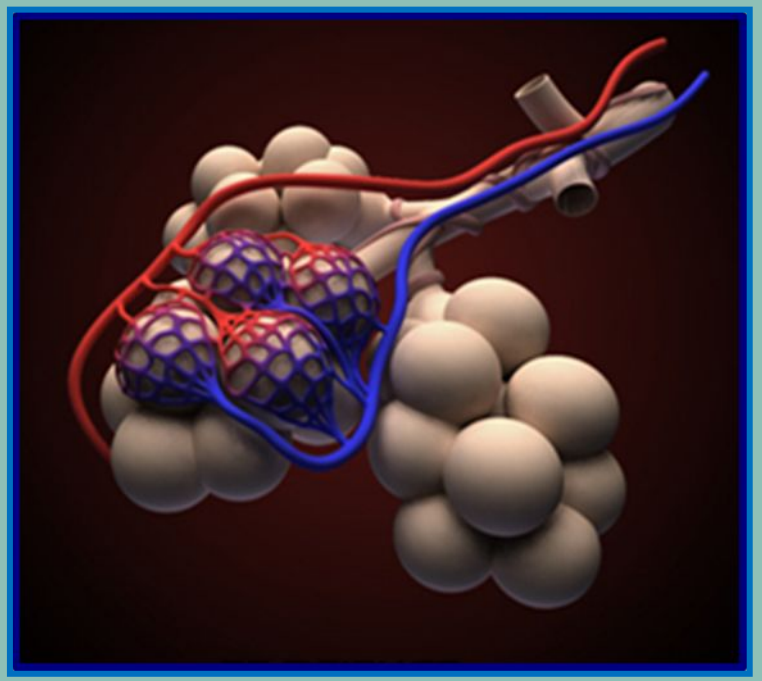
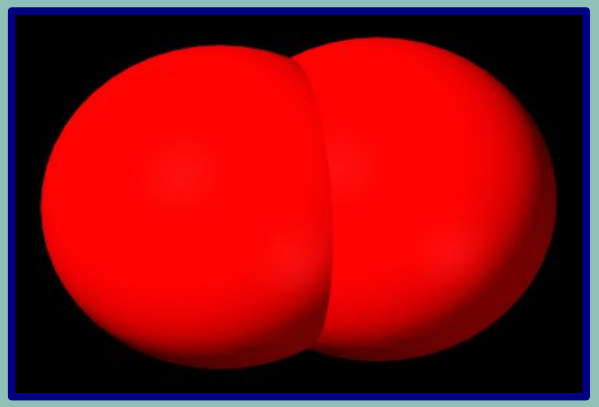
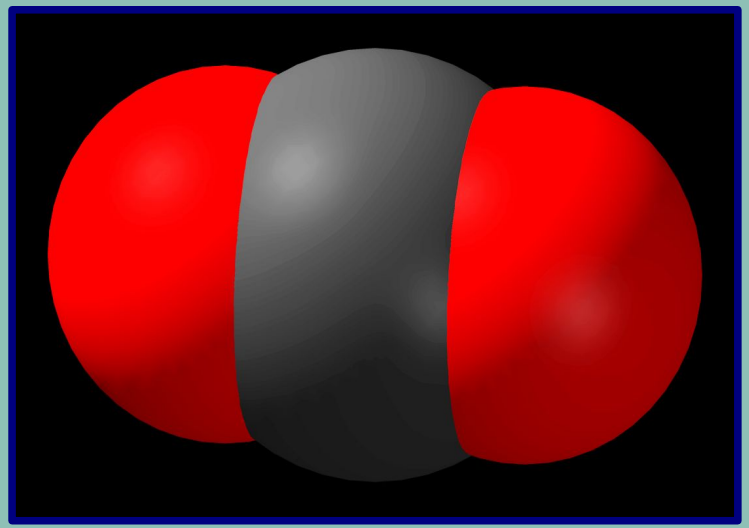
Lungs and GAS EXCHANGE



Why are you breathing?



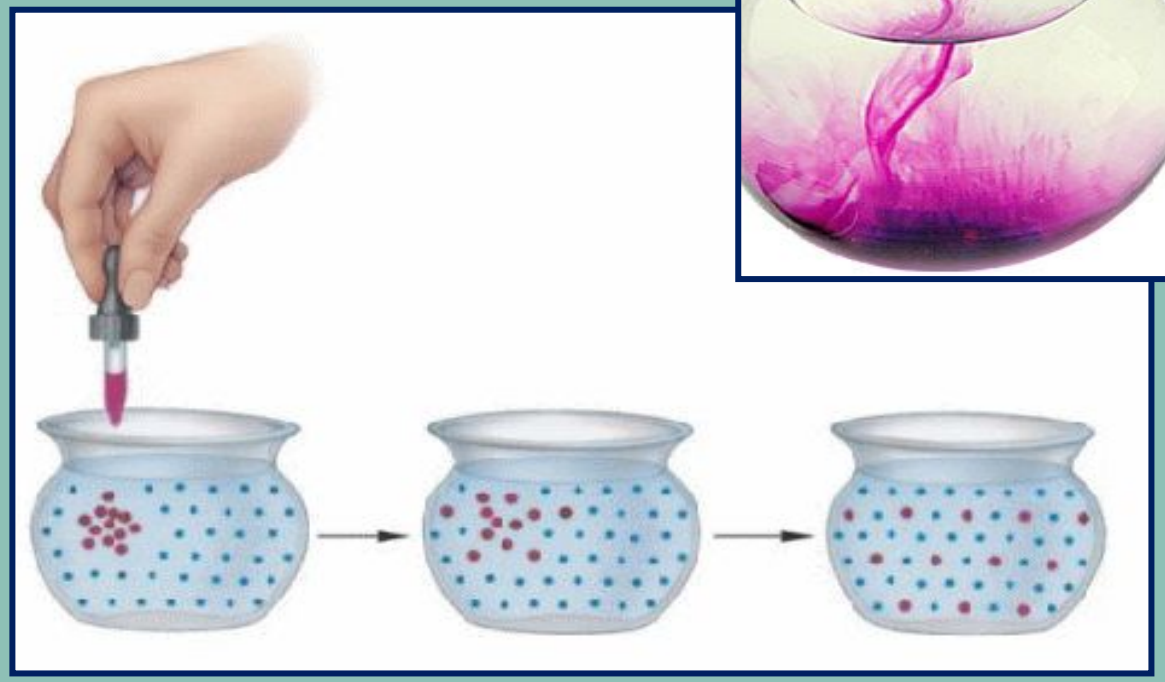


Respiratory surface:

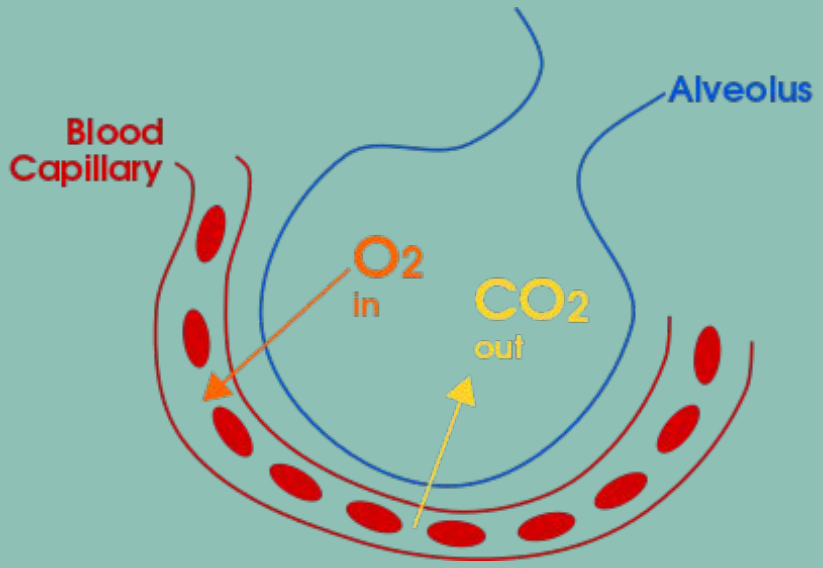
- Covered by cells
- Thin
- Moist
- Large surface area
- Good blood supply in organisms with blood vessels.

Diffusion

- Movement of a substance from an area of higher conc./partial pressure to an area of lower conc. /partial pressure.
- Caused by the random movement of particles.
- Relevant in gases and fluids.



Gas exchange by diffusion



- Only effective over short distances.
- Surface area for gas exchange needs to be: large, moist, permeable.
- Epithelial cells need to be as thin as possible in lungs and blood capillaries.

Breathing through the skin

- Thin moist skin.
- Small organisms: SA/volume = large.

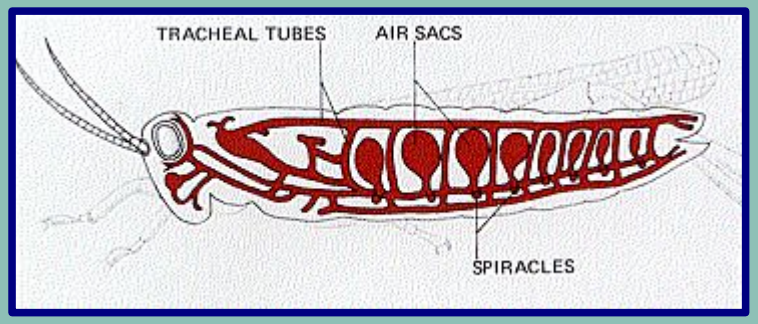
“Scrotum frog”. Giant water frog, Lake Titicaca frog
Has very small lungs

Specialised respiratory organs

- Lungs

- Gills

- Trachea

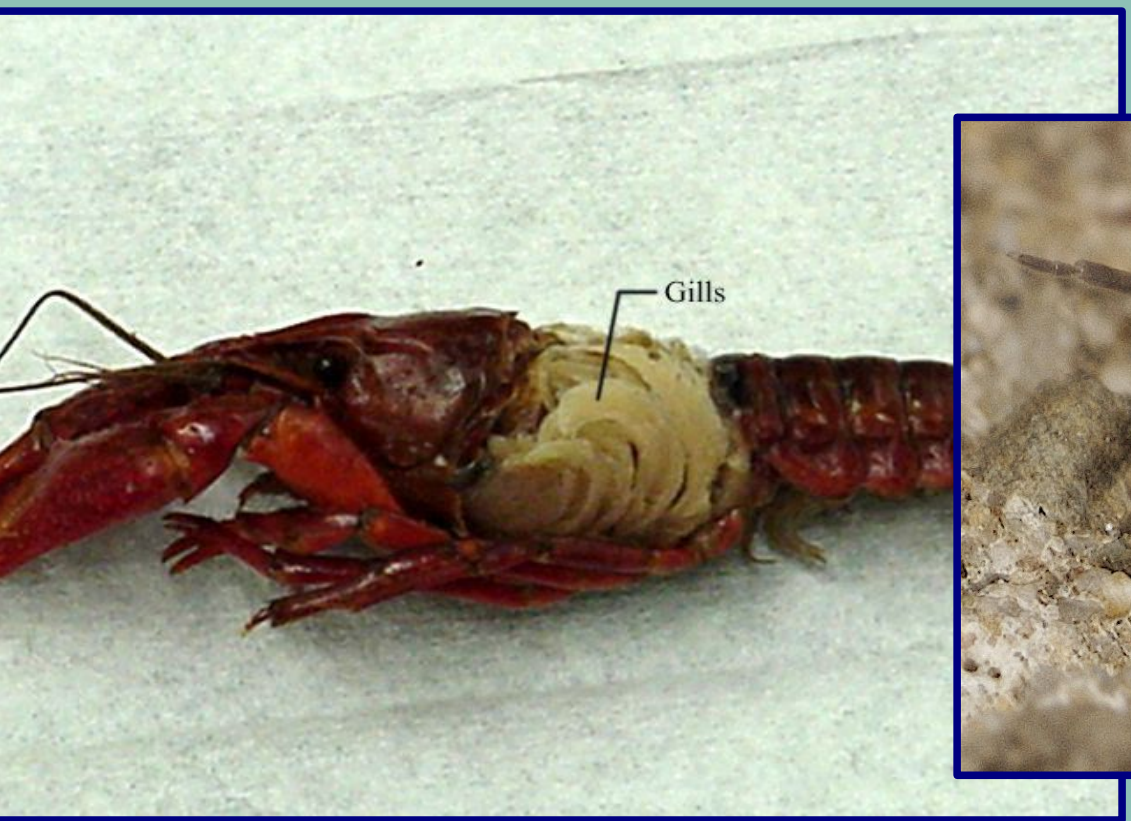


Lungs

- Internal organ, moist epithelium for gas exchange.
- Terrestrial vertebrates.
- Aquatic mammals who come up to the surface to breathe.
- Lungfish

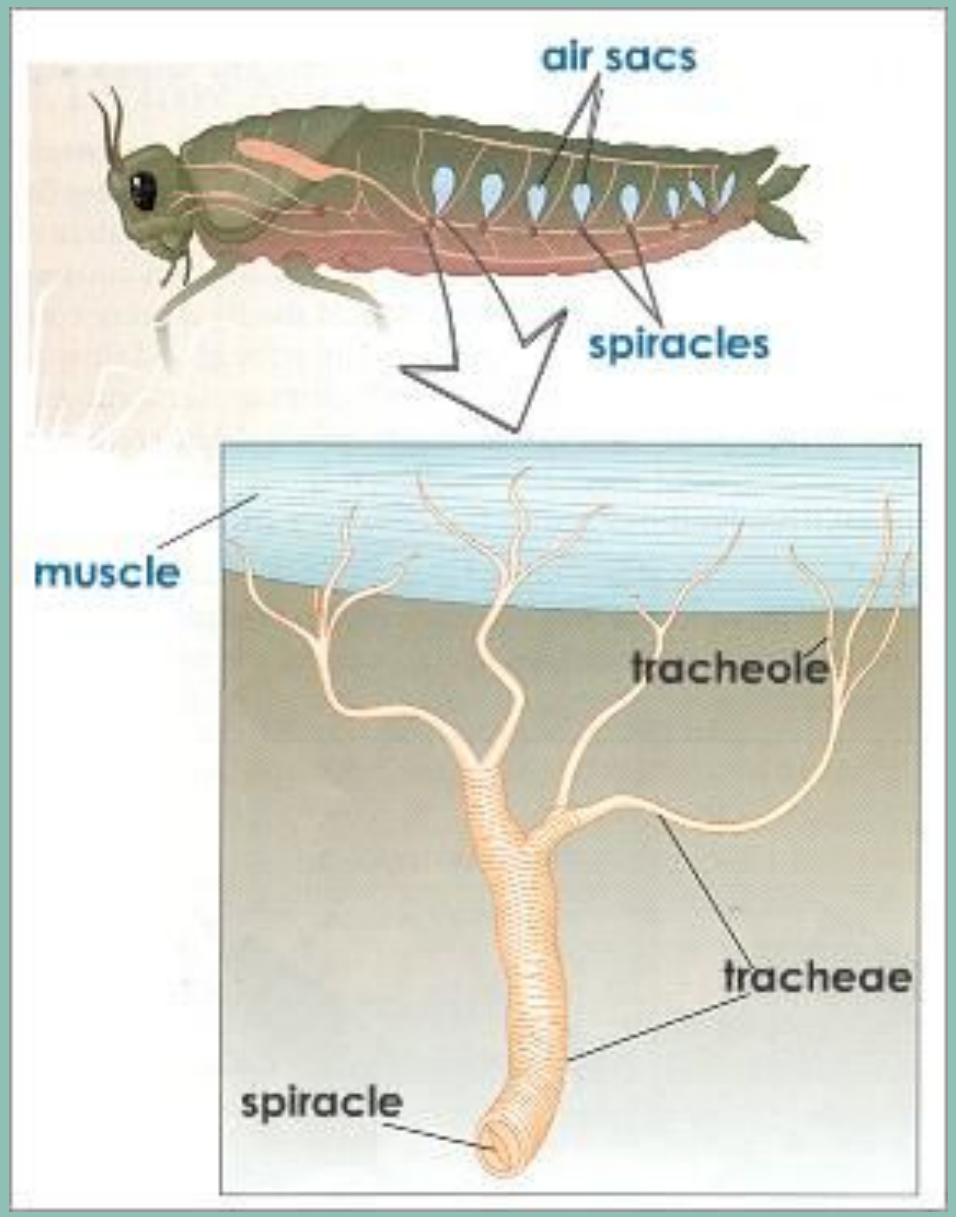
Gills

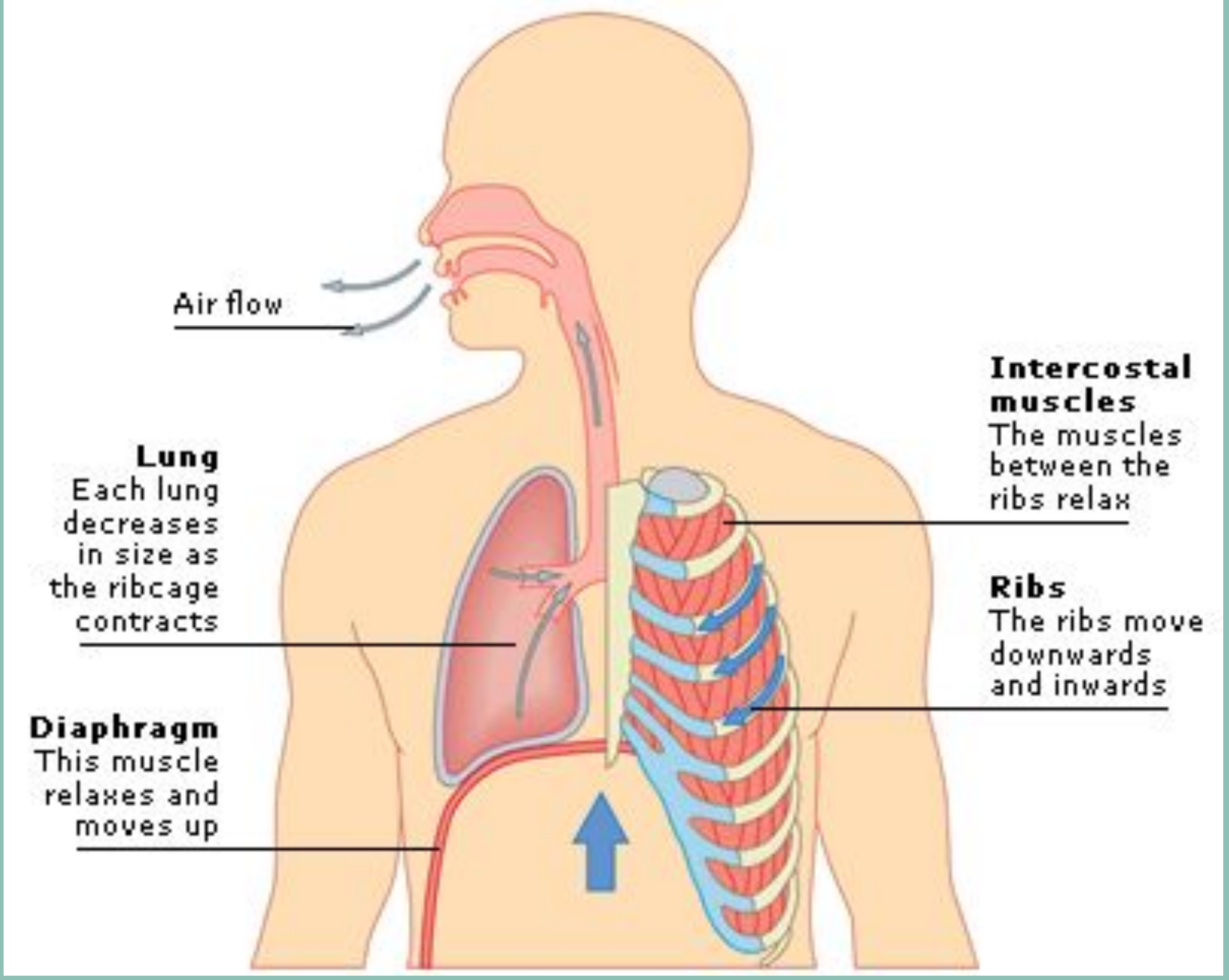
- Aquatic animals.
- Fish breathing: https://www.youtube.com/watch?v=bEeTlm5Hlq4
- Terrestrial animals who live in moist environments.



Trachea

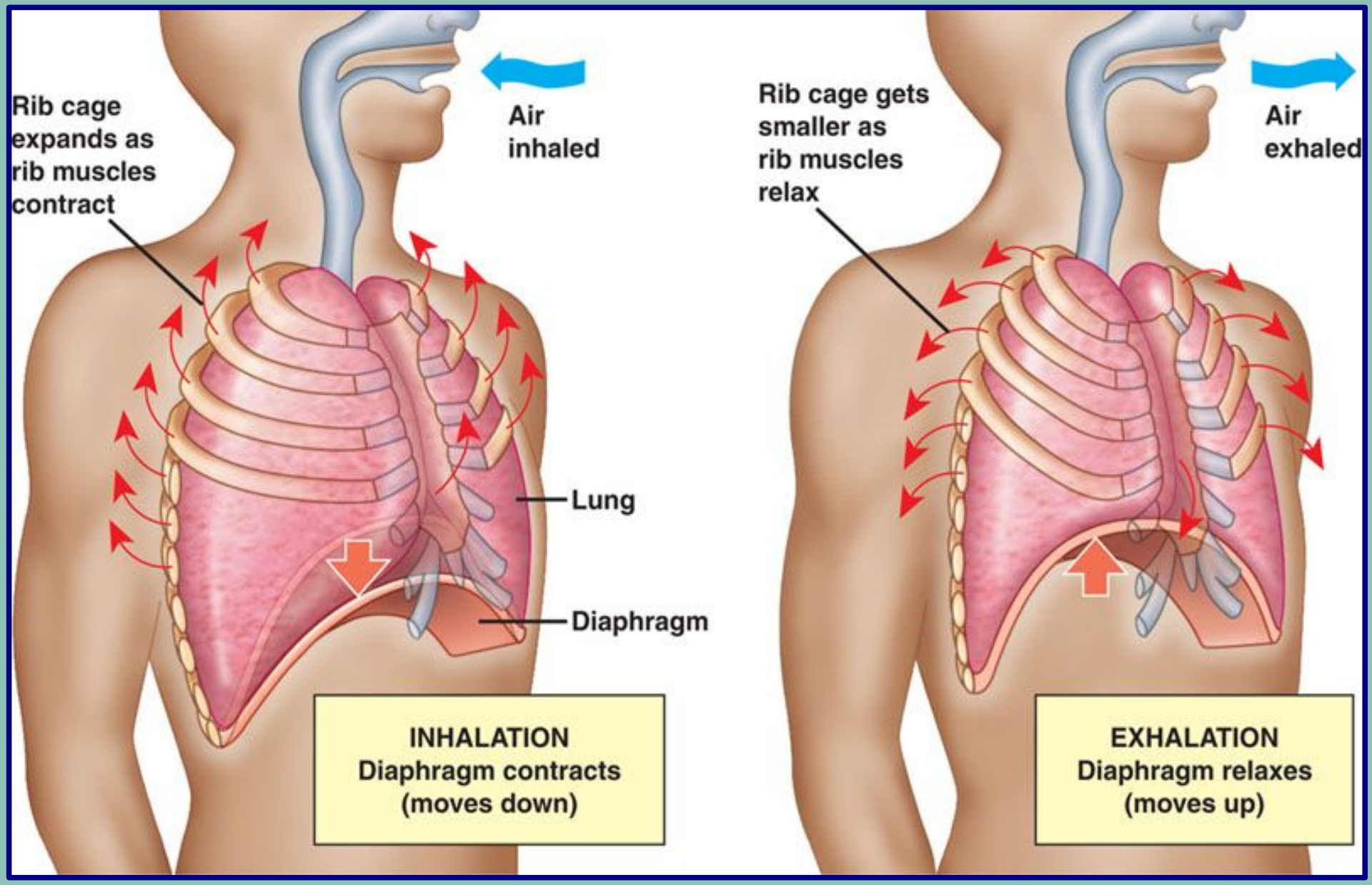
- Air enters through holes known as spiracles.
- The trachea branches into tracheoles.
- Gas exchange takes place between the tracheoles and the tissues directly.

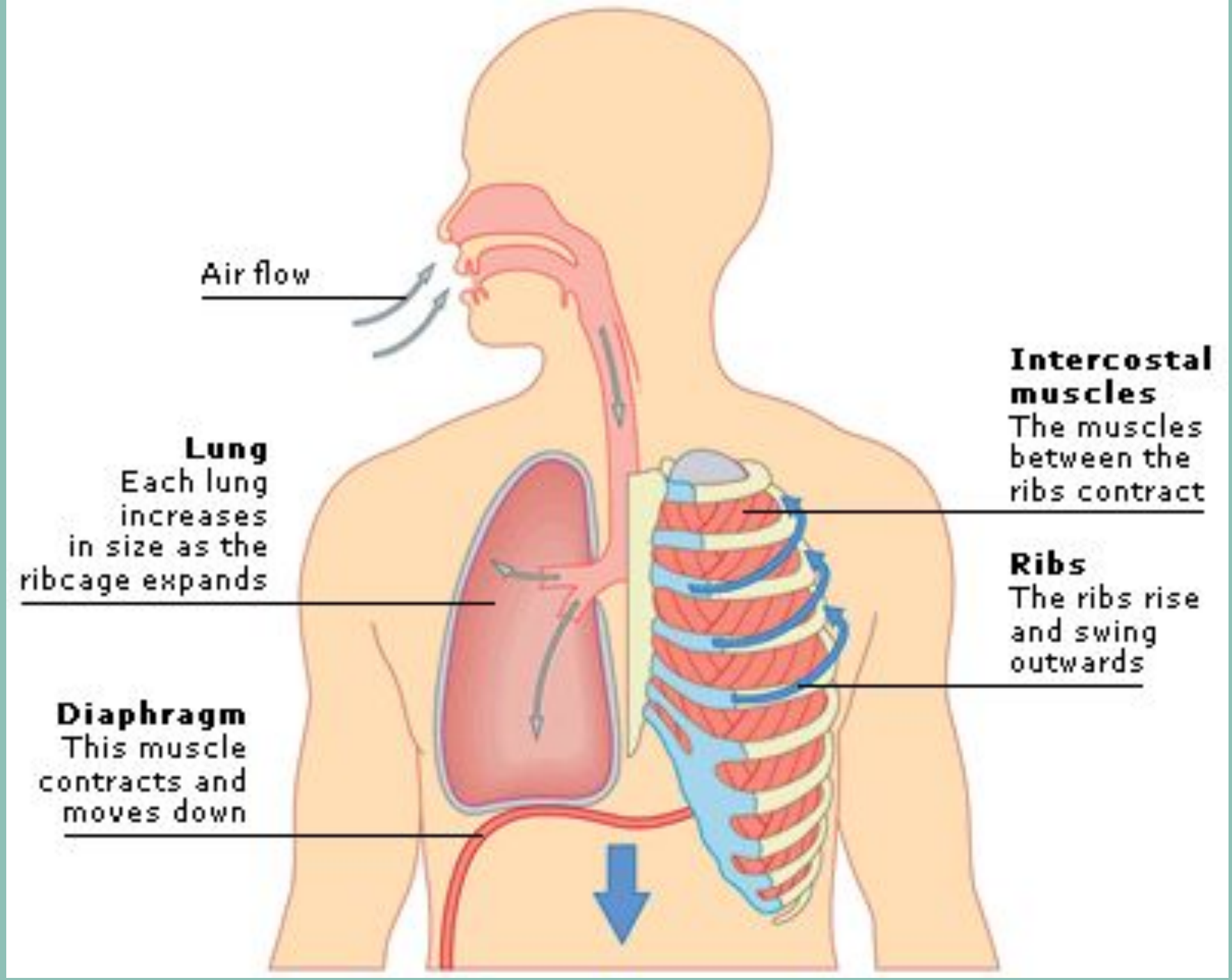



Air flow
Intercostal muscles
The muscles between the ribs relax
Lung
Each lung decreases in size as the ribcage contracts
Ribs
The ribs move downwards and inwards
Diaphragm
This muscle relaxes and moves up

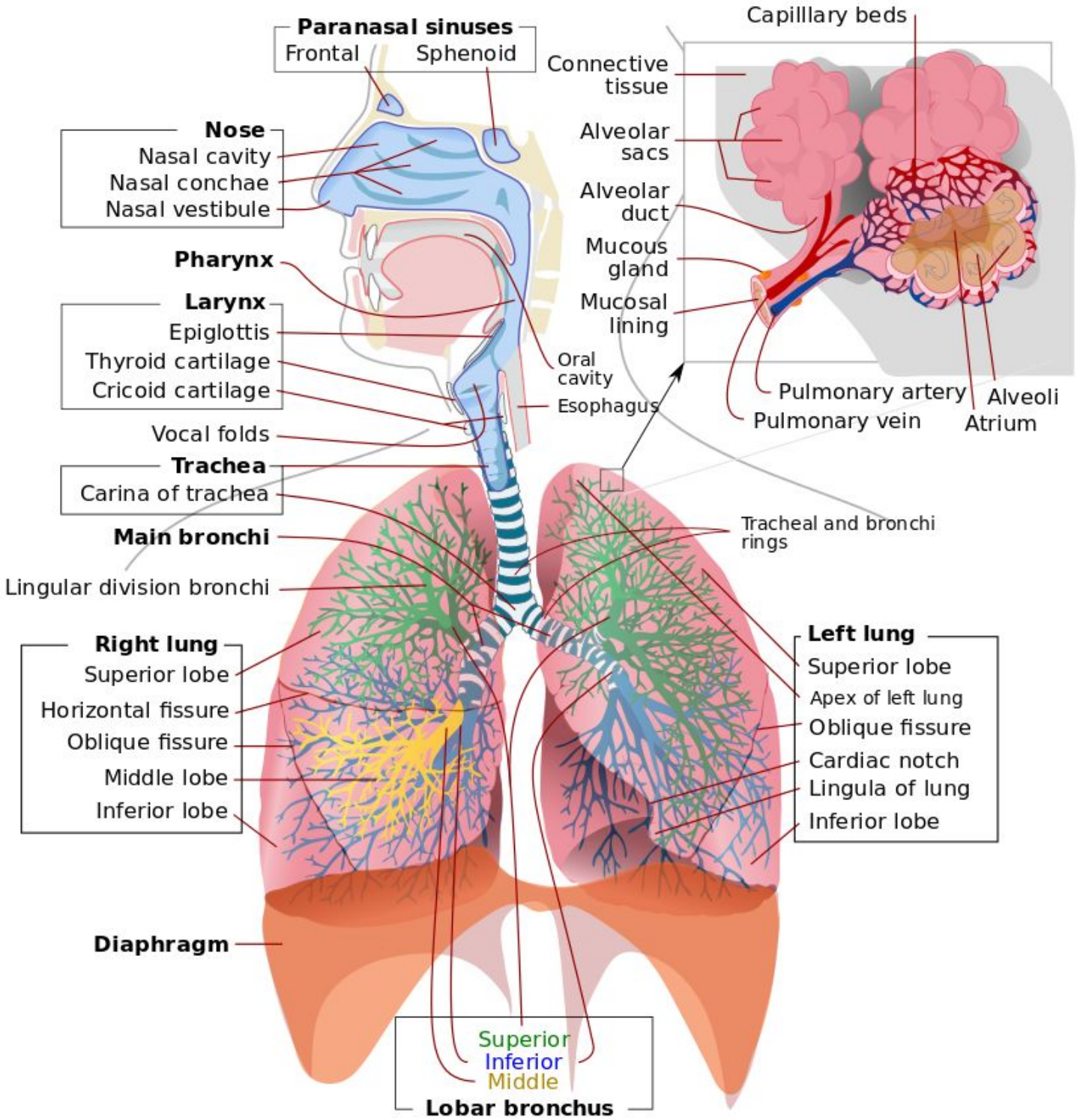
Exhaling

Ventilation (diaphragm = mellangärde)



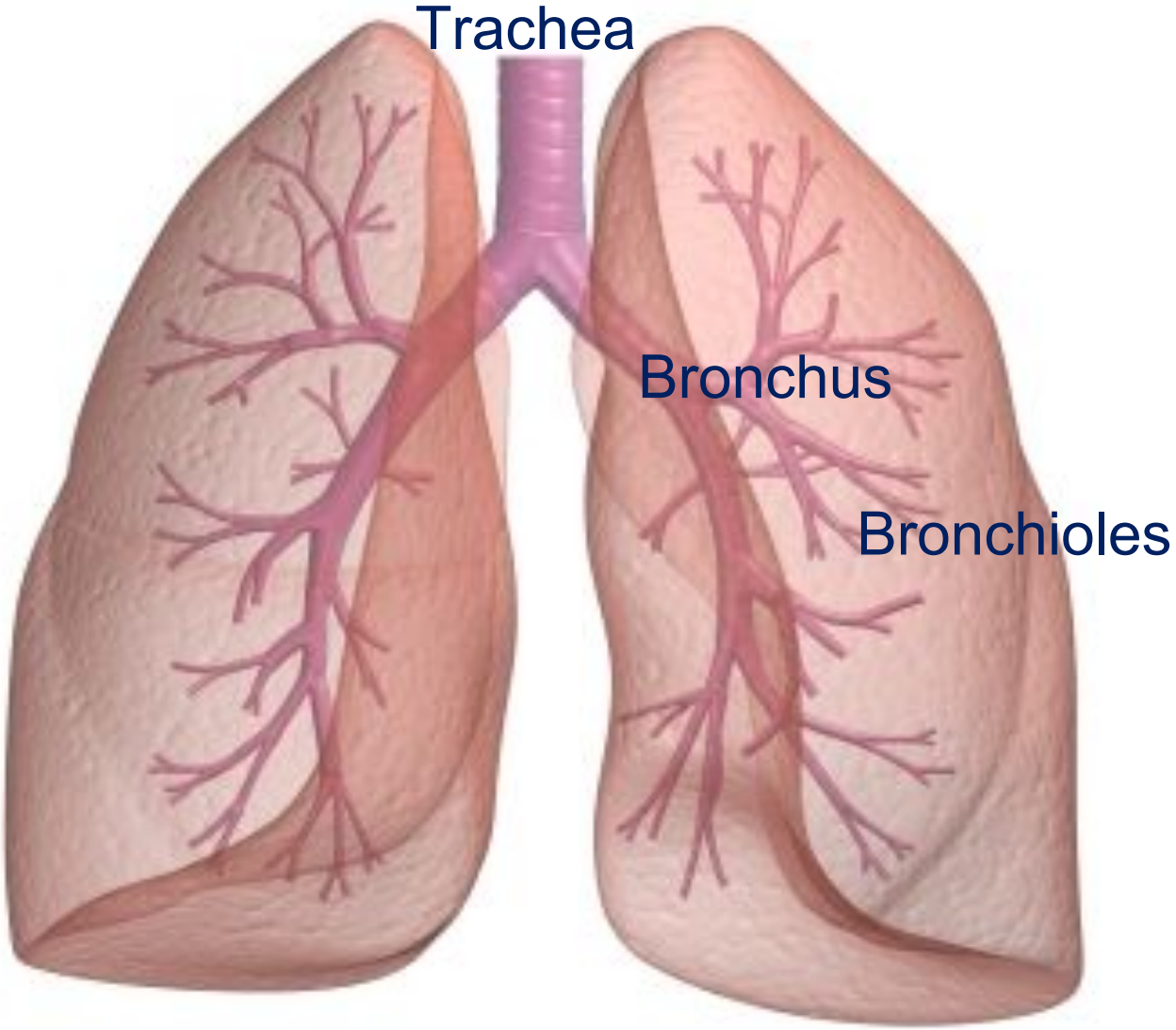

Air flow
Lung
Each lung increases in size as the ribcage expands
Diaphragm
This muscle contracts and moves down
Intercostal muscles
The muscles between the ribs contract
Ribs
The ribs rise and swing outwards

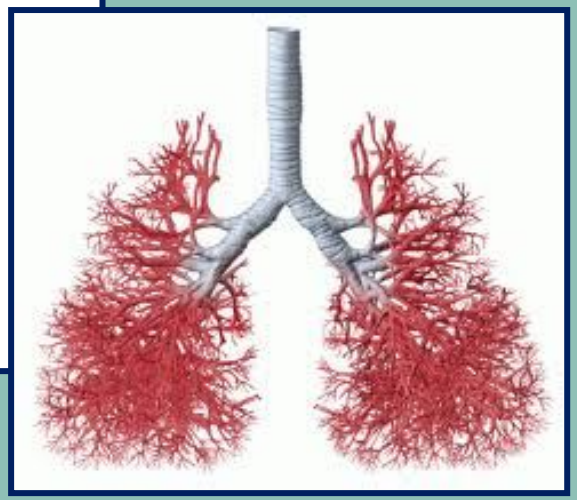
Inhaling


Paranasal sinuses
Frontal
Sphenoid
Nose
Nasal cavity
Nasal conchae
Nasal vestibule
Pharynx
Larynx
Epiglottis
Thyroid cartilage
Cricoid cartilage
Vocal folds
Trachea
Carina of trachea
Main bronchi
Lingular division bronchi
Right lung
Superior lobe
Horizontal fissure
Oblique fissure
Middle lobe
Inferior lobe
Diaphragm
Oral cavity
Esophagus
Tracheal and bronchi rings
Left lung
Superior lobe
Apex of left lung
Oblique fissure
Cardiac notch
Lingula of lung
Inferior lobe
Superior
Inferior
Middle
Lobar bronchus
Capilllary beds
Connective tissue
Alveolar sacs
Alveolar duct
Mucous gland
Mucosal lining
Pulmonary artery
Pulmonary vein
Alveoli
Atrium

Branchings in the lungs

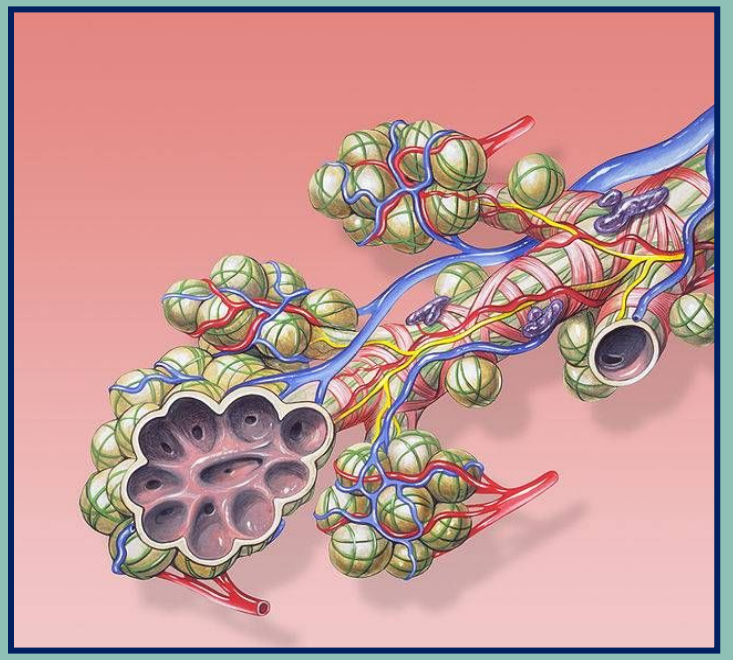
https://www.youtube.com/watch?v=xrh10zjNyDg

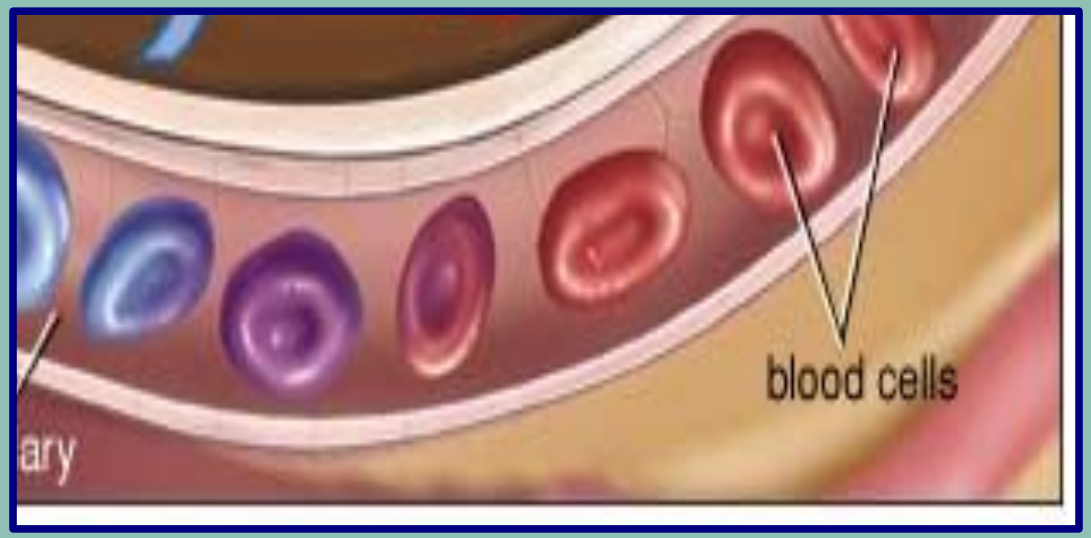


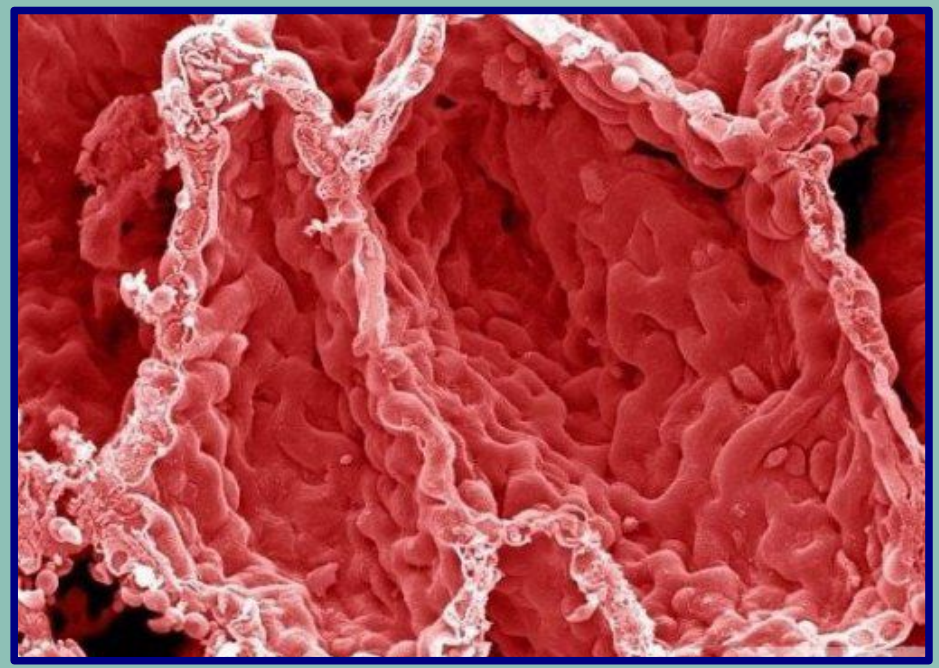


Alveoli

- Gas exchange: oxygen in, carbon dioxide out.
- Surface area: 100 m²
- 0,15 mm diameter







Lung volumes and capacities

- Tidal volume: The air volume exchanged in each breath during calm breathing (~0.5L).
- Vital capacity: The maximum air volume that can be expelled after a deep breath (~3-5L).
- Residual volume: The air volume that remains in the lungs after a maximal exhalation. (~1.5 L)
- A Spirometer is used to measure tidal volume and vital capacity.

Lung volumes and capacities

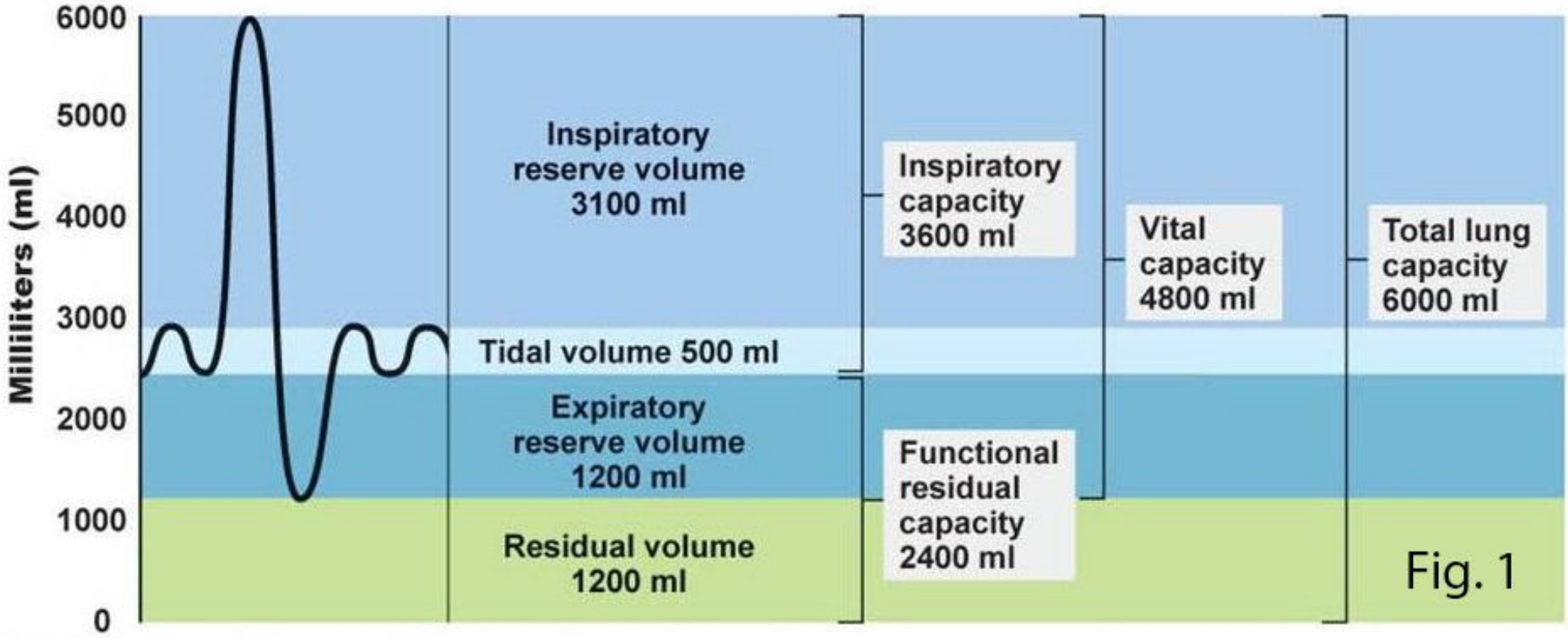


Fig. 1

”Dead air space”

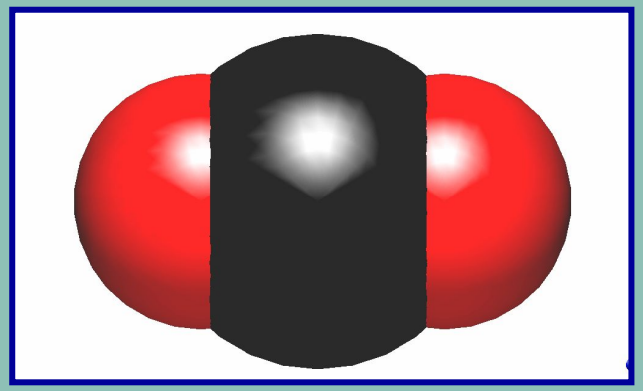
- Despite maximal exhalation there is some air left in the lungs, trachea and mouth.
- Therefore you will partly take in ”used air” when you take a new breath.

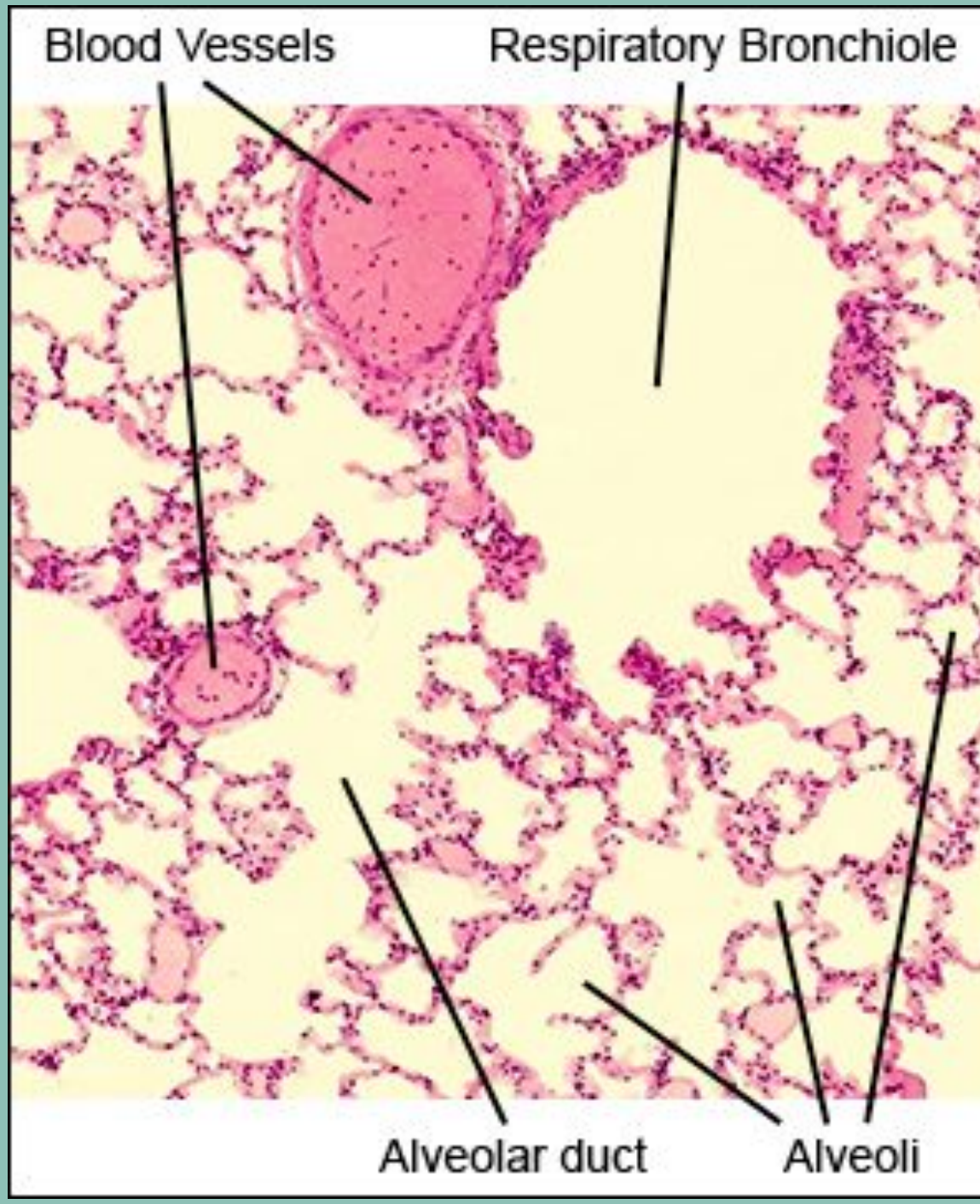
What controls ventilation?

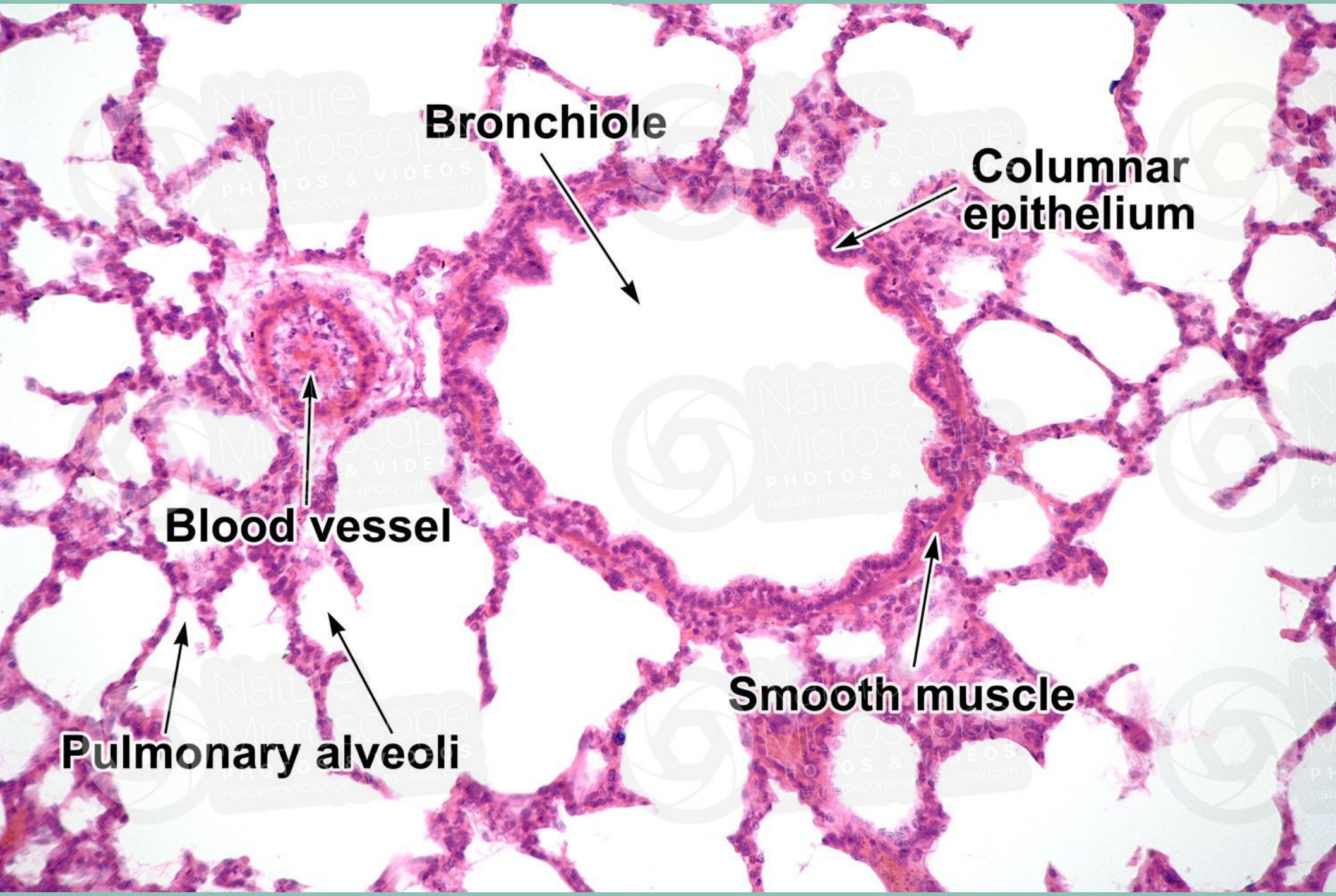
- Stretch receptors in the walls of the bronchi control the inhalation and exhalation by sending impulses to the muscles involved.
- During inhalation the receptors get stretched out and inhalation is inhibited.
- When exhalation has taken place the receptors are no longer stretched out and inhalation is again stimulated.

What controls rate and depth of ventilation?

- Not primarily the oxygen concentration that decides how fast and deep we breath.
- The carbon dioxide concentration in the blood controls ventilation by affecting pH.
- High carbon dioxide concentration = lower pH. Chemoreceptors give a signal about increased breathing rate and depth.




Blood Vessels
Respiratory Bronchiole
Alveolar duct
Alveoli


Bronchiole
Columnar epithelium
Blood vessel
Smooth muscle
Pulmonary alveoli

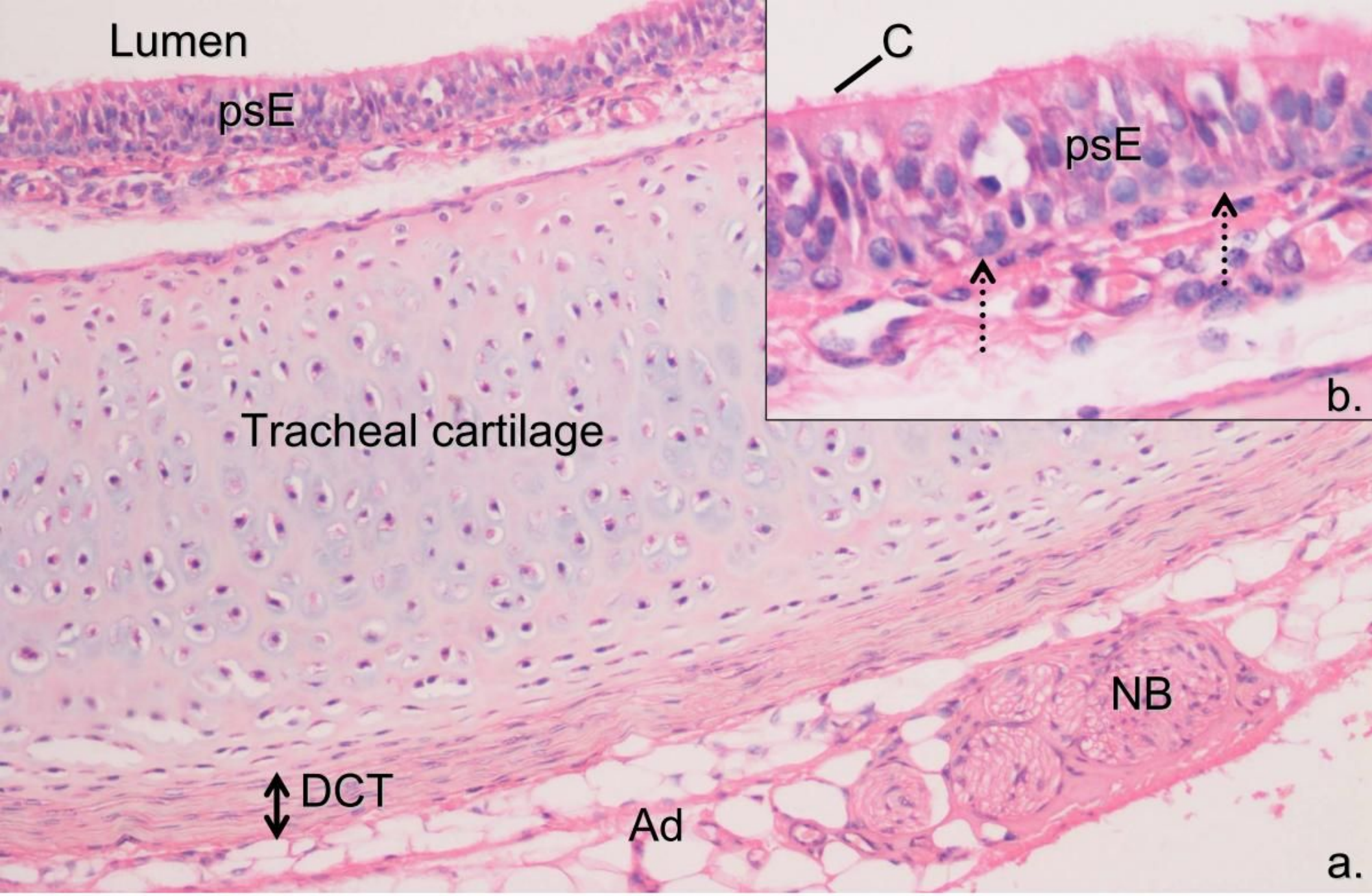
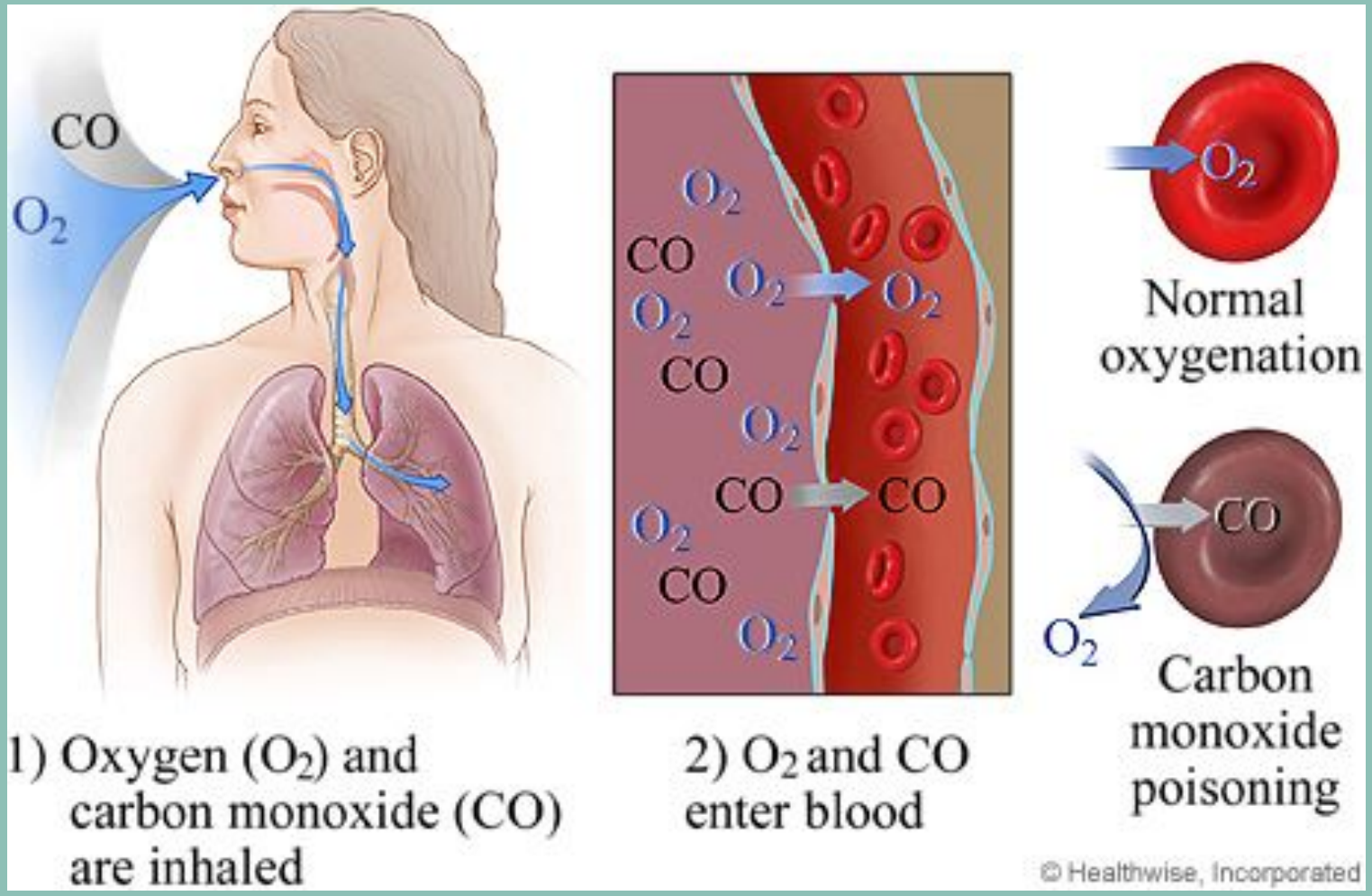


Fig 4. 93W4875
Trachea and esophagus

psE: Pseudostratified ciliated columnar epi.
C: Cilia DCT: Dense connective tissue
Ad: Adipose tissue NB: Nerve fiber bundle

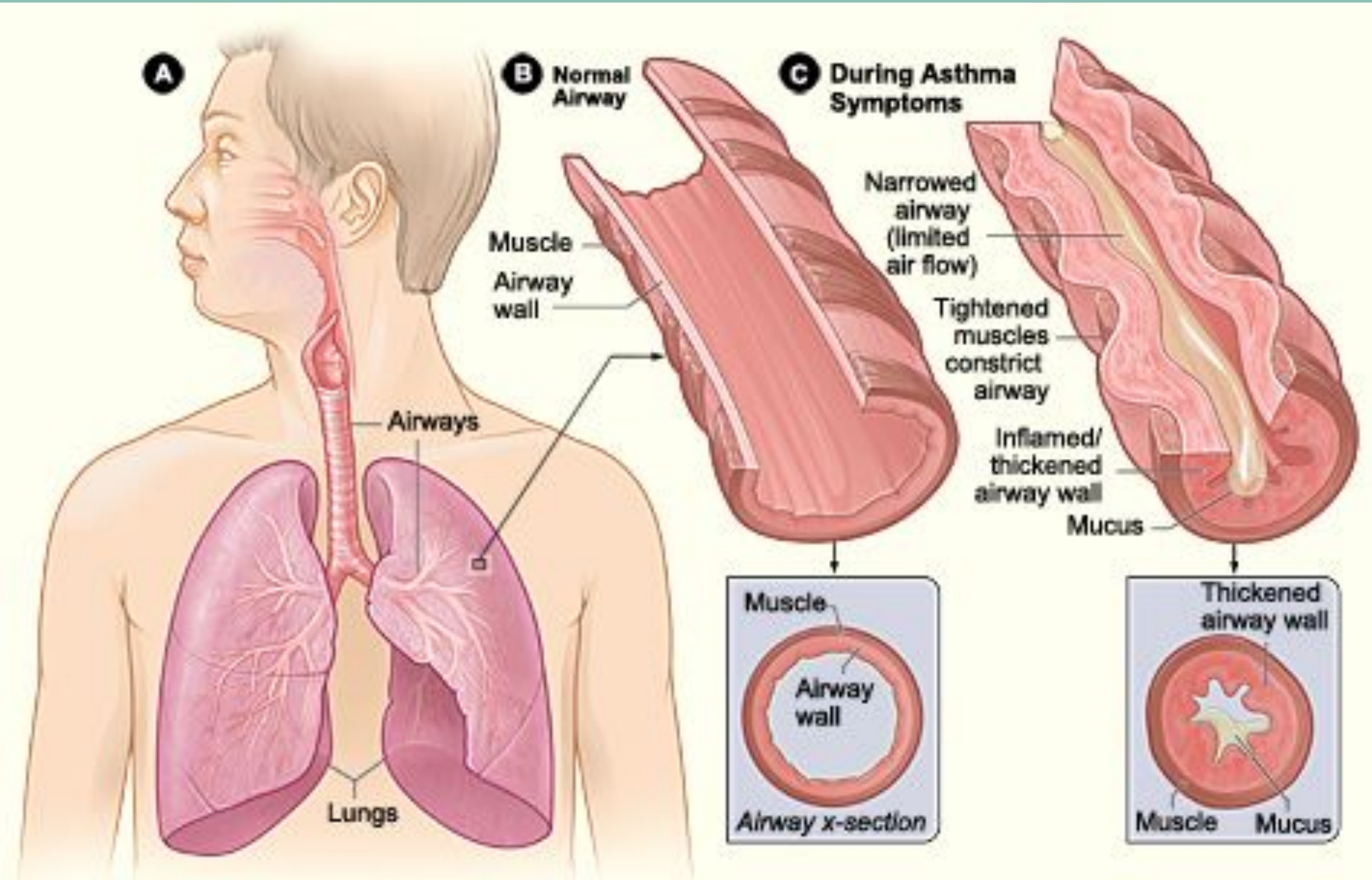
Slide 13 Trachea

Carbon monoxide poisoning

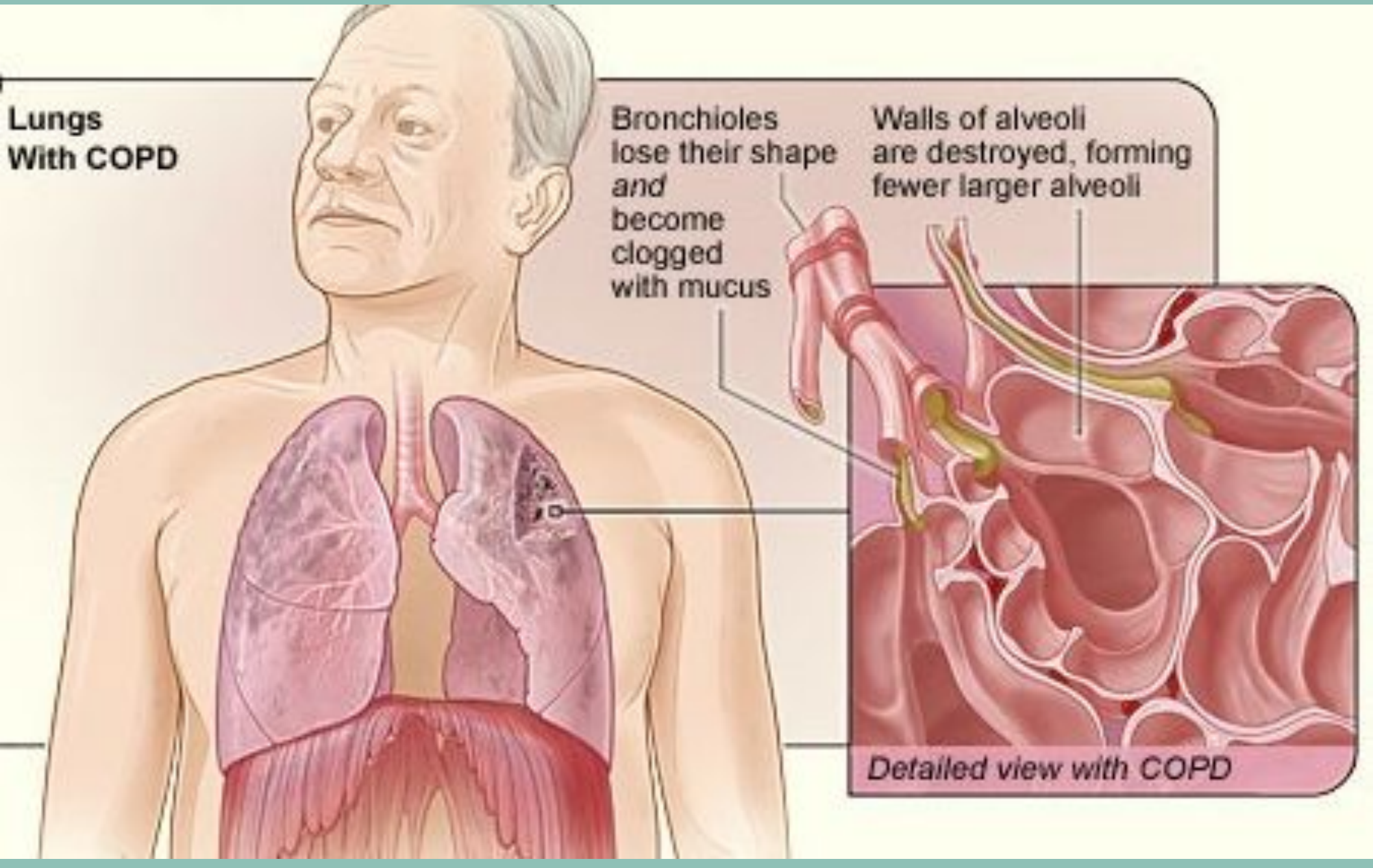


- Having a barbeque on a charcoal-burning grill indoors without proper venting
- Leaving a gas cooking stove on too long
- Allowing a car to run idle too long or running a generator or lawnmower in a closed garage
- https://www.youtube.com/watch?v=wKIrbq2pWvw

Asthma


A
B Normal Airway
C During Asthma Symptoms
Muscle
Airway wall
Airways
Lungs
Narrowed airway (limited air flow)
Tightened muscles constrict airway
Inflamed/ thickened airway wall
Mucus
Muscle
Airway wall
Airway x-section
Thickened airway wall
Muscle
Mucus

Chronic Obstructive Pulmonary Disease (COPD), Sw. KOL



Links to help

Revision and test quiz

http://www.bbc.co.uk/schools/gcsebitesize/science/triple_aqa/movement_of_molecules/gaseous_exchange_lungs/revision/1/

https://www.youtube.com/watch?v=PRxQcdH3NjY

https://www.youtube.com/watch?v=MrDbiKQOtlU