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](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.
Exhaling

Air flow

Lung
Each lung decreases in size as the ribcage contracts

Diaphragm
This muscle relaxes and moves up

Intercostal muscles
The muscles between the ribs relax

Ribs
The ribs move downwards and inwards
Ventilation (diaphragm = mellangärde)
Inhaling

- **Air flow**: The movement of air into the lungs.
- **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**
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.
psE: Pseudostratified ciliated columnar epi.
C: Cilia
DCT: Dense connective tissue
Ad: Adipose tissue
NB: Nerve fiber bundle
Slide 13 Trachea

Cilia
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=wKlrbg2pWvw](https://www.youtube.com/watch?v=wKlrbg2pWvw)
Asthma

A: Normal Airway

- Muscle
- Airway wall

B: During Asthma Symptoms

- Narrowed airway (limited air flow)
- Tightened muscles constrict airway
- Inflamed/thickened airway wall
- Mucus

C: Airway x-section

- Muscle
- Airway wall
- Mucus

Lungs

Thickened airway wall

Muscle

Mucus
Chronic Obstructive Pulmonary Disease (COPD), Sw. KOL

Lungs With COPD

Bronchioles lose their shape and become clogged with mucus.

Walls of alveoli are destroyed, forming fewer larger alveoli.

Detailed view with COPD.
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