

Gas exchange in humans

IGCSE Biology 0610 · Topic 11 revision notes

Everything from the 2 lessons of this topic on a few pages: the key idea of each lesson, the diagram to remember, the points to learn and the traps examiners set. Read it, cover it, test yourself.

1. The breathing system

2. Breathing and exercise

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1 The breathing system

Syllabus 11.1

Air passes through the **larynx, trachea, bronchi and bronchioles** to the **alveoli**, tiny air sacs surrounded by capillaries. Gas exchange surfaces in humans have four features: a **large surface area**, a **thin surface**, a **good blood supply** and **good ventilation with air**. Together they keep oxygen diffusing into the blood and carbon dioxide diffusing out as fast as possible.

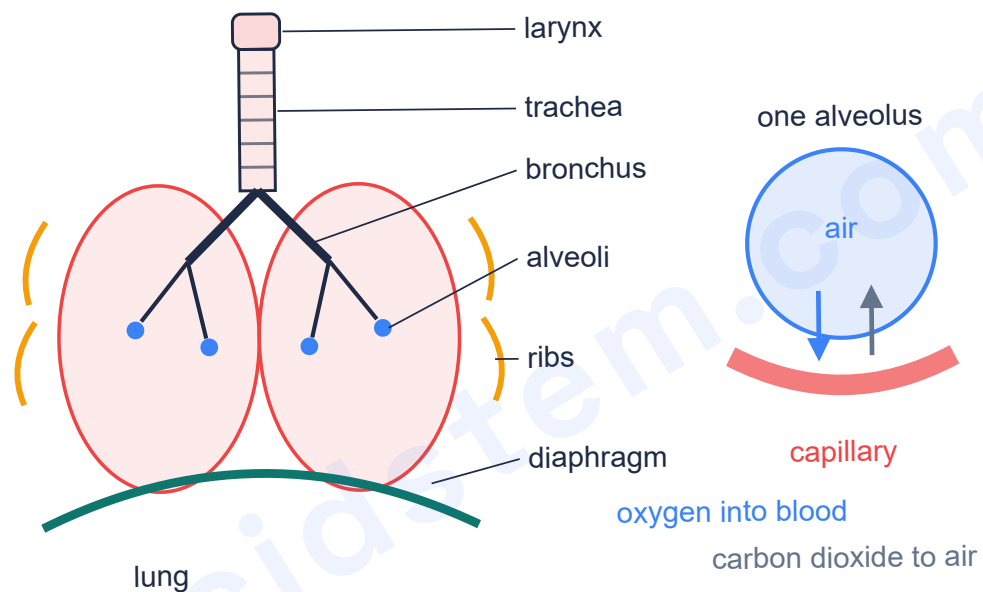


Fig. 1: the breathing system inside the thorax, and one alveolus with its capillary where oxygen and carbon dioxide are exchanged by diffusion

Four features, one job.

- ✓ **Airway order:** larynx, trachea, bronchi, bronchioles, alveoli.
- ✓ **Gas exchange surface:** large surface area, thin surface, good blood supply, good ventilation with air.
- ✓ **Say why:** area = more crossing at once; thin = short distance; blood and ventilation = steep concentration gradients.
- ✓ **Extended:** cartilage holds the trachea open; goblet cells make mucus; mucus traps; cilia sweep.

Watch out!

The order matters: trachea, then bronchi, then bronchioles, then alveoli. A common slip is to put bronchioles before bronchi. The singular of bronchi is *bronchus*, and of alveoli is *alveolus*.

"Thin" refers to the surface (one cell thick), not to the lungs being thin. And a good blood supply does not push oxygen in: it carries oxygen away so the concentration gradient stays steep.

Cilia do not trap anything: the mucus traps, the cilia move the mucus. Goblet cells make mucus; they are not ciliated. Keep the three jobs separate.

2 Breathing and exercise

Syllabus 11.1

Expired air contains **less oxygen** (about 16% instead of 21%), **more carbon dioxide** (about 4% instead of 0.04%) and **more water vapour** than inspired air, and turns limewater milky much faster. During physical activity breathing becomes **faster and deeper**. Extended: muscles change the volume of the thorax, which changes the pressure, so air moves in and out; extra carbon dioxide in the blood during exercise is detected by the brain, which increases the rate and depth of breathing.

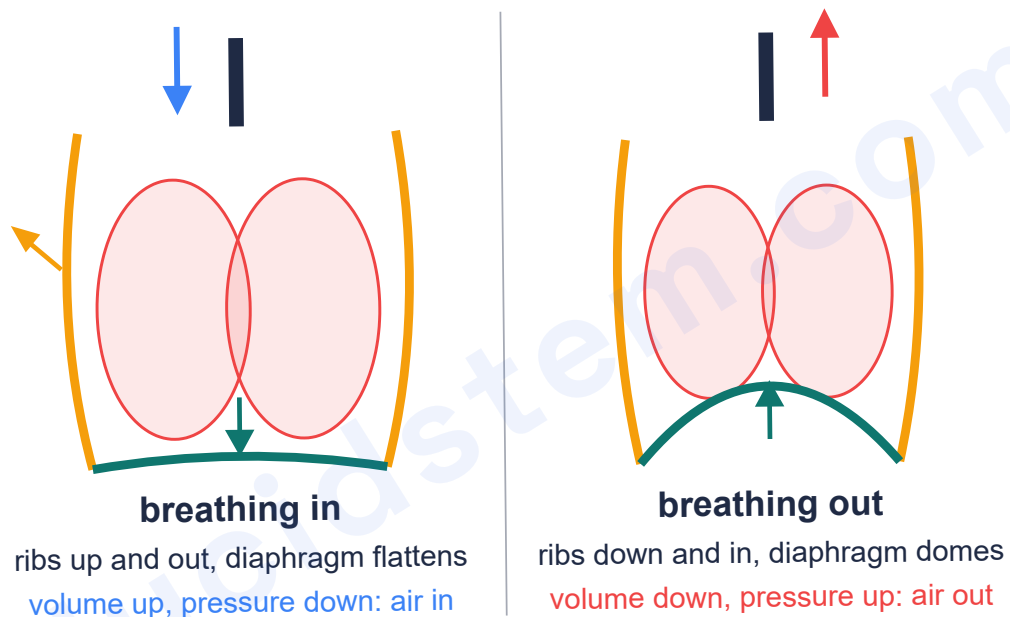


Fig. 1: breathing in enlarges the thorax and lowers the pressure inside the lungs, so air flows in; breathing out reverses the changes

Muscles, volume, pressure, air.

- ✓ **Expired vs inspired:** less oxygen (16% vs 21%), more carbon dioxide (4% vs 0.04%), more water vapour.
- ✓ **Limewater:** turns milky with carbon dioxide; expired air turns it milky faster.
- ✓ **Extended ventilation:** muscles contract, volume rises, pressure falls, air flows in; reverse to breathe out.
- ✓ **Extended control:** more carbon dioxide in the blood, detected by the brain, gives faster and deeper breathing.

Watch out!

Air does not rush in and then make the chest expand. The order is: muscles contract, volume increases, pressure falls, then air flows in. And the diaphragm flattens when it contracts; it domes upwards when it relaxes.

Expired air still contains plenty of oxygen (about 16%), which is why rescue breaths work. Do not write that expired air has "no oxygen" or is "all carbon dioxide".

In the Extended explanation the trigger is the rise in carbon dioxide in the blood, detected by the brain. Do not say the lungs detect a lack of oxygen, or that the muscles decide how fast to breathe.