

Gas exchange

**Why does gas exchange become harder as organisms increase in size?**

Gas exchange

**Four properties of a gas-exchange surface**

Gas exchange

**Three ways animals maintain concentration gradients at exchange surfaces**

Gas exchange

**Surfactant**

Gas exchange

**How does the branched network of bronchioles help gas exchange?**

Gas exchange

**Why are the alveoli covered in extensive capillary beds?**

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**Muscle actions during inspiration**

Gas exchange

**Muscle actions during forced expiration**

Permeable, thin tissue layer, moist and large surface area.

Surface area-to-volume ratio decreases and the distance from the centre to the exterior increases.

Fluid lining the alveoli that reduces surface tension, so alveoli do not stick together and collapse when air is breathed out.

Dense networks of blood vessels, continuous blood flow, and ventilation with air (lungs) or water (gills).

Blood flows close to all of the surface, removing  $O_2$  and bringing  $CO_2$  to keep gradients steep.

It carries air to and from hundreds of millions of alveoli, giving a very large surface area.

Internal intercostals contract, ribs move down and in; abdominal muscles contract, pushing the diaphragm up. Thorax volume falls, pressure rises.

Diaphragm contracts and flattens; external intercostals contract, ribs move up and out; abdominal muscles relax. Thorax volume rises, pressure falls.

Gas exchange

**Vital capacity**

Gas exchange

**Tidal volume**

Gas exchange

**Role of the waxy cuticle and epidermis  
in gas exchange**

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**Role of spongy mesophyll and air  
spaces**

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**Plan diagram**

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**Transpiration**

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**Four factors that increase the rate of  
transpiration**

Gas exchange

**How is stomatal density calculated?**

The volume of air breathed in or out in one normal breath.

Tidal volume + inspiratory reserve volume + expiratory reserve volume: the most air that can be breathed out after the deepest breath in.

Air spaces let gases diffuse through the leaf; moist spongy mesophyll walls give a large surface for gas exchange.

Reduce water loss by evaporation; the transparent epidermis protects the leaf and lets light through.

Loss of water vapour from the leaves and stems of plants, a consequence of opening stomata for gas exchange.

A diagram showing the distribution of tissues as outlined areas, with no individual cells drawn.

Number of stomata in the field of view  $\div$  area of the field of view ( $\pi r^2$ ), usually in stomata per  $\text{mm}^2$ .

Higher light intensity, higher temperature, lower humidity and higher wind speed.

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## Cooperative binding

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## Foetal vs adult haemoglobin

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## Bohr shift

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## Why is the oxygen dissociation curve S-shaped?

Foetal haemoglobin has a higher affinity for  $O_2$  (curve to the left), so it loads  $O_2$  from maternal blood in the placenta.

Binding of one  $O_2$  to a haem group changes haemoglobin's shape, so the other haem groups bind  $O_2$  more easily.

Cooperative binding: the first  $O_2$  binds with difficulty, the next bind easily (steep part), then haemoglobin saturates (plateau).

Higher  $CO_2$  lowers haemoglobin's affinity for  $O_2$ , moving the curve right, so more  $O_2$  is released in actively respiring tissues.