Gas exchange in single-celled organisms:

These are small so have a **large surface area to volume ratio. Oxygen is absorbed by diffusion across their body surface which is covered only by a cell-surface membrane.**

Gas exchange in insects:

Insects have evolved mechanisms to conserve water. **The increase in surface area required for gas exchange conflicts with conserving water because water will evaporate from it.**

Gas exchange:

Insects have evolved an **internal network of tubes called tracheae. These are supported by strengthened rings to prevent them collapsing**. They divide into smaller dead-end tubes called **tracheoles**. These **extend throughout all the body tissues of the insect.**

In this way, atmospheric air (with the oxygen it contains) is **brought directly to the respiring tissues, as there is a short diffusion pathway from a tracheole to any body cell.**

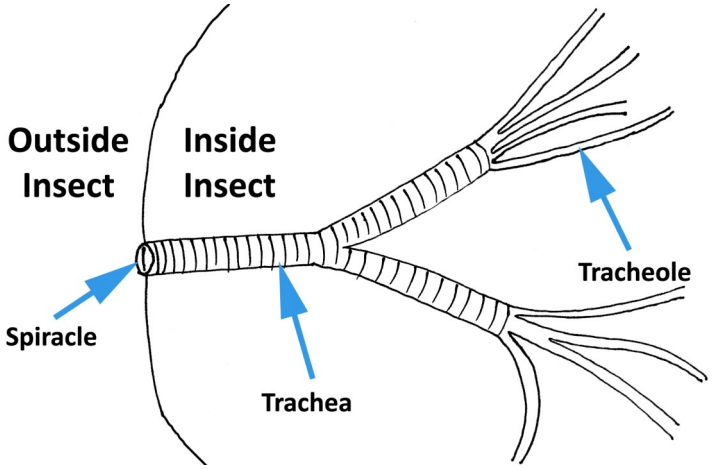
Gases enter and leave tracheae through tiny pores called spiracles on the body surface. The spiracles may open or close by a valve. **When they are open, water vapour can evaporate from the insect. But they mostly keep them closed to prevent this water loss. Periodically they open them for gas exchange.**

This system is effective for gas exchange but has limitations:

Relies mostly on diffusion to exchange gases between environment and cells—for diffusion to be effective, the diffusion pathway needs to be short = why insects are small. As a result, length of diffusion pathway limits the size that insects can attain. (not that this hinders them).

Respiratory gases move in and out of the tracheal system in three ways:

1. Along a diffusion gradient—when cells are respiring oxygen is used up and so its concentration towards the end of the tracheoles falls = creates a diffusion gradient that causes gaseous oxygen to diffuse from the atmosphere along the tracheae-tracheoles to cells. CO2 creates a diffusion gradient in the other direction (moves along tracheoles-tracheae to atmosphere).
2. Mass Transport—contraction of muscles can squeeze the trachea, enabling mass movements of air in and out. Further speeds up exchange.
3. Ends of tracheoles fill with water—during periods of major activity, muscle cells respire and carry out some anaerobic respiration = produces lactate (soluble and lowers water potential of muscle cells). Water moves from tracheoles into cells by osmosis.



Exchange in single-celled organisms and insects

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