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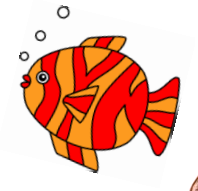
Comparing gas exchange in the worm, fish and mammal



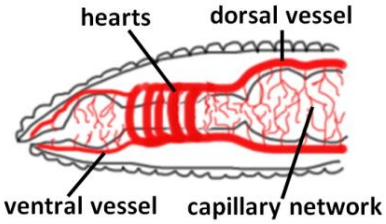
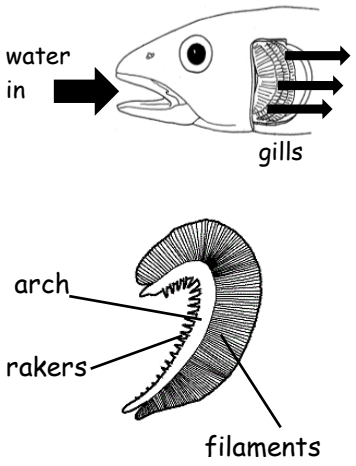
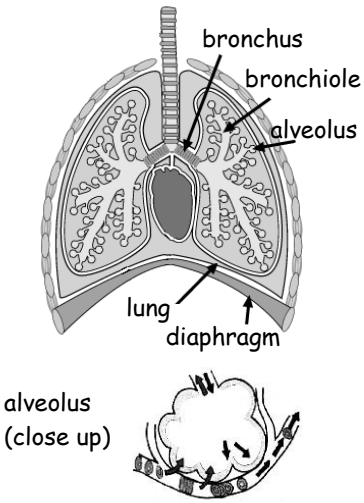
Gas exchange is the process in which oxygen gas is exchanged for carbon dioxide

Respiration is a chemical process to release energy

Breathing is the physical process involving muscular movement to exchange the gases

Features in common

Haemoglobin in blood, circulation system with hearts, short distance between cells and blood. All have thin, moist and large surface areas as part of the gas exchange surface.

Feature	Worm	Fish	Mammal/human
Habitat	Terrestrial Restricted to moist environments	Aquatic environments only	Terrestrial Not restricted to moist environments as internal lungs kept moist
Gas exchange structure	Skin	Gills, filaments, lamellae	Lungs Trachea, bronchi, bronchioles and alveoli
Passage of gases (flow chart)	O_2 in air ↓ Diffuses across skin ↓ Blood capillaries below skin CO_2 diffuses in opposite direction	O_2 in water ↓ Mouth ↓ Gill rakers ↓ Gill arches ↓ Gill filaments/ lamellae (gases diffuse) ↓ Operculum CO_2 leaves in water out the operculum	O_2 in air ↓ Nasal cavity ↓ Trachea ↓ Bronchi ↓ Bronchioles ↓ Alveoli (gas exchange) CO_2 diffuses in opposite direction
Labelled diagram(s)			

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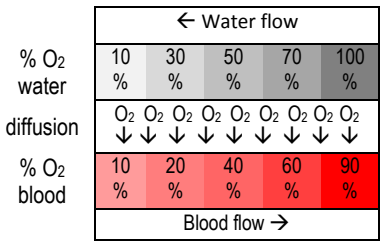
Features of organism	Long and thin body ∴ large surface area to volume ratio Blood vessels in skin highly vascularised Cold blooded	Lamellae large surface area to volume ratio Gills protected by operculum Rich blood supply to gills - highly vascularised Counter current – blood in gills flows in opposite direction to water direction	2 internal lungs, greatly branched ∴ large surface area to volume ratio Rich blood supply around alveoli Warm blooded
Supply of gas	Diffusion	Gulping water	Inhalation / exhalation using diaphragm and intercostal muscles
How achieve efficient gas exchange surface / adaptations	Restricted to moist habitats – not very efficient but enough due to their small body size, limited movement and don't need to regulate their body temperature Has mucus glands under the skin which moisten the skin so the gases can be dissolved ∴ can diffuse across membranes Nocturnal – less risk of drying out during the day Low metabolic rate ∴ don't need high amounts of energy	Lamellae, filaments always in water ∴ kept moist Counter current – water and blood flow in opposite direction ∴ always a concentration gradient ∴ maximising gas exchange efficiency  Water enters the mouth and exits the operculum ∴ isn't interrupted while organism exhales – gas exchange not interrupted No dead space in gills ∴ most of the water that passes over gills has the O_2 diffuse into the blood	Bring air into the body to lungs is efficient however only about 25% of the O_2 is exchanged into the blood the rest is exhaled – slow/ inefficient diffusion rate Not restricted to moist environments because the air is warmed and moistened by mucus as it passes through the nasal cavity. Diaphragm and intercostal muscles creates pressure difference so air moves into lungs Air enters and leaves via the same passage ∴ gas exchange has to be interrupted for exhalation

Key words:

- cell membrane
- trachea
- diffusion
- counter current
- nocturnal
- operculum
- gills
- bronchi
- terrestrial
- gas exchange
- diaphragm
- haemoglobin
- filaments
- bronchioles
- aquatic
- respiration
- gill rakers
- concentration gradient
- lamellae
- alveoli
- vascularised
- breathing
- gill arches
- SA / V ratio