SANGAM SKM COLLEGE NADI

LESSON NOTES

WEEK 1

BIOLOGY

YEAR 12

Strand 1	**COMPARATIVE FORM AND FUNCTION IN PLANTS AND ANIMALS**
Sub strand	**12.1.4.2 GAS EXCHANGE**
Content Learning Outcome	-Study the gas exchange in plants -Study gas exchange in animals

12.1.4.2 GAS EXCHANGE

- **Respiration**-release energy from the food they digest by "burning" the food with oxygen.
- Organisms must take in **oxygen** and then excrete the **carbon dioxide** waste produced, as the respiration reaction releases energy from glucose.
- Active organisms need a large **energy** supply and so must have a very efficient gas exchange system.
- **Sessile** organisms do not need as much energy and so their gas exchange systems are less efficient.

Gas Exchange in Plants

- Plants need carbon dioxide for photosynthesis and oxygen for respiration.
- Plants are **sessile** and do not need rapid gas exchange therefore, they are adapted for a slow diffusion method.
- Flowering plants exchange gases through their **stomata** present on the leaves:
- In the **light** there is a net intake of carbon dioxide for photosynthesis and a net output of oxygen from respiration.
- In the **dark** there is a net intake of oxygen for respiration and a net output of carbondixoide.

Factors affecting rate of gas exchange in plants	Efficient gas exchange systems must
❖ The area available for diffusion. ❖ The distance over which diffusion occurs. ❖ The concentration gradient across the gas exchange surface. ❖ The speed with which molecules diffuse through membranes.	❖ have a large surface area to volume ratio ❖ be thin ❖ have mechanisms for maintaining high concentration gradients ❖ be permeable to gases.

- Terrestrial plants have plenty stomata at the bottom of the leaves while aquatic plants have plenty stomata on the upper side of the leaves.
- *Woody plants* use **lenticels** for exchanging gases.
- Lenticels are raised lose cork tissue in woody stems, roots and some fruits which function in gas exchange for aerobic respiration.
- Lenticels allow oxygen in and carbon dioxide out.
- At night and during water shortages plants conserve water by closing the stomata.

Gas exchange in Pneumatophores

Pneumatophores are erect roots with specialized structures that allow for respiration. E.g. root mangroves.

Adaptation for Gas Exchange in Plants (refer to pg89 from Biology for all Y12 to fill in the blanks)

1. **_____,** small openings in the underside of most leaves, which allow gases to diffuse in and out.
2. _____ in the spongy layer of a leaf to allow carbon dioxide to diffuse more quickly to the photosynthesizing palisade layer.
3. **Thin leaves with broad surfaces** to maximize surface area to volume ratio for faster diffusion to cells.
4. **Lenticels** (small holes in the bark) in woody plant stems and small gaps in the stem surfaces of herbaceous plants that allow plants to respire.

Gas Exchange in Animals

- Small and _____ organisms can often get enough oxygen by diffusion alone.
- Larger, more active organisms must have a specialized organ system for exchange in gases quickly.
- Gas exchange systems in most active animals rely upon _____ systems.
- To assist this diffusion, the respiratory surfaces (lungs, skin, and gills) of all animals have the following three adaptations:

1. The respiratory surfaces are **_____** *to dissolve* oxygen and carbon dioxide.
2. They have a **_____ surface area** for gas exchange.
3. They are ***extremely*** **_____** so gases can pass through more quickly.

Activity

1) Why do organisms need oxygen?
2) Every organism on the planet uses up oxygen in respiration, yet we have not run out of oxygen. Explain why.
3) List the four respiratory surface adaptations for gas exchange that every vertebrate has.

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LESSON NOTES

WEEK 2

BIOLOGY

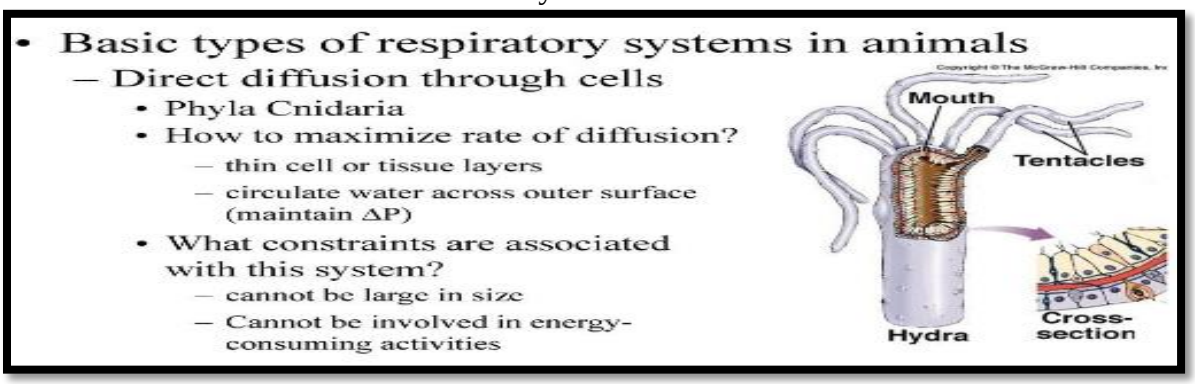
YEAR 12

Strand 1	**COMPARATIVE FORM AND FUNCTION IN PLANTS AND ANIMALS**
Sub strand	**12.1.4.2 GAS EXCHANGE**
Content Learning Outcome	Examine the method of gas exchange and the associated problems with exchange of gases in organisms in aquatic and terrestrial habitats.
Achievement indicator	-Study gas exchange in invertebrates

Gas Exchange in Invertebrates

(i) Cnidarians (corals, jelly fish, sea anemones)

- **direct diffusion** because relatively **sessile**.

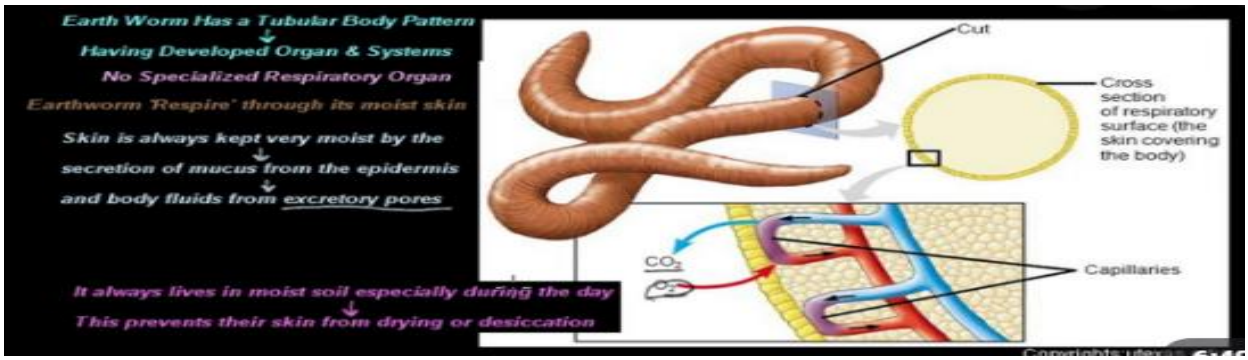


(ii) Paramecium

- Oxygen dissolved in the surrounding water is taken in and carbon dioxide is excreted out by diffusion through general body surface.

(iii) Annelids (segmented worms),

- diffusion through their **<u>moist skin</u>**
- The skin is kept moist by body's physiological processes such as secretion of moistening fluid by the mucus gland and by behavioural processes of the worms living in damp areas, avoiding sunlight and feeding at night.
- If the skin surface dries up and the oxygen does not diffuse into the blood, the worm will suffocate and die.



(iv) Insects

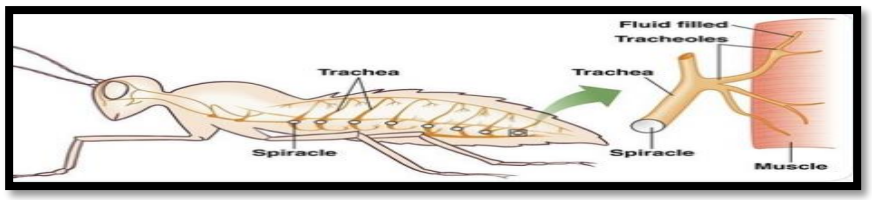
- diffusion through a tube system
- insects have a separate system of air pipes called **trachea** and **trachioles** through which air diffuses to and from body cells.
- The openings to these pipes, usually found on the underside of an insect, are called **spiracles.**

Steps of gas exchange in insects:

Air enters → spiracles -→trachea -→ trachioles -→body cells.

* Movement of the abdomen, thorax and air sacs assist air movement.

Adaptation of insects for water conservation



1) partially **close their spiracles** when they are not active.
2) The trachioles pass the cells, this prevents loss of moisture.
3) The trachioles are **thin and moist** at all times allowing for faster diffusion of gases between the trachioles and the body cells.
4) Larger, flying insects sometimes pump their abdomen in and out to aid the movement of air into their spiracles.

Adaptive Value

- a tube system is not suitable for larger and active animals because the body volume of larger animals is too great to be supplied by this kind of system.
- However, insects are quite small, so the gases do not have to diffuse very far to reach each of their body cells.

Activity

1) Bacteria and protists have no specialised structures for gas exchange. Gases simply diffuse in and out of the cells.What animal phylum also depends upon direct diffusion of gases to and from cells?
2) Explain why most animal groups cannot rely on direct diffusion to their cells for their gas exchange?
3) Earthworms reflexively move away from light. How is this behaviour adaptive for their method of gas exchange?

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LESSON NOTES

WEEK 3

BIOLOGY

YEAR 12

Strand 1	**COMPARATIVE FORM AND FUNCTION IN PLANTS AND ANIMALS**
Sub strand	**12.1.4.2 GAS EXCHANGE**
Content Learning Outcome	Examine the method of gas exchange and the associated problems with exchange of gases in organisms in aquatic and terrestrial habitats.
Achievement Indicator	-Study gas exchange in vertebrates

Gas Exchange in Vertebrates (backbone)

Adaptation of respiratory surfaces:

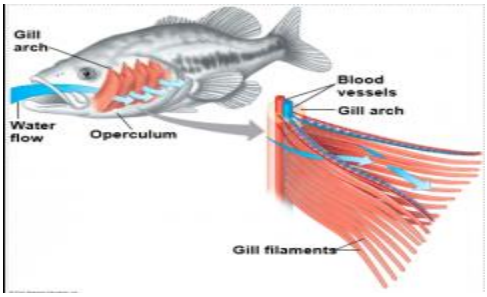
- **be well supplied with blood capillaries**
- **be thin and moist at all times**
- **have a large surface area.**

Fish

- have internal **gills.**
- Gills rest outside a fish's body, though they are protected under gill covers.
- Exchanging gases with water is more difficult than exchanging with air because;
  - Water contains less oxygen than air.
  - Water is harder to pump over the respiratory surface because it is denser.

Fish Adaptations for Getting Oxygen from Water

- Fish constantly pump fresh water over their gills using a muscular pharynx.
- Tiny ridges called **lamellae** on folds called **gill filaments** greatly increase gill surface area for gas exchange.
- Structures called *gill rakers* trap any bits of food.
- Gills dependent on the buoyancy of the water for support.
- Gills are packed with blood capillaries.



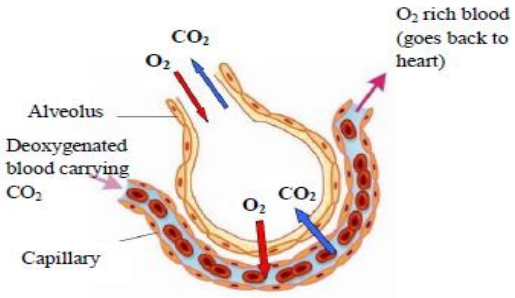
The direction of the blood flow in the gills is in the opposite direction to the flow of water on the gills. This ***counter current flow*** maximizes the concentration gradient thus maximizing the diffusion of O_2 from the water into the blood and CO_2 from the blood into the water.

Adaptive Value

- Since all the fish are aquatic, their respiratory system is specially adapted for exchanging gases with water and would suffocate quickly out of water.
- When placed on land, fish gill filaments stick together greatly reducing the surface area for gas exchange hence the gills quickly dry up and then no longer able to dissolve gases.

Amphibians

1) Young amphibian use external gills - **tadpoles** survive in water
2) Adult amphibians live on land, relying partly on their lungs and <u>moist skin.</u>



Gas Exchange in Reptiles, Mammals and Birds – lungs

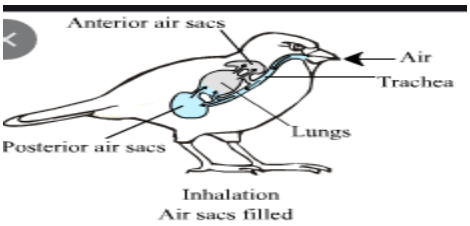
- Reptiles, such as lizards and snakes, were the first vertebrates adapted for living their entire lives on land.
- Evidence suggests that birds and mammals later evolved from reptiles.
- These three vertebrate classes have lungs and muscles specialised to suck air.

Adaptation for Efficient Gas Exchange

1. The alveoli in the lungs have thin, moist surfaces.
2. The alveoli create a large surface area for gas exchange.
3. Their lungs are extremely well supplied with blood capillaries.

<u>Birds</u>

- Have most efficient gas exchange system
- Birds instead have **one way air flow** through small tubes in their lungs. This way, birds do not just draw air into their lungs, but through them.



- Birds need this efficient air- supply system in order to provide their muscles with oxygen to get the energy needed for flying.

Evolutionary Trends in Gas Exchange

- As speedier organisms evolved, they needed more efficient gas exchange systems which actively pumped air or water and linked with a transport system.
- Terrestrial organisms evolved adaptations for reducing water loss from their respiratory surfaces.

Activity

1) Explain why an elephant could not survive with the trachea and spiracle system of gas exchange that insects use.
2) Why it is important for insects to partly close their spiracle when they are not very active?
3) Give two reasons why land animals cannot use gills for gas exchange.