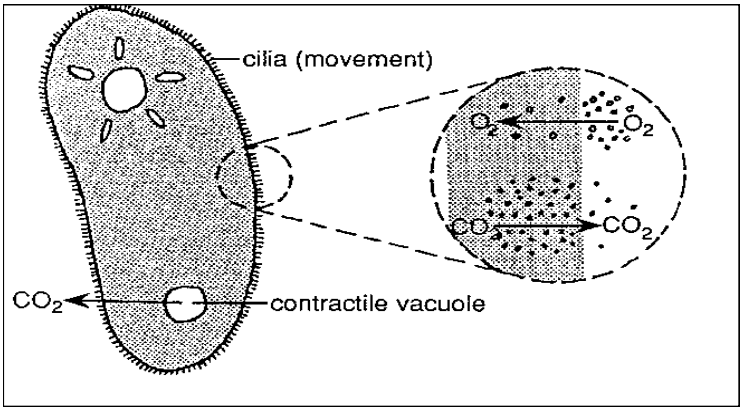
Year/Level: 12C/D week 18 **Subject:** Biology

Strand	1 structure & life processes
Sub Strand	1.4 comparative form and function in plants and animals
Content Learning Outcome	Describe gas exchange in protists, annelids and arthropods

Gas Exchange In Protista

Eg. Paramecium

- Gas exchange occurs by diffusion across the cell membrane
- Some CO_2 is removed actively by the contractile vacuole
- Long and flat shaped to increase the efficiency of gas exchange.



Note: *Bacteria and fungi also rely on direct diffusion for gas exchange*

GAS EXCHANGE IN ANIMALS

- Smaller, sessile organisms often get enough oxygen by diffusion alone, however, larger more active organisms need a more specialized organ system for gas exchange.
-All organisms depend upon diffusion for exchange of oxygen and carbon dioxide across the respiratory surfaces (ie lungs, skin, gills)

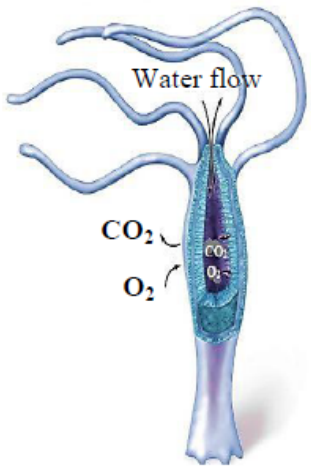
Adaptations for gas exchange surface:

- Moist –dissolves CO_2 and O_2.
- Extremely Thin-gasses can pass through easily.
- Large Surface Area-maximum exchange of gasses.
- Well supplied with blood vessels.

Gas Exchange in Invertebrates

Gas Exchange in Cnidarians – direst diffusion

- Cnidarians are well aquatic and relatively sessile.
- Some common cnidarians include corals, sea anemones and jelly fish.
- These animals rely on simple diffusion to exchange oxygen and CO_2 between cells and surrounding water.
- A cnidarian's cells do not need much oxygen since these animals are inactive.
- Thus, cnidarians do not need a transport system to carry gases to and from their body cells.
- Oxygen and carbon dioxide move to and from a cnidarian's body cells by diffusion alone.



Source: *http://image.slidesharecdn.com/*

Activity

1. List four respiratory surface adaptations for gas exchange that every vertebrate has.

   _____
   _____
   _____
   _____

2. Bacteria and protists have no specialized structures for gas exchange. Gases simply diffuse in and out of the cells
   a. What animal phylum also depends upon diffusion of gases to and from cells?

      _____
      _____

   b. Explain why most animal groups cannot rely on direct diffusion to their cells for their gas exchange needs

      _____
      _____
      _____
      _____
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3. Give one adaptive value of the gas exchange system in paramecium?

   _____
   _____
   _____

4. Give adaptive value of direct diffusion?

   _____
   _____
   _____

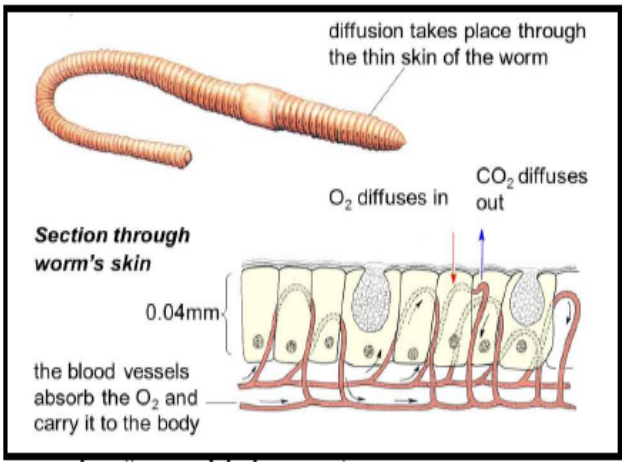
Gas Exchange In Annelids – Diffusion Through Skin

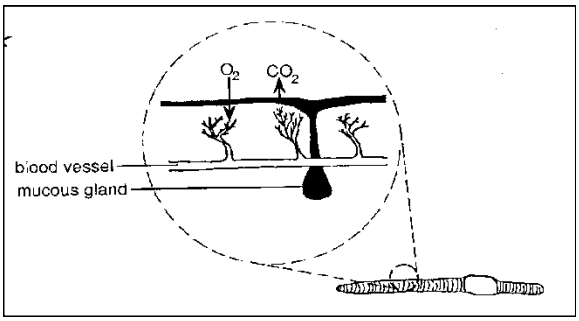
Eg. Earthworms

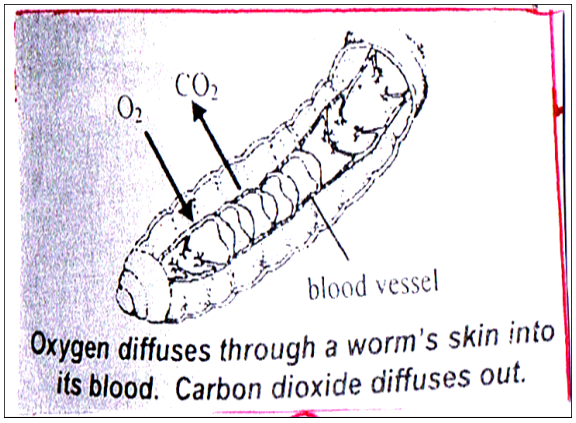
- Diffusion through moist skin
- Skin is kept moist by mucous glands and the worm inhabits damp area and avoids sunlight
- This method of gas exchange is suitable for earthworms (despite it being a relatively 'large' animal) due to the following adaptations:

Adaptations

1. Low metabolic rate – does not use O_2 rapidly
2. Highly vascularized skin (full of blood vessels) – allows extensive gas exchange between air and blood
3. Blood contains hemoglobin which carried O_2 to all the body parts.







If an annelid's skin surface dries up and the oxygen diffuses into the blood, the worm will suffocate and die.

❖ However, desiccation poses little threat to worms in their natural underground habitat.

❖ Annelids mostly burrow into soil to avoid desiccation due to over exposure to air and sunlight.

Exercise

1. Earthworms reflexively move away from light. How is this behaviour adaptive for their method of gas exchange?

_____

_____

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_____

2. List three as to why gas exchange through the skin is suitable for a relatively 'large' animal like the earthworm?

_____

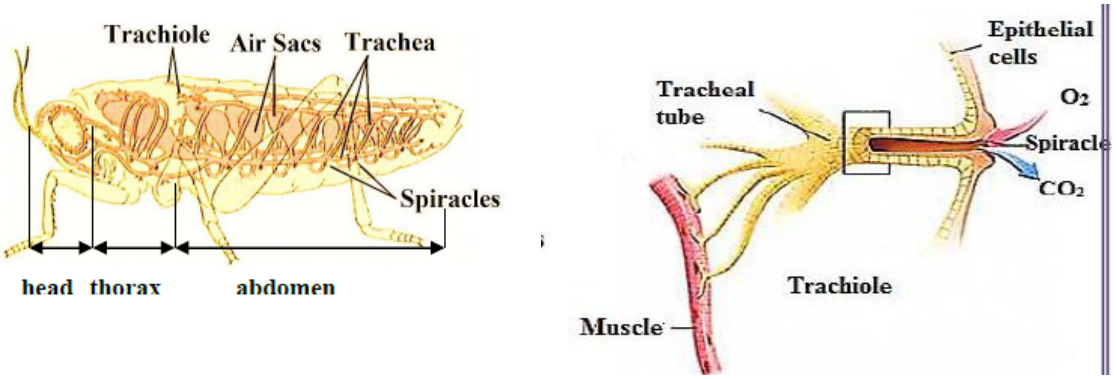
_____

Gas Exchange in Insects – Diffusion through a tube system

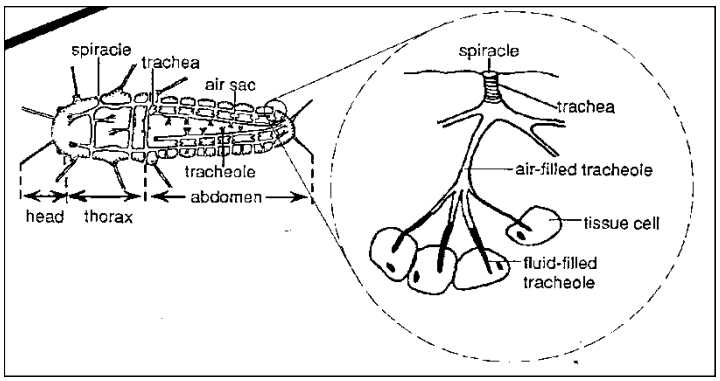
- Insects cannot survive on gas diffusion through the skin because:
  - Most insects live above the ground and so cannot keep their skin moist.
  - They are so active that diffusion through their outer surface alone cannot provide enough oxygen to their body cells.
- Insects have a unique gas exchange system.
- Even though insects have a transport system, insect blood does not carry oxygen to body cells.
- Instead, 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:

1. Air enters through the external openings in the thorax called the spiracles.
2. The air moves into the trachea and branches out into the trachioles. These trachioles are connected to the body cells. Movement of the abdomen, thorax and air sacs assist air movement.
3. Air (oxygen) reaches the body cells through the trachioles.
4. Similarly, CO_2 diffuses out of the body.



Respiratory System of a Grasshopper



Adaptation of insects for water conservation

In order to reduce water loss from the moist walls of the trachea most insects;

- partially close their spiracles when they are not active.
- The trachioles pass the cells just like capillaries pass by each cells in humans, this prevents loss of moisture.
- The trachioles are thin and moist at all times allowing for faster diffusion of gases between the trachioles and the body cells.
- Larger, flying insects sometimes pump their abdomen in and out to aid the movement of air into their spiracles.

Adaptive Value

- This form of gas exchange through a tube system is not suitable for larger and active animals.
- The body volume of larger animals is too great to be supplied by this kind of system.
- They need oxygen to be actively pumped to body cells.
- However, insects are quite small, so the gases do not have to diffuse very far to reach each of their body cells.

Note:
The circulatory system is not involved in gas exchange at all.

EXERCISE

1. Compare an insects gas exchange to that of an earthworm. Relate the differences to the animals lifestyles.

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_____
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2. Explain why an elephant could not survive with trachea and spiracle system of gas exchange that insects use.

_____
_____
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3. Why is it important for an insect to partly close their spiracles when they are not very active?

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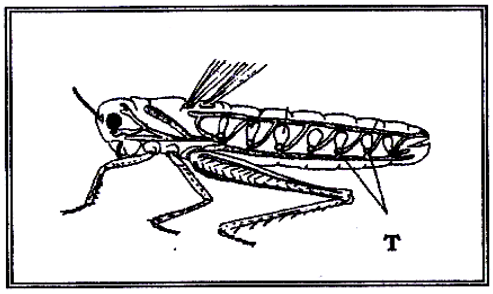
4.Study the diagram below of the respiratory system of the grass hopper and answer the questions that follow.

Grasshopper



Source: *Biology* by Cardogen and Green, 1988.

(i) Name the lateral openings labeled T through which air travels.

(ii) The walls of the trachea must remain moist for effective gas exchange. State one way in which insects control water loss from tracheal walls

_____

(iii) Give **one** reason why simple diffusion across the skin is inefficient for insects

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