Study of Respiration and Circulation

S. Y. B. Sc. Sem. III

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What is respiration?

Exchange of gases like O_2 and CO_2 through respiratory surface

Why?

Use of O2 in metabolism where glucose is broken down into energy. Thus this energy is used for various purposes of body maintenance like growth, circulation, digestion, control and coordination etc.

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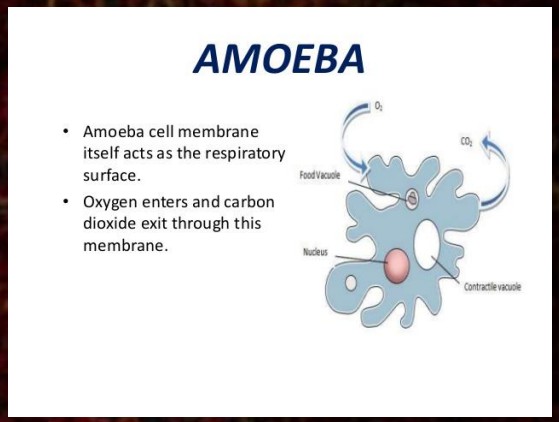
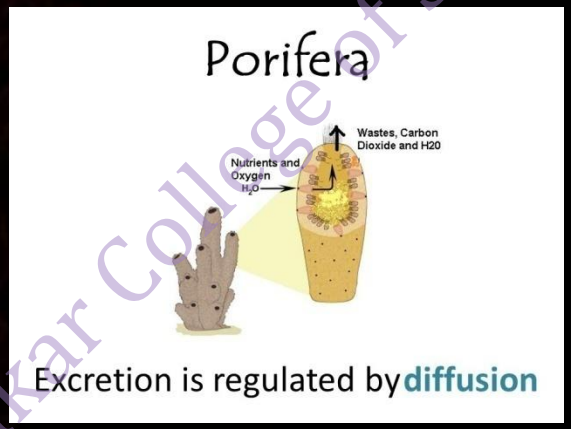
Types of Respiration

1. Simple Surface diffusion as found in lower animals like *Amoeba*, Sponge, *Hydra*, earthworm etc.





Hydra

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2. In higher animals special respiratory surfaces are developed like skin, buccal cavity, gills and lungs. E.g. earthworm, spider, *Rohu*, frog and pigeon.

The primary requirements of Respiratory surface are as follows

It must be thin

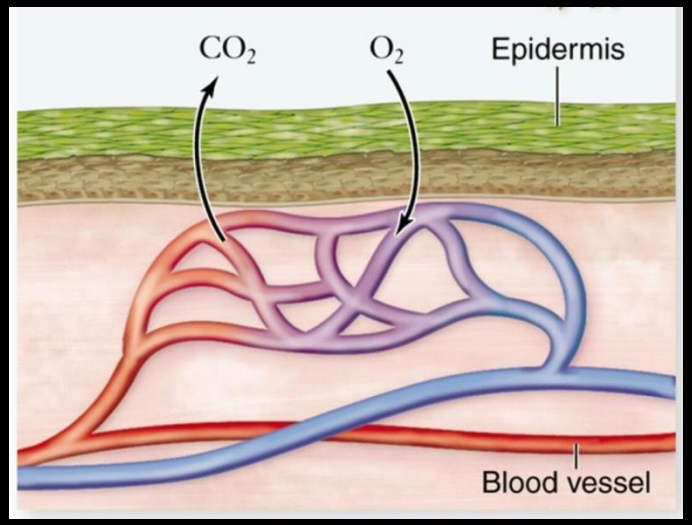
It must be permeable to gases O_2 and CO_2

It must be moist

It must be highly vascular

It must have large surface area

It must be in direct contact with the sources of O_2 (air/water)



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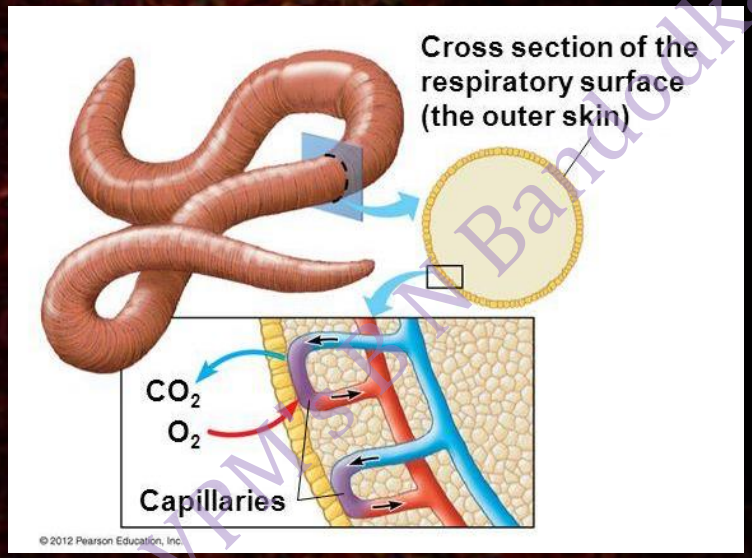
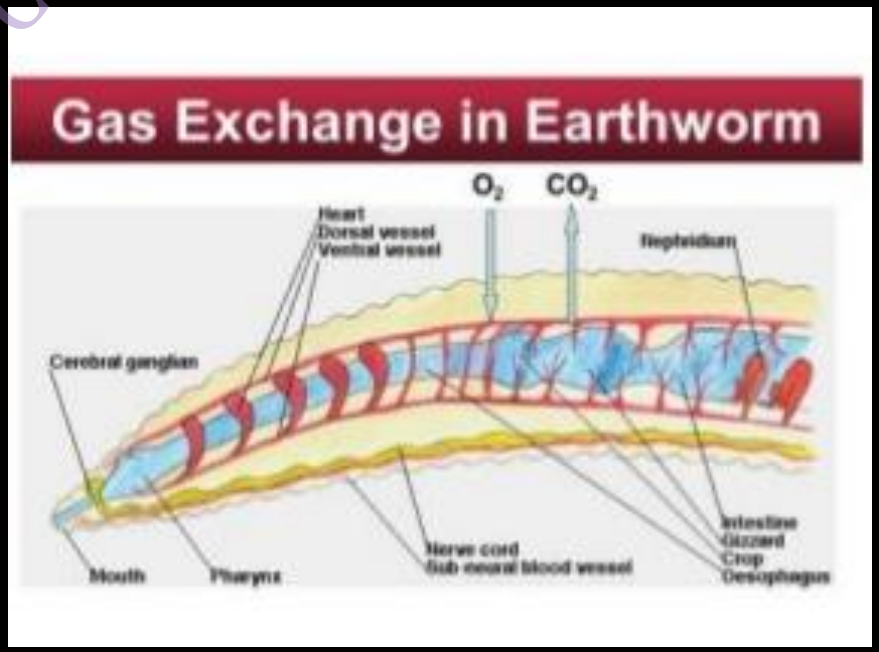
Earthworm

Phy: Annelida; Class: Oligocheata

- Skin is respiratory organ of earthworm
- Oxygen from the atmosphere diffuses in to blood
- Carbon dioxide from blood defuses to the atmosphere through the moist skin





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Earthworm

Earthworm respire through the skin called as cutaneous respiration.

Skin of earthworm is highly vascular and it is kept moist by integumentary glands and coelomic fluid.

Oxygen (O2) diffuse through skin to the blood in the capillaries beneath the skin where it combines with the hemoglobin to form oxyhemoglobin.

Oxyhemoglobin is circulated through blood vessels to different parts of the body.

Oxyhemoglobin breaks into oxygen and hemoglobin to release O2 in the tissue through diffusion where it is utilized for metabolism and the CO2 released is diffused out of the body through skin.

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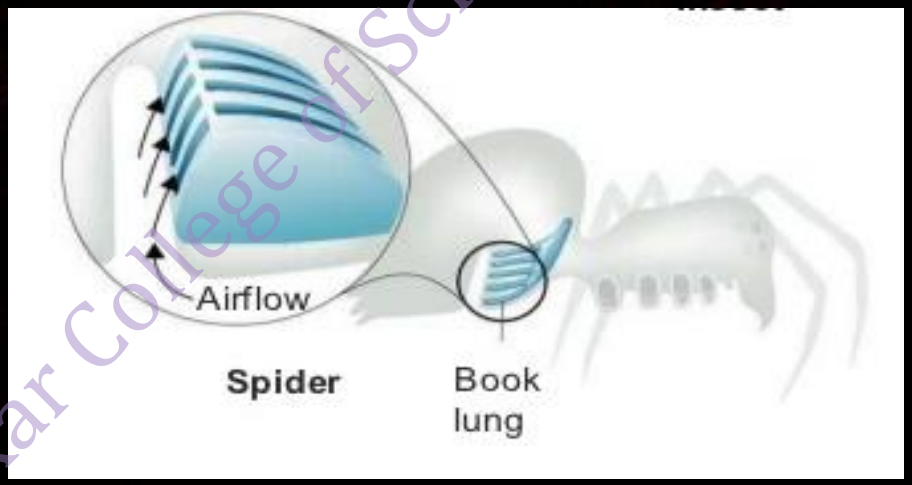
Spider –book lungs

Phy: Arthropoda Class: Arachnida



Spiders breath with book lungs and trachea. There are varied numbers of book lung present species to species.

Book lung is situated in a sac which is lined by thin cuticle and divided into two chambers viz. Atrial and pulmonary

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Spider

.Atrial chamber: this is an anterior, small, dorsoventrally compressed air space which is opened to the exterior by small pores known as ostia. Ostia allow air to atrium.

Pulmonary chamber: it is a posterior oval shaped compartment holding a series of (about 150) vertically hanging leaf-like arranged parallel to each other (book like).

Each lamella is hollow inside holding **intra-lamellar space** filled with blood or haemolymph.

And each of them is connected internally to each other at bases.

The lamellae are held apart with the help of bristles and ridges to hold **inter-lamellar spaces** to allow air from atrial chamber to circulate through lamellae for gaseous exchange.

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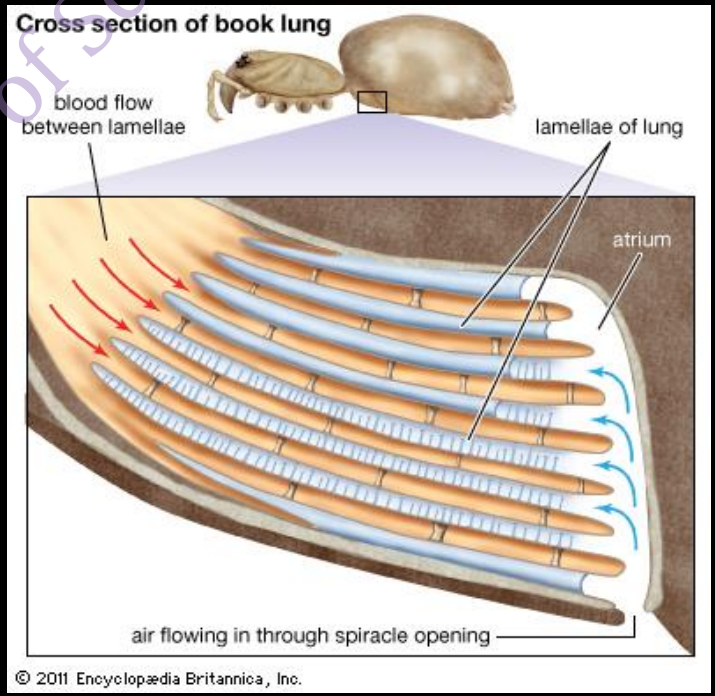
Mechanism of respiration in spiders

The oxygen present in air into the inter-lamellar spaces is absorbed into the blood through thin surfaces of the lamellae and CO2 is expelled out to the inter-lamellar spaces. The respiration is carried out with the help of dorso-ventral and atrial muscles. Dorso-ventral muscles contract to compress pulmonary chamber and air is forced into atrial chamber. Then atrial muscles contract to compress atrial chamber and air is finally forced to exterior. Later these muscles relax simultaneously and air suctioned into atrium first and then into inter-lamellar spaces.



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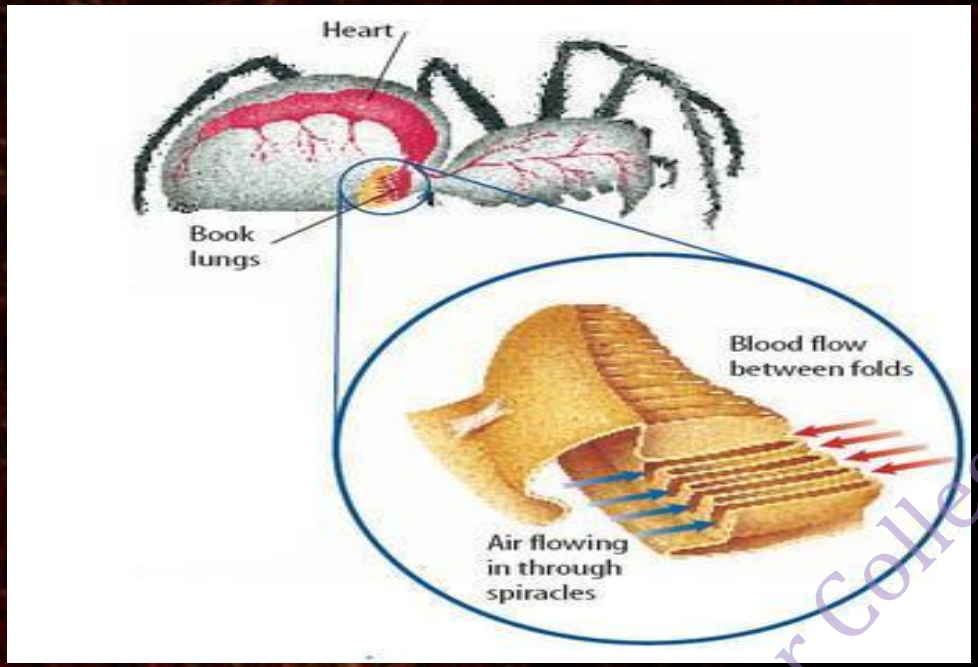

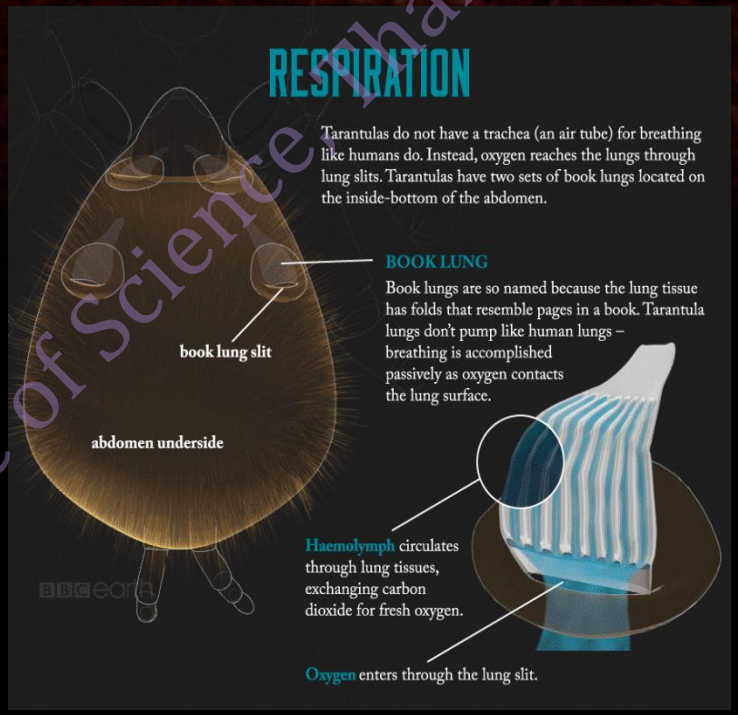

The counter flow of air and blood is maintained in the inter-lamellar and intra-lamellar spaces to enhance the absorption of the oxygen. The exchange of gases taken place due to **concentration gradients of O2 and CO2.**

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Rohu (*Labeo rohita*): a fish

It a fresh water fish commonly known as major carp. It is bony fish in which the gills are covered by an operculum. They not visible externally and hence called as internal gills.

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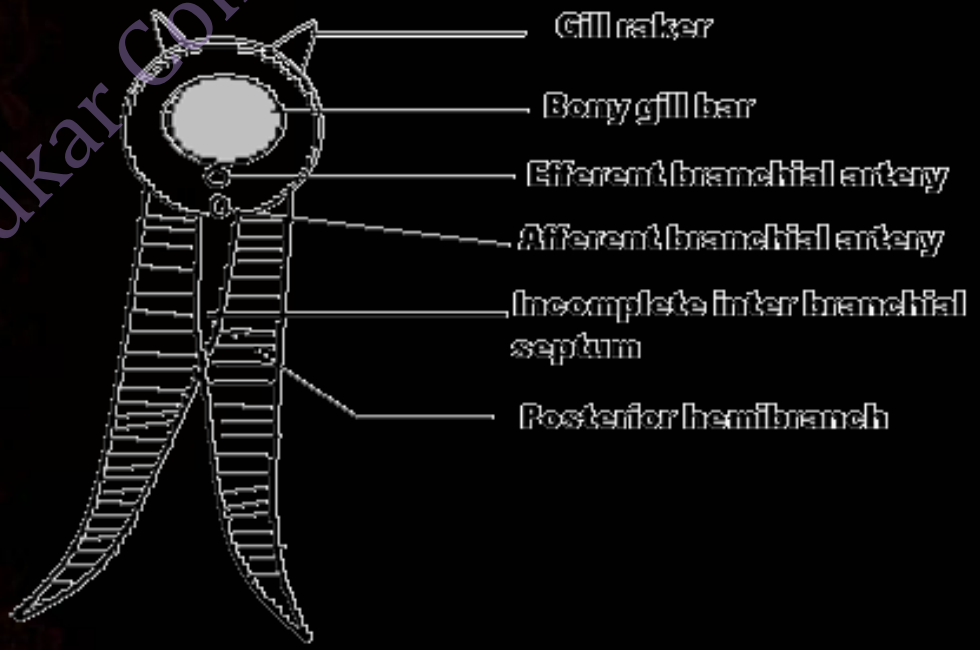
Structure of gill in Rohu

There are numerous gill lamellae arranged in two rows on the bony gill arch in a gill known as holobranch. On opposite side to lamellae there are gill rakers.



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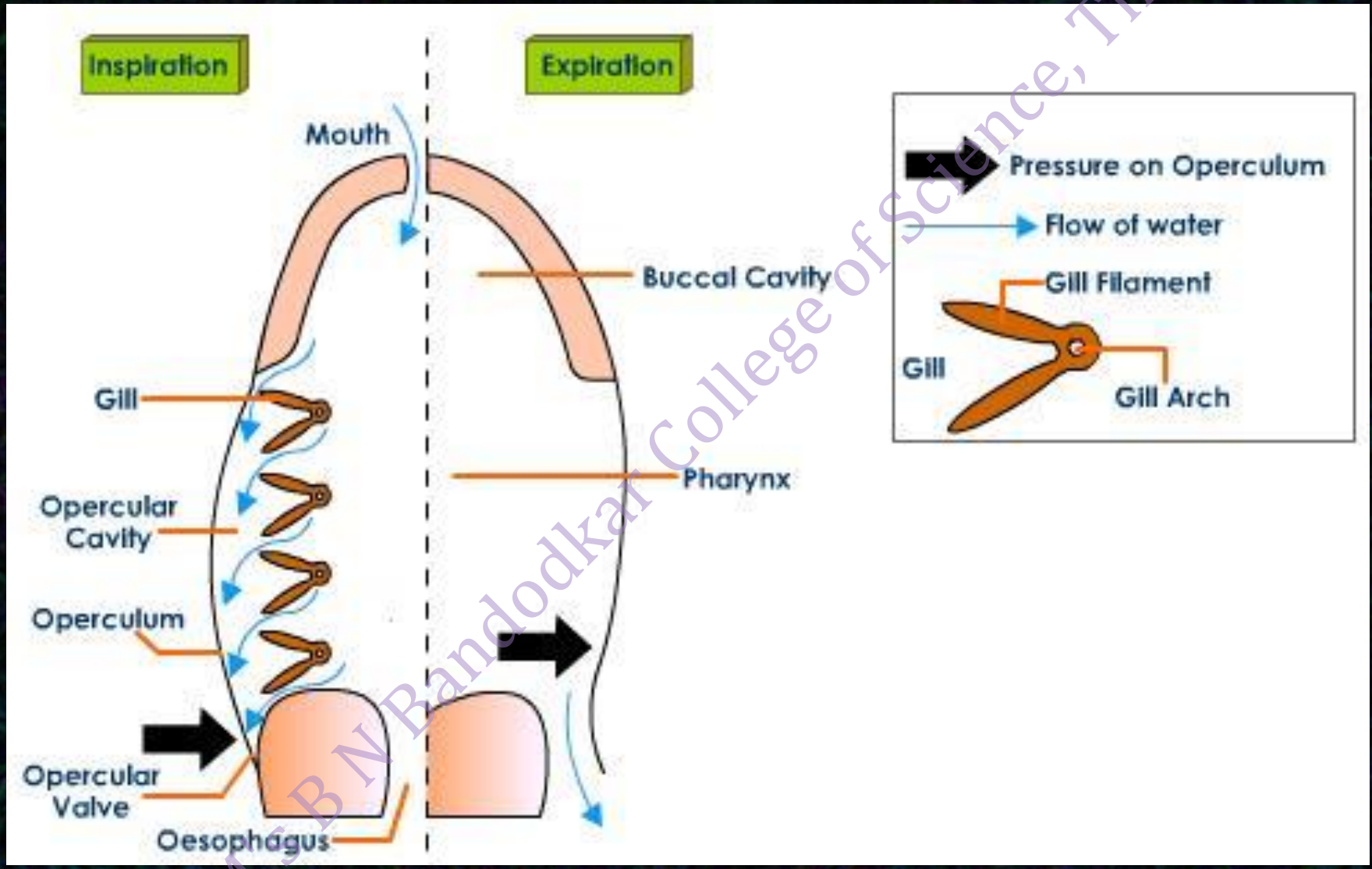

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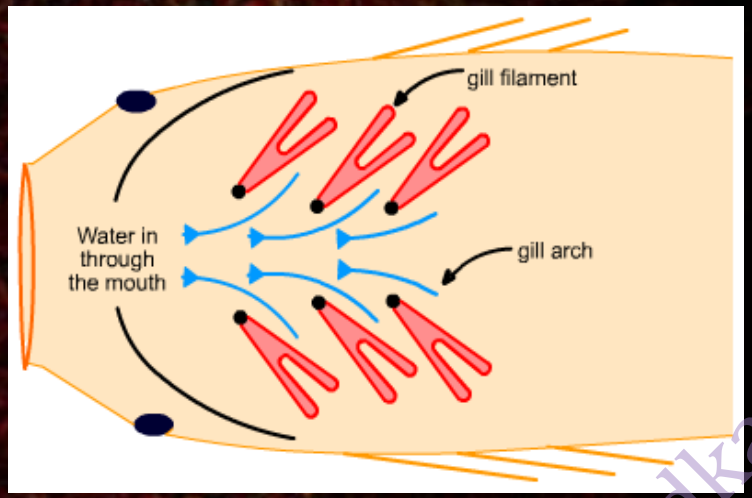
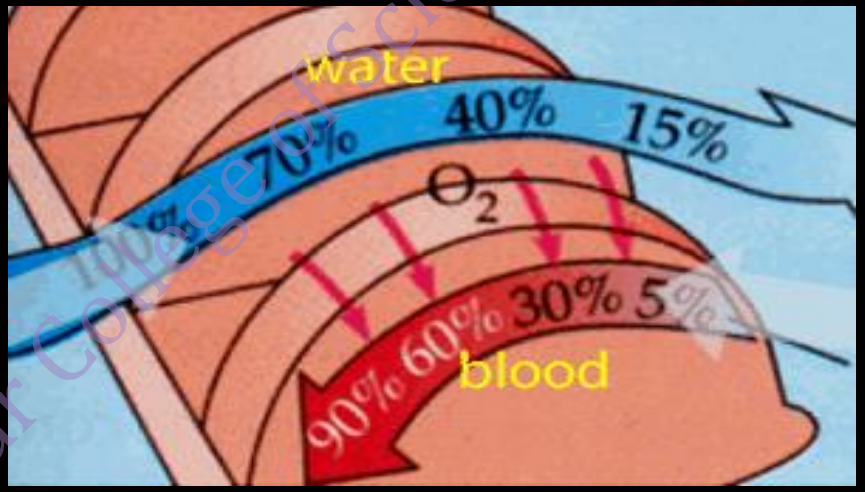
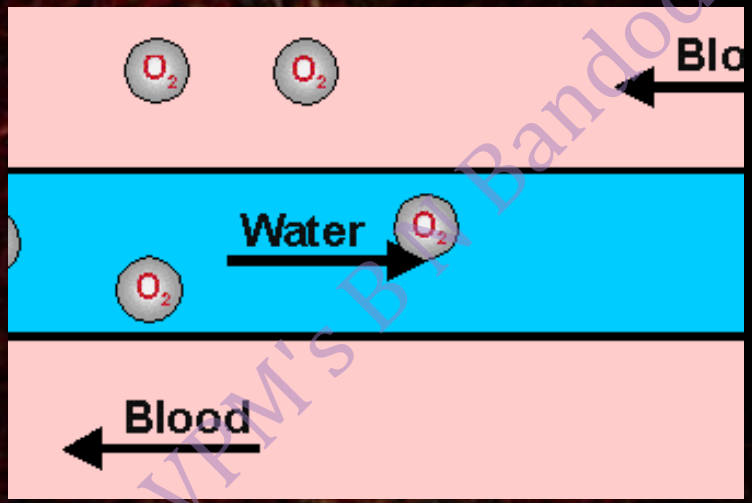
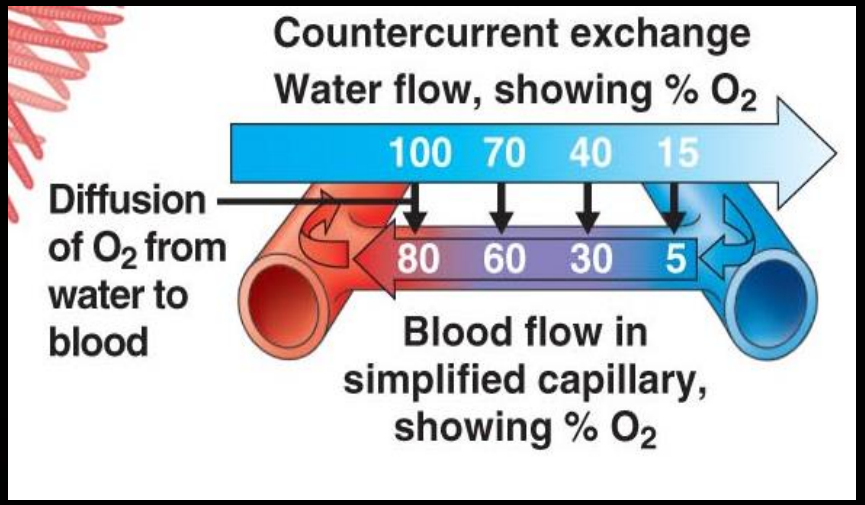
Mechanism of fish respiration









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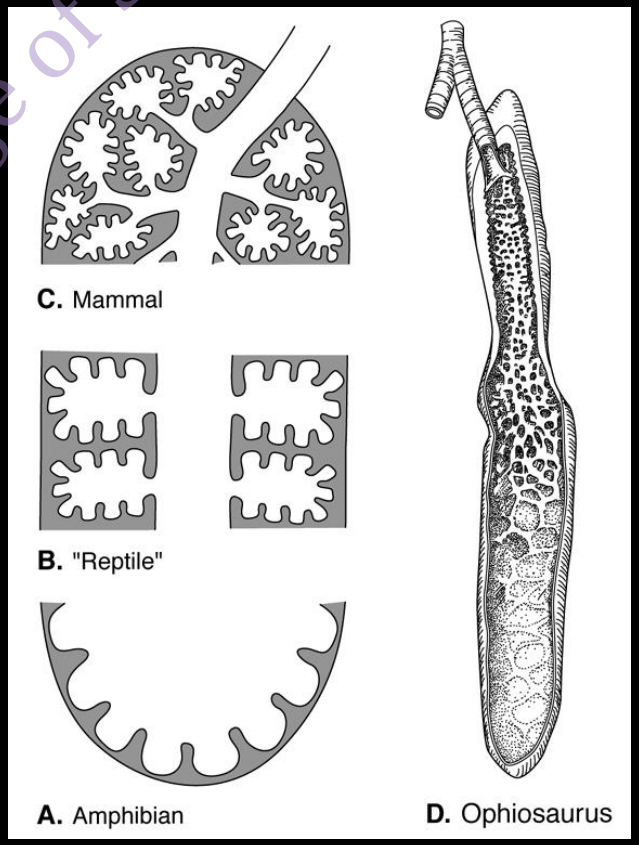
Respiration through lung

Respiration in terrestrial animals is carried through lungs. Lungs are developed according to the activeness of the animal. E.g. the sluggish animal like frog have very simple lungs while highly agile animals like mammals the lungs are highly evolved.



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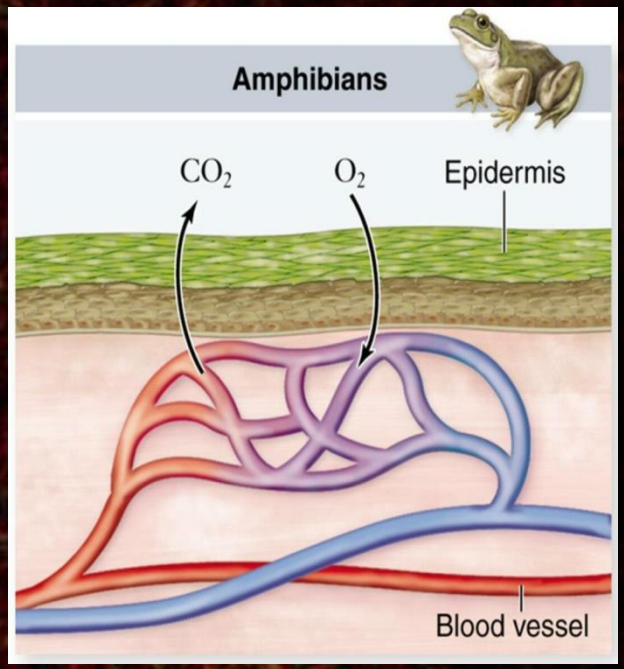
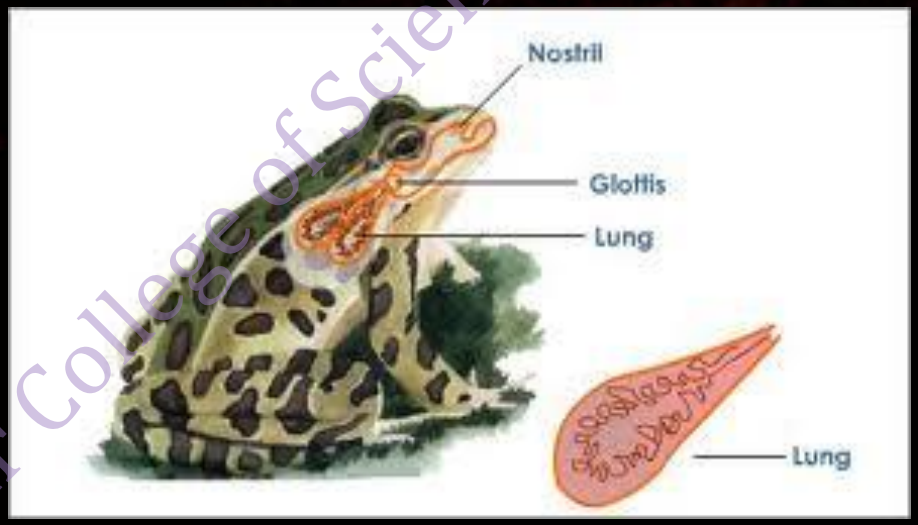
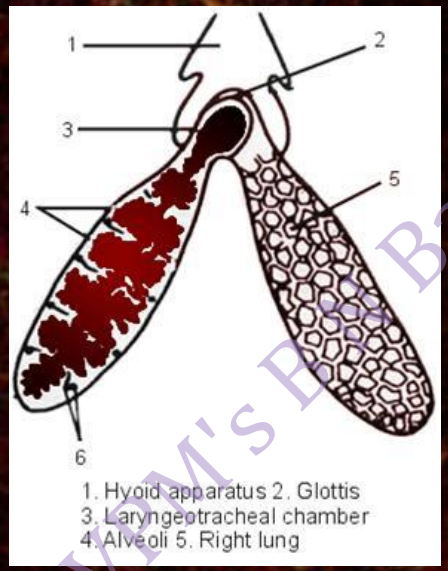
Frog







Frog respire through skin, buccal cavity and lungs. Lungs are poorly developed in frog.

The respiration is performed by the set of bucco-pharyngeal muscles attached to the hyoid apparatus.

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Mechanism of respiration in frog

The muscles which are attached to dorsal side of hyoid apparatus are called as pterohyal muscles and those attached to ventral side are sternohyal muscles. Sternohyal muscles contract to descend the flood of buccal cavity so that air is suctioned through nostrils into the buccal cavity. Then jaws are tightened to close nostrils and glottis is opened. Now pterohyal muscle contract to raise floor of buccal cavity to force the air into lungs. The process is reversed during expiration.

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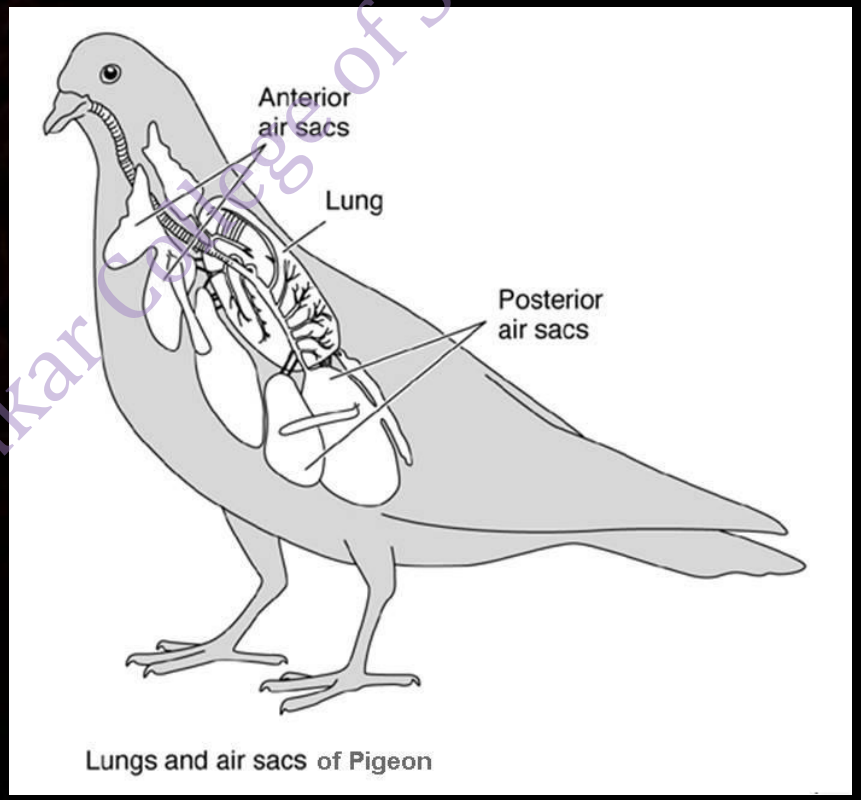
Pigeon: Respiratory system

Respiratory system of pigeon consists of

1. Nares
2. Trachea
3. Syrinx
4. Lungs and
5. Air sacs



Lungs and air sacs of Pigeon

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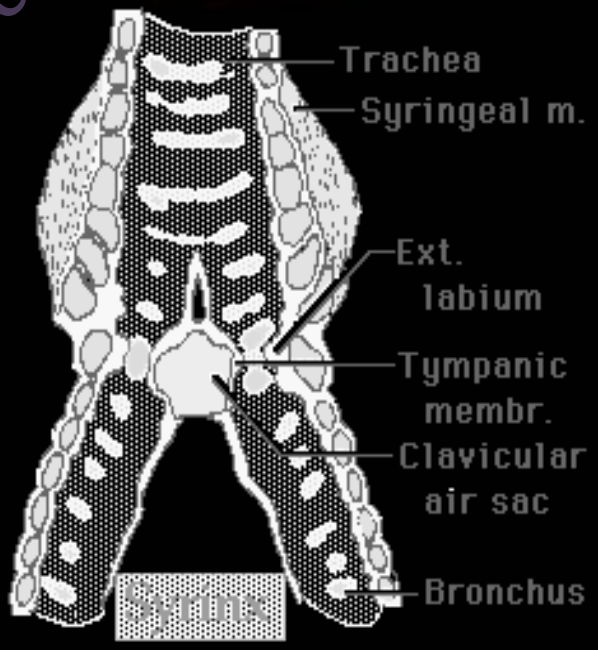
Syrinx

In **birds** larynx is not developed instead a **lower larynx** is developed at the junction of trachea with bronchi known as **syrinx**. Syrinx is developed from last tracheal cartilage called tymphanum and some branchial membranes called as membrane typhaniformis interna and externa. In singing birds membrane semilunaris is developed supported by bony ridge called pessulus.



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Lungs of Birds

Birds have highly modified lungs. Lungs are supplemented by air sacs called as **cellulac aereae**. Lungs are small but highly vascularized. Bronchus divides to secondary bronchi giving rise to 4 ventral **entrobronchi**, 8 dorsal **ectobronchi** and 6 lateral bronchi.

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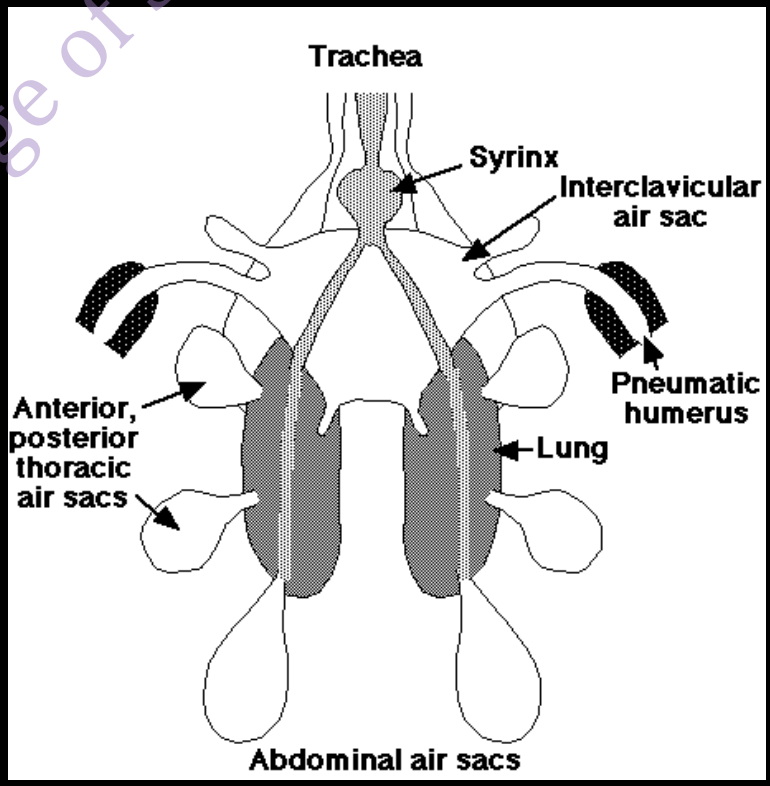
Air sacs in birds

There are 5 types of paired or unpaired air sacs in birds. Cervical, anterior thoracic, posterior thoracic and abdominal air sacs are paired whereas **inter-clavicular** sac is unpaired. Some birds extend their airsac in bones to form light weight pneumatic bones.



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Mechanism of respiration
in Pigeon

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