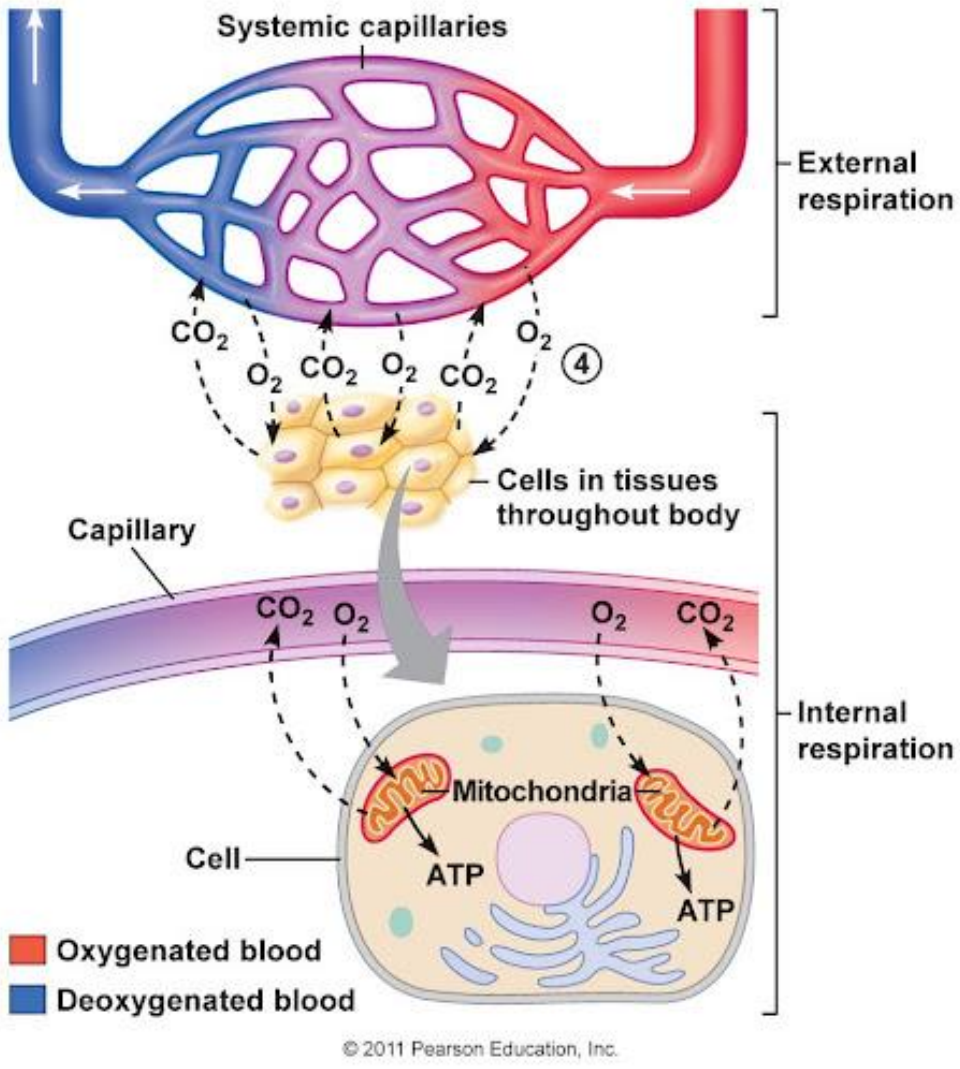
RESPIRATORY SYSTEM

Respiration = exchange of O_2 & CO_2 over moist respiratory surface



EXTERNAL RESPIRATION

Exchanges Gases Between the respiratory surface and the Bloodstream.

Gas transport

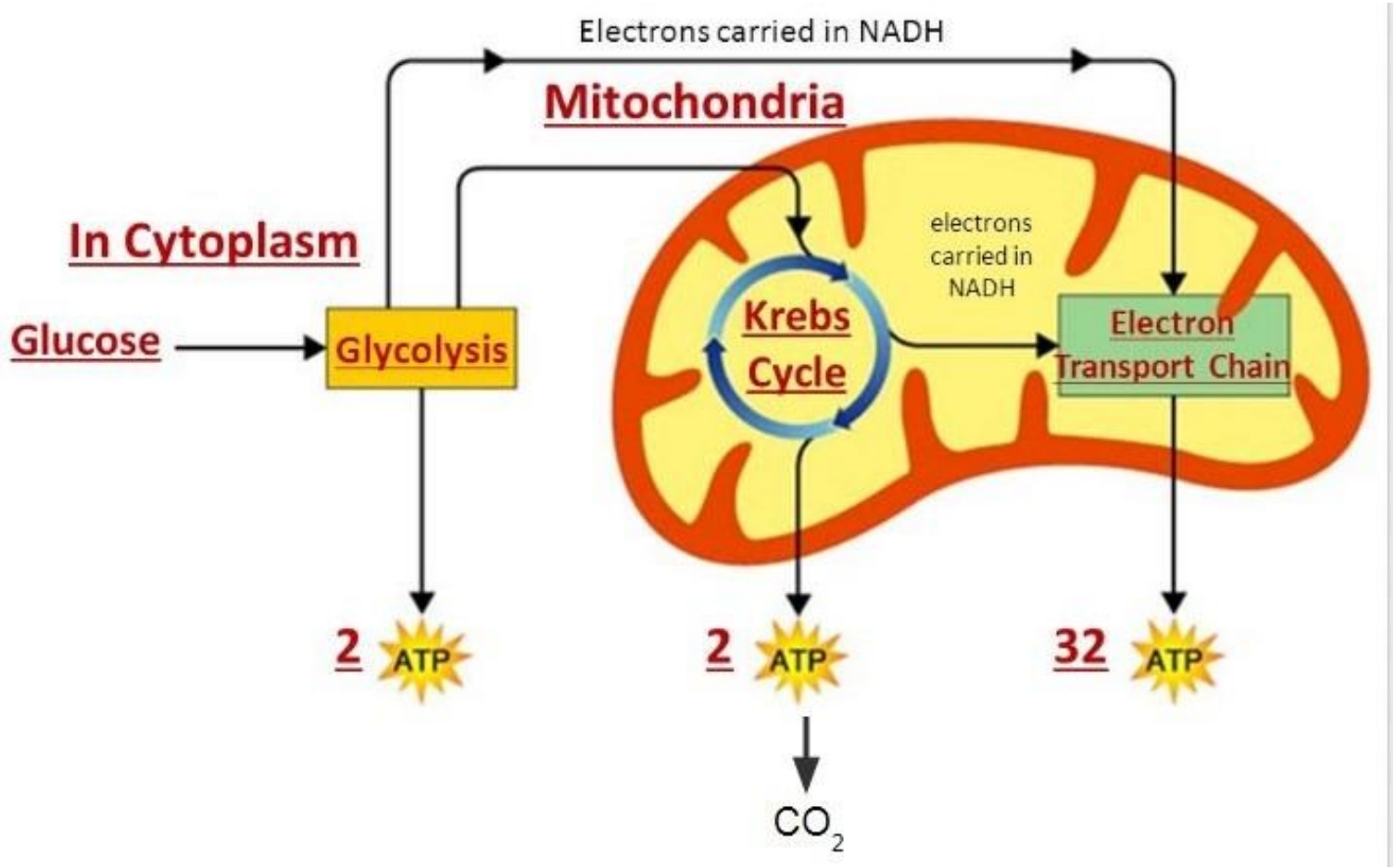
INTERNAL RESPIRATION

Within the cell

INTERNAL RESPIRATION

Glucose + O_2= H_2O + CO_2 + energy

ADP + fosfat + E = **ATP**



RESPIRATION:

▶ **ANAEROBIC** (no oxygen = glycolysis)

▶ **AEROBIC** (oxygen, evolutionary younger)

- when there was enough oxygen in atmosphere
- organisms have more energy

AEROBIC transpiration features

Closely connected to circulation

Respiratory surface must be wet

- Animals use:

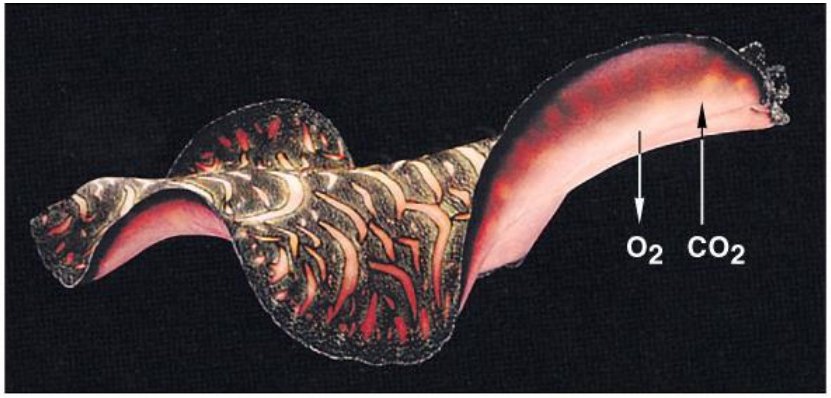
I. body surface
II. gills
III. tracheas
IV. lungs

origin

1. **ectodermal – gills / tracheas** (polychaetes, crustaceans, echinoderms, insects) – **skin twist**
2. **endodermal – gills / lungs** (vertebrates) – **from front part of digestive tract**

I. Body surface

- protists, sponges, platodes, cnidarians, round worms, plankton crustaceans, some annelids, amphibians and other animals in small quantity)

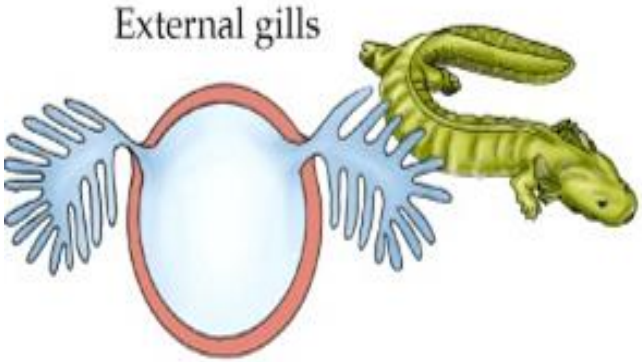


- Small animals (big surface, small volume)
- Body surface thin
- Aquatic habitats/wet habitats
- Low metabolic activity

II. gills

► aquatic animals:

• **external gills**

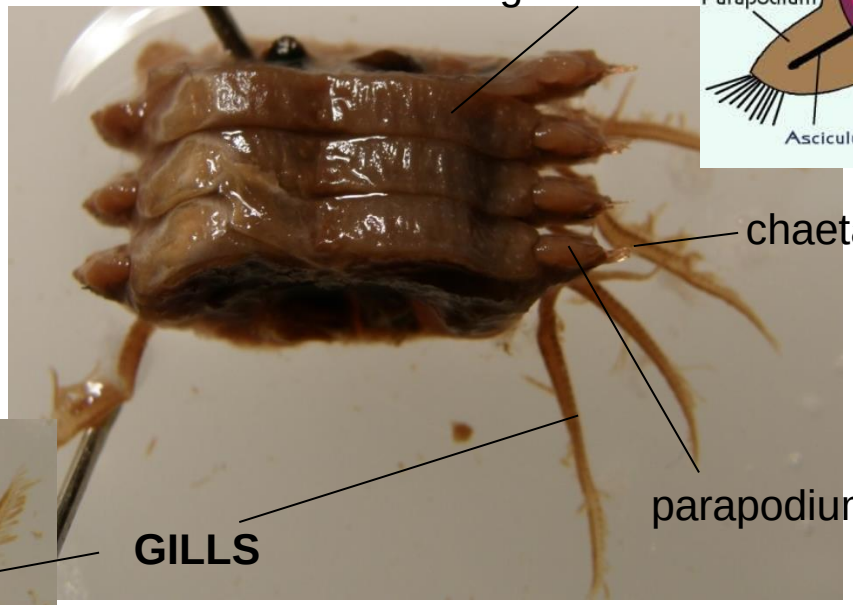


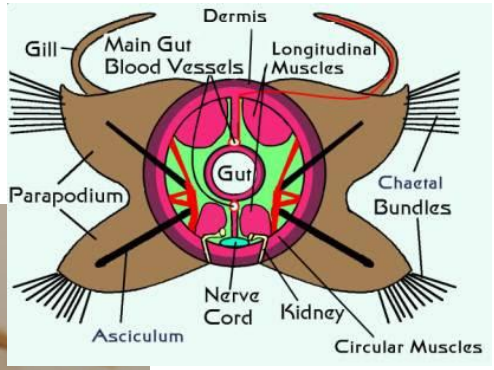
tadpole

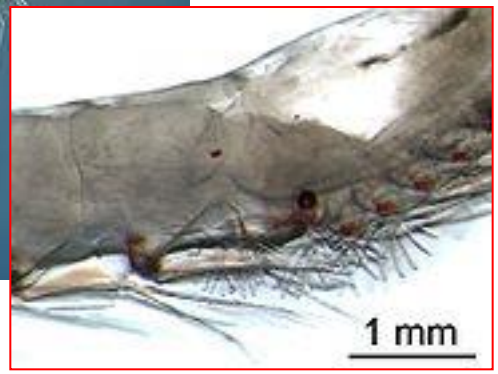
¡Some amphibians

snails

Polychaeta – a pair of gills on each segment

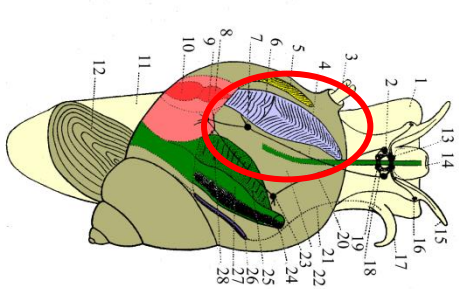


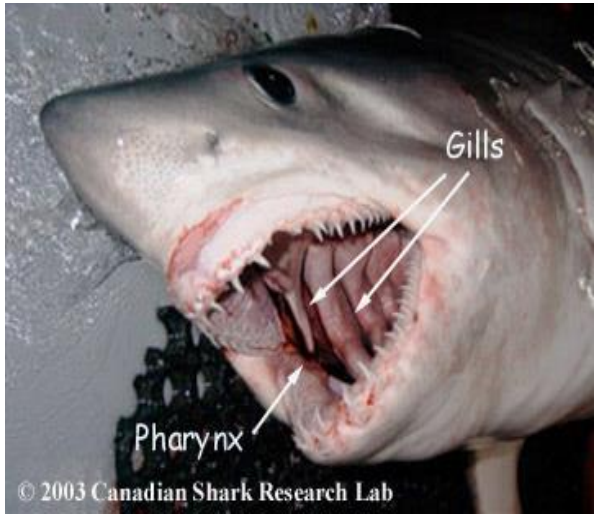


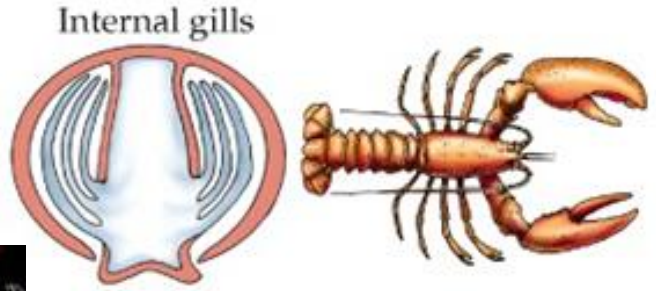


Krill

• **internal gills** – bigger, protected by body parts (some snails, bivalvs, cephalopods, some crustaceans, fish)

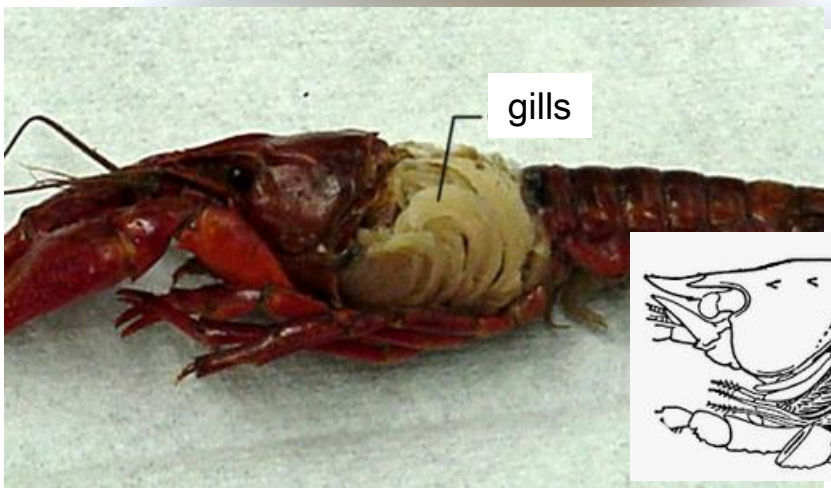


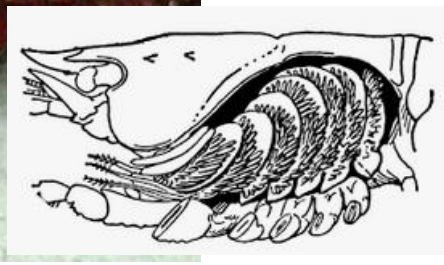




Invertebrates

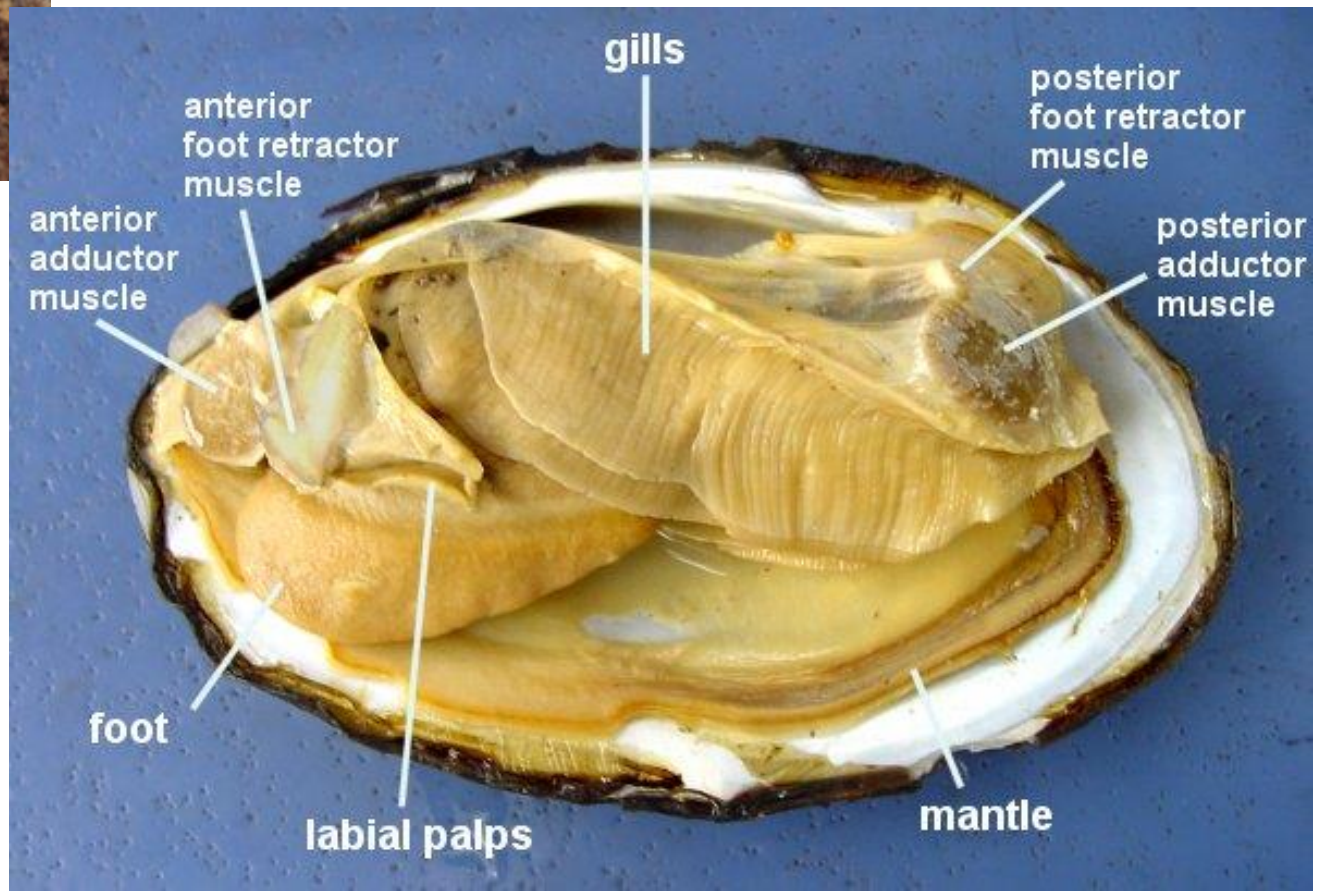
- gills developed on the coxa of walking legs, or as a skin fold



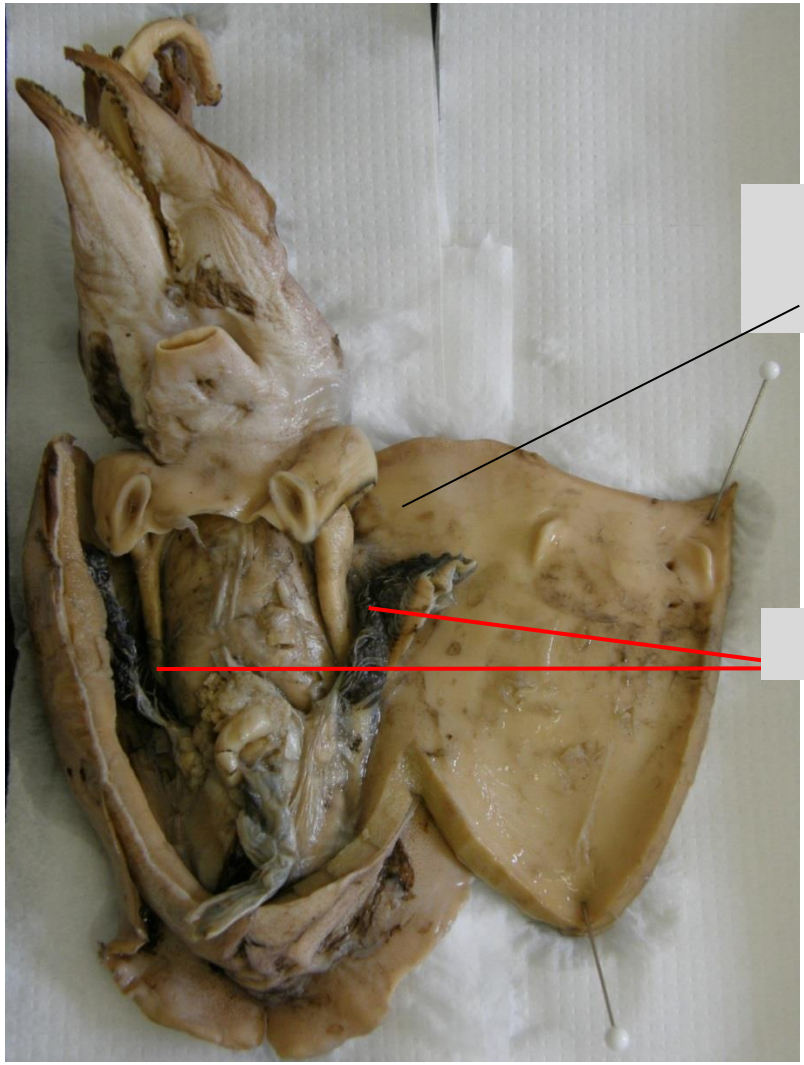


Bivalves

One pair mantle cavity

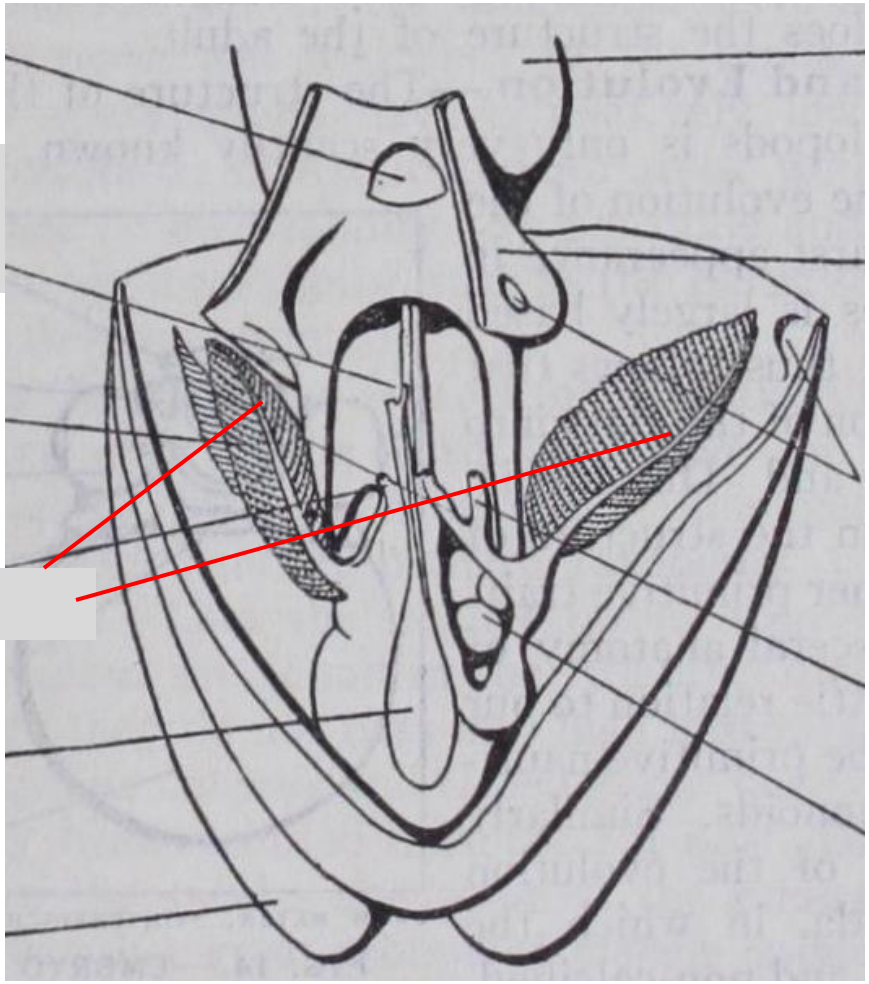


Gills in cephalopods

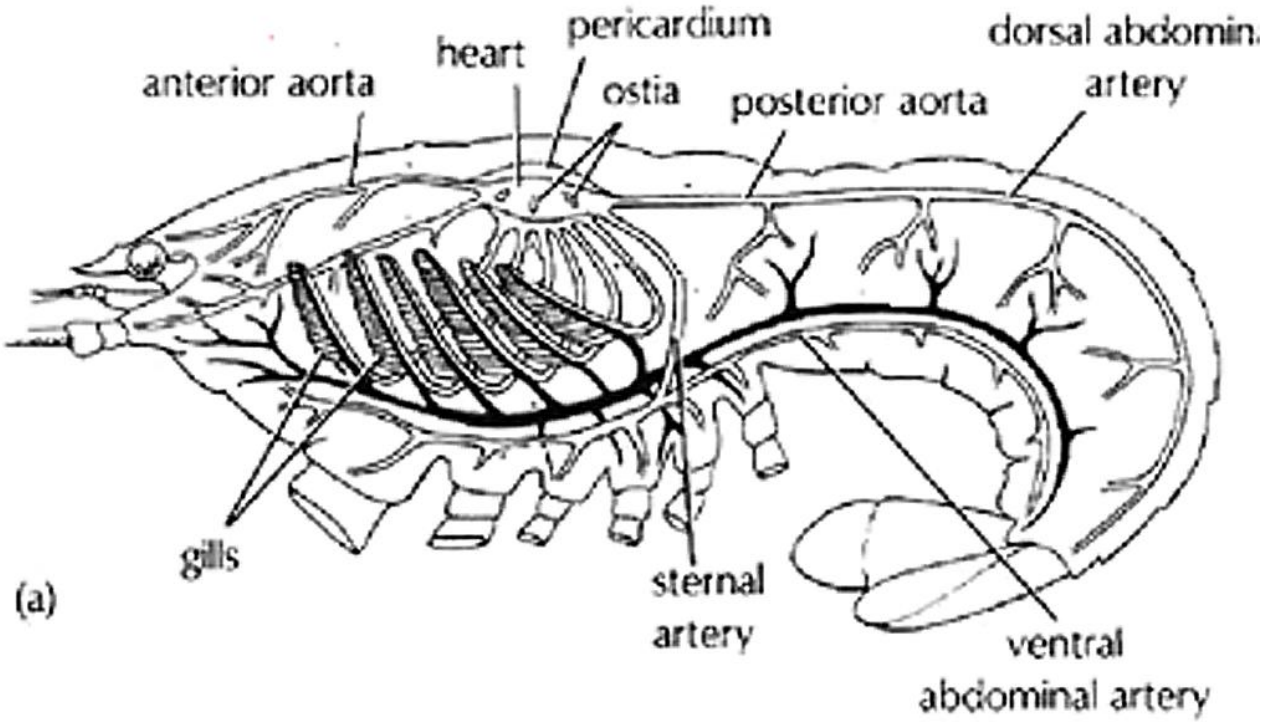


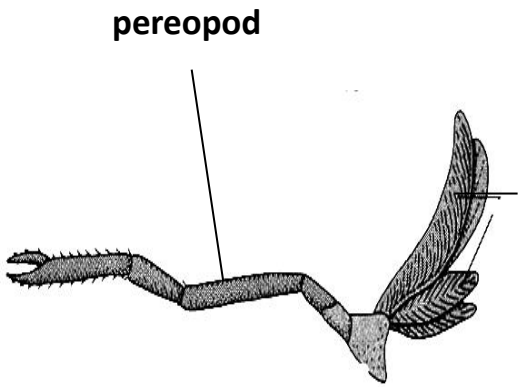
Mantle cavity

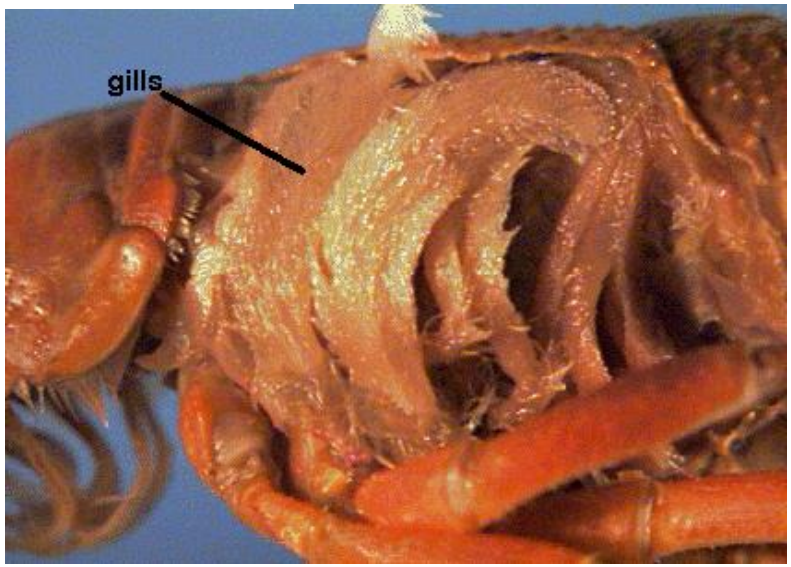
gills



Crustaceans



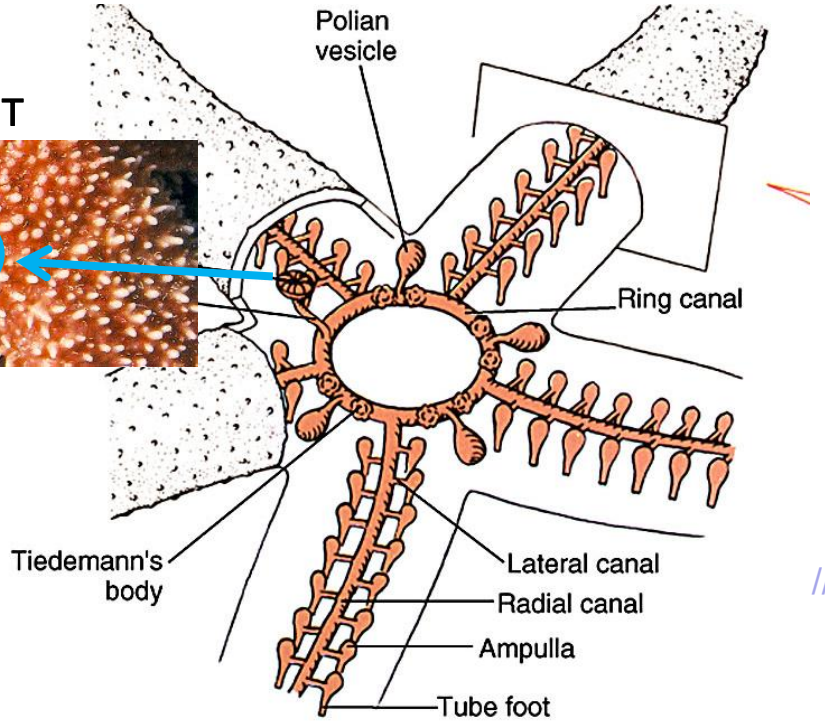


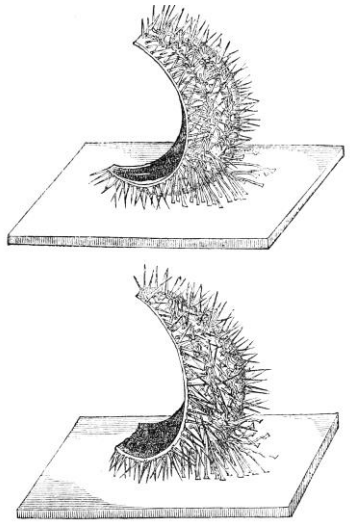


ECHINODERMS

- **Ambulacral system**

MADREPORIT



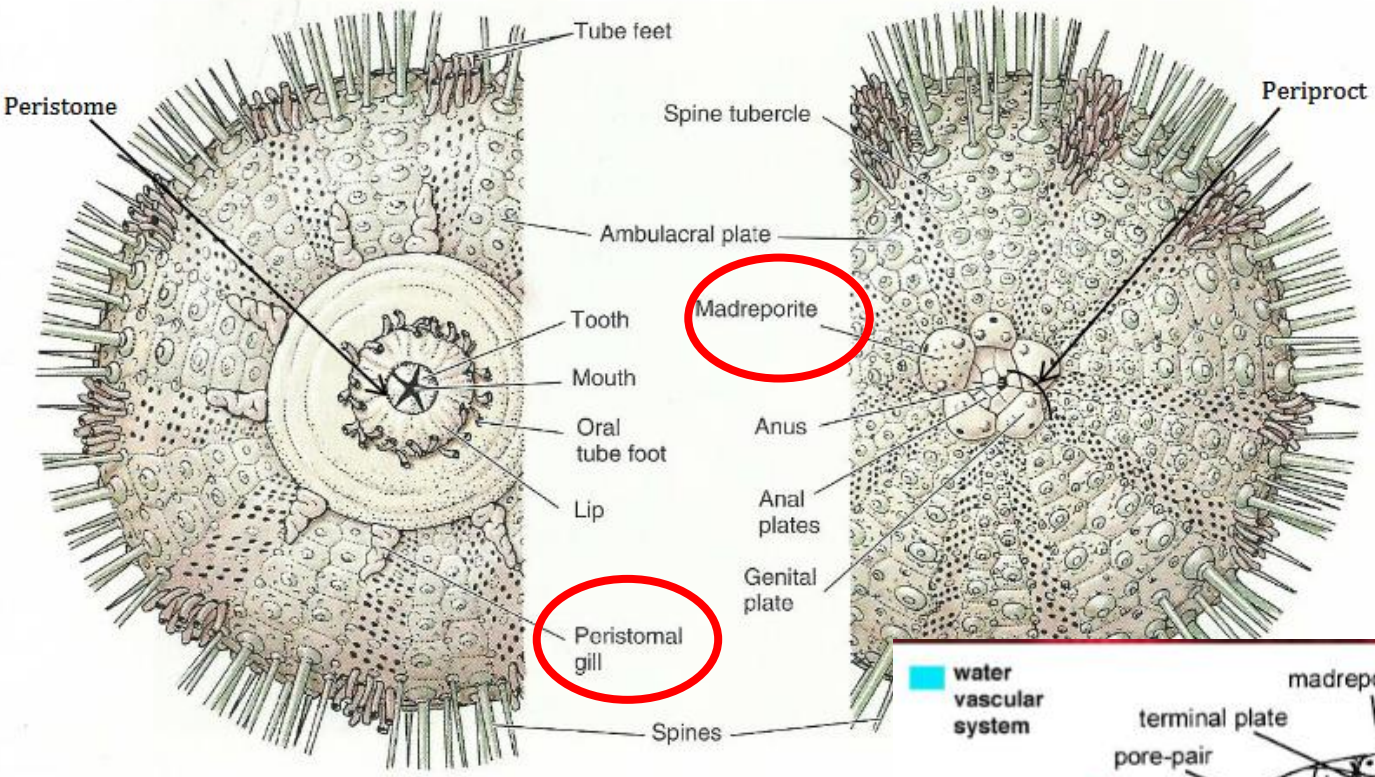


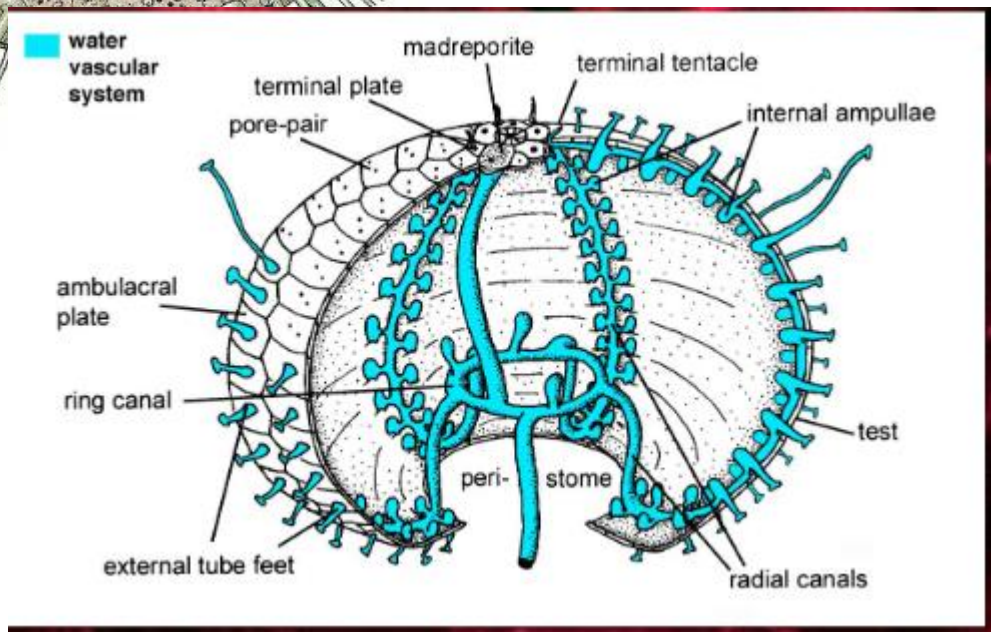
//www.youtube.com/watch?v=K2G7L5hcEt8

- sea water enters the system (respiration, circulation, feeding, moving)

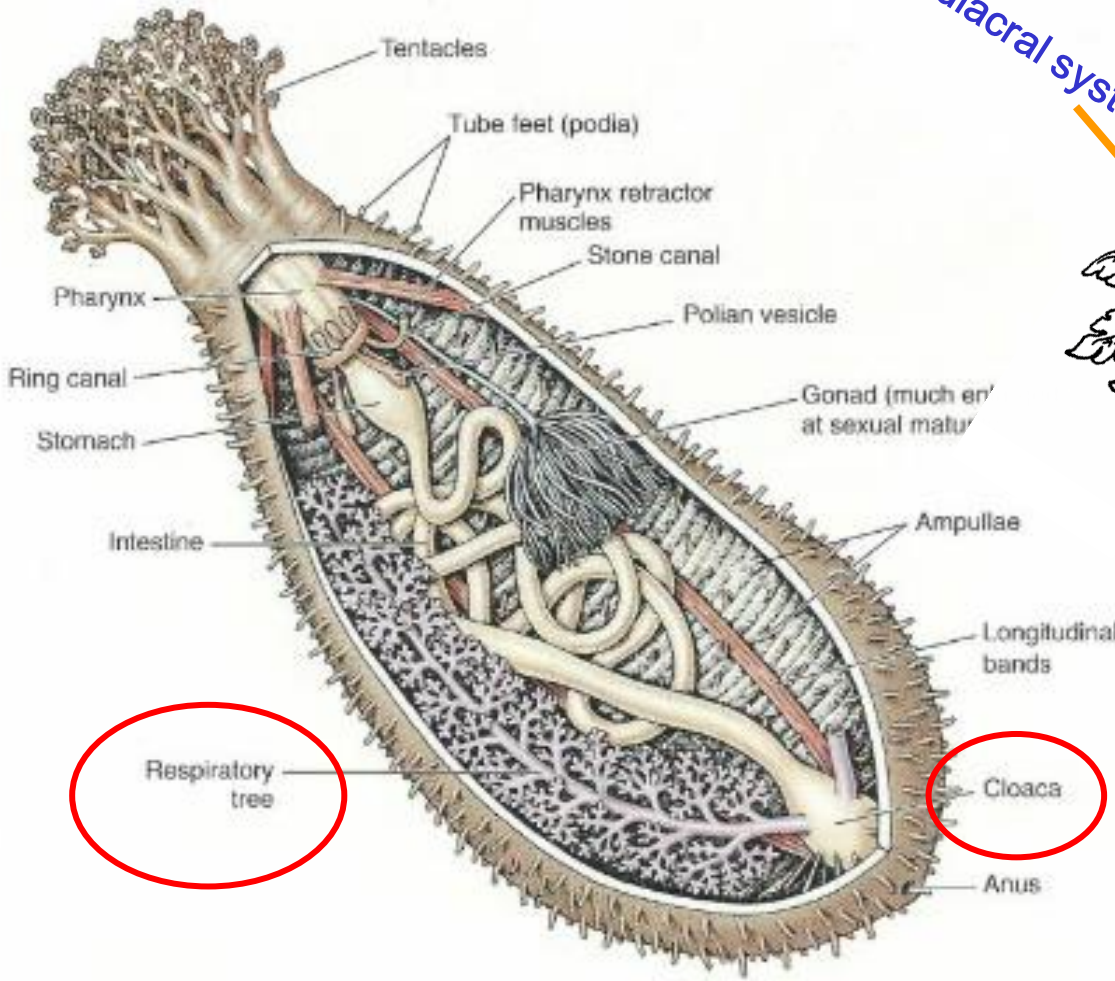
- Sea urchins

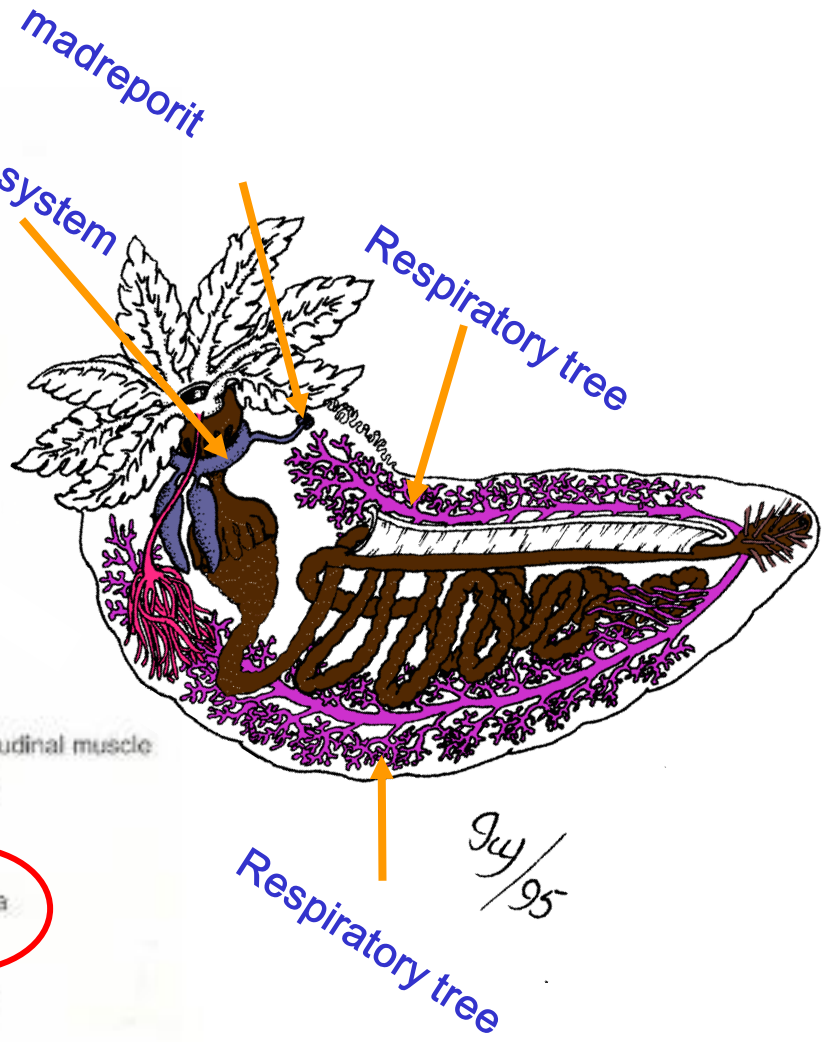
invertebrates





- **Sea cucumbers** - respiratory tree from cloaca + ambulacral system

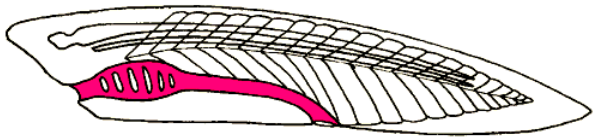




Phylum Chordata – subphylum Tunicata & Cephalochordata

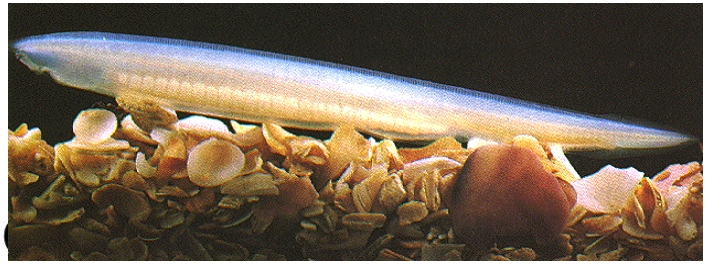
Gills developed from the front part of digestive tract

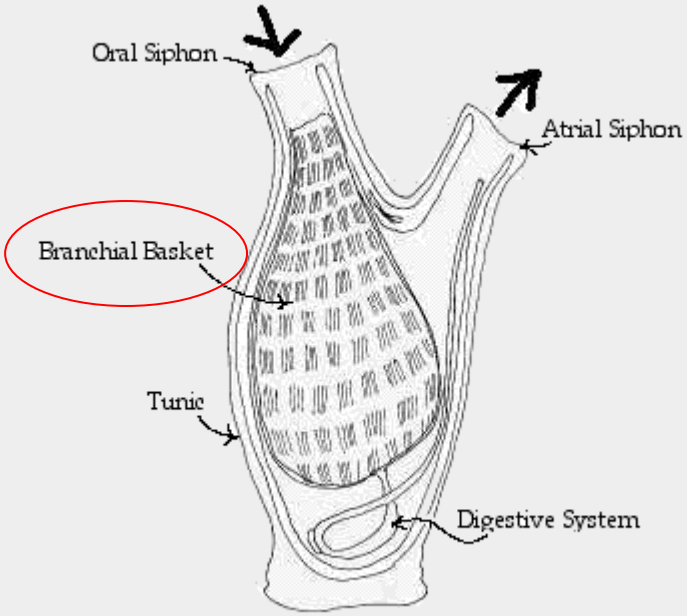
most primitive – respiration and feeding

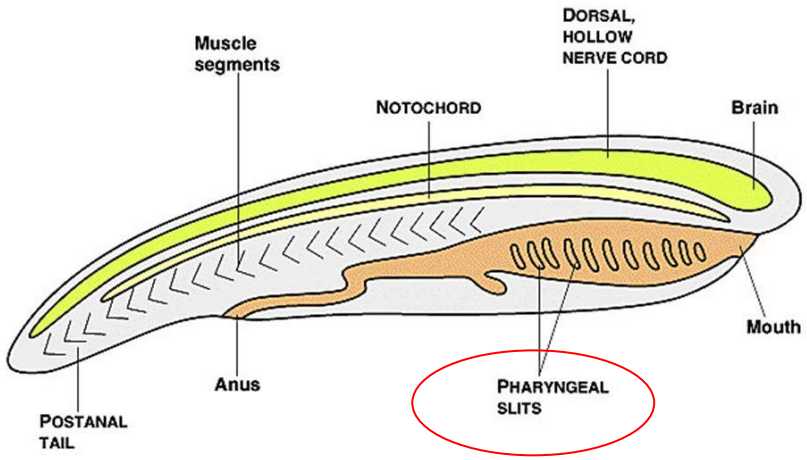


Tunicate

Lancelet

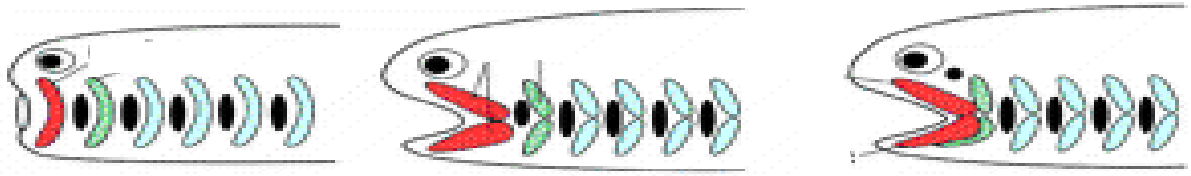




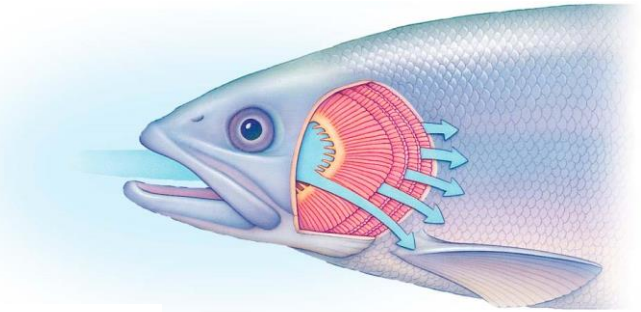


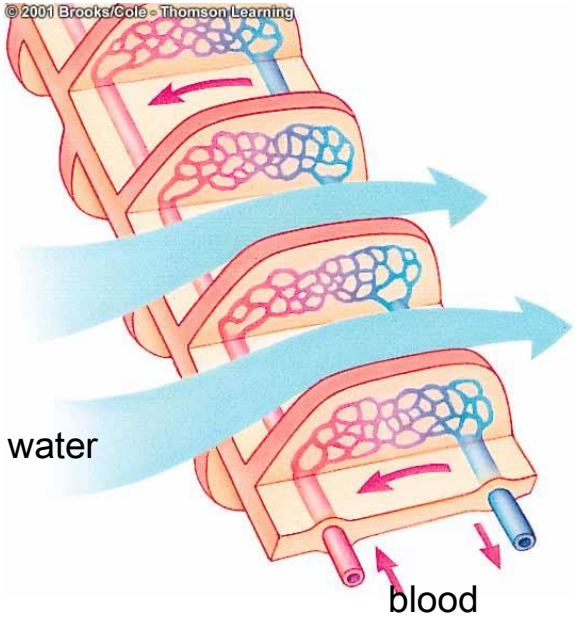
Phylum Chordata) – subphylum Vertebrata

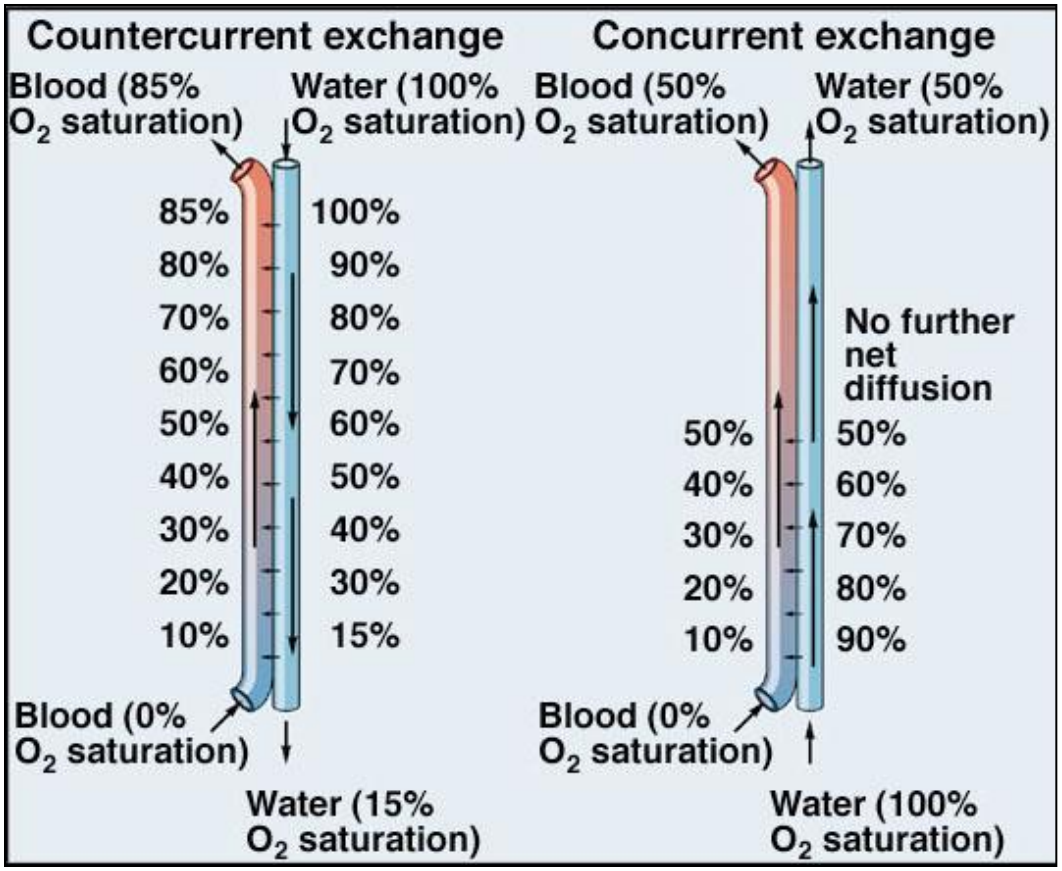
- once jaws were developed, no more dual function – real gills developed



Water flows over gills opposite from the blood in the vessels



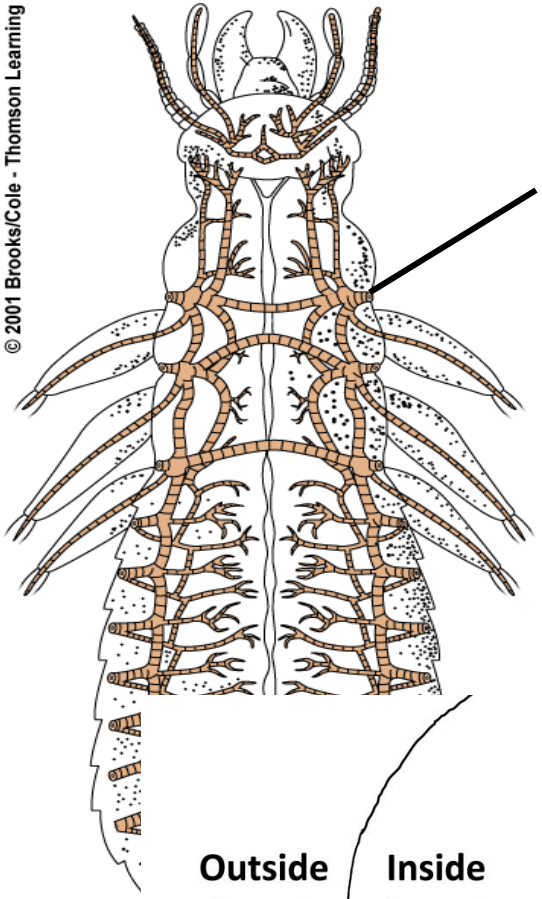


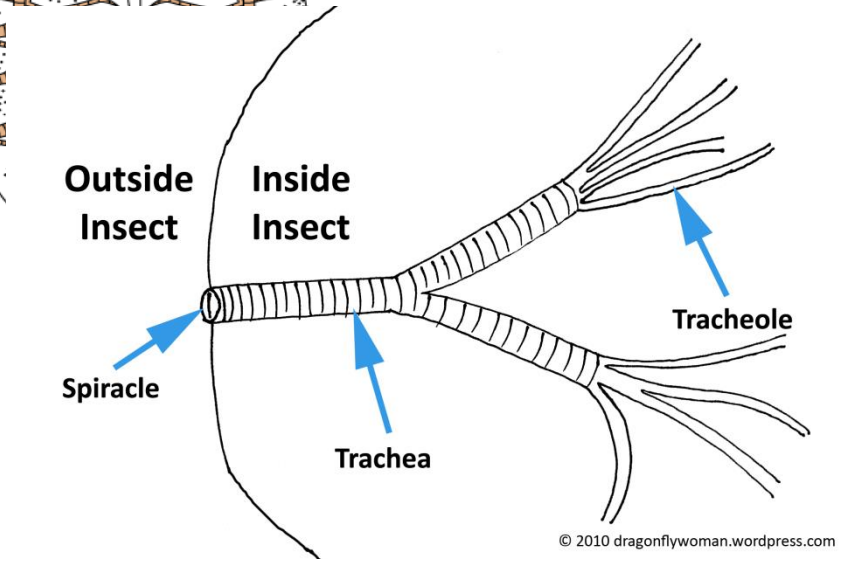


III. tracheas

- terestrial Insects

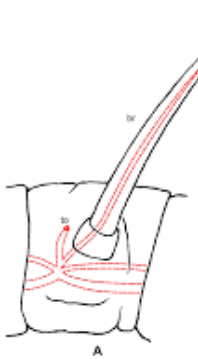
- Invagination of cutilce – tubes
- **Stigma / spiracle**
- **Tracheas**
- **Tracheoles**

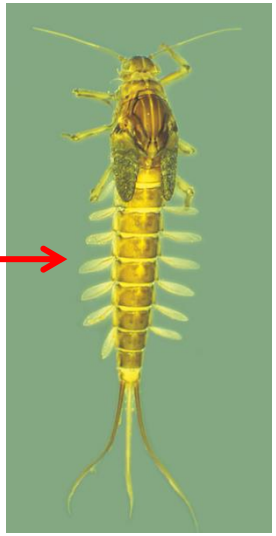




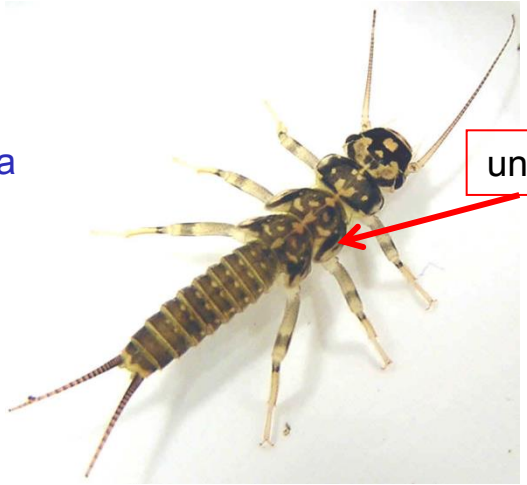
Tracheal gills (in water larvae of Insects)

Ephemeroptera





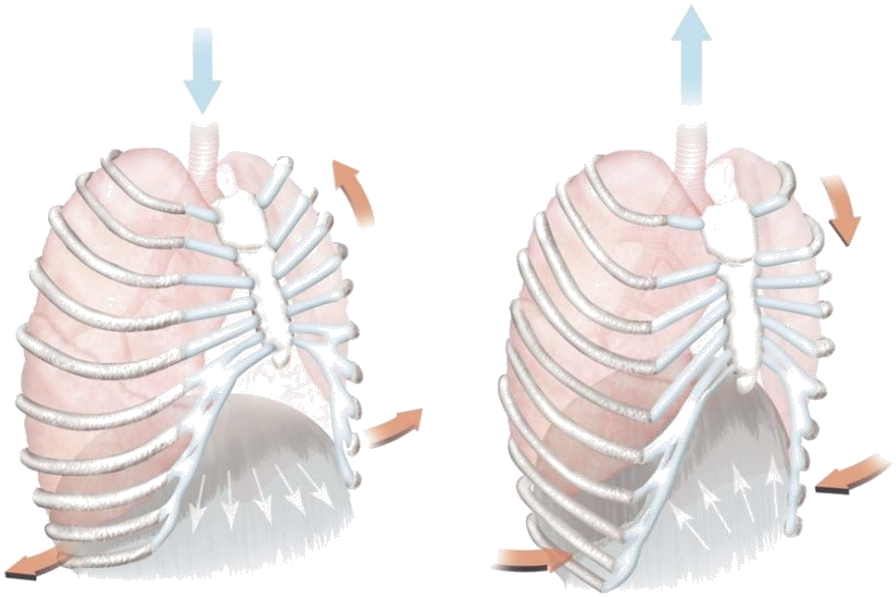
Plecoptera



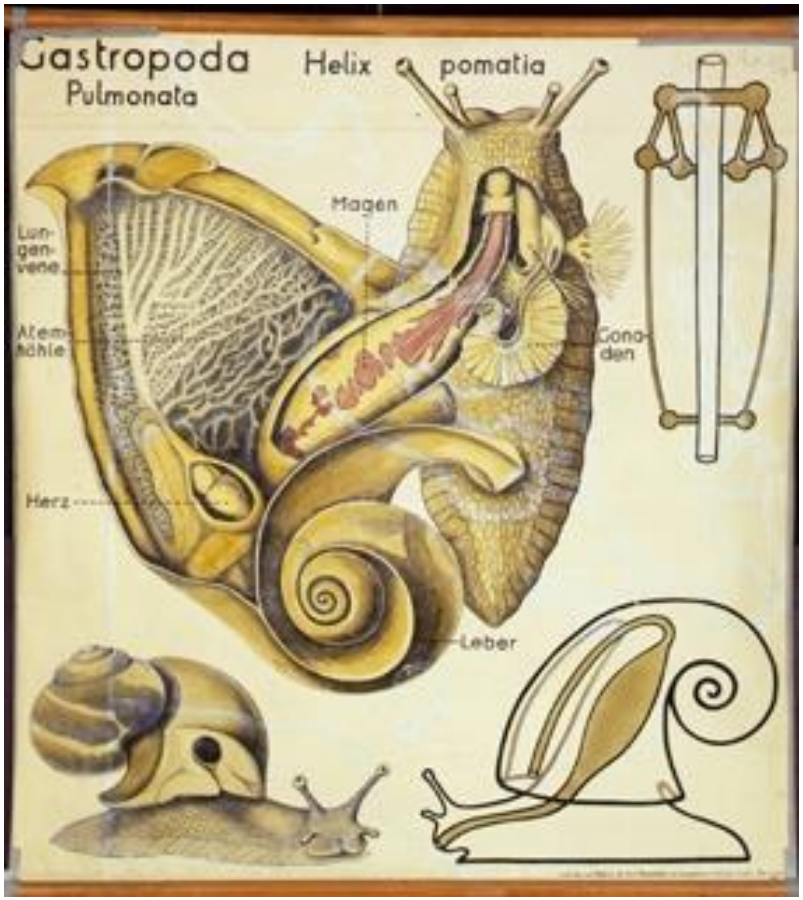
under

IV. lungs

Terrestrial vertebrates→ **ventilation**



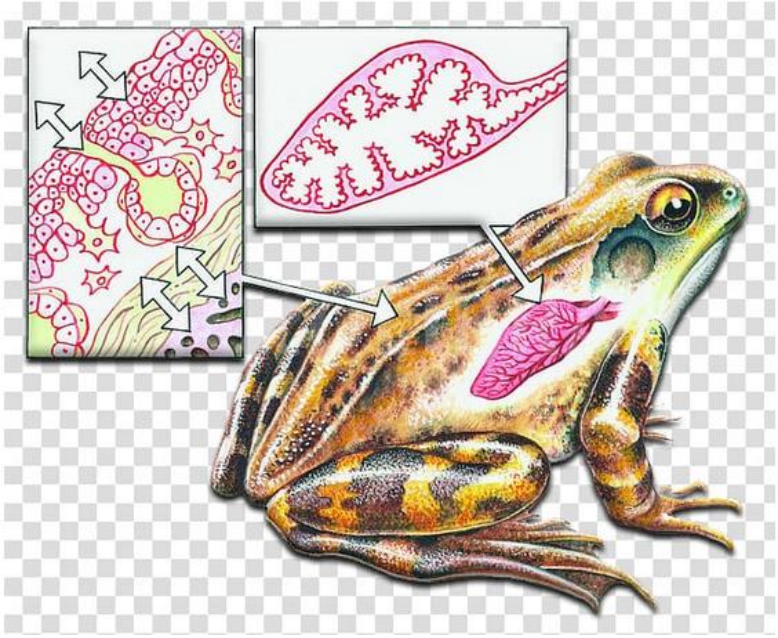
Terrestrial snails
→ **Diffusion - mantle**

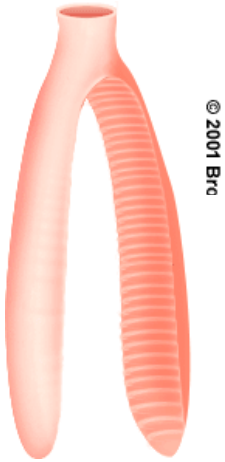


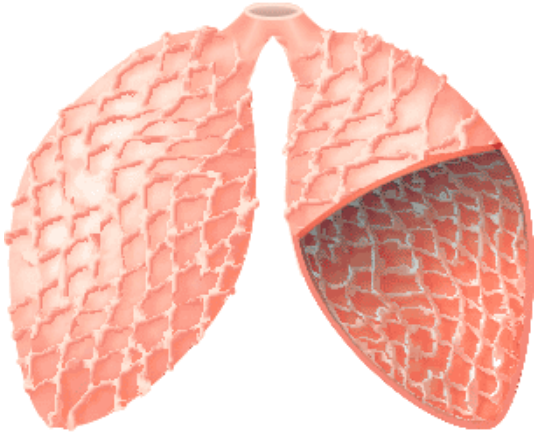
amphibians

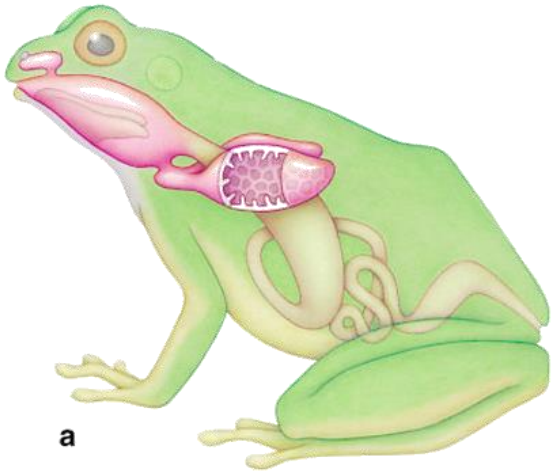
► simple

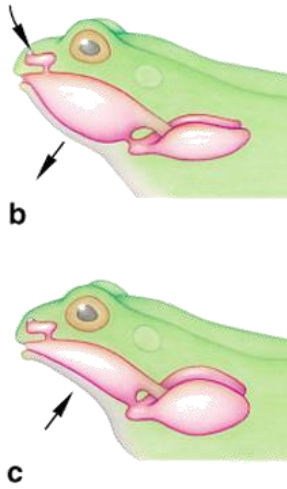
- lungs(~65%) i **skin** (~35%)

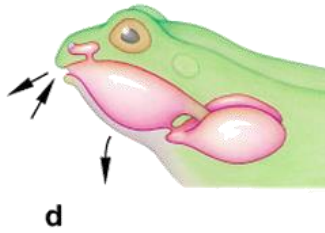










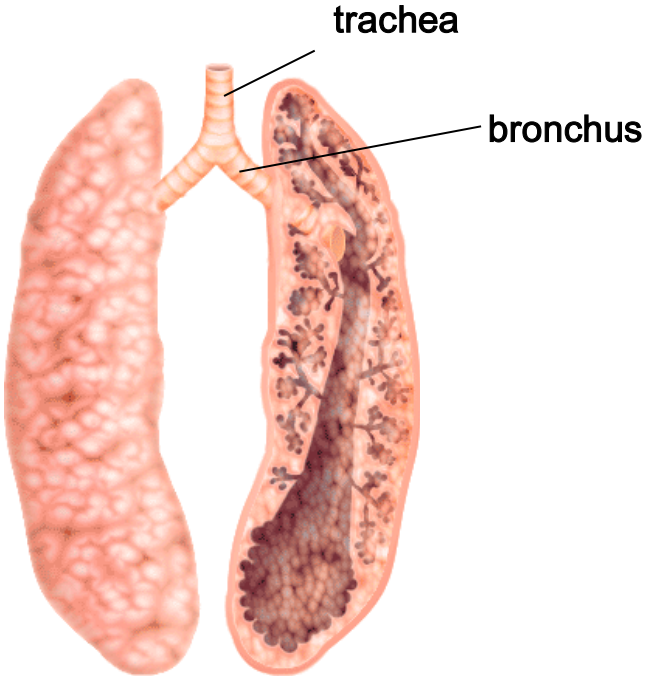


- They swallow the air

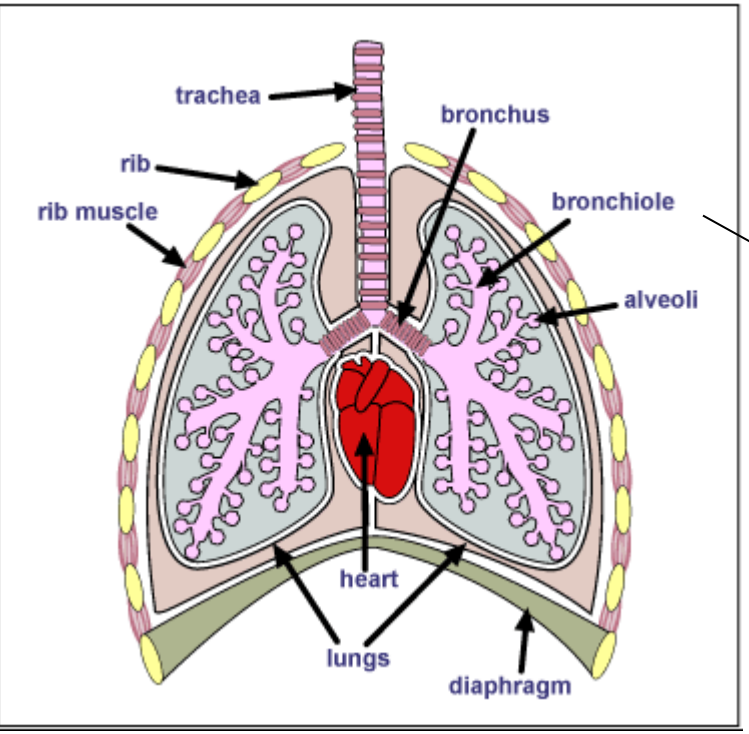
• **reptiles**

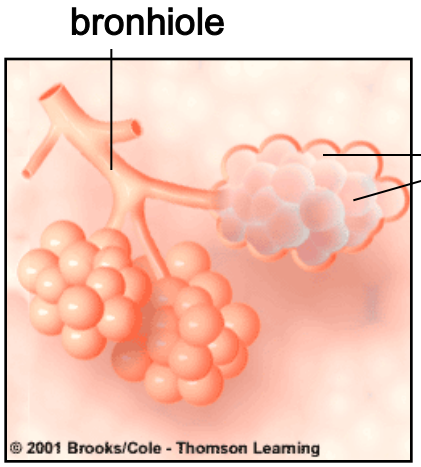
- Using only lungs

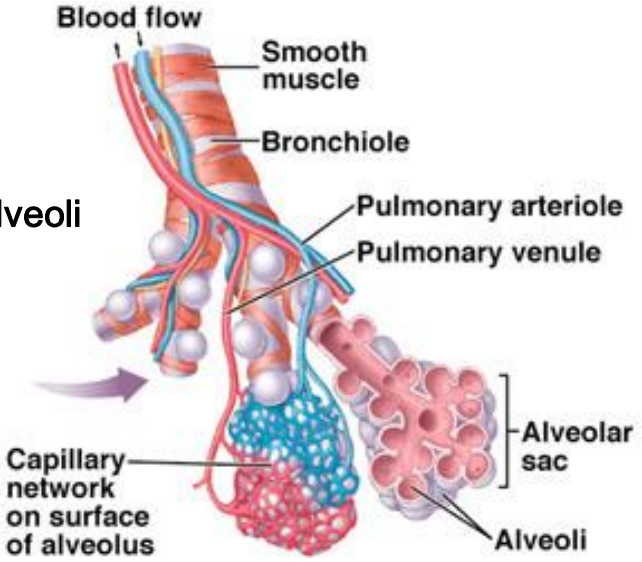
- **Lungs a bit more complex**

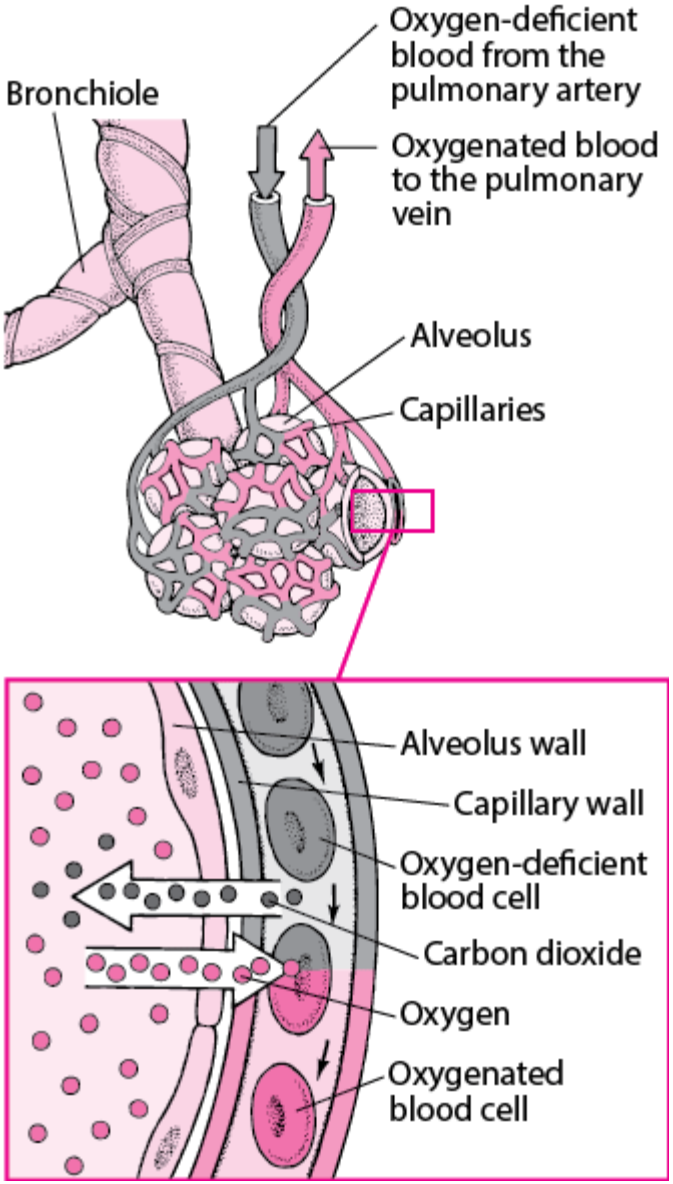


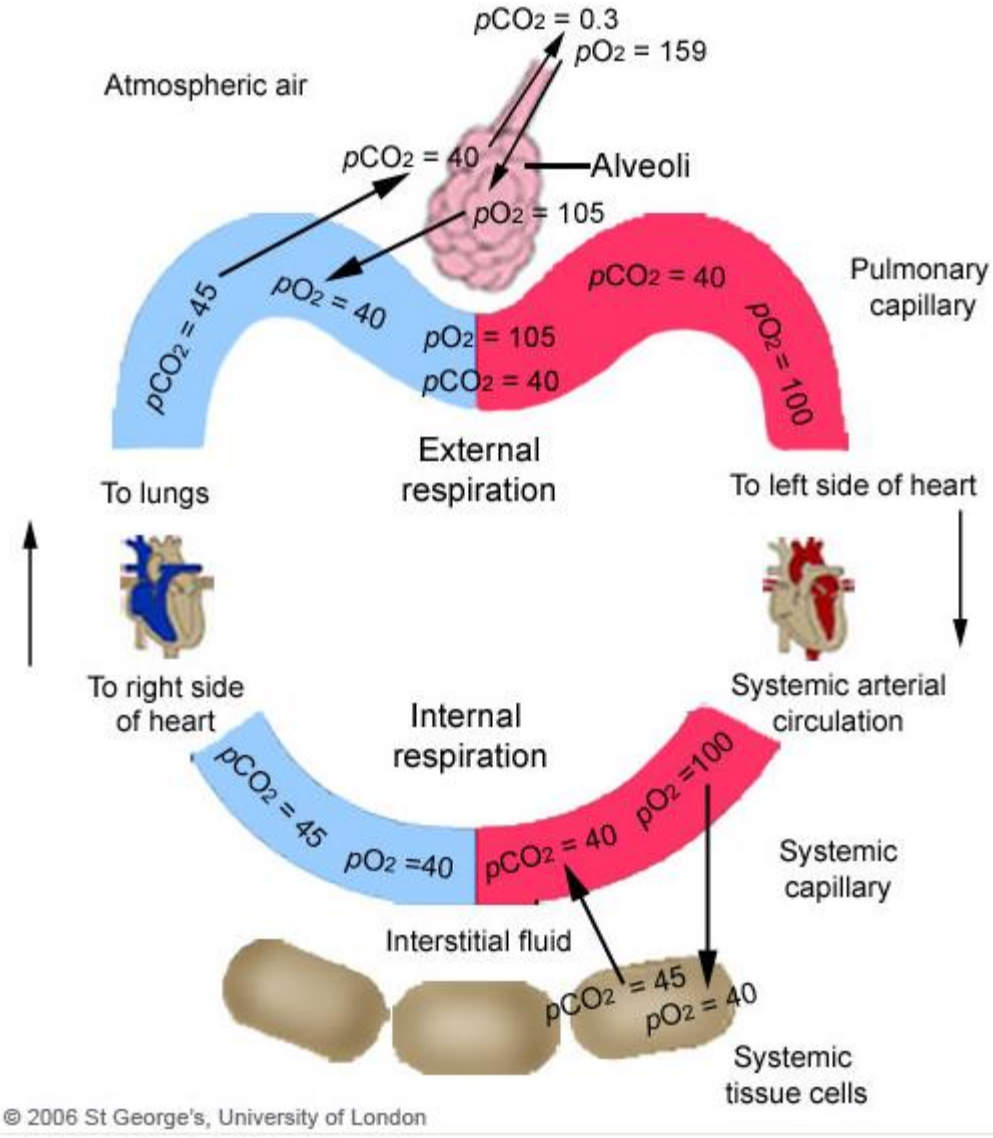
- mammals


trachea
bronchus
rib
rib muscle
bronchiole
alveoli
heart
lungs
diaphragm

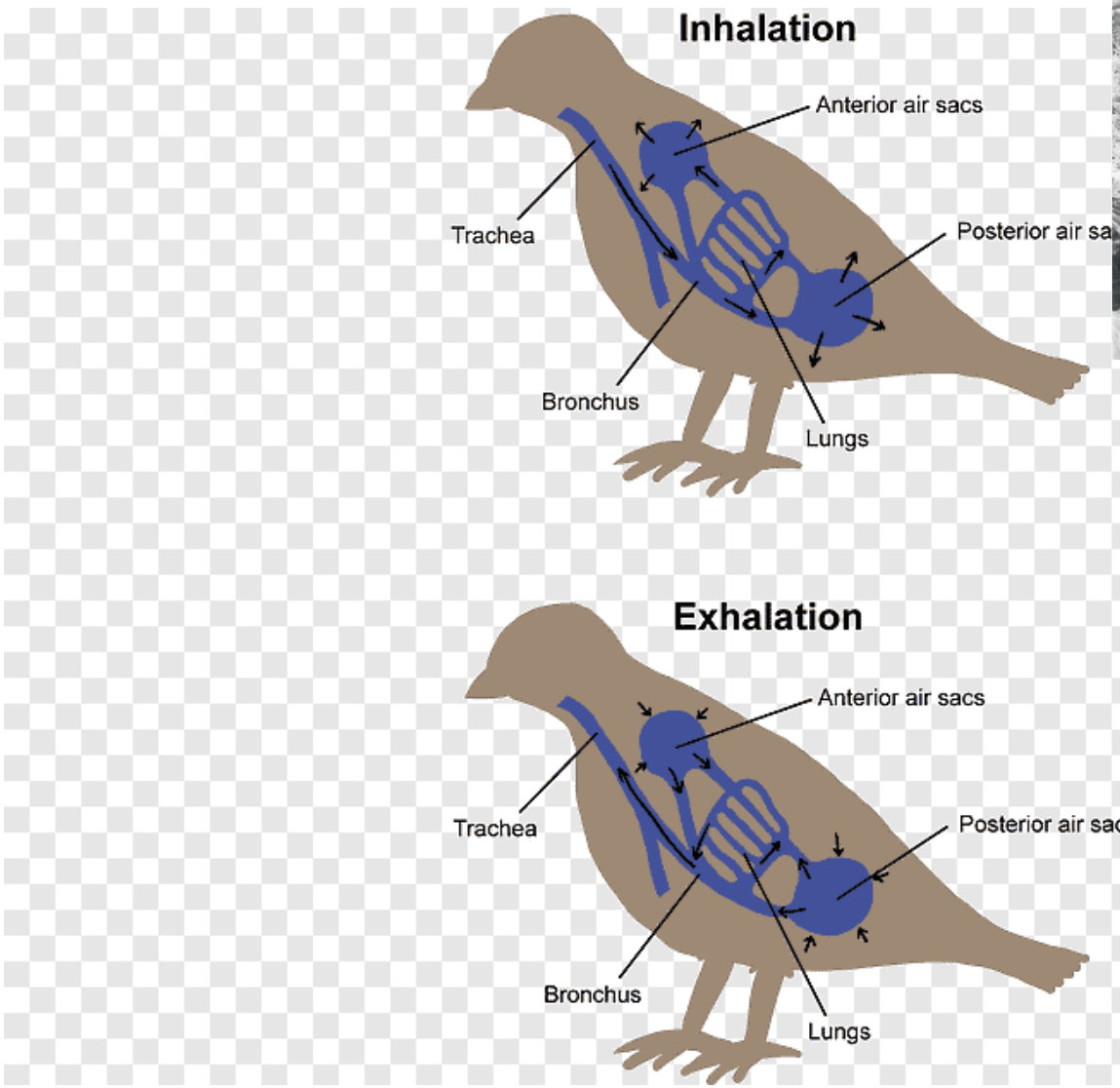

bronhiole
alveoli
© 2001 Brooks/Cole - Thomson Learning

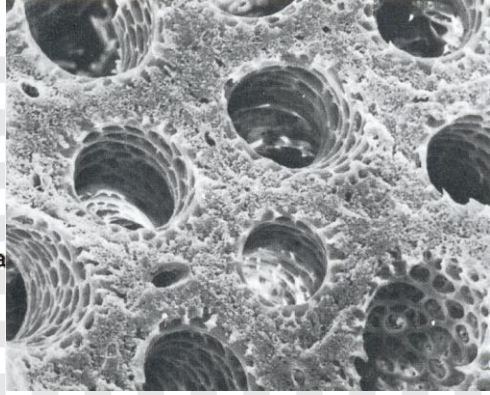

Blood flow
Smooth muscle
Bronchiole
Pulmonary arteriole
Pulmonary venule
Alveolar sac
Capillary network on surface of alveolus
Alveoli

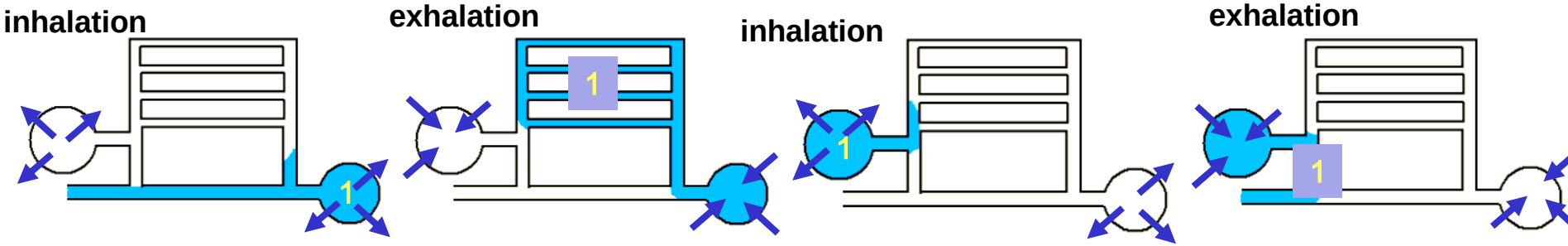




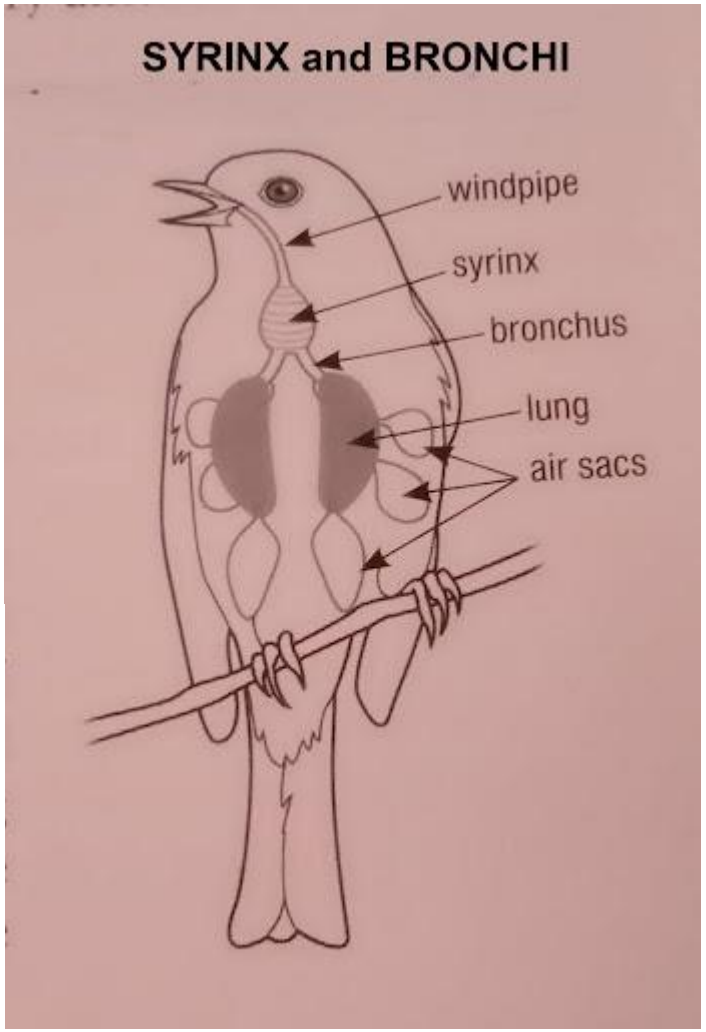
BIRDS

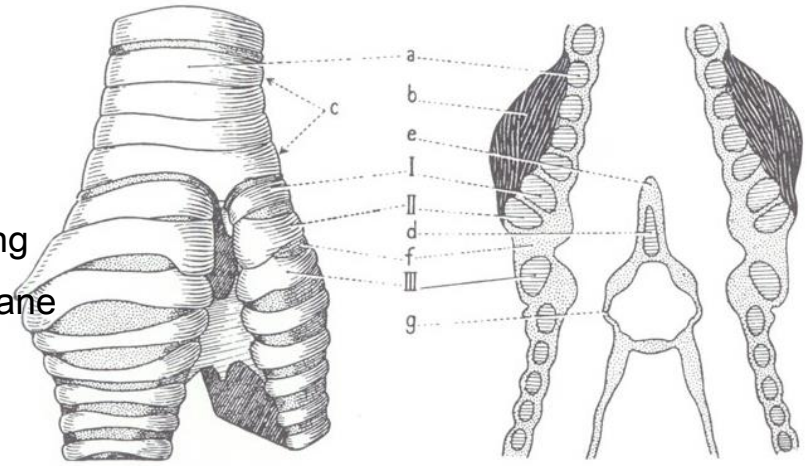

Inhalation
Anterior air sacs
Trachea
Posterior air sa
Bronchus
Lungs
Exhalation
Anterior air sacs
Trachea
Posterior air sacs
Bronchus
Lungs




inhalation
exhalation
inhalation
exhalation
1
1
1
1

- To produce sound- *syrinx*





ring

membrane

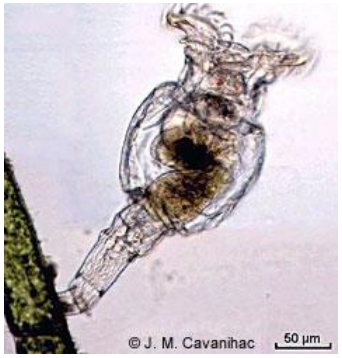
https://www.youtube.com/watch?v=ZGhVXgMoz4g

Circulatory system

ROLES:

- carries oxygen, nutrients, and hormones to cells, and removes waste products, like carbon dioxide
- immune reaction,
- thermoregulation,

- Single cell organisms, flatworms, pseudocoelomata – no special circulatory system;

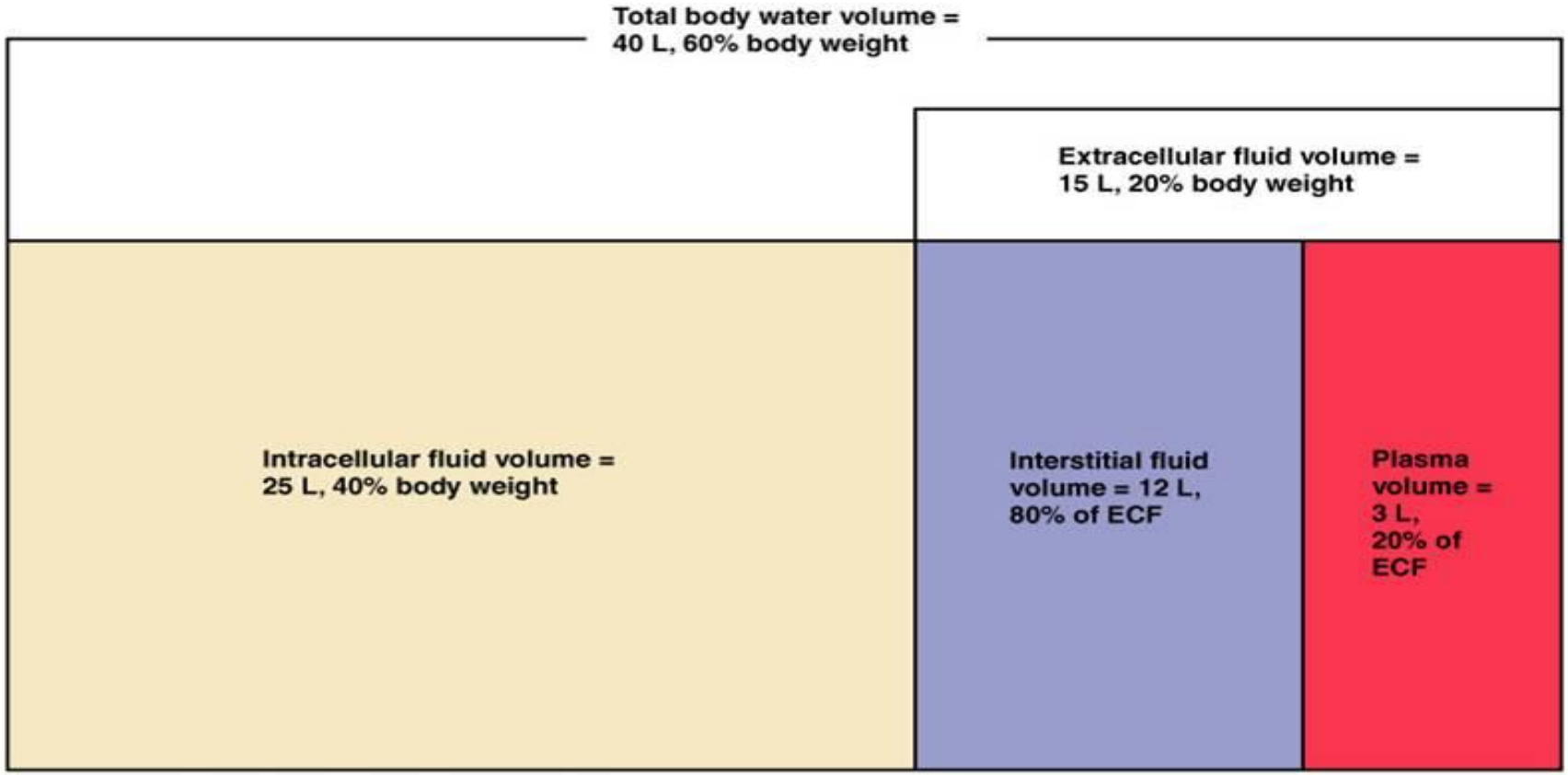


- Other multicellular animals – circulatory system exist, the role is carried out by body fluids

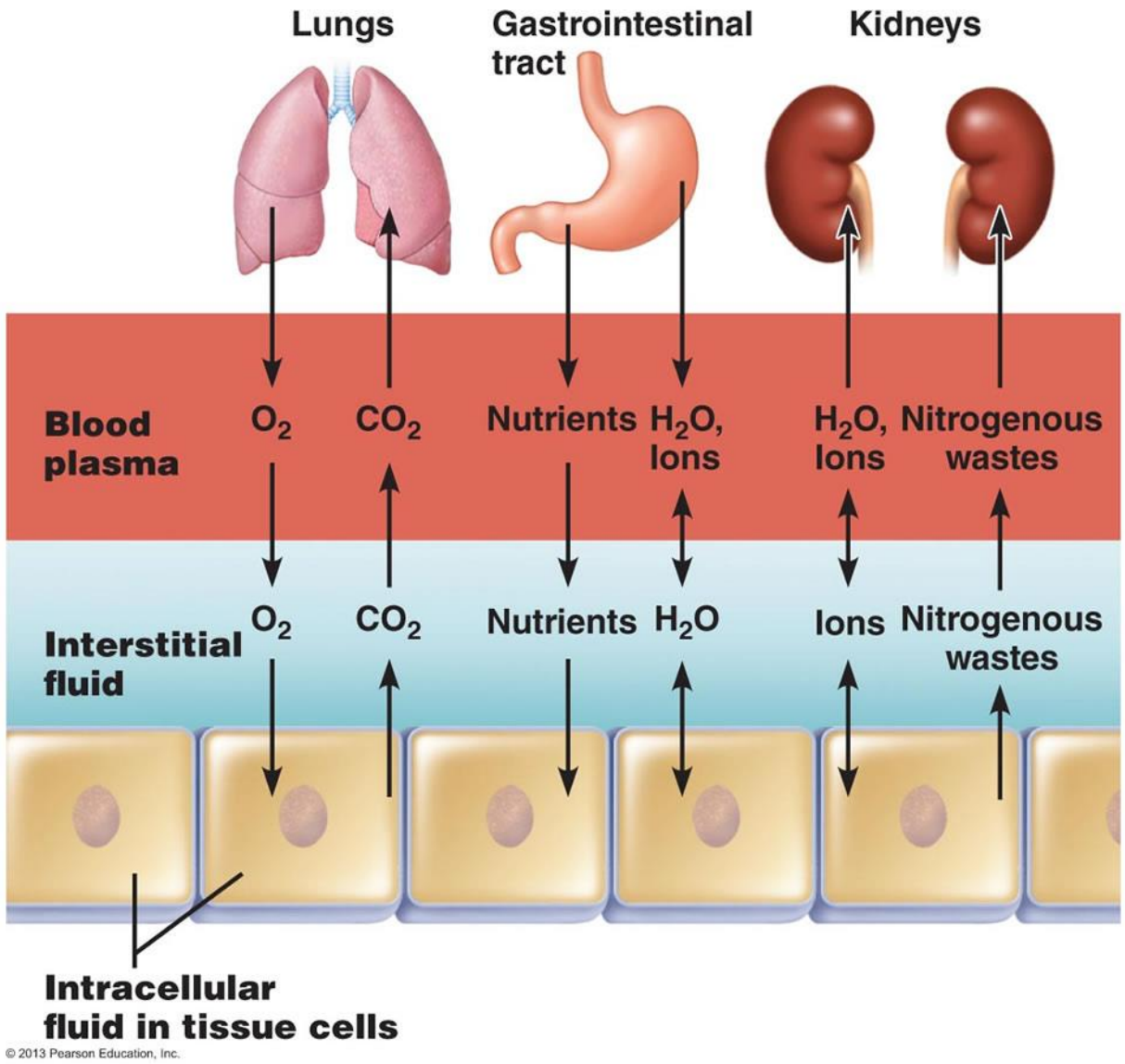
Animals could not become bigger and more active without well developed circulation

Body fluids – mainly water

- **extracellular**
- **intracellular**

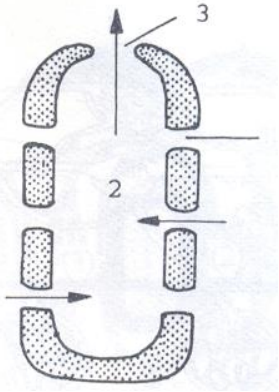


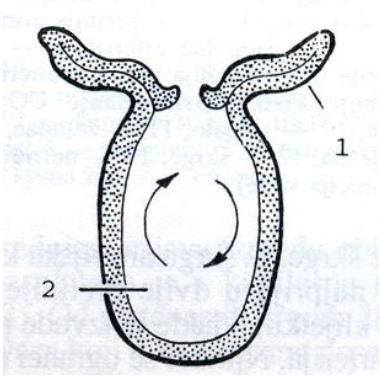
Extracellular



Extracellular :

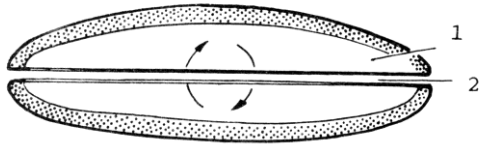
“hydrolymph”- similar to surrounding water – it is not the product of animal’s body





Body products (contains respiratory pigments):

- **coelom fluids**
- **haemolymph -** animals with open circulatory system
- **blood and lymph –** animals with close circulatory system



Slika 10.226. Optjecanje kod oblića: 1 — pseudocel, 2 — probavilo

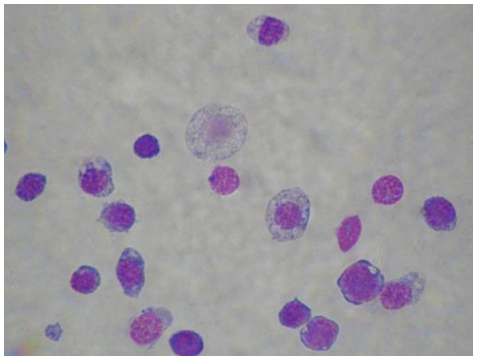
RESPIRATORY PIGMENTS (CHROMOPROTEIDS)

- complex proteins with metal ion in their structure

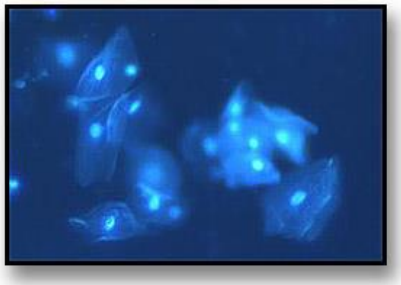
- **dissolved in the body fluids or linked to special cells**

haemocytes - invertebrates

Erythrocytes - vertebrates

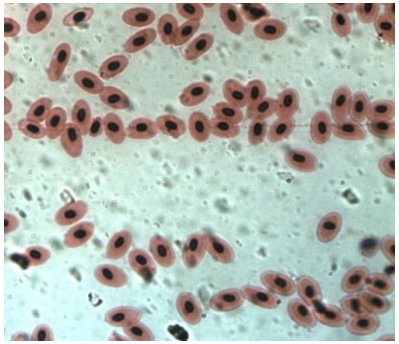


insect

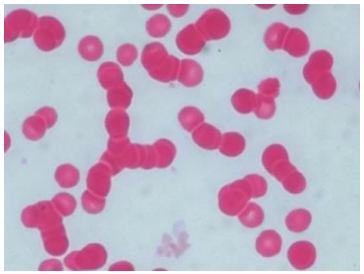


crustacean

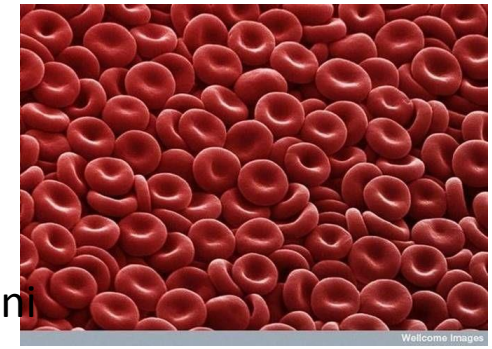
bival



fish



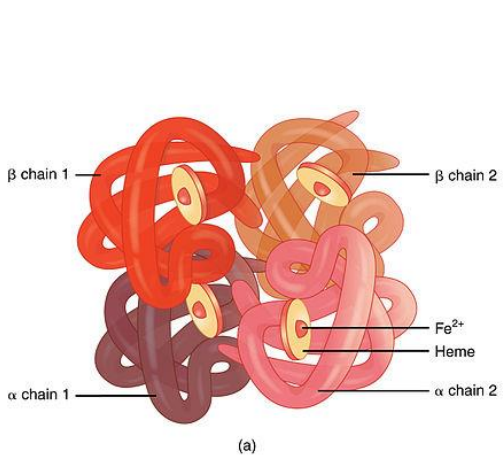
dog

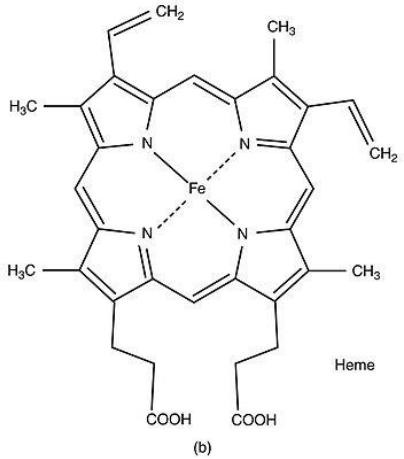


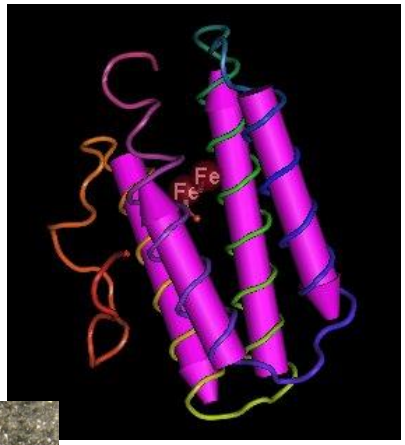
humani

- **Fe-ion** as central metal ion:

- **Haemoglobin** (vertebrates, some crustacean), linked to cells, with O_2 red
- **Hemerythrin** (some polychaete, brachiopods, acorn worms or Enteropneusta ..), linked to cells, with O2 violet-pink

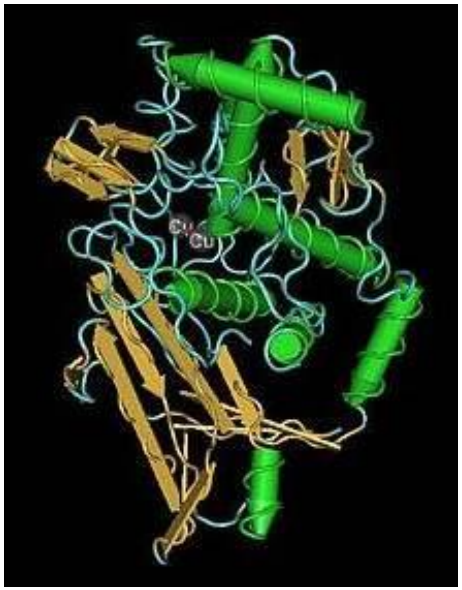




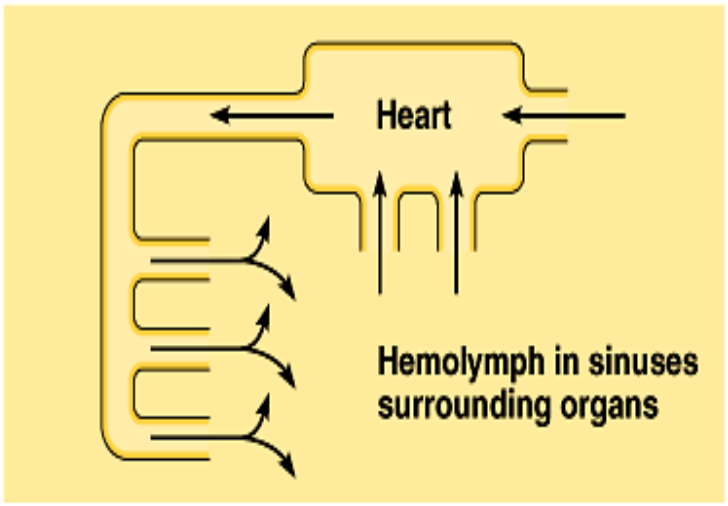


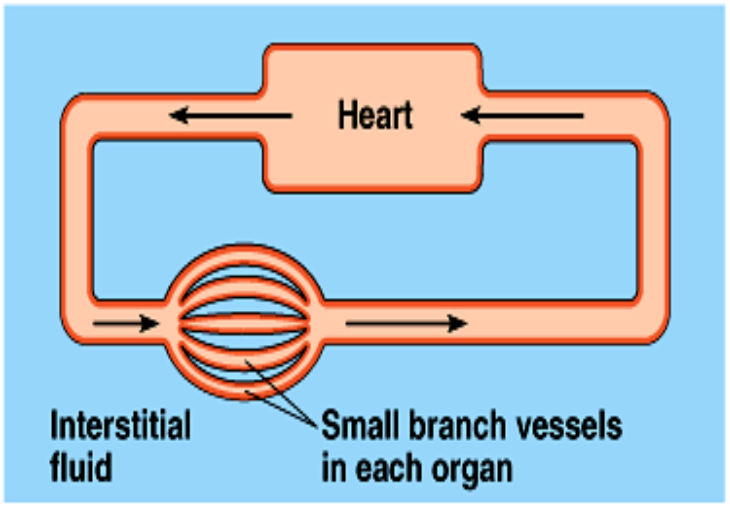
- **Cu-ion** as central :

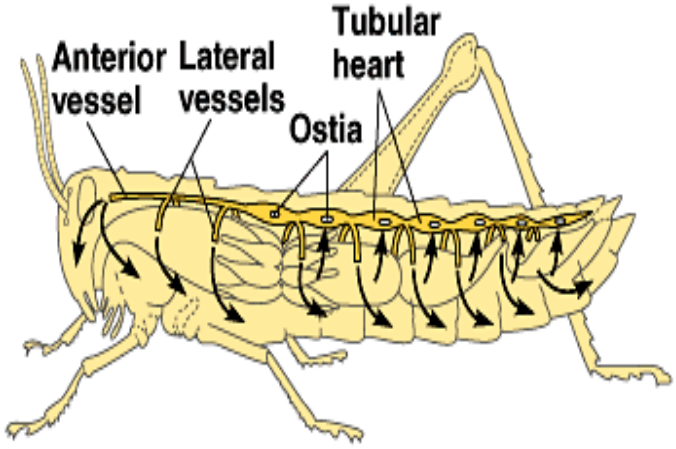
- **haemocyanin** – dissolved in body fluid (haemolymph or blood), with oxygen blue
- polyplacophora, cephalopods, some gastropods, crustaceans



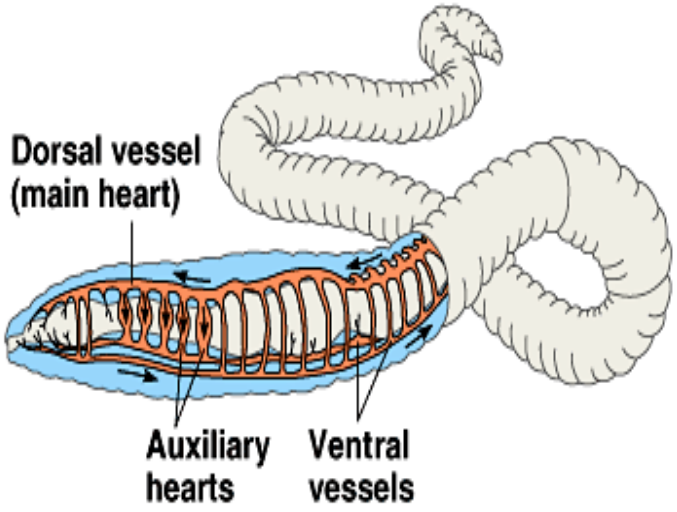
► **circulatory system type:**







(a) Open circulatory system



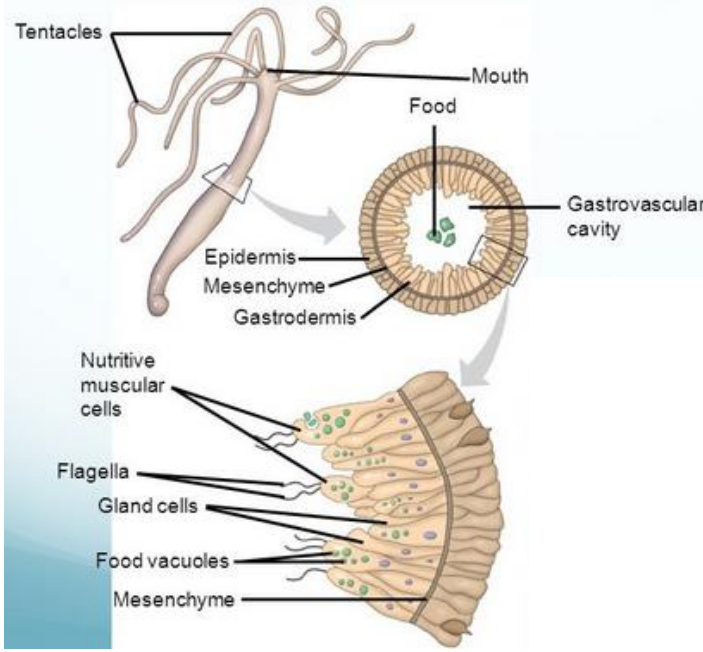
(b) Closed circulatory system

overview

No special system:

Choanocytes take oxygen and food

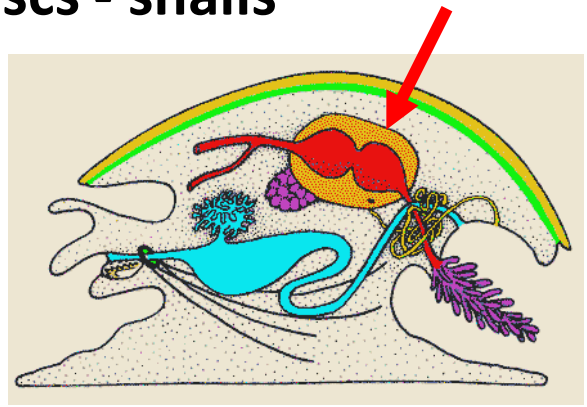
Cells of gastrodermis take oxygen and food

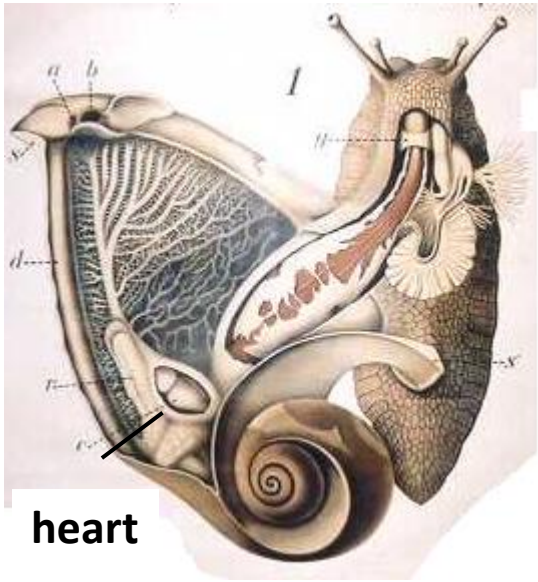


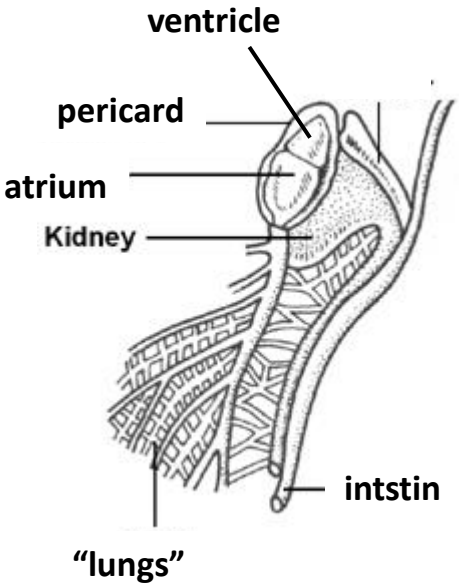
Single cell organisms, flatworms, pseudocoelomata – no special system, transport done by cytoplasm

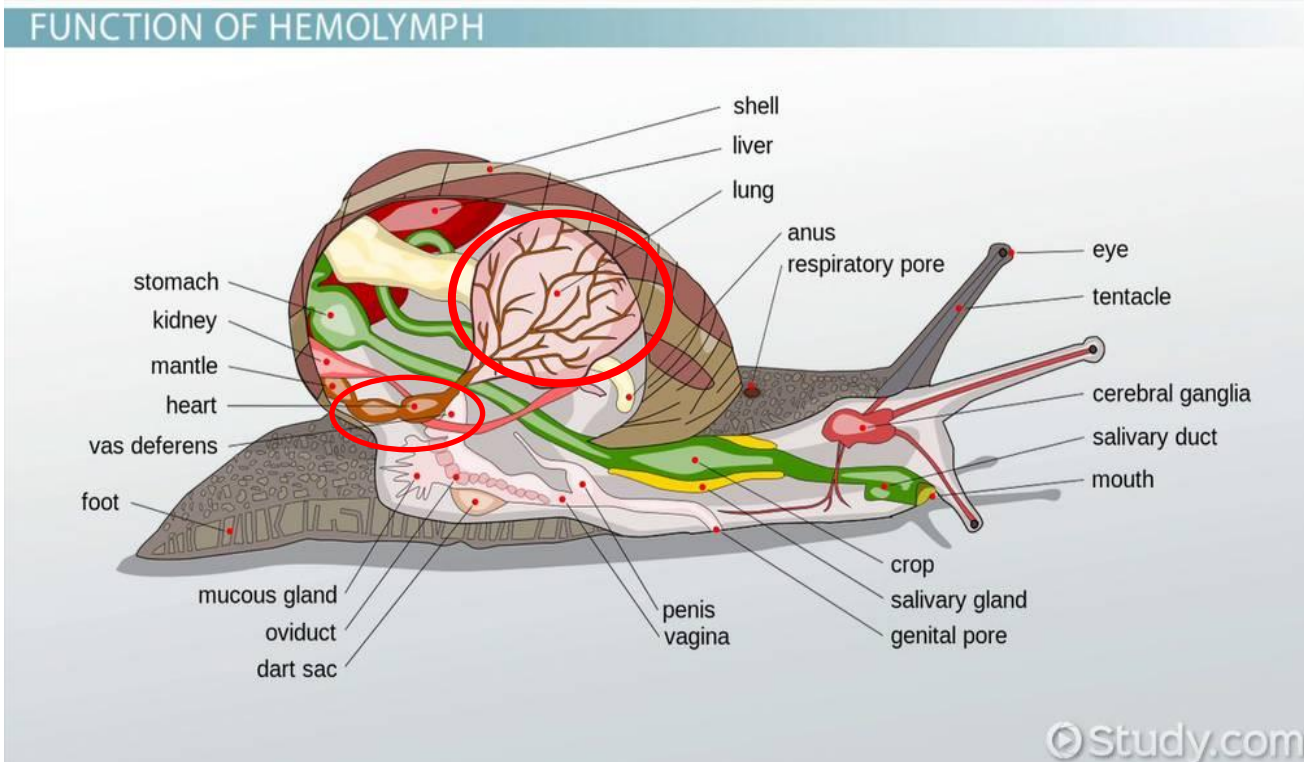
Open circulatory system

- molluscs - snails

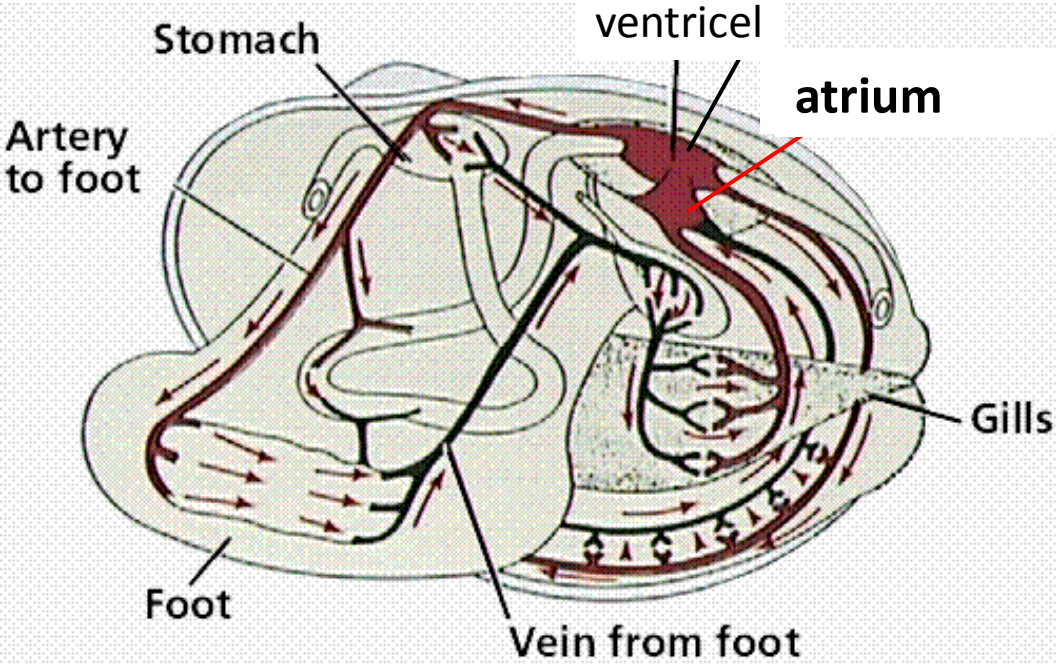


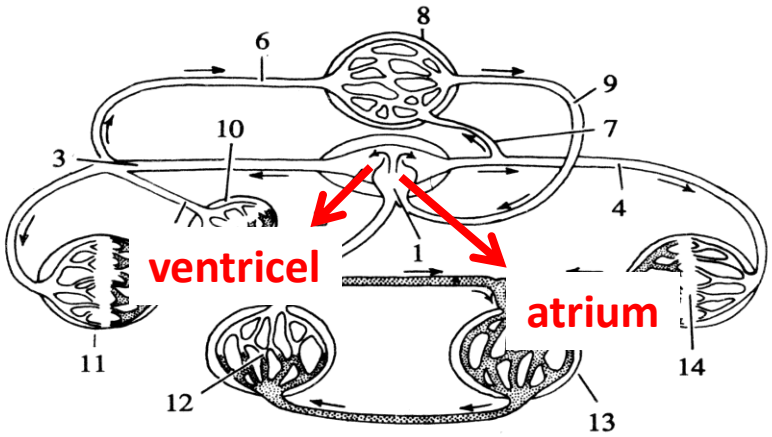


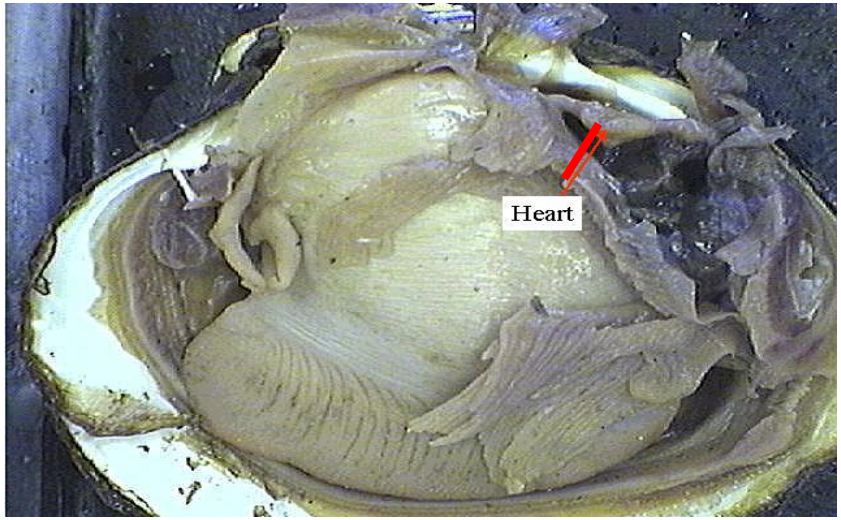




- **molluscs - bivalvs**



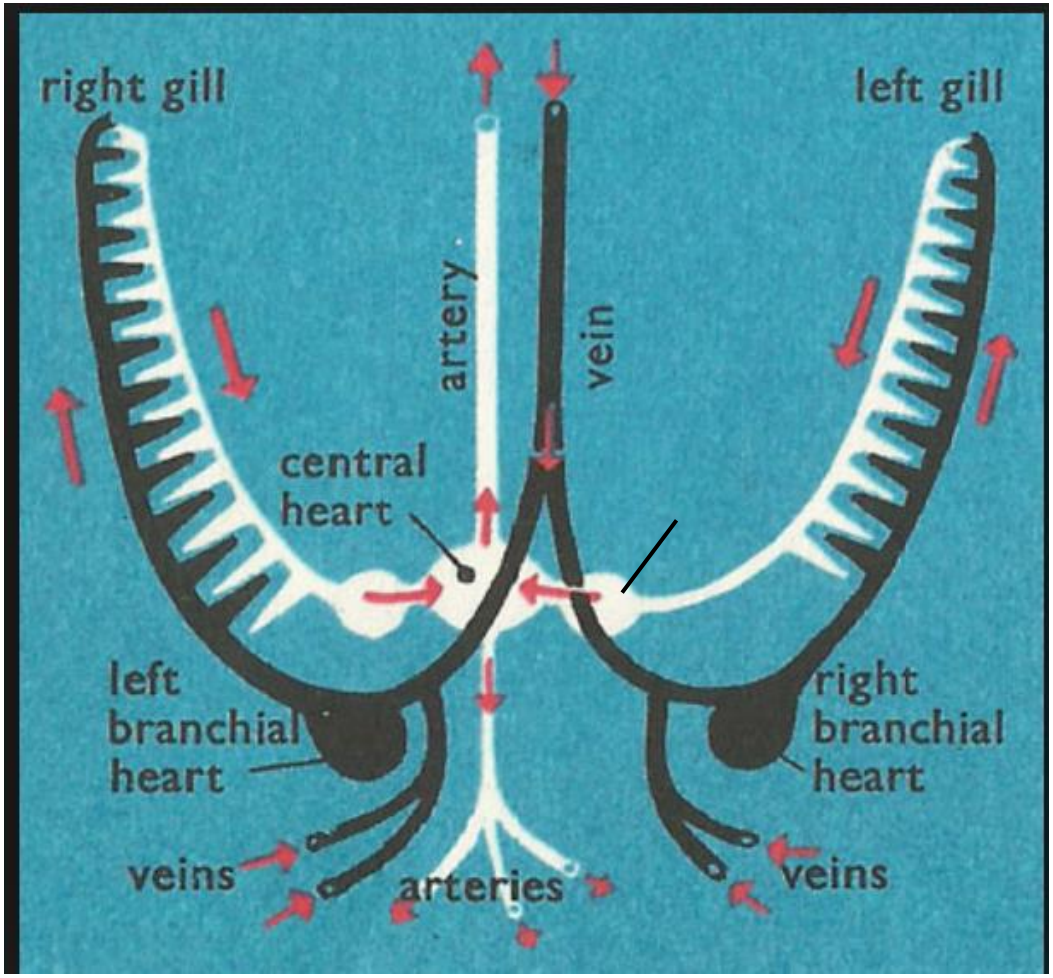




- **molluscs - cephalopods**

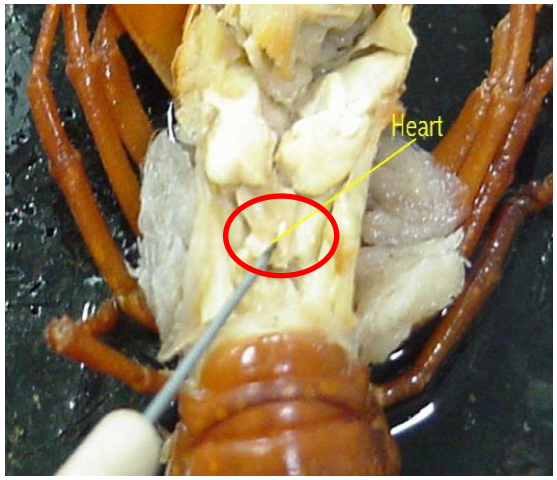
  - **CLOSED SYSTEM**

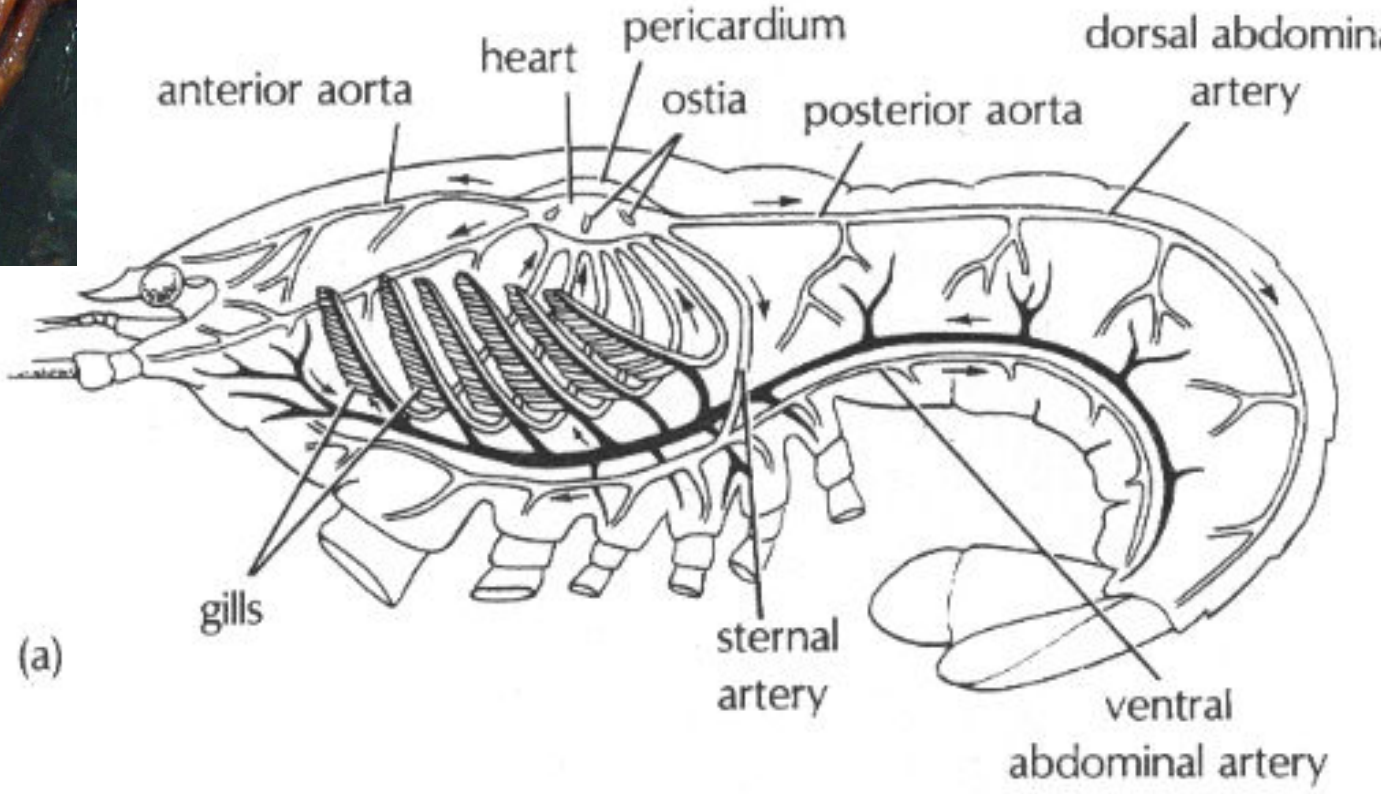
  - **heart** (ventricle + 2 atriums) + **branchial hearts**



- **arthropods**

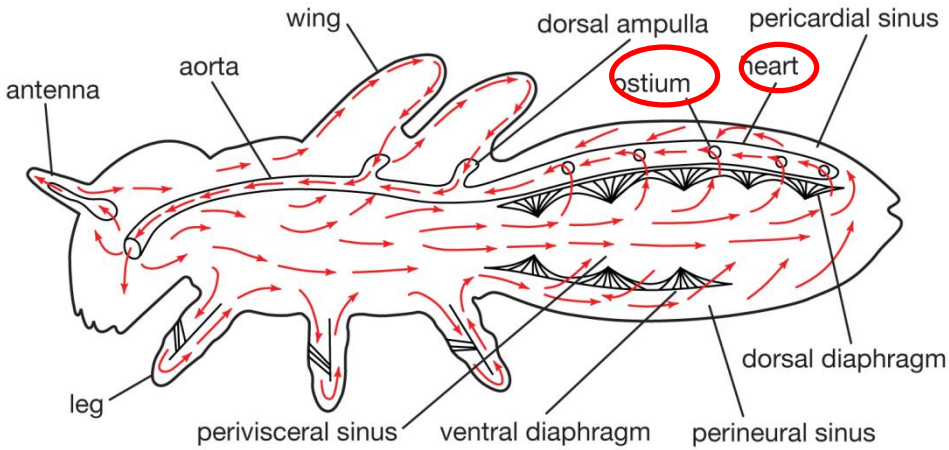
crustaceans

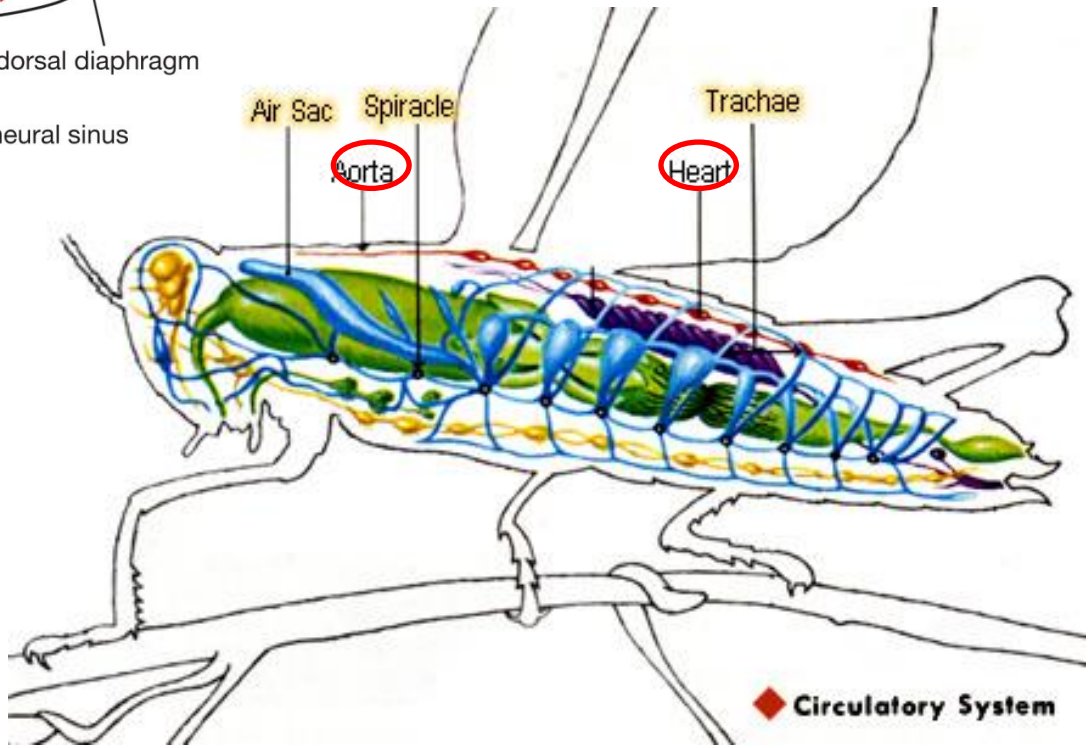




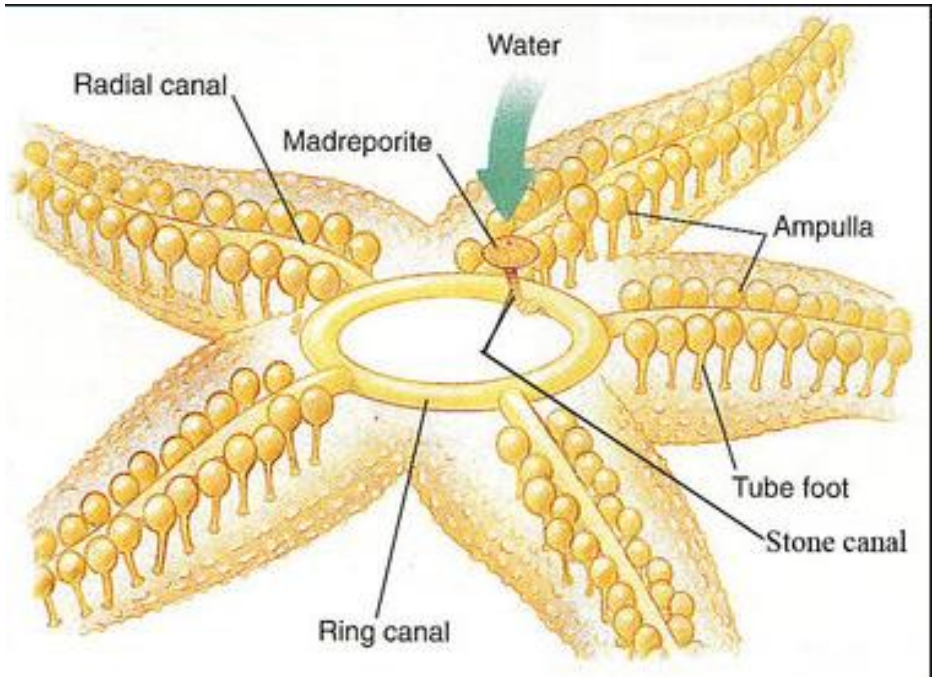
- **arthropods:**

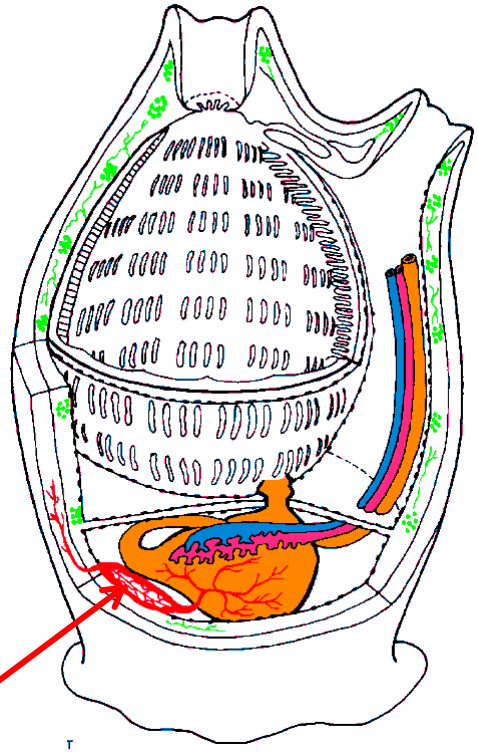
insects





•Echinoderms – not developed well = ambulacral system





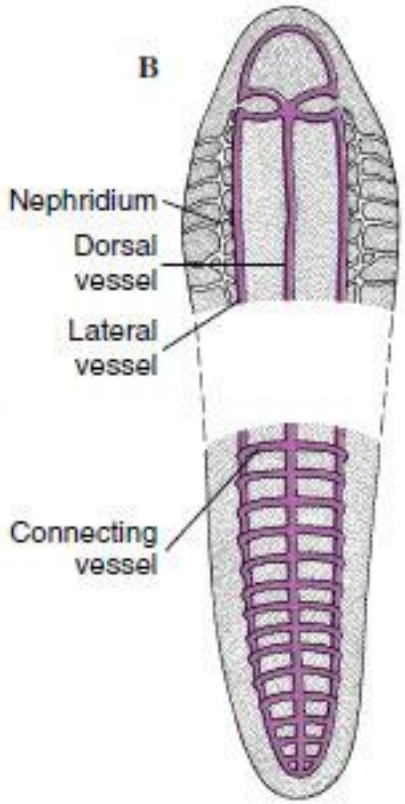
Phylum Chordata – subphylum Tunicata & Cephalochordata

- **OPEN SYSTEM**
- Hear change direction of circulation

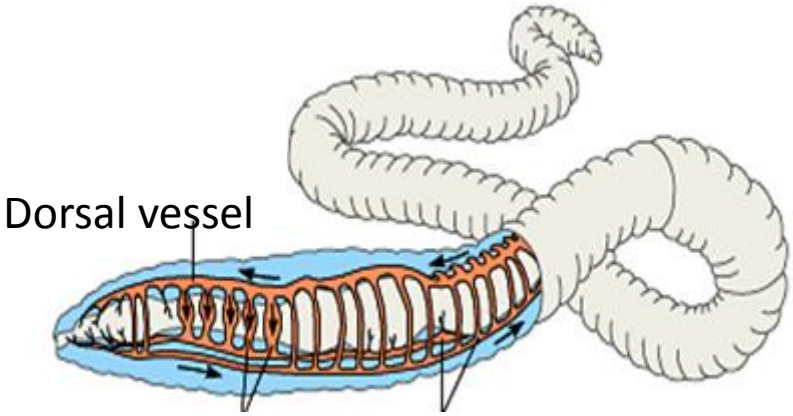
CLOSED CIRCULATORY SYSTEM

invertebrates:

Nemertina (ribbon worms**)** – **the 1. with closed system**



Annelids – coelom fluid and blood



vertebrates:

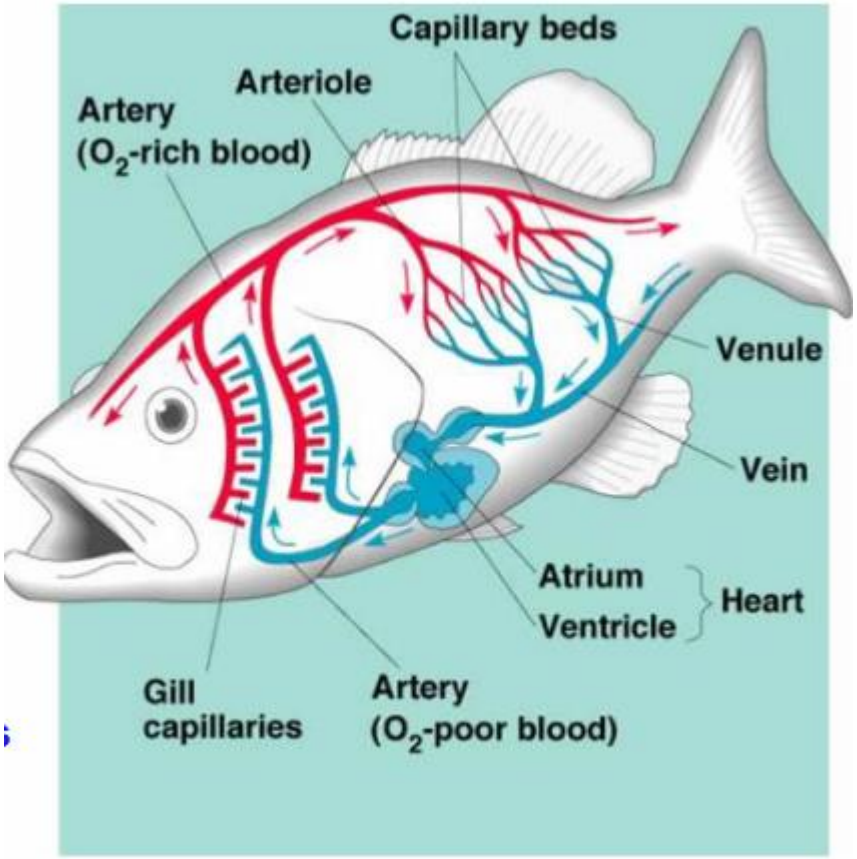
Close system

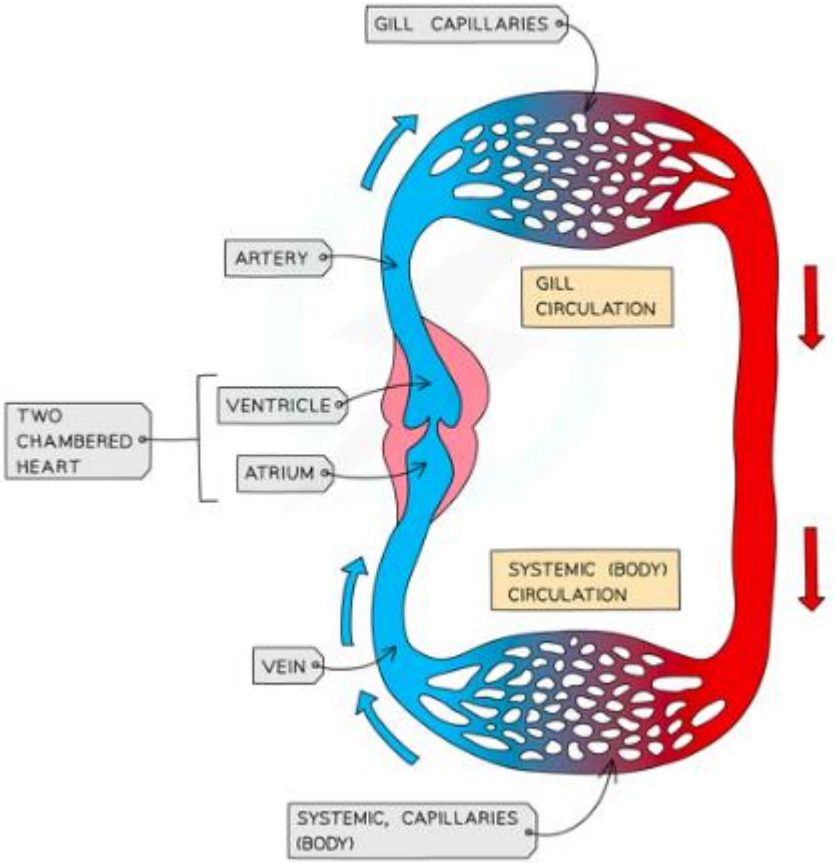
Aquatic - Breathing with gills

1 circulatory „system” = single-loop

Deoxygenated blood into heart

(1 atrium, 1 ventricle)

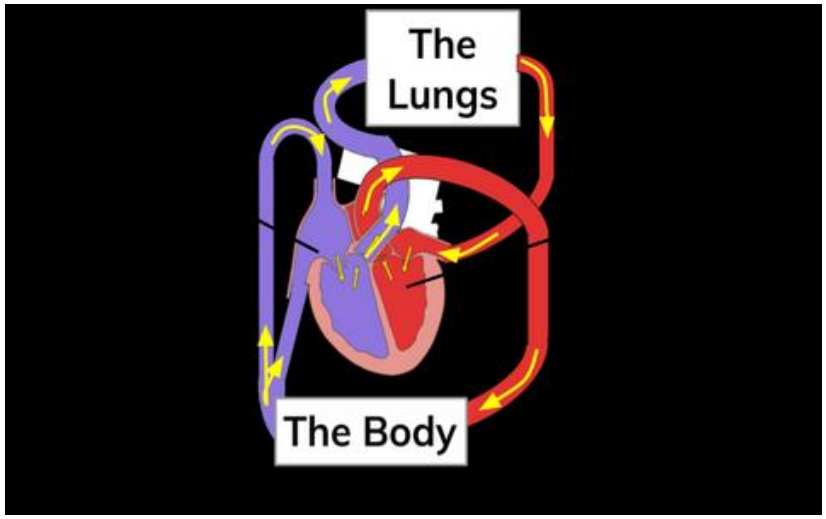




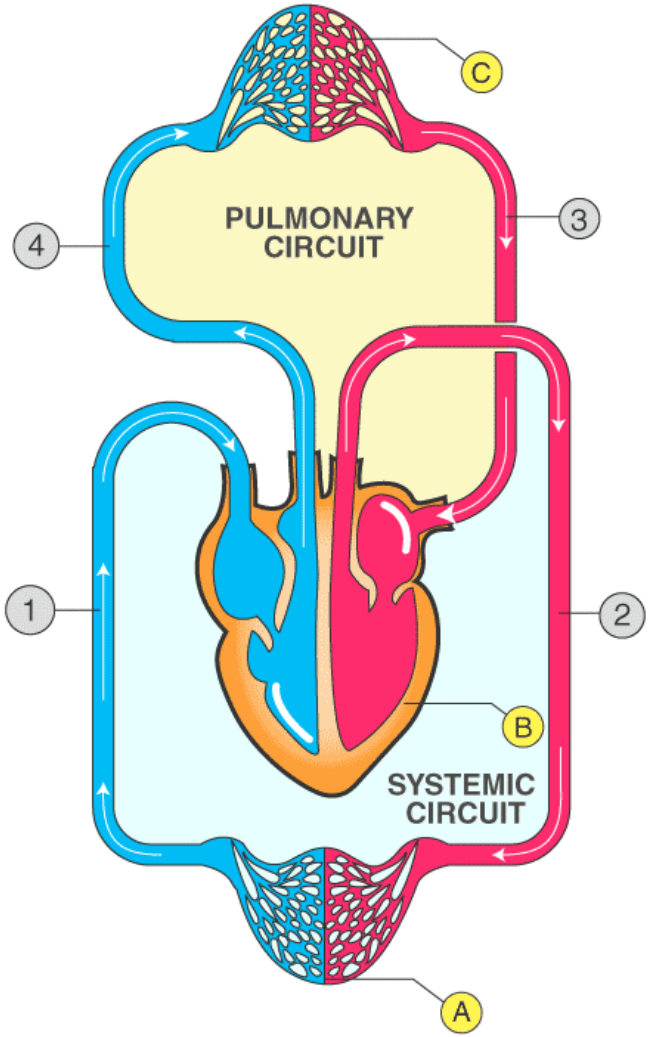
vertebrates:

<u>Terrestrial – breathing with lungs</u>

2 circulatory „systems” = double loop



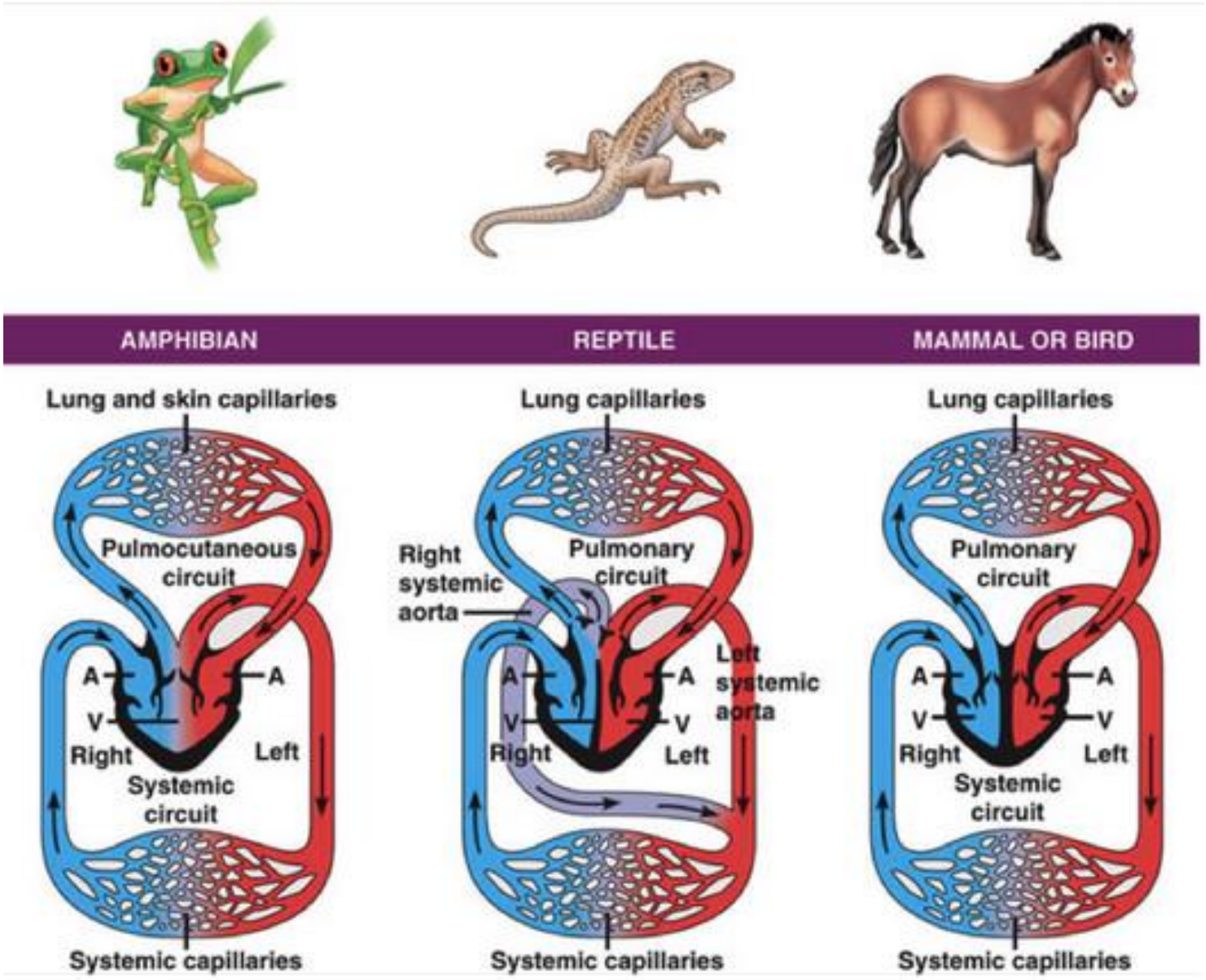
DOUBLE CIRCULATION



1. Vena cava from body
2. Aorta to body
3. Pulmonary vein from lungs
4. Pulmonary artery to lungs

A. Capillaries of body organs apart from the lungs
B. Heart
C. Lung capillaries

-When oxygen. blood started to return to heart – heart started to split into „arterial part” and „veine part”



▶ Vertebrates also posses lymphatic system:

- **The lymphatic system is a network of tissues, vessels and organs that work together to move a colourless, watery fluid called lymph back into the circulatory system (veins)**
- **remove cell parts, bacteria, fat (synthesised in the intestines)**
- **other main function is that of immune defence**
- Complementing venous part of the circulation

The cells of the lymph are mostly **lymphocytes**. Associated lymphoid organs are composed of lymphoid tissue, and are the sites either of lymphocyte production or of lymphocyte activation. These include the **lymph nodes** (where the highest lymphocyte concentration is found), the **spleen**, the **thymus**, and **the tonsils**.

lymphatic system is not a closed system