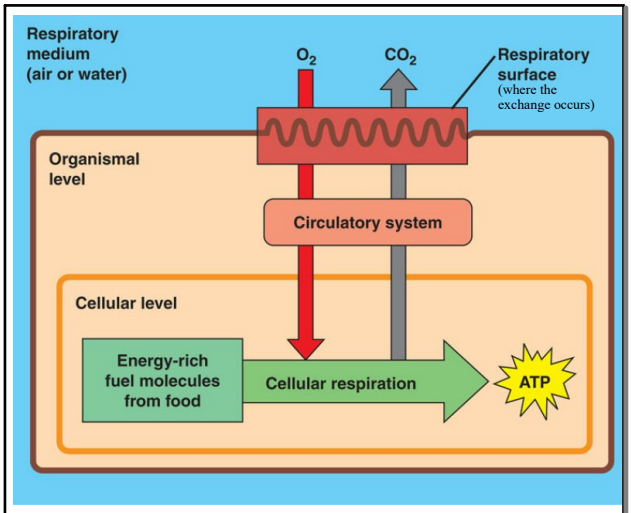
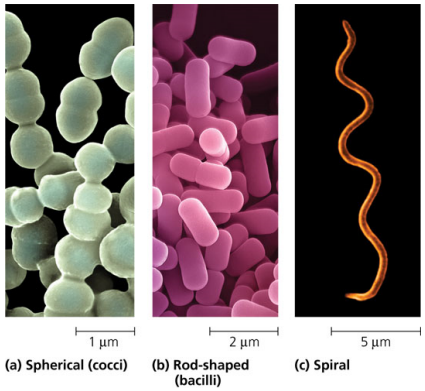


Big Picture



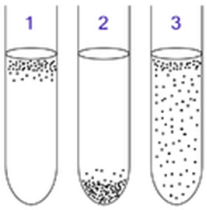
Why don't bacteria need a circulatory system?

- every cell is surrounded by fluid
- cells are small so diffusion is sufficient

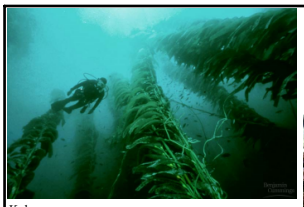
Shapes

Some bacteria don't use oxygen at all.

Bacteria are in three different groups depending on their tolerance for oxygen.
1. obligate aerobes
2. obligate anaerobes
3. facultative aerobes



Respiration in bacteria



Kelp

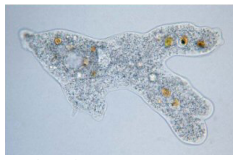
Most protists are:
- single-celled
- aquatic

Do they require a circulatory system?

Slime molds

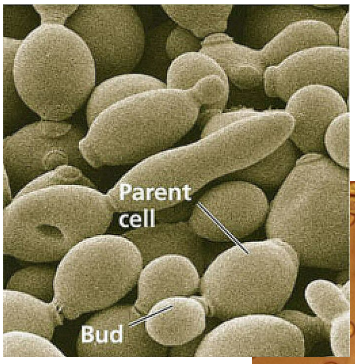
Molds and mildews

Paramecium



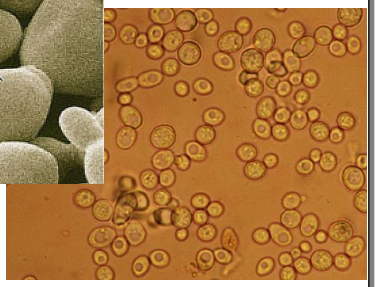
Amoeba moving

Protists



Yeasts are single-celled fungi

Do they need a circulatory system?



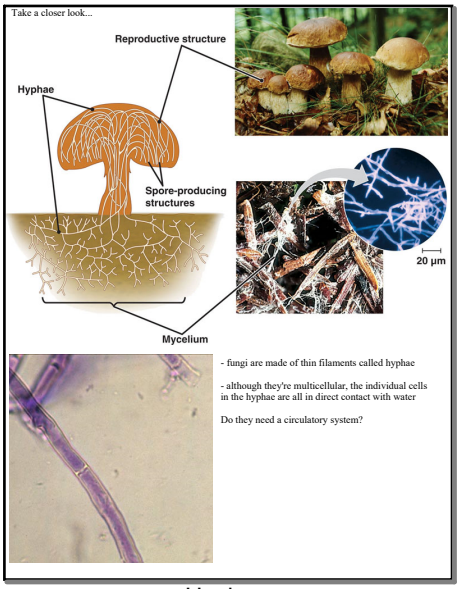
Yeast

Most fungi are large and multicellular

Do they require a circulatory system?

Fungal diversity

Take a closer look...



- fungi are made of thin filaments called hyphae

- although they're multicellular, the individual cells in the hyphae are all in direct contact with water

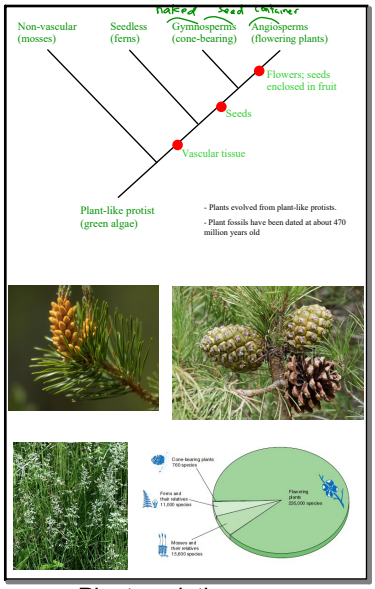
Do they need a circulatory system?

Hyphae

1. Why do some organisms require a circulatory system while others do not?

2. Seaweeds can attain large sizes without the presence of support or vascular tissue while mosses cannot. Why did the transition to a terrestrial lifestyle for plants require a system of transport?

CQ



- Plants evolved from plant-like protists.

- Plant fossils have been dated at about 470 million years old

Plant evolution

Liverworts

Mosses

- these plants have no system for transporting water or nutrients

- therefore, less support

Hornworts

Back

Nonvascular

- these plants have a system through which they can transport water and nutrients throughout the plant

- reproduce using spores

Back

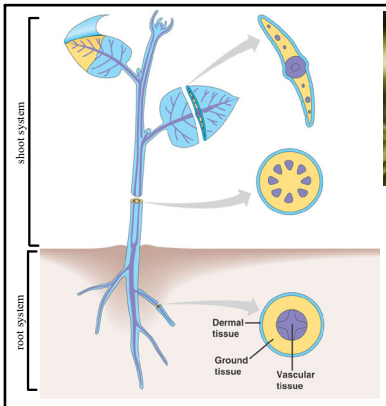
Ferns

- large plant-like protists (*i.e.*, seaweeds) are surrounded by water and nutrients so most cells can just absorb them from the environment

- terrestrial plants require a system for collecting and transporting water

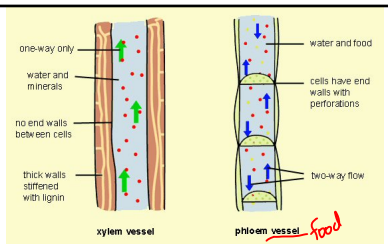
- water and minerals from the roots can travel to all parts of the plant and food made in the leaves can travel to nonphotosynthetic parts of the plant.

Roots



- the vascular tissue conducts materials throughout plant
- mosses (and other nonvascular plants) lack vascular tissue so they must remain small and grow close to their water source

Tissues



- cells are dead at maturity
- hollow cells form a continuous channel through the plant from the roots to the leaves
- conduct water and minerals upward from the roots.
- hard walls which provide support to the plant

- carry sugar from where it is made to nonphotosynthetic parts of the plant
- cells are softer than xylem and are living at maturity.

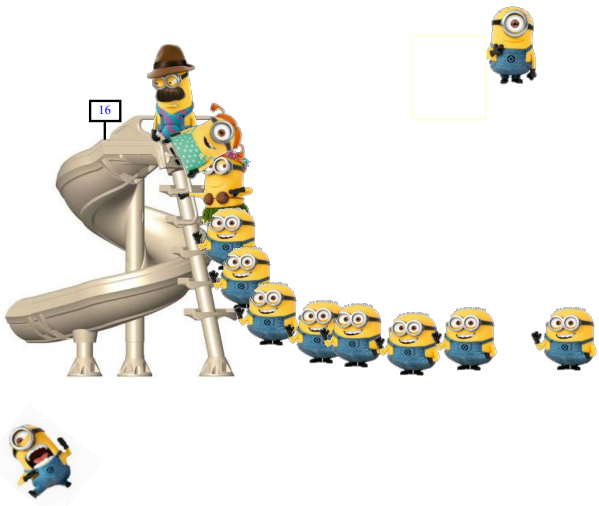
Xylem and phloem

3. Root hairs are small structures on roots that increase the surface area of the root. Why is it important for root hairs to develop soon after germination?

4. Explain why xylem and phloem together can be considered a transport system.

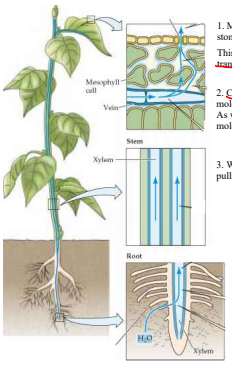
5. Cork is a tough, waterproof tissue that replaces the epidermis in some plants. Older roots become covered in cork as they mature. Explain. Would you expect both young and old roots to have vascular tissue? Explain.

CQ



Transpiration

Why do plants need water?
- for photosynthesis



1. Most water absorbed by roots is lost through the stomata in the form of water vapor.
This loss of water from the leaves is called transpiration.

2. Cohesion - the attraction between water molecules.
As water molecules exit stomata, they pull water molecules xylem in the leaves.

3. Water moving through the leaf xylem pulls molecules from the stem.

4. Water moving through the stem pulls molecules from the roots.
- pulling = tension

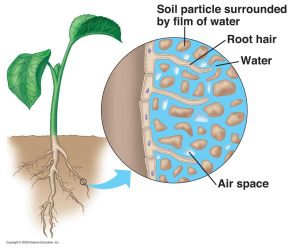
This process is called transpiration-cohesion-tension

Why is this a problem for plants?
- they lose lots of water through the stomata

Why not close the stomata?
- they must exchange O_2 and CO_2 with the air
- they try to achieve gas exchange without also losing too much moisture from their leaves

Why does water move into the roots?

Movemenet of water



- most water enters through root hairs (huge surf. area)
- the solutes in root hairs maintain the movement of water into the roots by osmosis
- this is called root pressure
- transpiration-cohesion-tension then keeps the water moving upward through the plant

- solutes in the roots are taken from the soil by active transport.

[solute]?
[solute]?

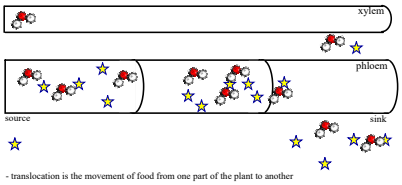
Root pressure

6. How does the cooperation of transpiration-cohesion-tension theory and root pressure result in water moving throughout the entire plant?

7. If you were able to inject some air bubbles into the xylem vessels of a tree, what would happen?

CQ

Translocation (pressure-flow hypothesis)



- translocation is the movement of food from one part of the plant to another
- it is described by the pressure-flow hypothesis
- sugar is loaded into phloem cells in a leaf by active transport
- water follows by osmosis, increasing the pressure in the phloem tube
- the pressure pushes the sugar solution through the phloem
- as more sugar is loaded in and more water enters, the process continues
- as the solution moves throughout the plant, cells that need the sugar remove it from the phloem\
- water moves out by osmosis
- this makes space for more solution to flow to those cells

- loading and unloading the sugar requires energy but the movement of the solution is passive
- the result is that the sugar made by photosynthesis moves throughout the plant from where it is made (the source) to where it is stored or used (the sink)

Phloem loading

Translocation

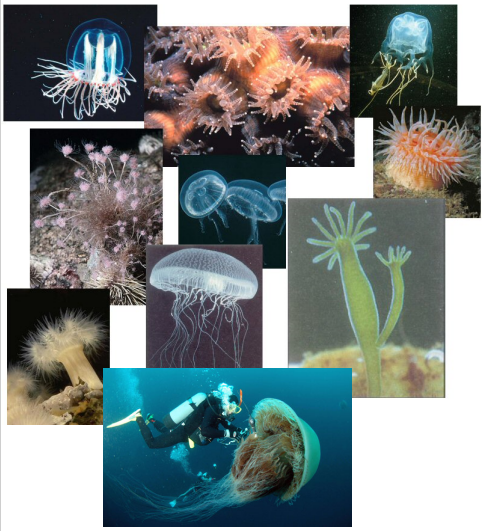
8. Explain the pressure flow hypothesis.

9. Why are maple trees tapped in early spring rather than in summer or autumn?

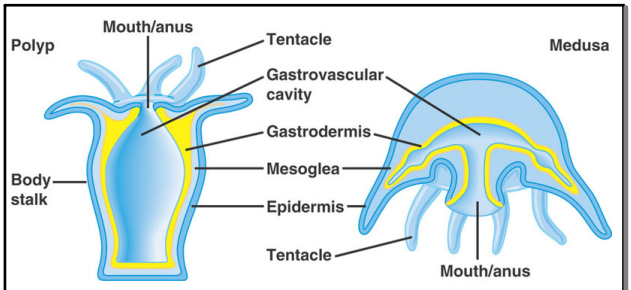
10. Explain the compromise the plant has to make between photosynthesis and water conservation.

CQ

Cnidaria



Cnidarian diversity

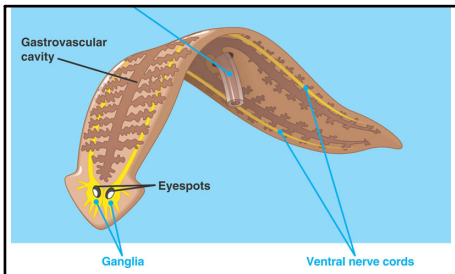


Jellyfish Swimming

Body forms

Platyhelminthes

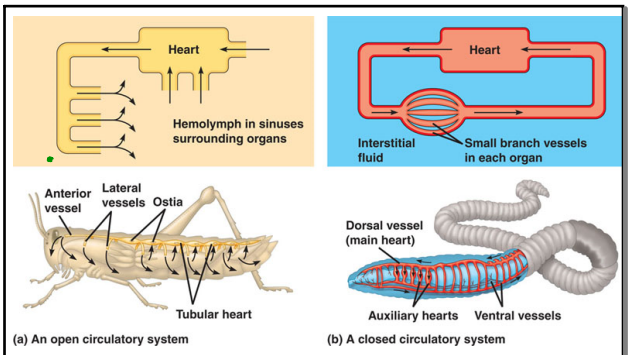
Platyhelminthes diversity



Is there anything like a circulatory system?

- not really, but the gut branches which helps distribute nutrients

Planarian

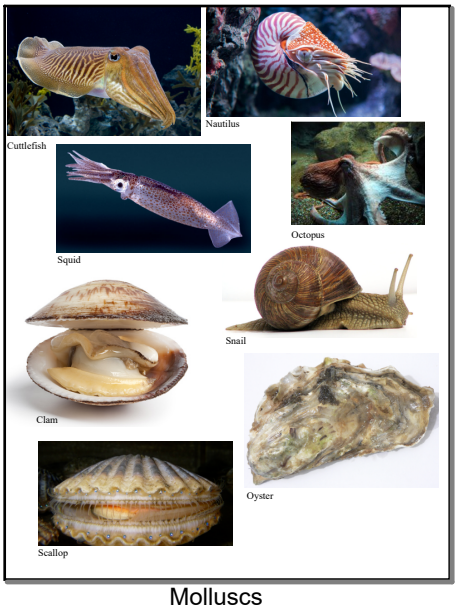


(a) An open circulatory system

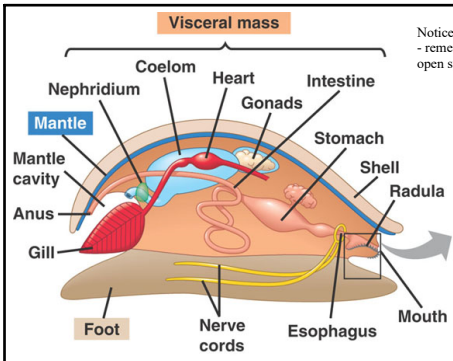
(b) A closed circulatory system

Advantages:
1. blood goes to all cells
2. need less blood

Open and closed



Molluscs



Notice the open circulatory system - remember that arthropods have a open system as well

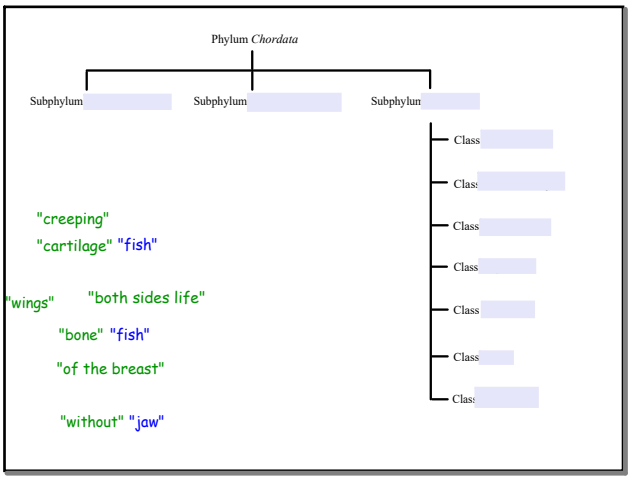
Snail internal

11. Why are open circulatory systems found mostly in animals that are small?

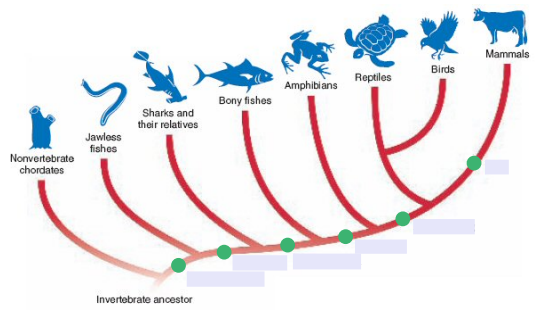
12. Some organisms have a circulatory system with blood but the blood has no hemoglobin.
a) What is the function of the blood in these organisms?
b) Why is it an advantage to have hemoglobin in the blood?

Update your charts.

CQ



Subphyla and classes

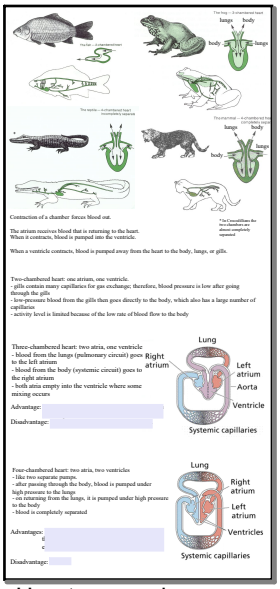


Cladogram

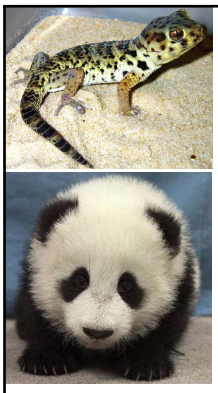
Evolutionary trends in vertebrates

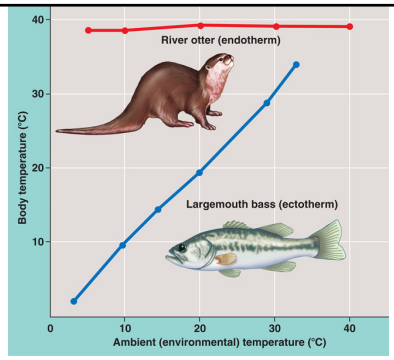
Lifestyle	
Heart	
Cerebrum	

Trends in vertebrates



Heart comparisons

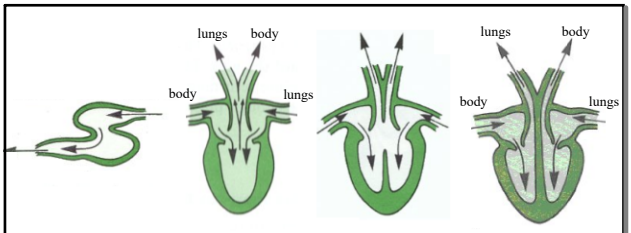




What's the advantage?
1.
2.

What's the cost?

Endo/Ecto



	Fish	Amphibian	Reptile	Bird/mammal
# chambers				
blood pressure				
blood mixing				
ecto-/endothermic				

Heart Summary

13. How is circulation through two loops (as in amphibians, birds, and mammals) superior to circulation through just one (as in the fishes)?

14. The blood that enters the lungs of an amphibian has relatively (more, less) oxygen than the blood that enters the gills of a fish. The reason for this is that the blood that goes from an amphibian's heart to its lungs is _____ . The blood that is carried to all organs of a fish's body is _____ . The blood that is carried to the fish's gills is _____ . The blood that is carried to the organs of an amphibian is _____ .

15. Why is the three chambered amphibian heart not as efficient as a four chambered heart?

CQ

What do we already know?

What is the composition of air?
Dry air = 78% N_2 + 20% O_2 + 0.93% Argon + 0.04 CO_2

What is the purpose of gas exchange?
Obtain oxygen and get rid of carbon dioxide

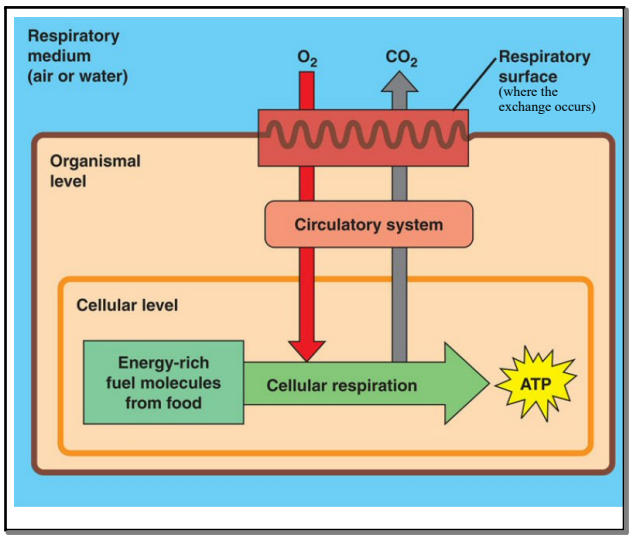
Why do we need Oxygen?
Most cells obtain energy from organic compounds using cellular respiration
$C_6H_{12}O_6 + 6O_2 \longrightarrow 6H_2O + 6CO_2 + 36ATP$ (energy)

What characteristics should the exchange surface have for efficient diffusion?
Large surface area and moist

Why do the gases diffuse?
The difference in oxygen concentration between the interior of the organism and the external environment

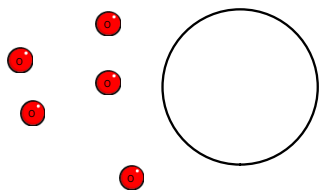
How are gases distributed?
The circulatory system

Some background



Big Picture

How does gas exchange occur?



- diffusion across membranes

- exchange surface must be wet

- remember the importance of surface area and volume

- diffusion is too slow for large organisms

- a circulatory system is needed to get materials (including O_2) to every cell and to carry away wastes

Diffusion

16. What purpose is served by the respiratory system?

17. Why do organisms require oxygen?

18. a) Why do some organisms require a respiratory system while others do not?
b) Why is a respiratory surface an important part of the respiratory system?

CQ

Evolution of Complex Respiratory Systems
What were the trends we saw in kingdom animalia regarding respiratory systems?

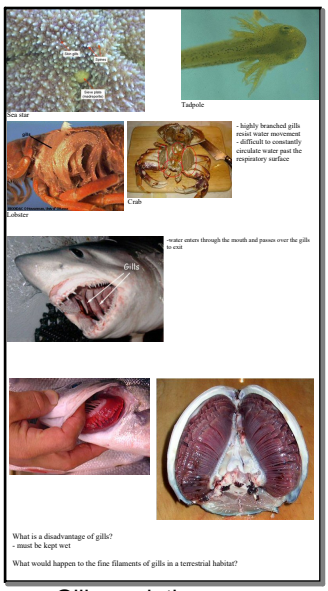
- most primitive phyla do not possess special respiratory organs
- they get oxygen by creating a water current to constantly replace water over the diffusion surface
- protists and simple animal phyla are small enough for simple diffusion to work for them

What is a better method of getting oxygen for larger organisms?
- respiratory organs with an increased surface area over which diffusion occurs

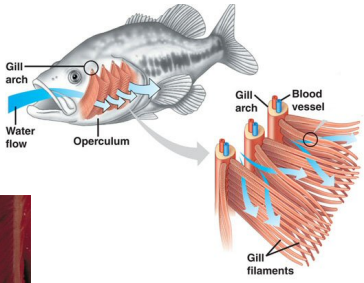
What does this larger surface area enable?
- getting more oxygen from the environment
- provides contact between the external environment and internal circulating fluids (*e.g.*, blood)

How do we increase the surface for exchange?
-respiratory organs
- gills
- lungs

Evolution of systems



Gills evolution

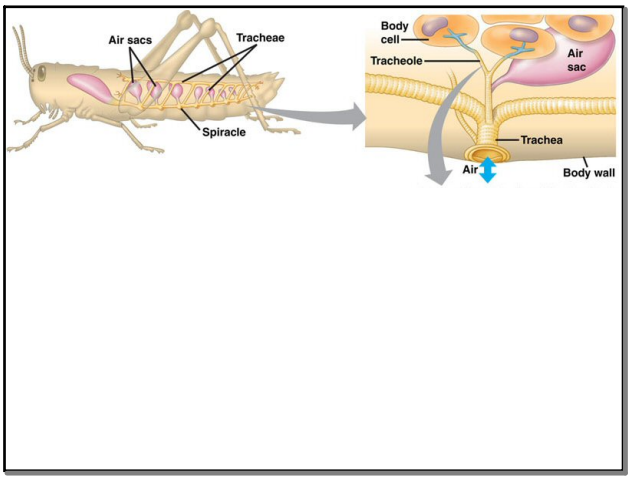


- gills extract dissolved oxygen from the water moving over them

- water is brought in through the mouth and passes over filaments rich in blood vessels which provide a huge surface area

- water is then forced out slits in the side of the throat

Fish gills



Tracheal systems

19. Why are gills necessary in more complex organisms such as molluscs?

20. There is far more O_2 in the air than in an equal volume of water. Despite this fact, the gills of a fish are able to extract sufficient O_2 from the water but not from the air. Hence, a fish out of water suffocates. Explain why this is so.

21. a) What is a tracheal respiratory system?
b) Why is it an advantage?
c) Why is this especially important for flying insects?

CQ

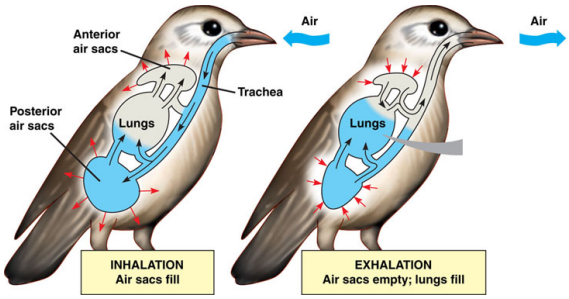
Terrestrial organisms constantly lose water to the atmosphere.
Why would this make gills even more inefficient for terrestrial animals?
- huge surface area for water loss

Amphibians
Simple lungs that are not very efficient
Offset by: High Oxygen concentration in the air
Diffusion of gases through the skin
Less active and ectothermic → decreased O_2 demand

Reptiles
More active → Greater need for oxygen
Watertight skin → Cannot obtain O_2 through skin
More developed lungs → Larger surface area

Mammals
Very active and endothermic → Require a large amount of oxygen

Development of lungs



Inhalation (both air sacs)
- posterior sacs fill with fresh air from outside
- anterior sacs fill with stale air from lungs

Exhalation (both sacs deflate
- air from the posterior sacs enters the lungs
- air from anterior sacs goes out the trachea

Bird respiration

22. a) Why are amphibians considered to be transitional between fishes and terrestrial vertebrates?
b) What adaptations allowed amphibians to colonize the land?
c) What features of the frog restrict them to living near the water?
d) State the advantage and disadvantage of using the skin as a respiratory surface.

23. How has the respiratory system of birds developed over that of other vertebrates?

24. Why is the respiratory surface for terrestrial organisms inside rather than outside the body?

CQ

Attachments

amoeba.m1v

Amoeba eats paramecia.mp4

Jellyfish Swimming.m1v