Circulation and Gas Exchange

III

Circulatory System

- Open vs. closed circulatory systems
- Hemolymph vs. blood
- Artery, capillary, vein
- 2-, 3-, 4- chambered heart
- Pathway of circulation
- Atrium
- Ventricle

Circulatory Systems

- Two types: open and closed
- Used to transport oxygen to cells and waste carbon dioxide away.
- Also transport of other substances such as hormones, glucose, nitrogenous wastes

Open circulatory system

- Found in invertebrates such as clams and insects

- Heart pumps fluid to through vessels out to body into spaces called sinuses.
- Fluid in sinuses bathes cells and organs.

- Hemolymph collecting in sinuses can be drawn back into the heart.
- Body movements can aid circulation by squeezing sinuses and pushing blood back into the heart.
Example of open circulation

• Found in earthworms (annelids), squids & octopus (cephalopods), vertebrates

• Fluid (called blood) stays in the vessels
• Smaller branching vessels supply tissues

Example of closed circulatory system: Earthworm

The annelid worm Riftia pachyptila

Riftia pachyptila anatomy
Compare and contrast open vs. closed

- Open less effective at circulating all the fluid
- Doesn’t matter if metabolism is slow, e.g., clams
- Insects use trachael system to supply oxygen and get rid of carbon dioxide

Closer look at closed circulatory system

- Also called cardiovascular system: heart, blood vessels, blood
- Three main types of blood vessels
  - Arteries, capillaries, veins
Blood vessels some major points

• Arteries are thicker walled, veins have valves

Blood vessels some major points

• Arteries transport blood AWAY from heart, veins TOWARDS heart
  – Doesn’t necessarily correlate with oxygenated vs. deoxygenated blood

Fetal hemoglobin important points

• Oxygen binding curve shows how hemoglobin binds increasing amounts of oxygen as oxygen concentration increases
• Fetal hemoglobin binds oxygen more strongly than mother hemoglobin so that the fetus can get oxygen from mother’s bloodstream
HemoglobinBohr shift

- Important points:
  - Hemoglobin binds less tightly to oxygen when CO2 is high. This is the condition found in respiring tissues like muscles.

The vertebrate circulatory system - types of hearts

- Two chamber - fish
- Three chamber - amphibians
- Four chamber - mammals, crocodiles

First a few things about amphibian respiration

- Involves both lung and surface respiration

Gas exchange structures

- Surface only (very small organisms ≤ 1 mm)
- Gastrovascular cavity (hydra, jellyfish, also flatworms)
- Gills, tracheal systems, lungs
- Mixture of the above

Some divers breathe through their skin
Lake Titicaca frog [http://www.youtube.com/watch?v=j06d2CjolcI](http://www.youtube.com/watch?v=j06d2CjolcI)
Telmatobius culeus

http://www.youtube.com/watch?v=6mzscdhAymM

2-chamber

3-chamber

4 chamber
Summary

- Respiratory surfaces and types of circulatory systems reflect the lifestyle and size of the organism
- Investigated last type of respiratory surface, the lung.
- Different types of circulatory systems
- Next time: Nutrition

Transposition of the great blood vessels

Willo the dinosaur with a 4 chambered heart

Willo belongs to the Ornithischian, or "bird-hipped" line of dinosaurs. It is a Thescelosaurus, a plant-eater with teeth like salad tongs, ideal for browsing vegetation in its riparian forest habitat. Thescelosaurs lived during the late Cretaceous, and ranged from Wyoming and the Dakotas northward into Alberta, Canada. The species is uncertain, but believed to be T. neglectus. It was about 13 feet (4 meters) long and about 665 pounds (300 kg) in the flesh. Its gender is unknown.

http://www.dinoheart.org/fastfacts/index.html
http://www.dinoheart.org/insideout/index.html