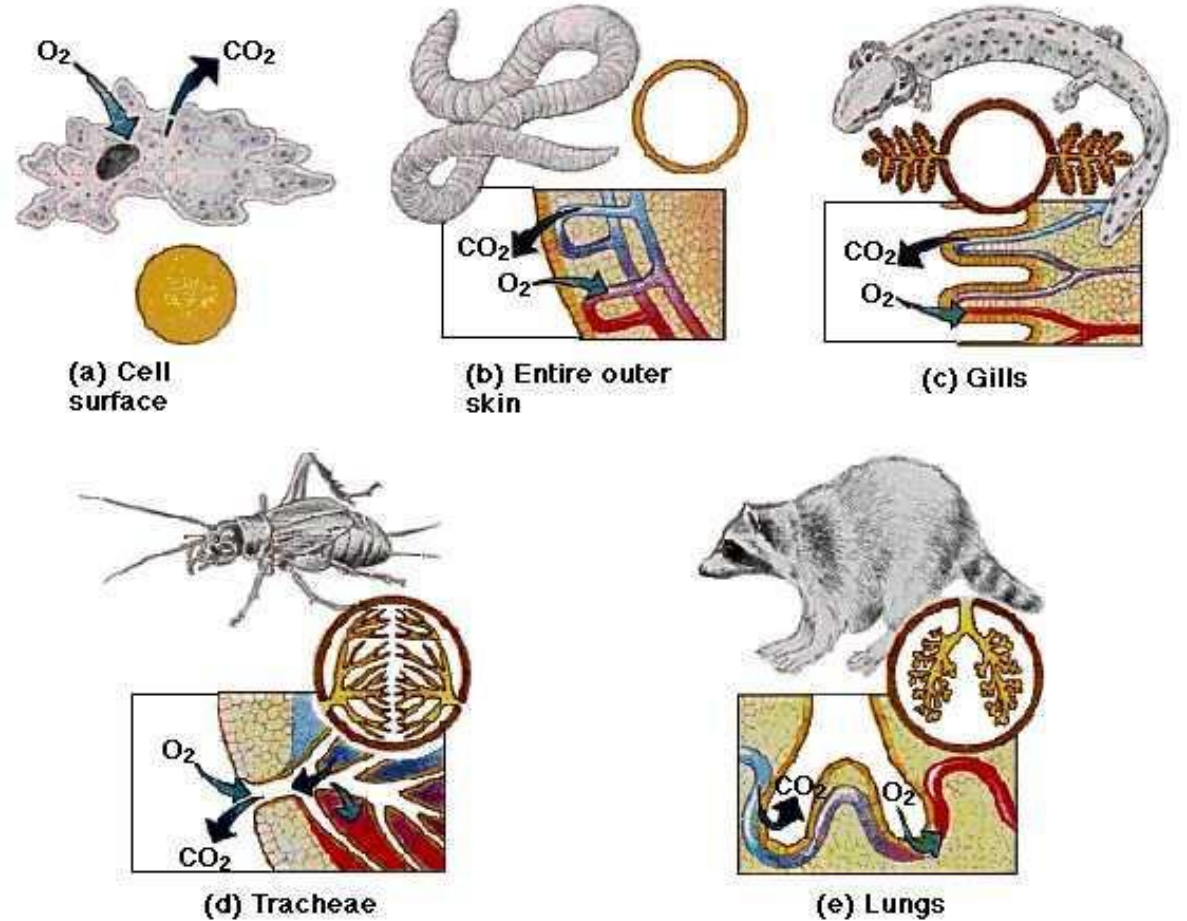


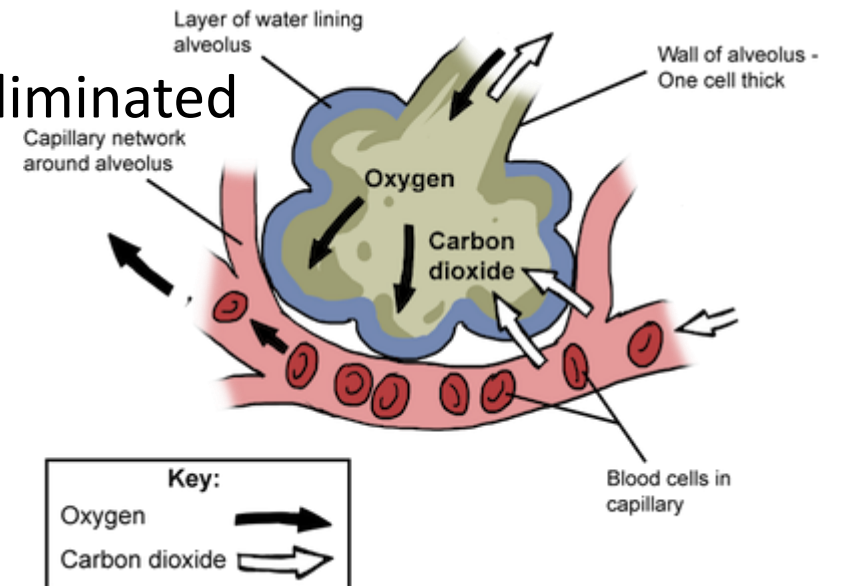
# How Do Animals Breathe and Transport Materials?

## Lesson 11



# How do animals respire and transport materials?

- To obtain the energy in food, all animals must carry out chemical reactions
- In these reactions...
  - Food molecules join with oxygen
  - Energy is released
  - Carbon dioxide is formed as a waste product and eliminated
- The process of gas exchange (oxygen in, carbon dioxide out) is called respiration

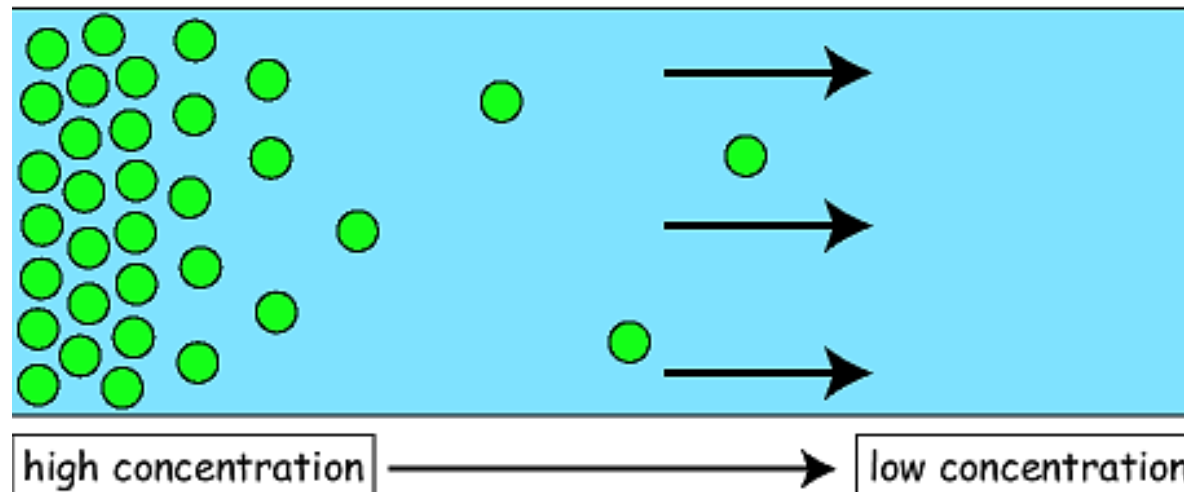
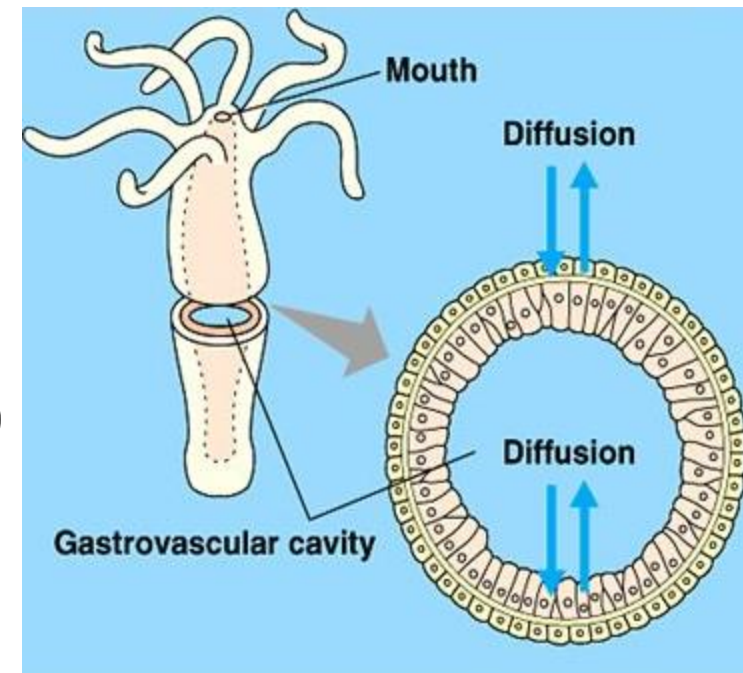


# Gas Exchange in Simple Animals

Animals respire in different ways

**Example:** sponges and cnidarians (i.e. jellyfish, hydra)

- Their body wall is made of just 2 cell layers
- Water outside the animal touches the cells in one layer
- Water inside the animal touches cells in the other layer
- Both layers of cells get oxygen and get rid of carbon dioxide by **diffusion**
  - **Diffusion** = movement from an area of high concentration to an area of low concentration

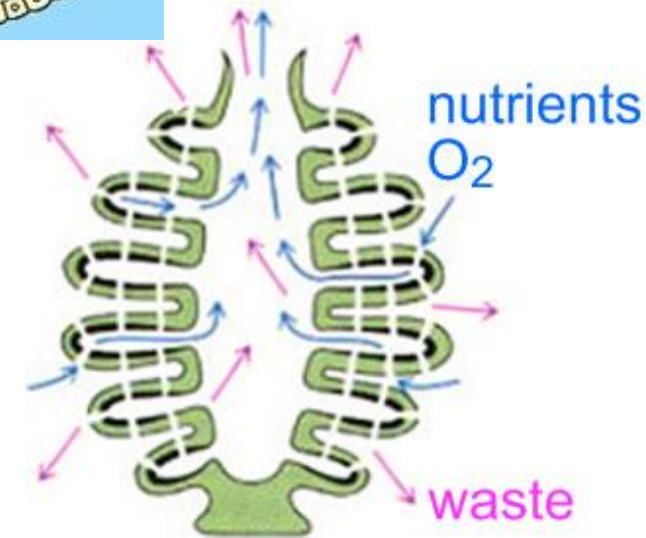
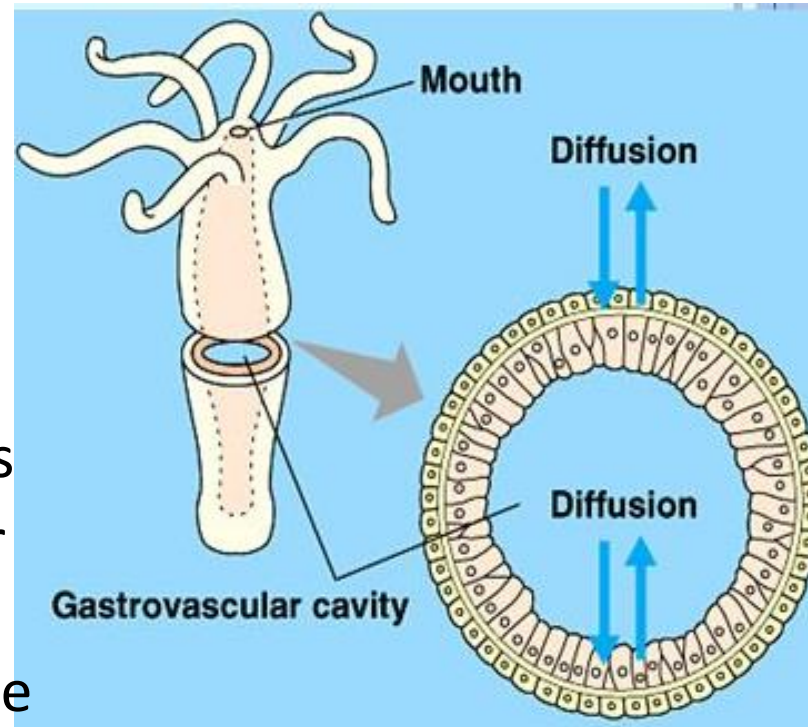


# Gas Exchange in Simple Animals cont'd

Animals respire in different ways

**Example:** sponges and cnidarians (i.e. jellyfish, hydra)

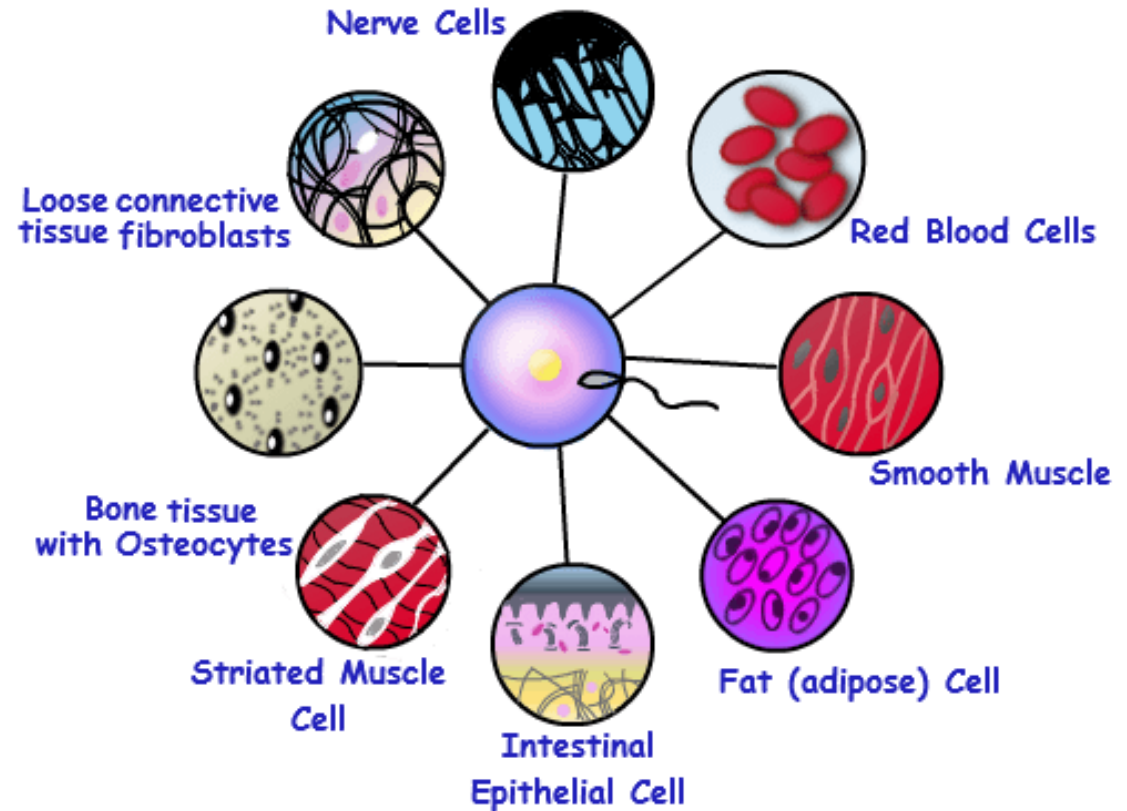
- The concentration of oxygen is higher in the water than in the cells
  - Oxygen diffuses from the water into the cells
- The concentration of carbon dioxide is higher in the cells than in the water
  - Carbon dioxide diffuses from the cells into the water



# Gas Exchange in Other Animals

Animals respire in different ways

- Most animals are not just two cell layers thick
- They contain many cells deep inside the body
- These cells cannot exchange gases directly with the outside environment
- Animals like these must have a special organ for gas exchange
  - Such organs come in many different forms

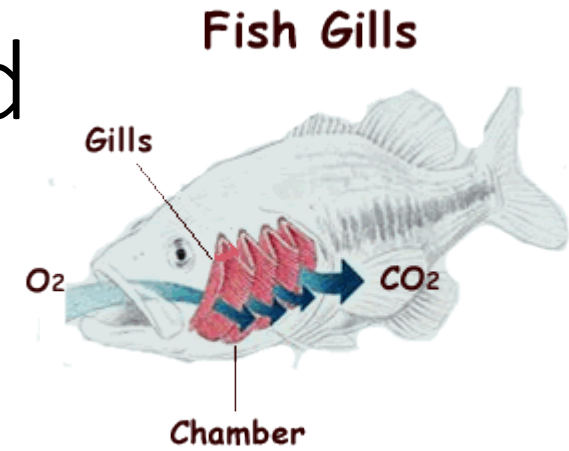




# Gas Exchange in Other Animals cont'd

Animals respire in different ways

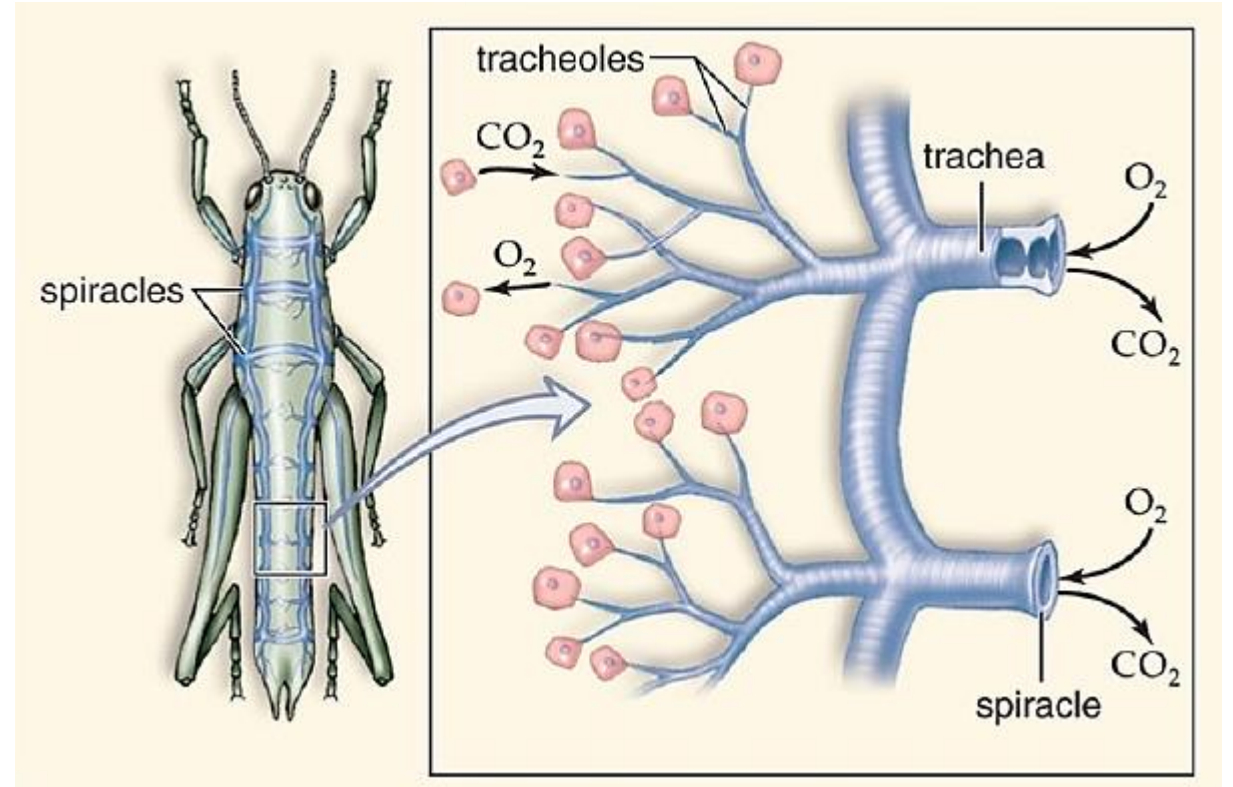
- Animals that live in water usually have gills
  - E.g. fish, tadpoles, lobsters, clams
- Gills often have a feathery structure
  - Provides a large surface area to allow diffusion to happen quickly
  - Oxygen diffuses from the water into the gills
  - Carbon dioxide diffuses in the opposite direction (gills → water)



# Gas Exchange in Other Animals cont'd

Animals respire in different ways

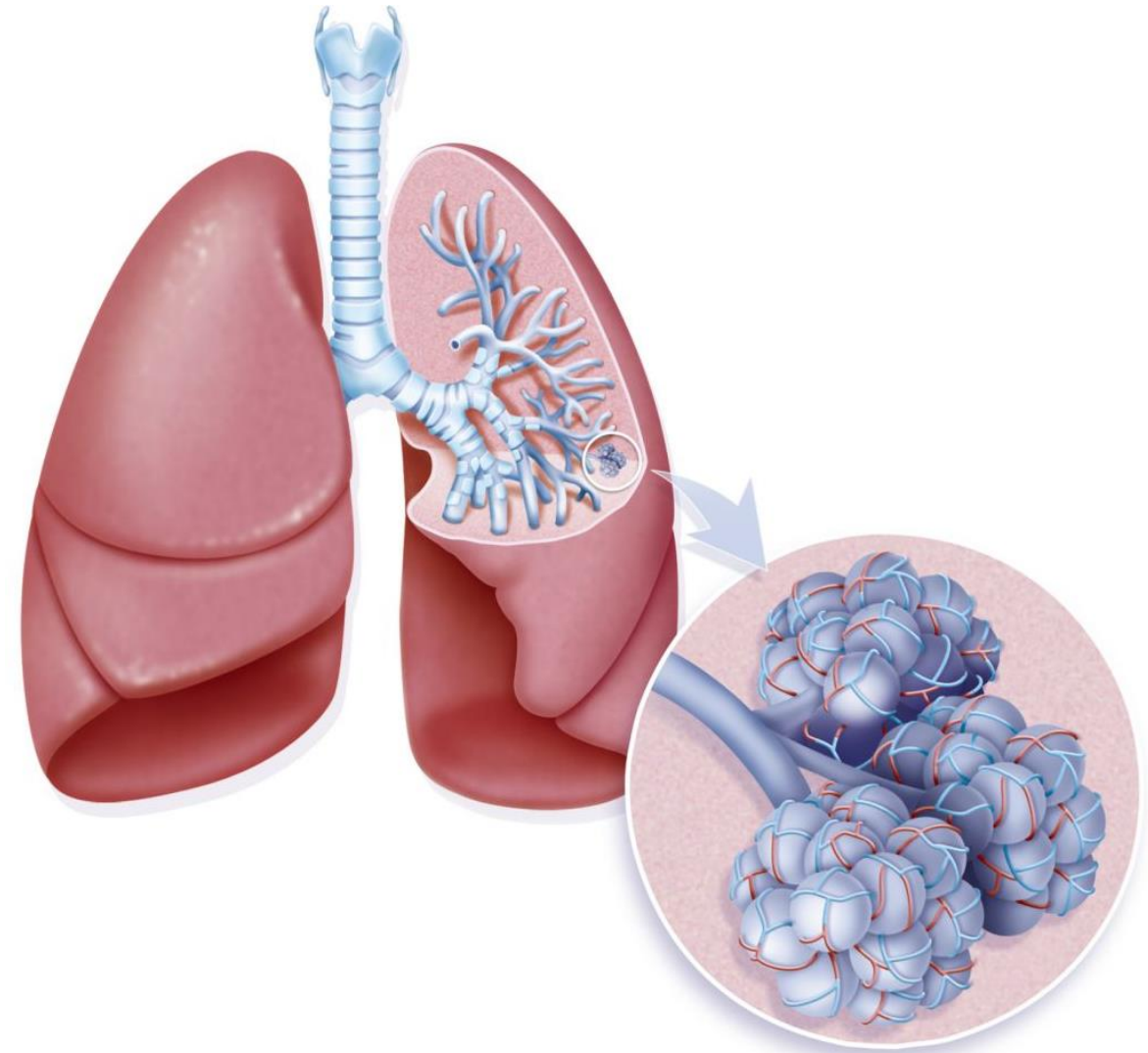
- Land animals exchange oxygen and carbon dioxide with the air
- Insects use a system of tubes to carry air into the body
  - The tubes have very fine branches that reach almost all of the animal's cells
  - The entrances to the tubes are scattered over the insect's body



# Gas Exchange in Other Animals cont'd

Animals respire in different ways

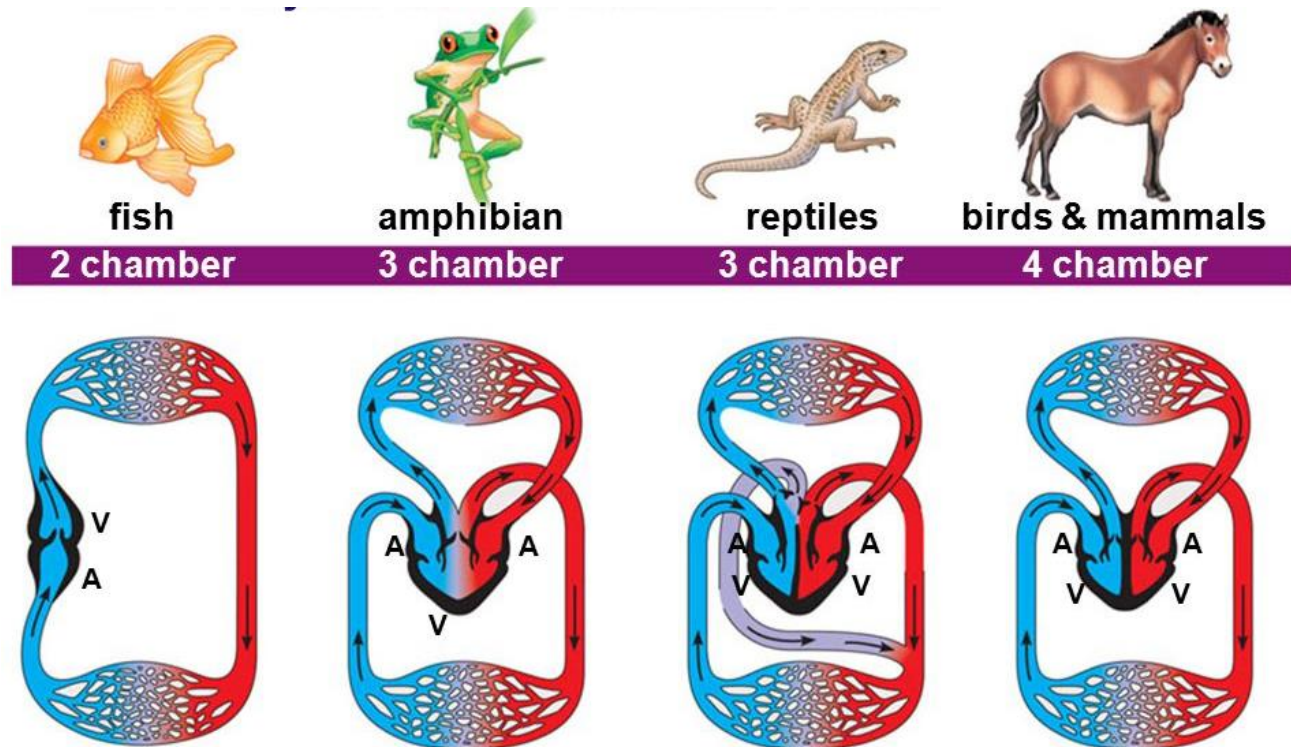
- Most other animals use lungs for gas exchange
  - Lungs are like balloons inside the body
  - When you inhale, or breathe in, you draw air into your lungs
  - Exhaling, or breathing out, forces the air back out
  - Like gills, lungs provide a large surface area for gas exchange



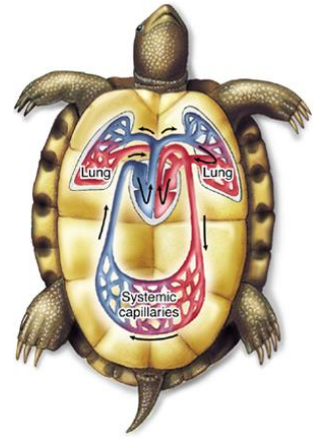
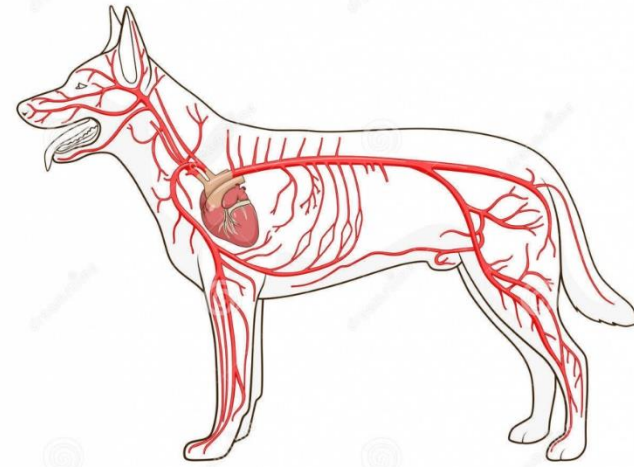
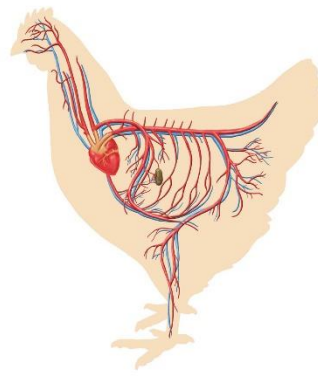


# Circulatory System

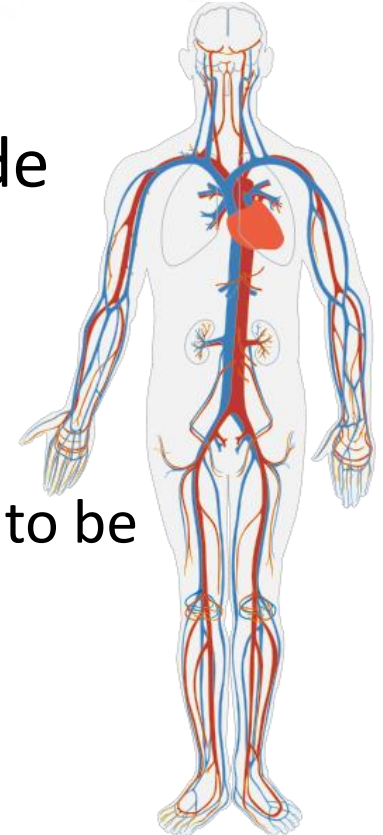
- Animals must transport oxygen from their gills or lungs to the rest of their body
- They must transport carbon dioxide from the rest of their body to their gills or lungs
- A **circulatory** system performs these jobs



# Circulatory System

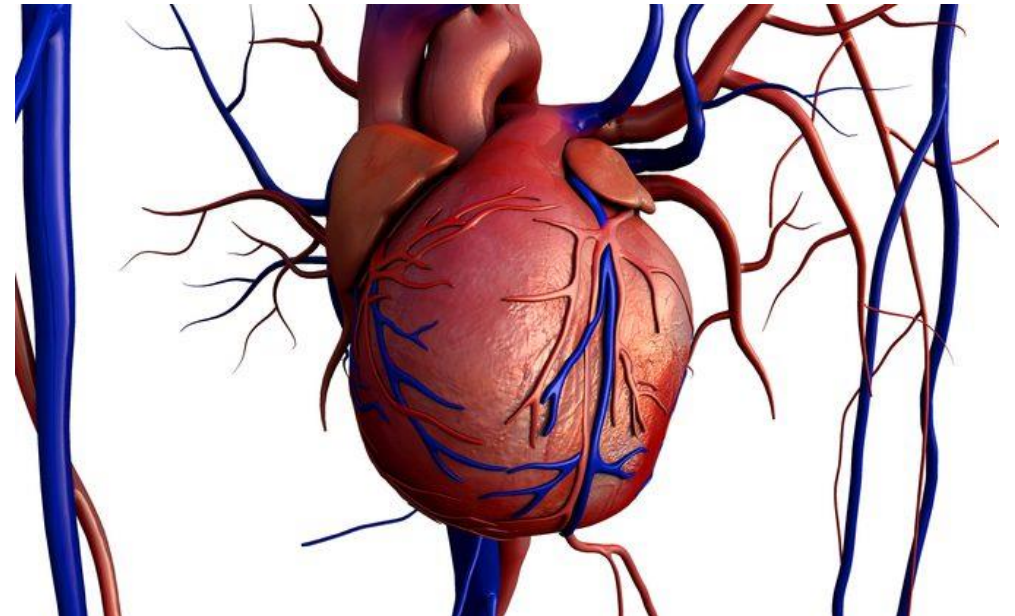


- Circulatory means flowing in a circle
- The circulatory system moves blood through the body
- In the gills or lungs, oxygen enters the blood and carbon dioxide leaves
- As the blood circulates,
  - It delivers oxygen to all the cells in the body
  - Picks up carbon dioxide from the cells to bring back to the gills/lungs to be expelled
  - It also carries nutrients from the digestive tract to cells



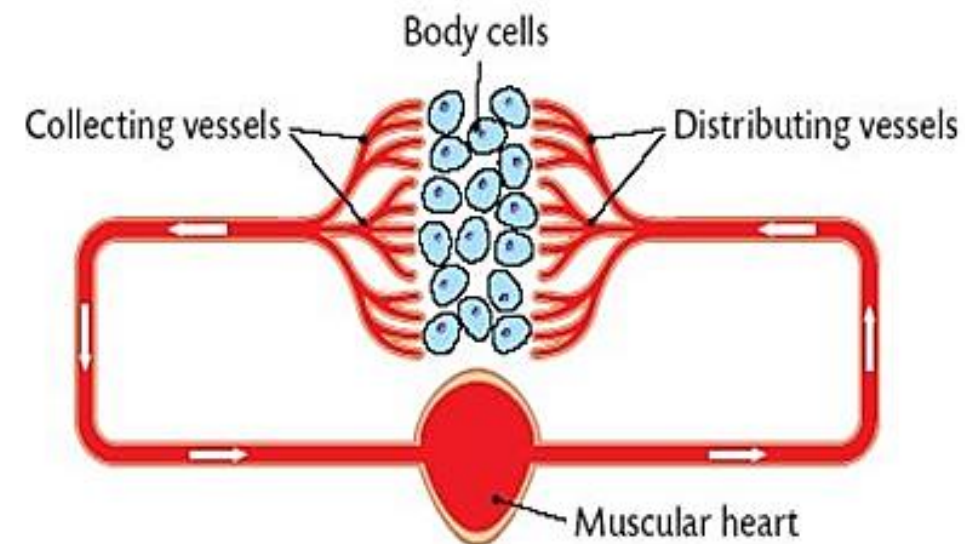
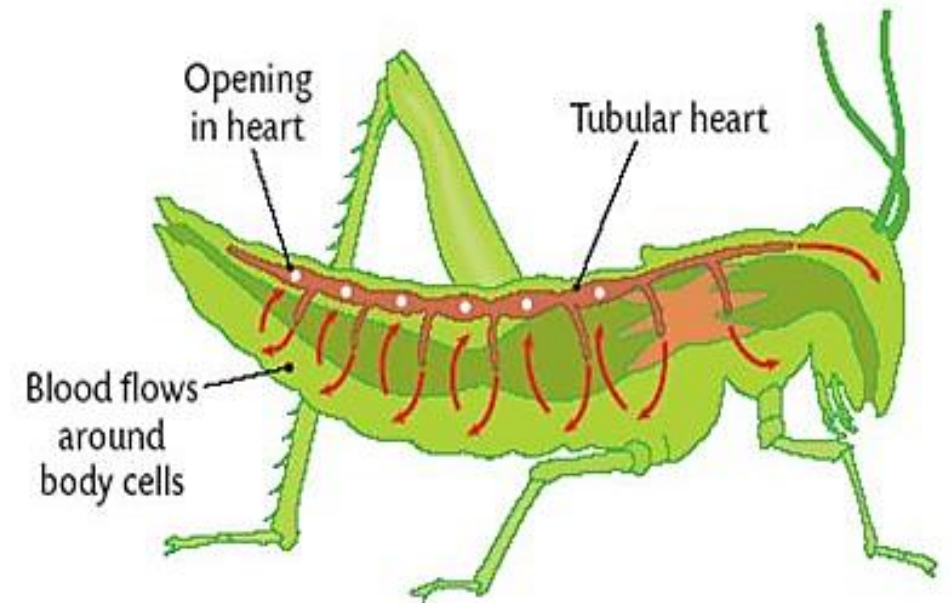
# Circulatory System

- All circulatory systems have a set of tubes and one or more pumps
  - The tubes are called blood vessels
  - The pumps are called hearts
- When a heart contracts, or pulls together, it squeezes blood through the blood vessels



# Open Circulatory System

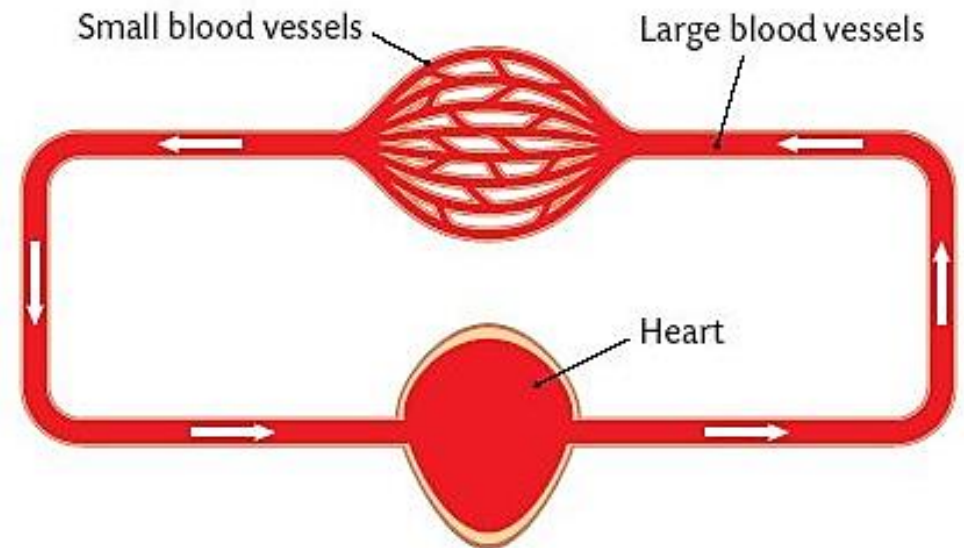
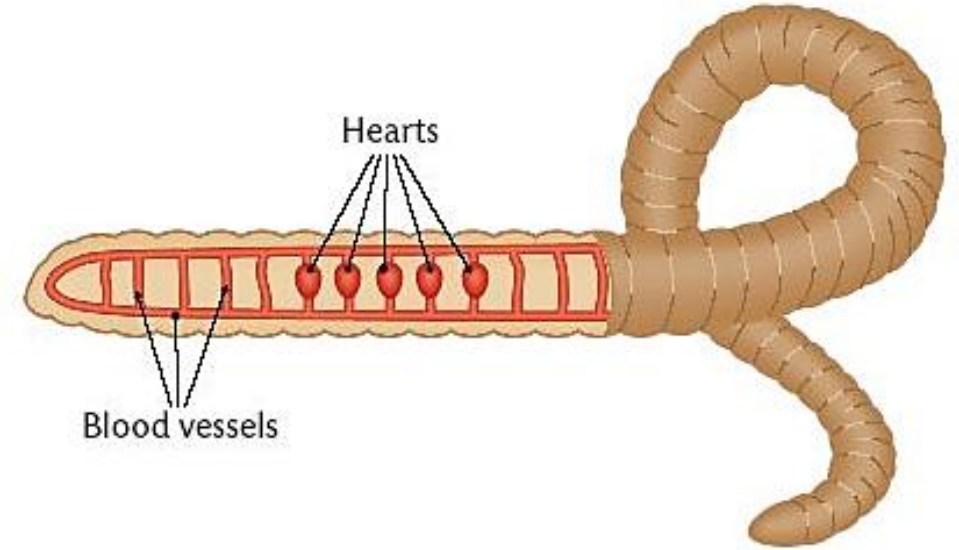
- Arthropods (E.g. crabs, **insects**, spiders, scorpions etc.) and mollusks (E.g. snails, slugs, octopi etc. )
- In an open circulatory system, blood leaves one set of vessels
  - The blood enters spaces around the animal's organs
  - The blood flows slowly through the spaces
  - The blood makes direct contact with cells
  - The blood then enters another set of vessels and returns to the heart





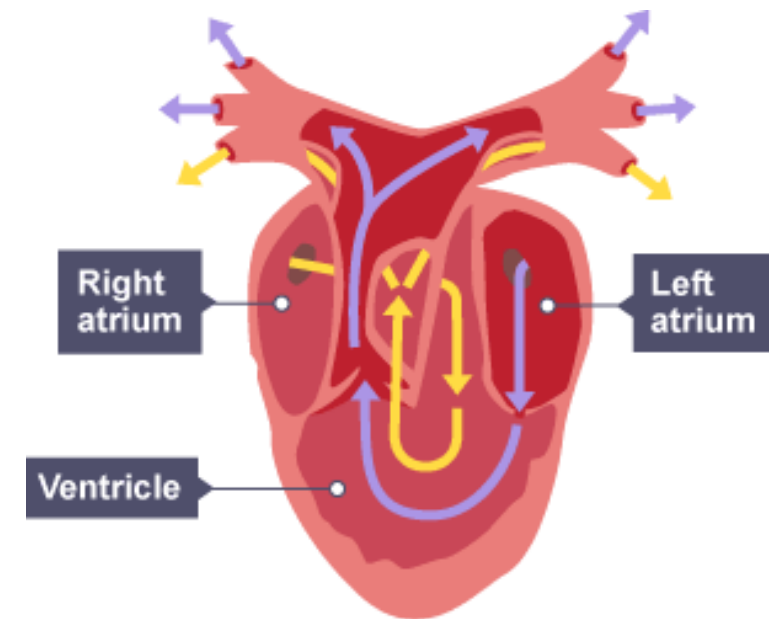
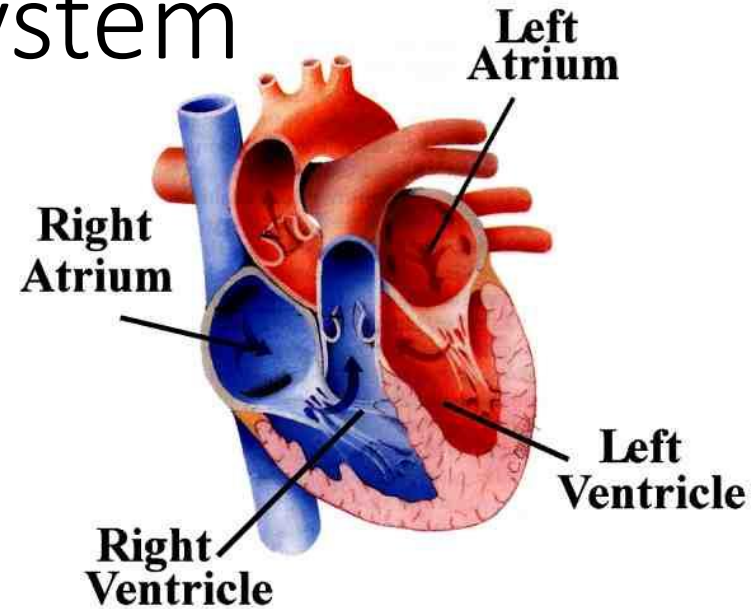
# Close Circulatory System

- Annelids (E.g. earthworms, leeches), vertebrates (E.g. fish, birds, mammals, amphibians, and reptiles)
- In a closed circulatory system, the blood stays inside vessels at all times
  - The smallest vessels have very thin walls
  - Oxygen and carbon dioxide diffuse into or out of the blood across these walls



# Vertebrate Circulatory System

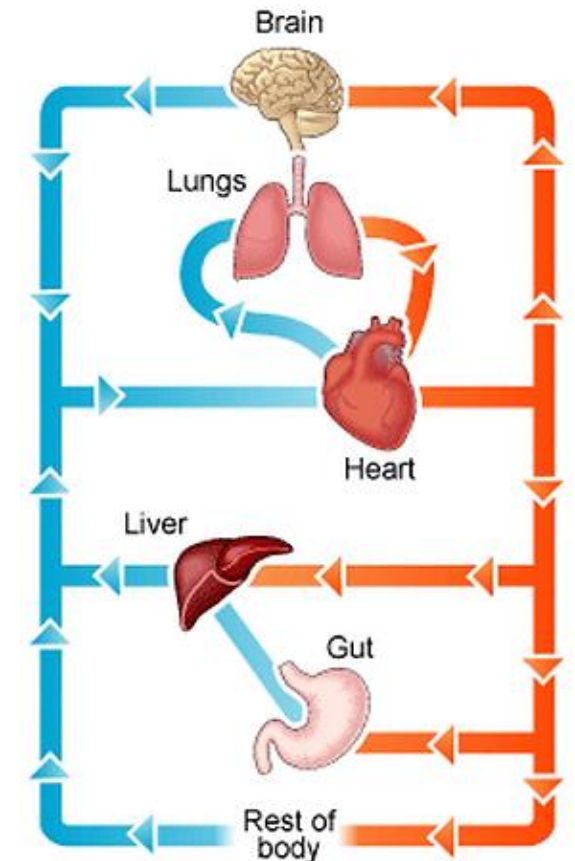
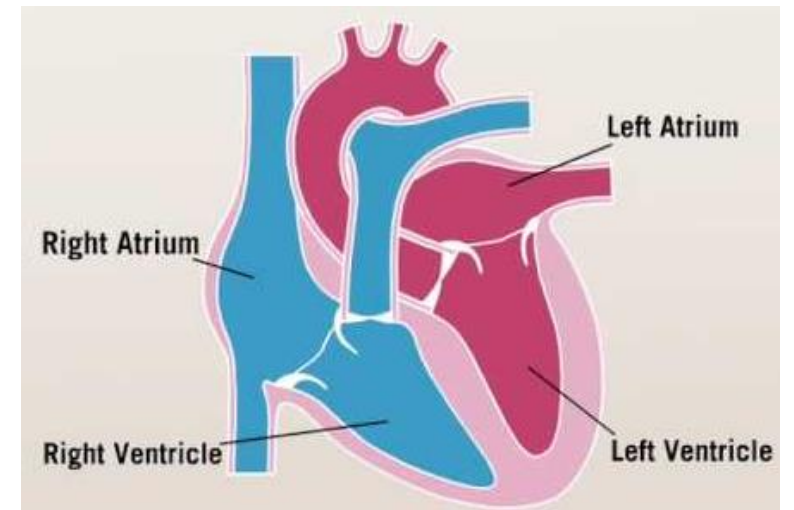
- The circulatory system of a vertebrate includes a single heart
- The heart is divided into enclosed spaces called chambers
- The **atria** are chambers that receive blood that returns to the heart
- The **ventricles** are chambers that pump blood out of the heart to the rest of the body
- Amphibians and most reptiles have two atria and one ventricle (3 chambered heart)
- Birds, mammals, and some reptiles have two atria and two ventricles (4 chambered heart)



# Vertebrate Circulatory System

## Mammals and Birds:

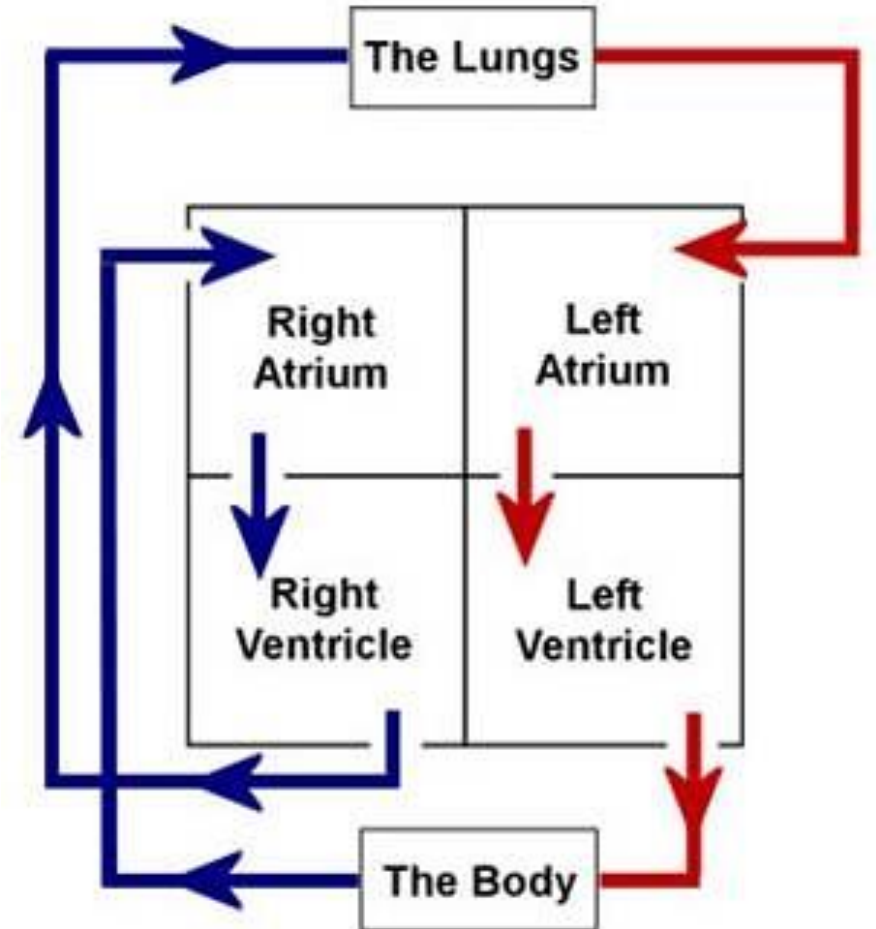
- The **left atrium** receives blood from the lungs
  - This blood has a lot of oxygen that was picked up in the lungs
  - This blood has little carbon dioxide
  - The **left atrium** pumps the blood to the **left ventricle**
- The **left ventricle** pumps the blood to the rest of the body
  - The blood delivers oxygen to body tissues and picks up carbon dioxide that has formed as waste



# Vertebrate Circulatory System

## Mammals and Birds:

- The blood returns to the **right atrium** of the heart
  - The blood has little oxygen and a lot of carbon dioxide
  - The blood moves from the **right atrium** to the **right ventricle**
- The **right ventricle** pumps the blood to the lungs
- In the **lungs**, oxygen enters the blood and carbon dioxide leaves the blood
- The blood returns to the left atrium, completing the cycle

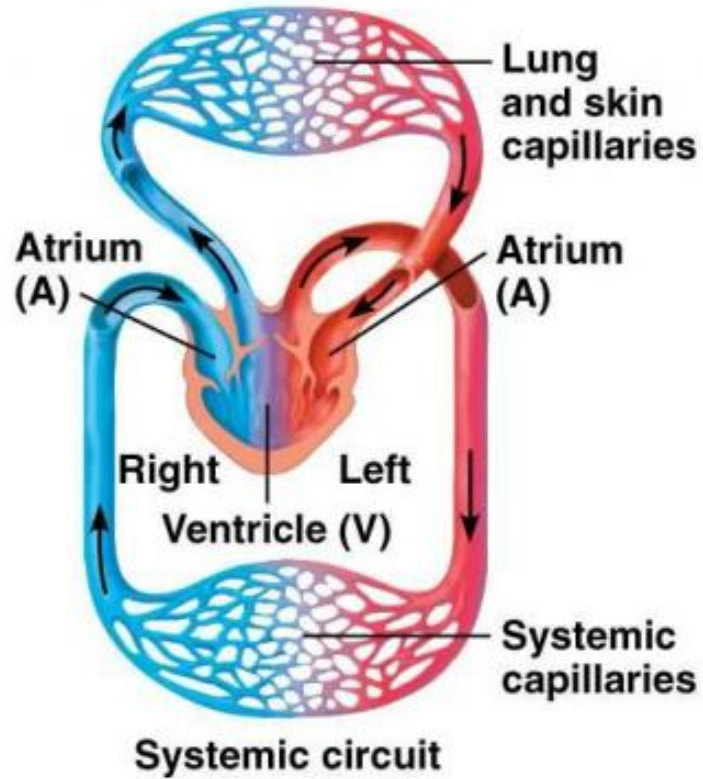






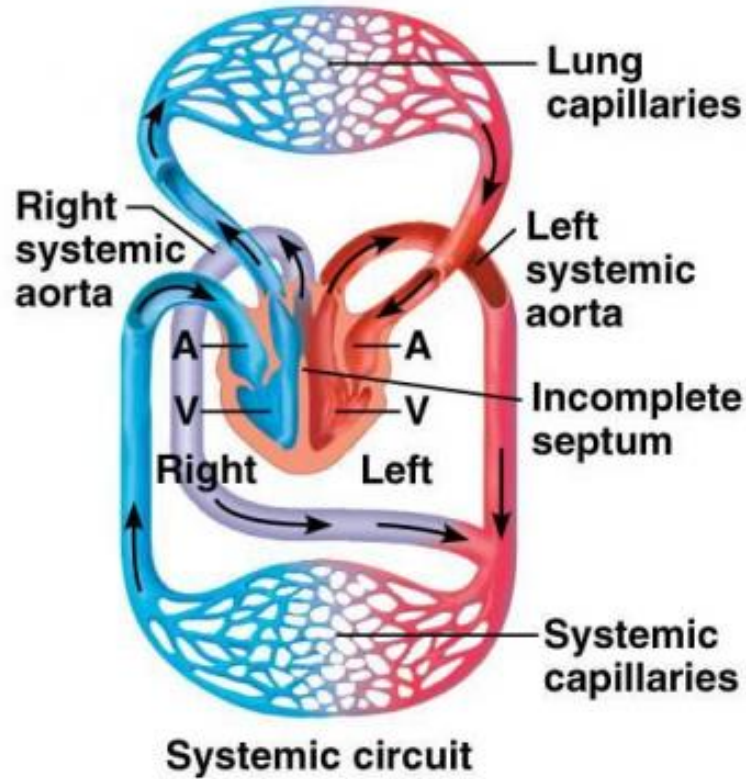
## Amphibians

Pulmocutaneous circuit



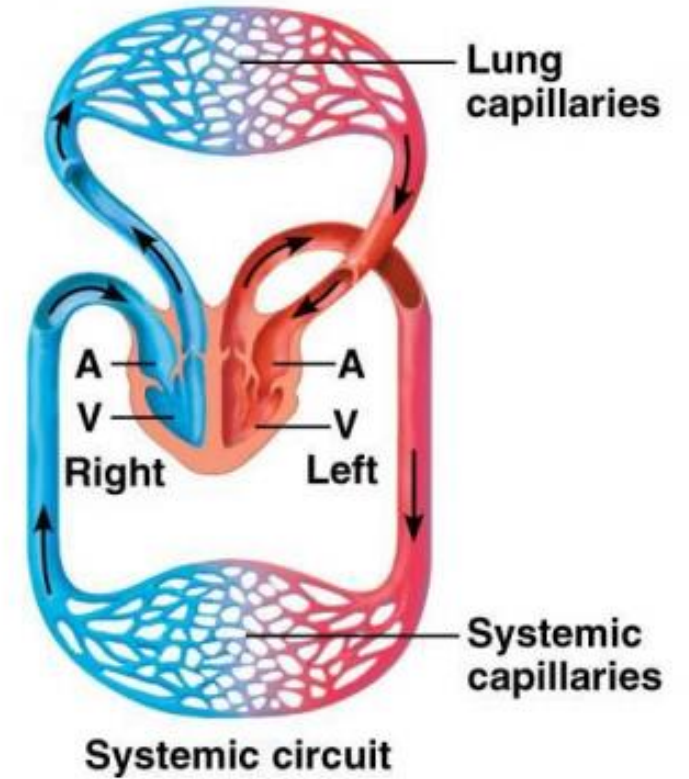
## Reptiles (Except Birds)

Pulmonary circuit



## Mammals and Birds

Pulmonary circuit



### Key

- Oxygen-rich blood
- Oxygen-poor blood

# Self-Check

1. How are gases exchanged in a sponge?
2. Describe the system that insects use to respire (carry oxygen and carbon dioxide in and out of the body/cells)
3. What is the difference between an open and a closed circulatory system?
4. What is the function of the atria in a vertebrate heart?
5. In a bird's heart, where does blood go from the right ventricle?

***On a separate piece of paper, answer the questions above. To be collected next class.***