

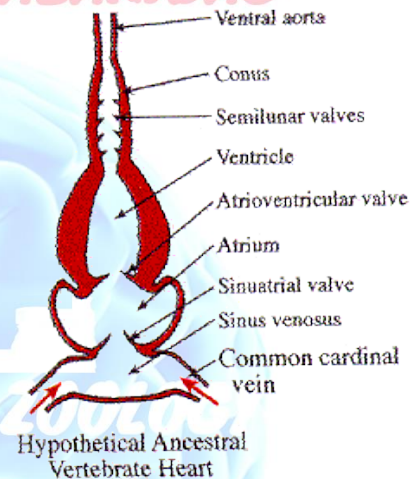
## COMPARATIVE ANATOMY OF HEART IN VERTEBRATES

Closed circulatory systems are a characteristic of vertebrates; however, there are significant differences in the structure of the heart and the circulation of blood between the different vertebrate groups due to adaptation during evolution and associated differences in anatomy.

### HEART OF CARTILAGINOUS FISHES

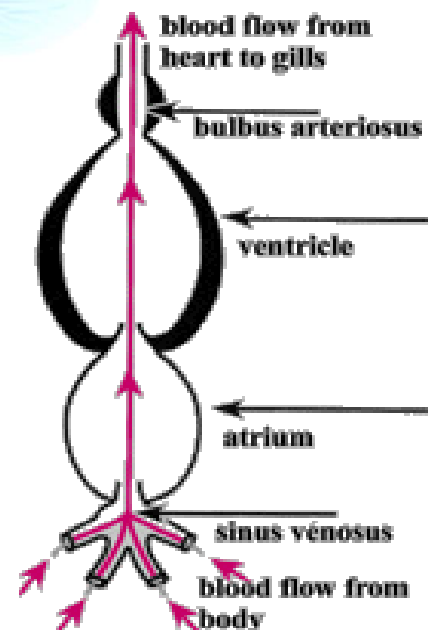
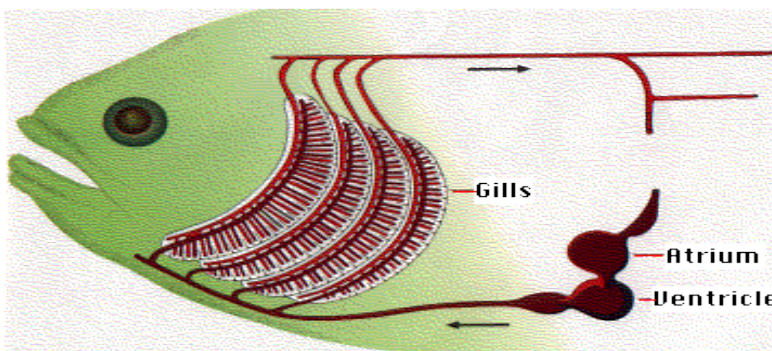
Two chambered venous heart which having –  
sinus venosus, atrium, ventricle, & conus arteriosus

- the sinus venosus receives blood & is filled by suction when the ventricle contracts & enlarges the pericardial cavity
- the atrium is a thin-walled muscular sac; an A-V valve regulates flow between atrium & ventricle
- the ventricle has thick, muscular walls
- the conus arteriosus leads into the ventral aorta (and a series of conal valves in the conus arteriosus prevent the backflow of blood)



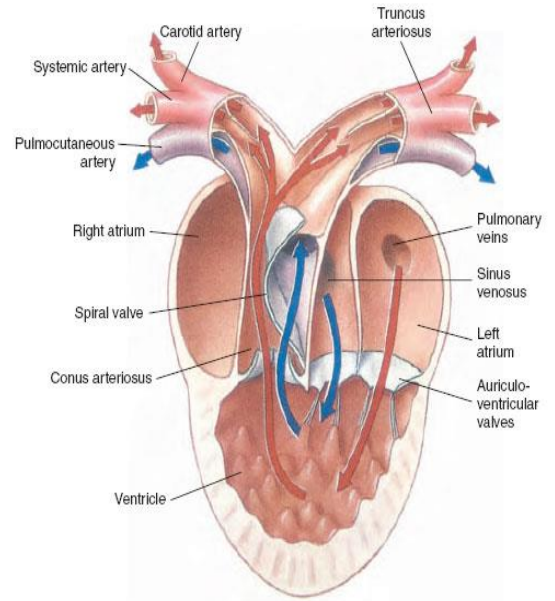
### HEART OF TELEOST FISHES:

heart is similar to that of cartilaginous fishes, except a bulbus arteriosus (a muscular extension of the ventral aorta) is present rather than a conus arteriosus (a muscular extension of the ventricle)



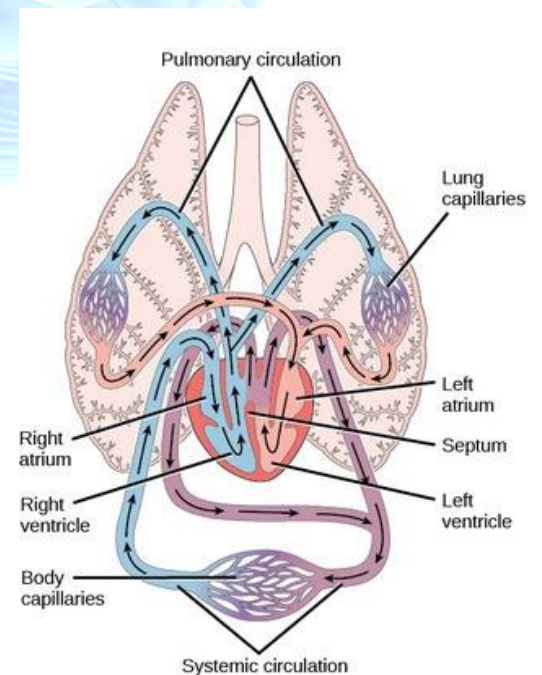
## HEART OF AMPHIBIANS:

- Amphibians have a three-chambered heart that has two atria and one ventricle rather than the two-chambered heart of fish .
- The two atria receive blood from the two different circuits (the lungs and the systems). There is some mixing of the blood in the heart's ventricle, which reduces the efficiency of oxygenation.
- The advantage to this arrangement is that high pressure in the vessels pushes blood to the lungs and body.
- The mixing is mitigated by a ridge within the ventricle that diverts oxygen-rich blood through the systemic circulatory system and deoxygenated blood to the pulmocutaneous circuit where gas exchange occurs in the lungs and through the skin. For this reason, amphibians are often described as having double circulation.



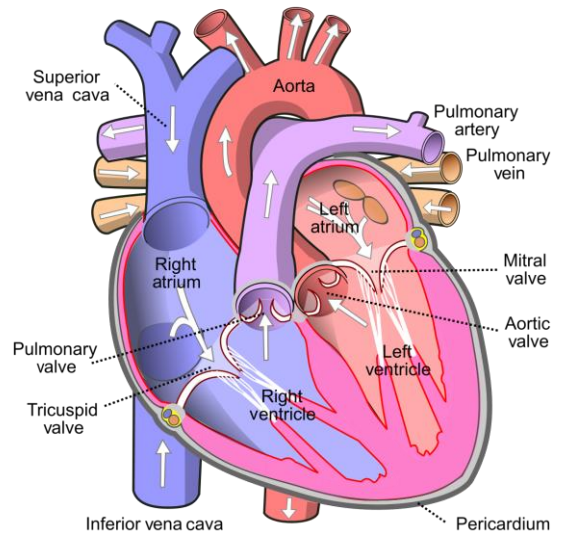
## HEART OF REPTILES:

- Most reptiles also have a three-chambered heart similar to the amphibian heart that directs blood to the pulmonary and systemic circuits.
- The ventricle is divided more effectively by a partial septum, which results in less mixing of oxygenated and deoxygenated blood.
- Some reptiles (alligators and crocodiles) are the most primitive animals to exhibit a four-chambered heart.
- Crocodylians have a unique circulatory mechanism where the heart shunts blood from the lungs toward the stomach and other organs during long periods of submergence; for instance, while the animal waits for prey or stays underwater waiting for prey to rot.
- One adaptation includes two main arteries that leave the same part of the heart: one takes blood to the lungs and the other provides an alternate route to the stomach and other parts of the body.
- Two other adaptations include a hole in the heart between the two ventricles, called the foramen of Panizza, which allows blood to move from one side of the heart to the other, and specialized connective tissue that slows the blood flow to the lungs. Together, these adaptations have made crocodiles and alligators one of the most successfully-evolved animal groups on earth.

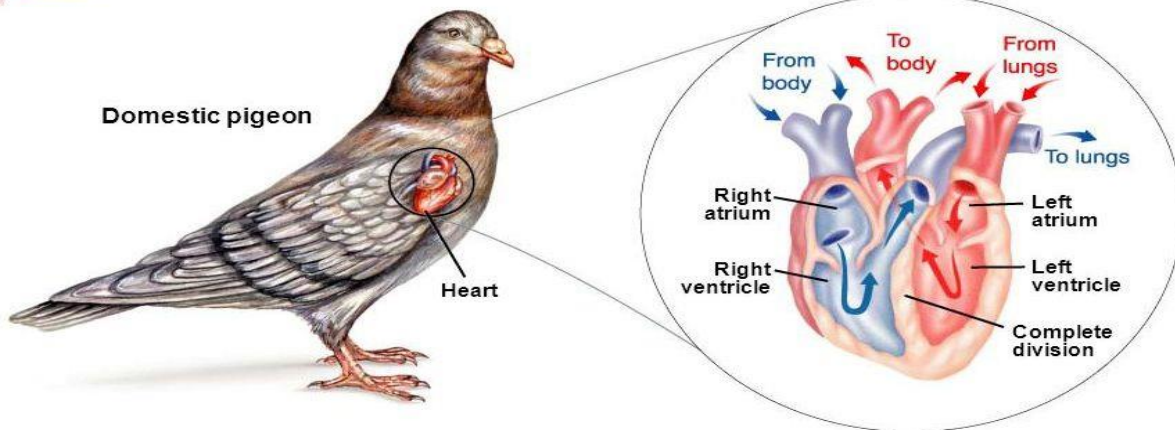


**HEART OF MAMMALIAN:**

In mammals and birds, the heart is also divided into four chambers: two atria and two ventricles (figure d). The oxygenated blood is separated from the deoxygenated blood, which improves the efficiency of double circulation and is probably required for the warm-blooded lifestyle of mammals and birds. The four-chambered heart of birds and mammals evolved independently from a three-chambered heart.



- On the outside, the heart mainly consists of a dark red muscle. It is attached to four very important blood vessels: the Vena Cava, the Pulmonary Artery, the Pulmonary Vein and the Aorta.
- Internally, the heart is made up of four main cavities: two Atria (singular: atrium) and two Ventricles. The atria hold blood briefly, then allow it to fall into the ventricles, which provide the actual 'pump'.
- The atria are separated from the ventricles by Atrioventricular Valves (specifically called Tricuspid Valves - right; and Bicuspid/Mitral Valves - left).
- The ventricles are separated from the aorta and the pulmonary artery by the Semilunar Valves (specifically called, respectively, the Aortic and Pulmonary Valves). These prevent blood from flowing in the wrong direction back into the heart.



**SUMMARY**

There are significant differences in the structure of the heart and the circulation of blood between the different vertebrate groups due to adaptations during evolution and associated differences in anatomy. Fish have a two-chambered heart with unidirectional circulation. Amphibians have a three-chambered heart, which has some mixing of the blood, and they have double circulation. Most non-avian reptiles have a three-chambered heart, but have little mixing of the blood; they have double circulation. Mammals and birds have a four-chambered heart with no mixing of the blood and double circulation.