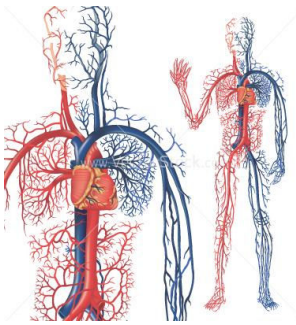
Topic 20: Components of Circulation

- What does the circulatory system do?
- How do the heart, vessels & blood develop?
- What is hemopoiesis?
- What are the components of the circulatory system?
- What are the divisions of the circulatory system?
- How does heart morphology differ among vertebrates?
- What is the lymphatic system and what does it do?

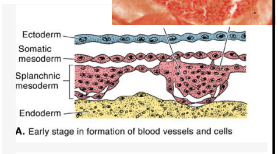
What does the circulatory system do?



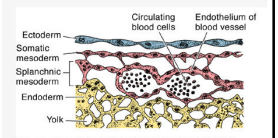
How does the circulatory system develop?

- Circulatory system develops early
- Why?

- _____
  - Intra & extra-embryonic
  - _____ and vessels
    - Blood islands combine
    - Peripheral cells → Endothelium
    - Central cells → Erythrocytes



A. Early stage in formation of blood vessels and cells

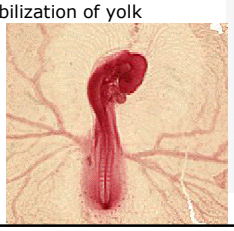


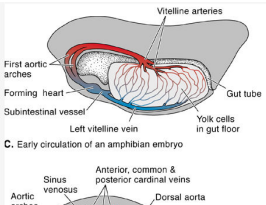
B. Later stage in formation of blood vessels and cells

Liem et al. Fig. 19-4; unsw.edu.au

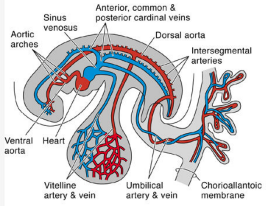
How does the circulatory system develop?

- Blood islands combine into vessels
- Early development of:
  - _____
  - _____
- Mobilization of yolk





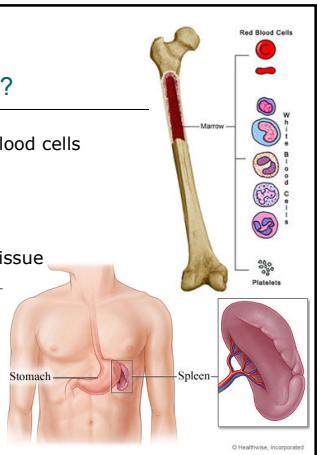
C. Early circulation of an amphibian embryo



Liem et al. Fig. 19-4; unsw.edu.au

What is hemopoiesis?

- The production of new blood cells
  - Life spans:
    - 120d for erythrocytes
    - 1-2d for leukocytes
- Anamniotic hemopoitic tissue
  - _____
- Embryonic amniotes
  - _____
  - _____
- Adult amniotes
  - _____
  - _____



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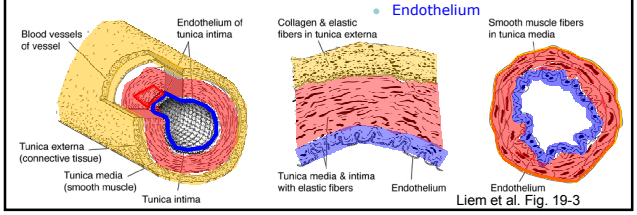
Blood Vessels

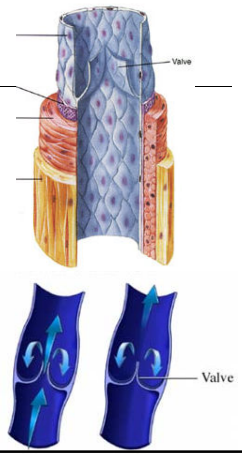
- _____
  - Carry blood away from heart
  - Resist high blood pressure
  - Thick-walled
  - Smooth muscle in wall
- _____
  - Connective tissue
  - Blood vessels
- _____
  - Smooth muscle
  - Elastin
- _____
  - Endothelium



Liem et al. Fig. 19-3

Blood Vessels

- _____
  - Carry blood back to heart
  - Low pressure
  - Thinner walls
  - Valves to prevent back-flow
    - Failure → varicose veins
- Same layers
  - Tunica externa
  - Tunica media
  - Tunica intima



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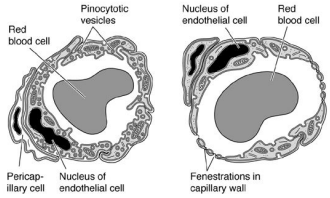
Blood Vessels – Capillaries

- Allow diffusion between blood and tissues
- Only _____
  - 1 cell thick walls
- Pressure intermediate
- Thin – one erythrocyte passes at a time
- Account for most _____

Vessel	Number	Diameter (mm)	x.s. Area (mm^2)
Aorta	1	10.000	79
Capillary	1 billion	0.008	60,320
Vena Cava	1	12.500	122

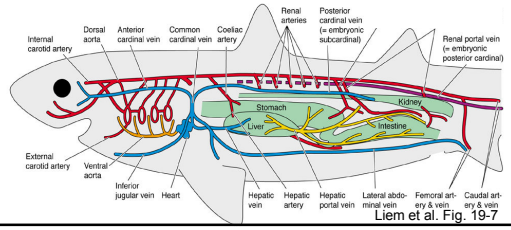


Liem et al. Fig. 19-3, Table 19-1

What are the divisions of the circulatory system?

What are these for?

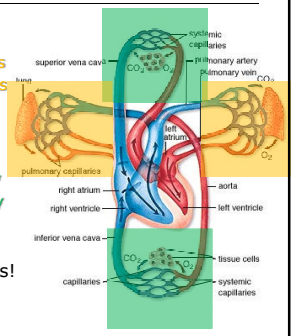
- _____
  - Carries blood away from heart
  - High pressure
  - Takes blood to gills, lungs or body
- _____
  - Carries blood to heart
  - Low pressure
- _____
  - Carries blood from guts to liver
- _____
  - Carries blood from body to kidneys



Liem et al. Fig. 19-7

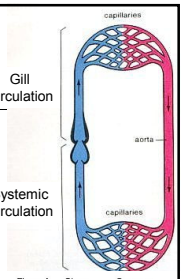
What are the divisions of the circulatory system?

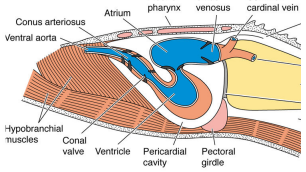
- _____
  - Arteries taking blood to lungs
  - Veins taking blood from lungs
    - From lungs where?
- _____
  - Arteries taking blood to body
  - Veins taking blood from body
    - From body where?
- Only in vertebrates with lungs!
- Vertebrates with gills have a single circuit



Fish Heart

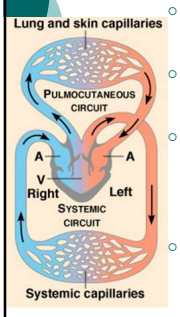
- Single circuit circulation
- Heart → Gills → Body → Heart
- S-shaped tube
- Two main chambers + two extra chambers
  - _____
  - _____
  - _____
  - _____
- Valves between each chamber



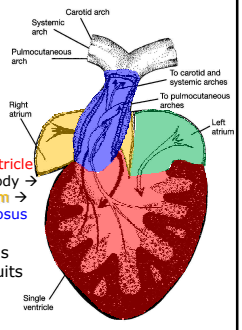


Liem et al. Fig. 19-6; universe-review.ca

Amphibian Heart



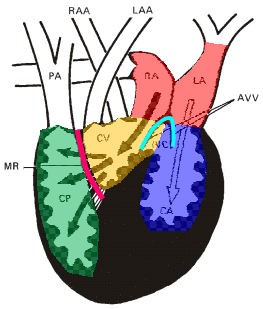
- Two circuits
  - Pulmocutaneous
  - Systemic
- _____
  - Left & Right atrium
  - Ventricle
- Blood flow:
  - Lungs → L atrium → Ventricle → Conus arteriosus → Body → Sinus venosus → R atrium → Ventricle → Conus arteriosus → Lungs
- _____ keeps mixing of blood from circuits to a minimum



Herpetology Fig. 7-8

Lizard Heart

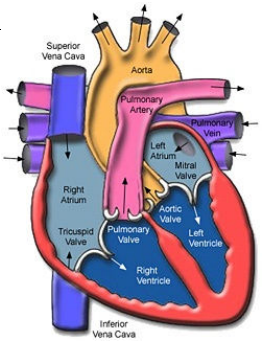
- Also three chambers
  - R & L atrium
  - Ventricle
- Ventricle is subdivided
  - 3 sub-chambers
- Don't need to know details



Herpetology Fig. 7-9

Mammal Heart

- Two circuit circulation
  - Completely separated
  - High efficiency – Why?
- _____
  - R & L Atria
  - R & L Ventricles
- Blood flow
  - Lungs → Pulmonary v. → L atrium → L ventricle → Aorta → Body → Vena cava → R atrium → R ventricle → Pulmonary a. → Lungs



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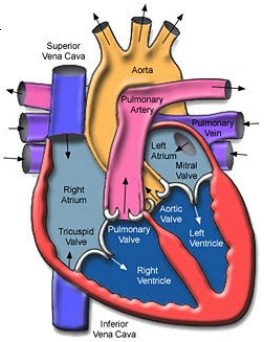
Mammal Heart

- Valves
  - _____ valve
    - L atrium/L ventricle
  - _____ valve
    - L ventricle/Aorta
  - _____ valve
    - R atrium/R ventricle
  - _____ valve
    - R ventricle/Pulmonary a.



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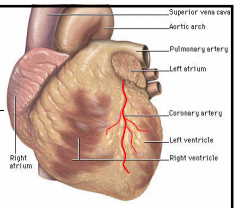
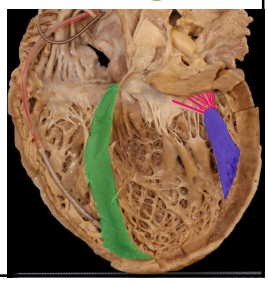
Mammal Heart

- _____
  - Supply blood to heart muscle
- _____
  - Bands of muscle in ventricles
  - Prevent collapse of ventricle due to suction
- Papillary muscles and chordae tendinae
  - Keep bicuspid & tricuspid valves from inverting
- Interventricular septum





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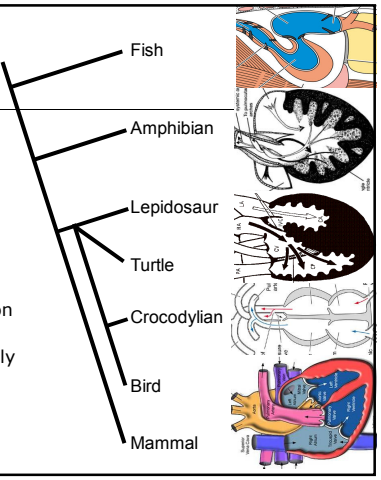
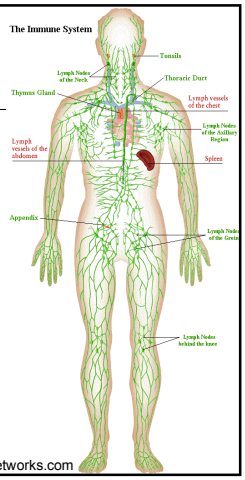
Heart Evolution



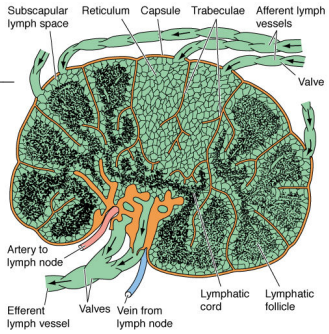
1. 1 Ventricle, 1 Atrium
2. 2 Atria
3. Incomplete subdivision of ventricle
4. 2 Ventricles completely separated

What is the lymphatic system?



- Circulatory function
  - Collects _____
  - Returns to main circulation via anterior cardinal v.
  - Does not transport _____

What is the lymphatic system?



Liem et al. Fig. 19-21

- Lymphatic ducts transport _____
- _____
  - Filter lymph
  - Immune function
  - Lymphocytes
    - Produced in thymus
    - Produce antibodies