

# Embryonale Ontwikkeling van het Hart

“ Van evolutie tot kliniek”



Y.J. Taverne

Cardiale Morfologie – ERCATHAN

Afdeling Anatomie – Afdeling Cardiothoracale chirurgie

Erasmus MC Rotterdam

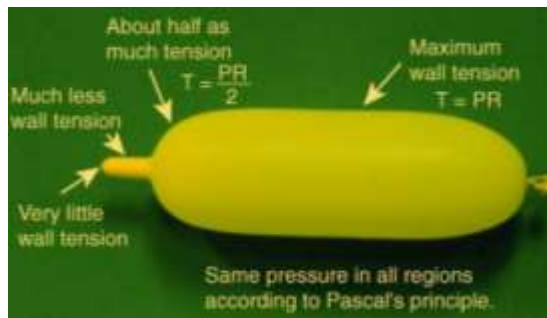
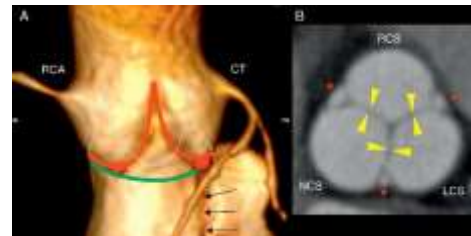
# Bouwpakket hart



# Functionele anatomie

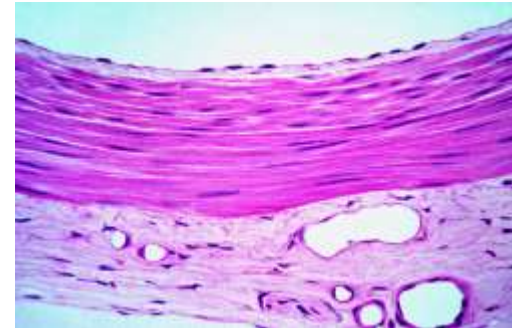
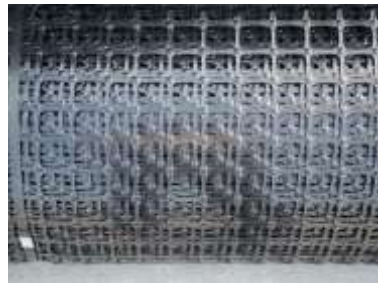
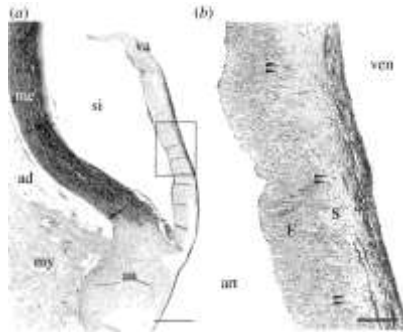
- Organogenese = grootste en langste experiment
  - Alle informatie is er → vraagstelling en het begrip
- Taal vanaf functionaliteit naar morfologie = fysica
  - *“What we observe as material bodies and forces are nothing but shapes and variations in the structure of space”.*

Erwin Shrodinger



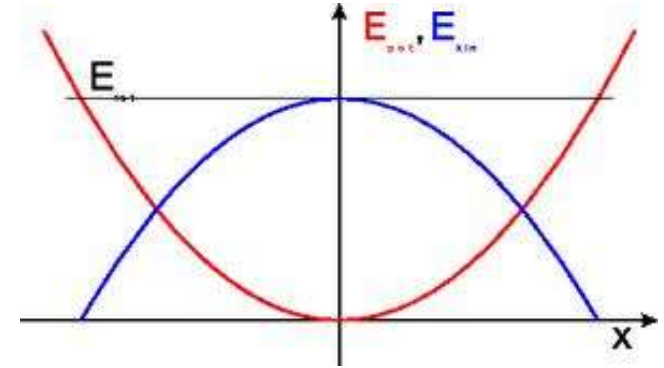
# Evolutie functionaliteit

- Hart = functionele entiteit
  - Fundament = transmissie E
  - Variabelen =  $V \sim R \sim F \sim P$

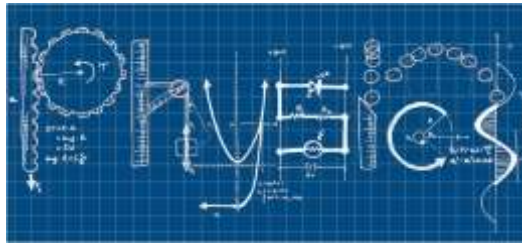
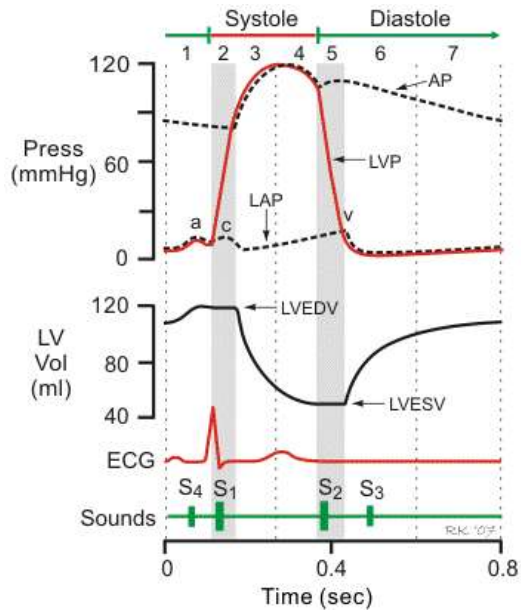
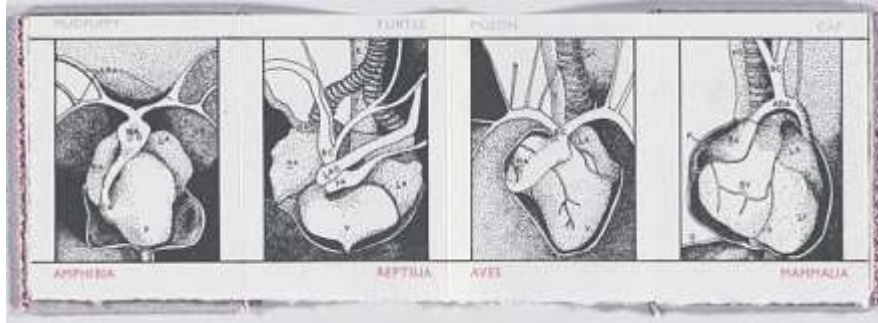


# Evolutie functionaliteit

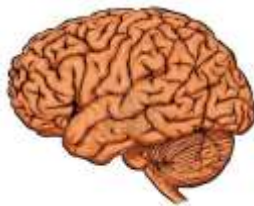
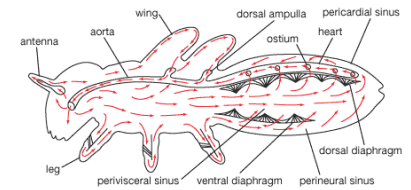
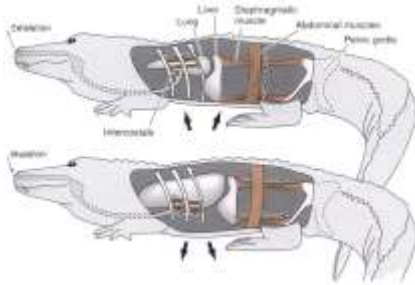
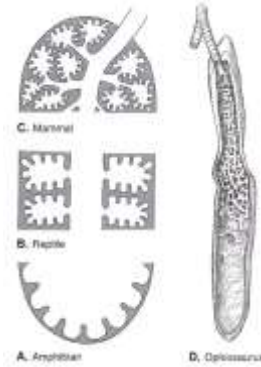
- RR = Potential Energy
- BF = Kinetic Energy
- HF = Pulsatility



- RR = CO x HF
- CO = SV x R perif
- SV = contractility / preload / afterload



# Evolutie



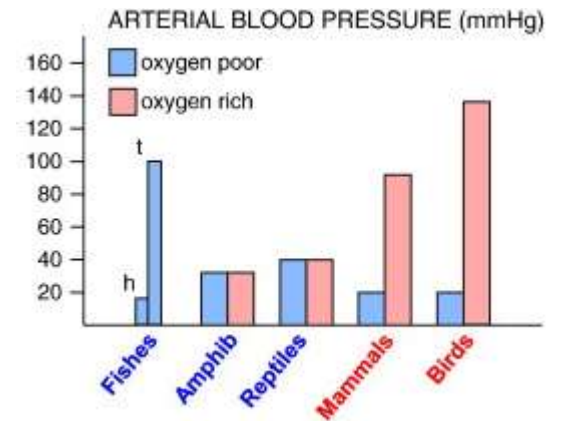
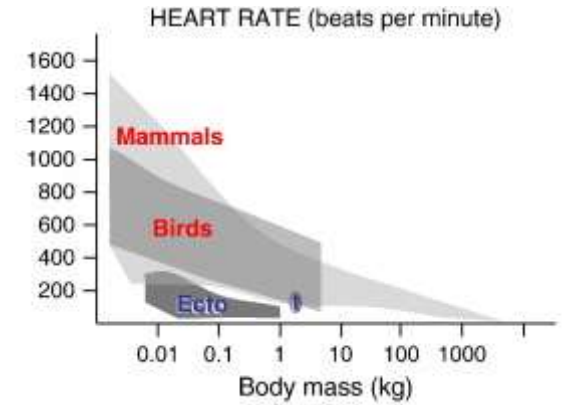
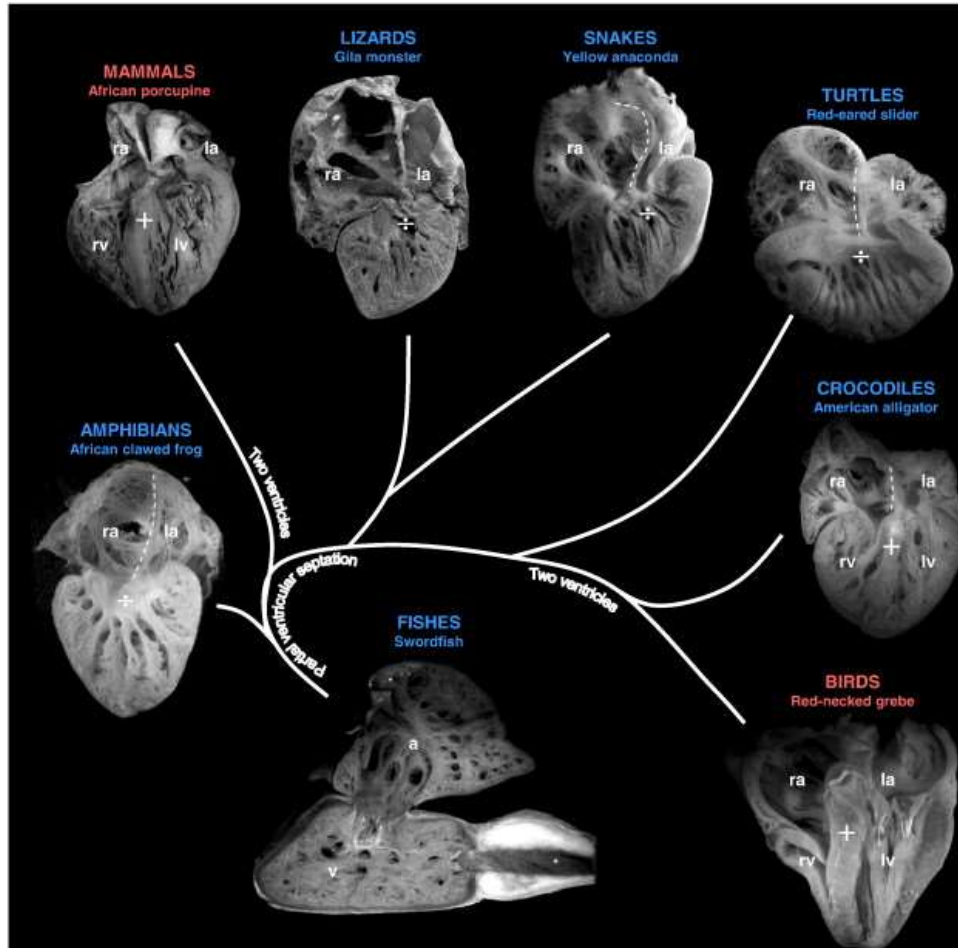
# Evolutie

- Evolutionary point of view:
  - reptiles = critical moment evolution heart
- Birds/ mammals: 4 chambers
- Reptiles: 3 chambers
- Invertebrates: blind ending system (tube)
- Evolution from 3 → 4 chambers
  - Reptiles= 'continuum'

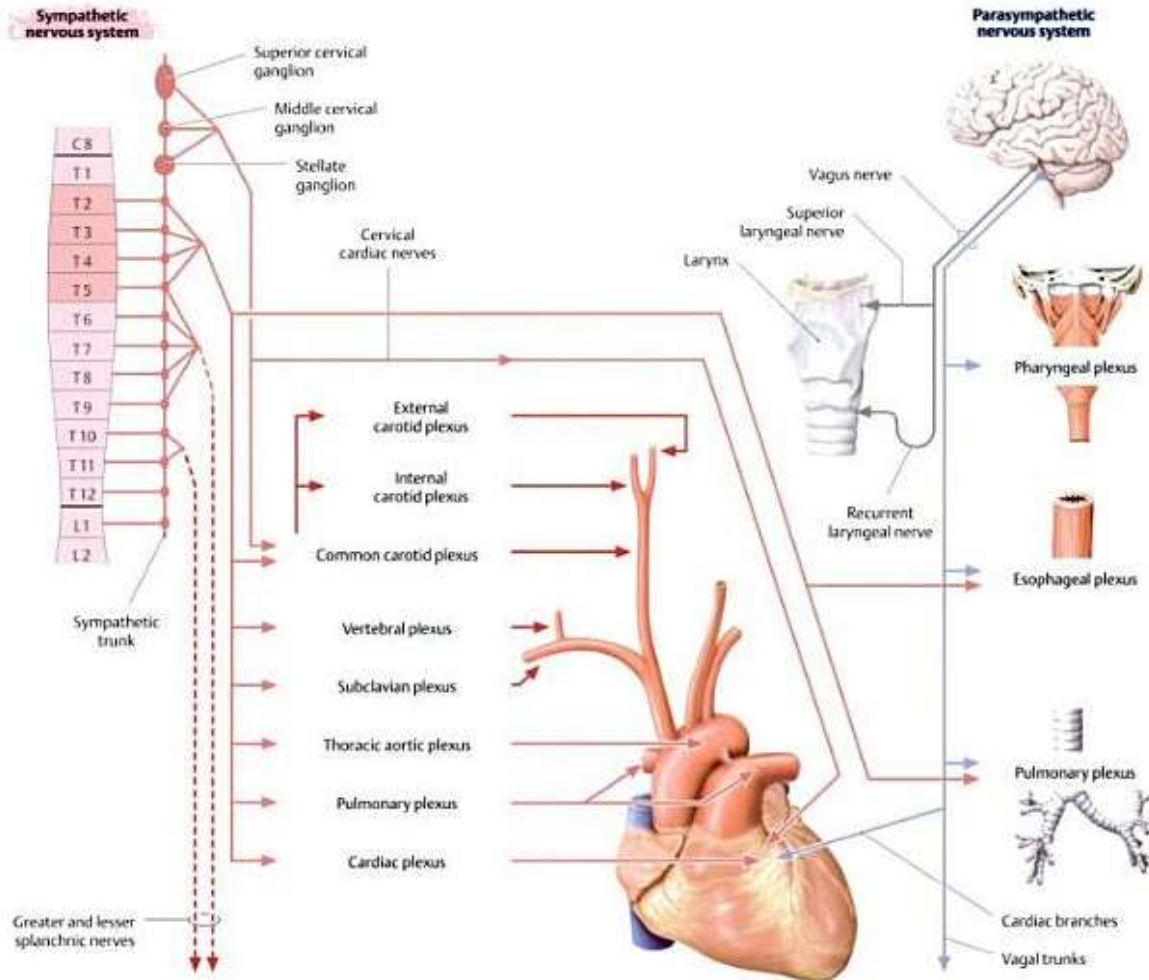




# Evolutie

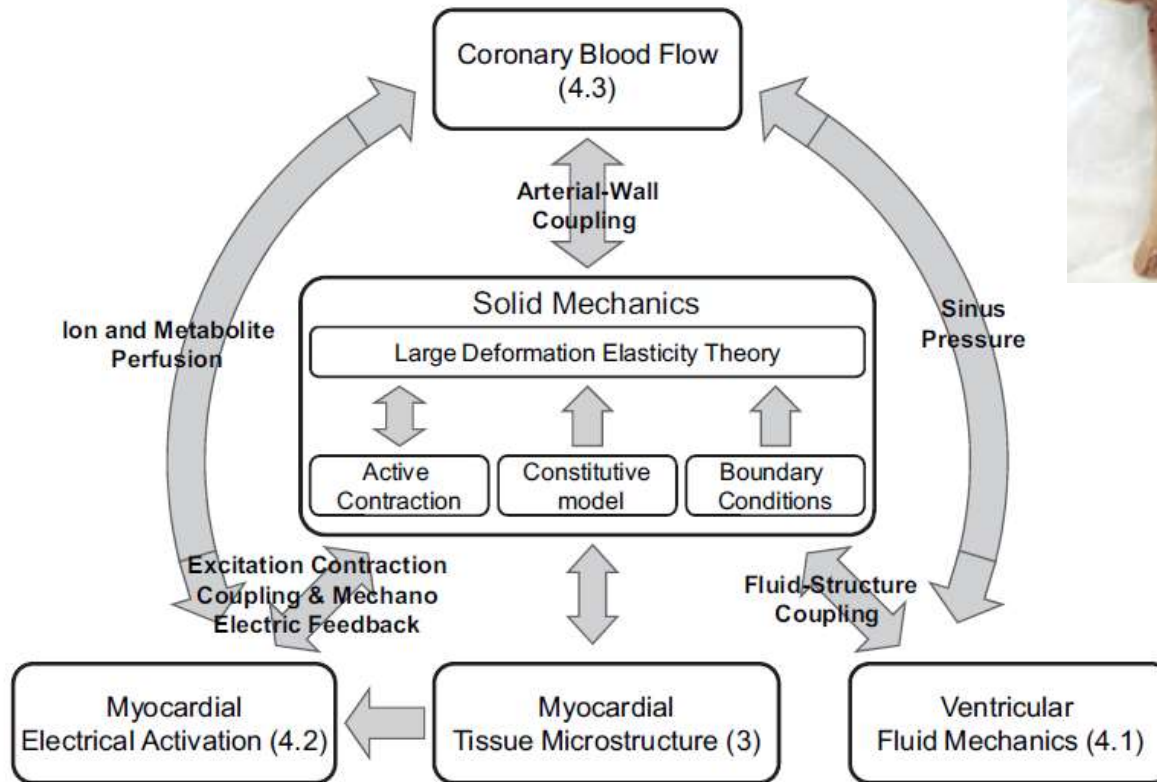


# Evolutie - omgevingsinvloeden

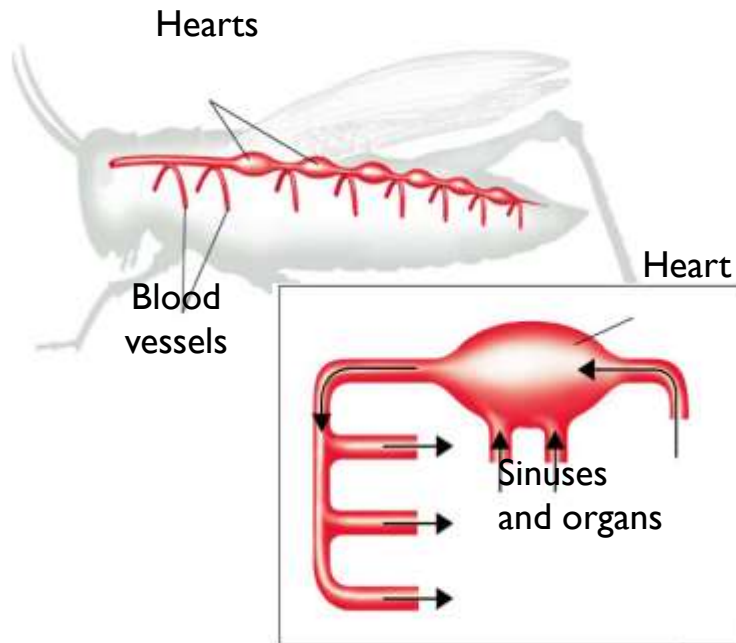
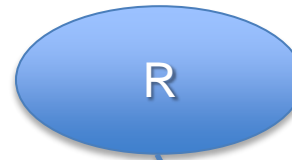
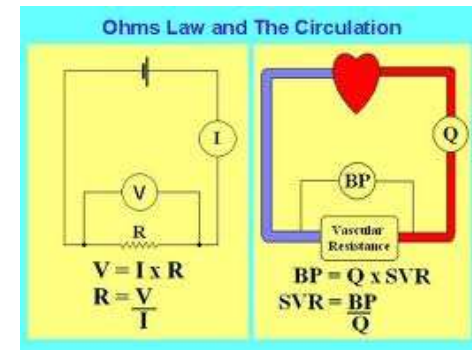


# Evolutie - organogenese

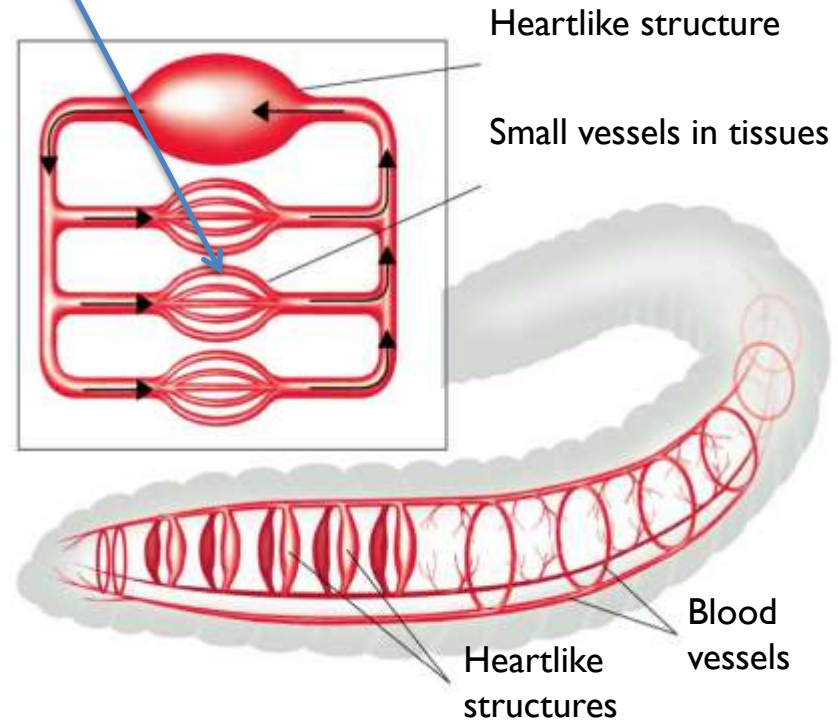
- Organogenesis



# Blood flow



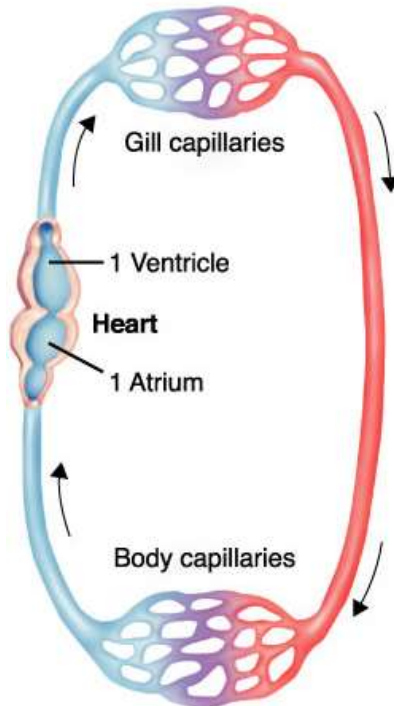
**Insect:**  
**Open Circulatory System**



**Annelid:**  
**Closed Circulatory System**

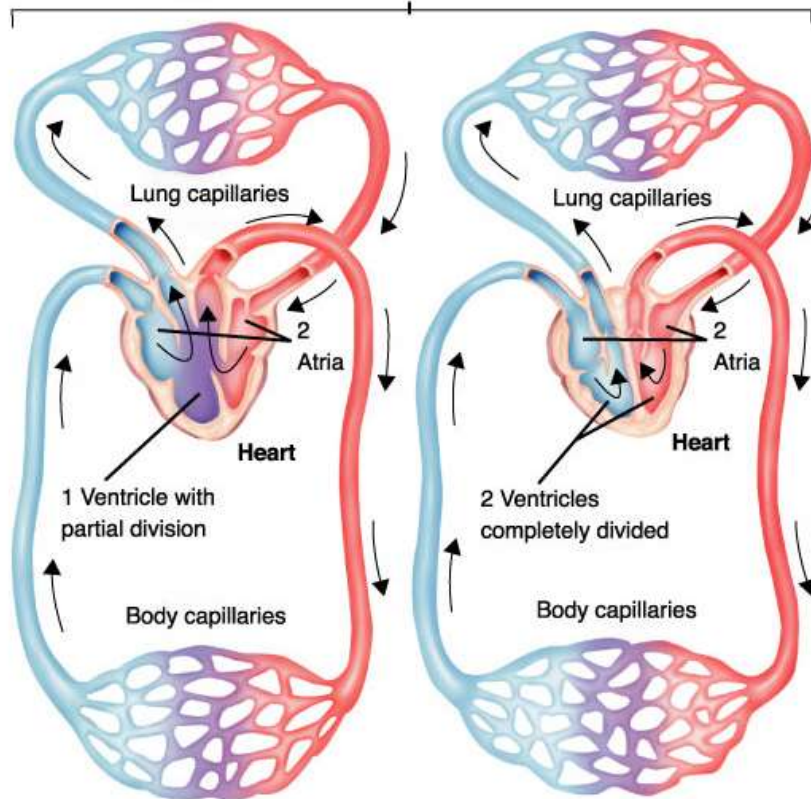
# Blood flow

## Single-Loop Circulatory System



FISHES

## Double-Loop Circulatory System

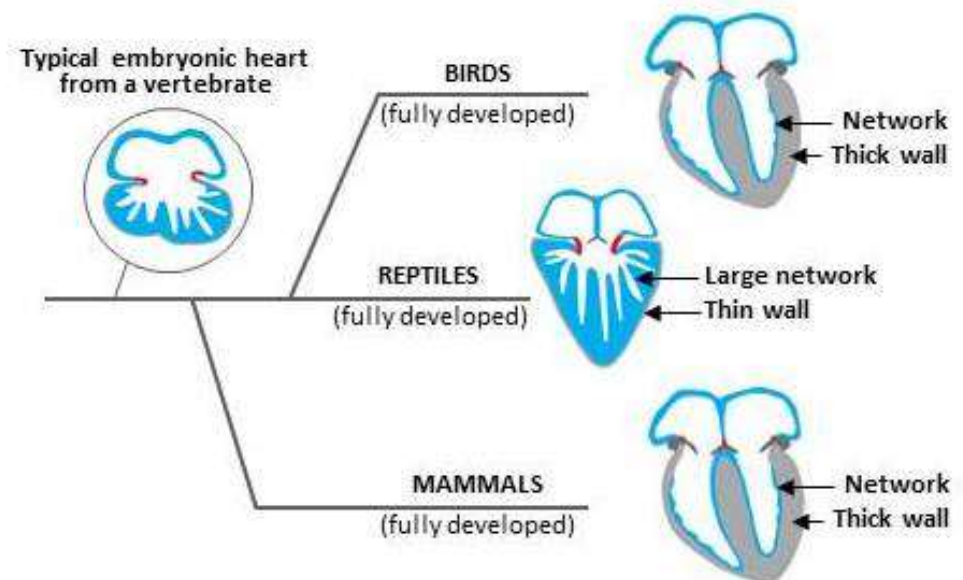
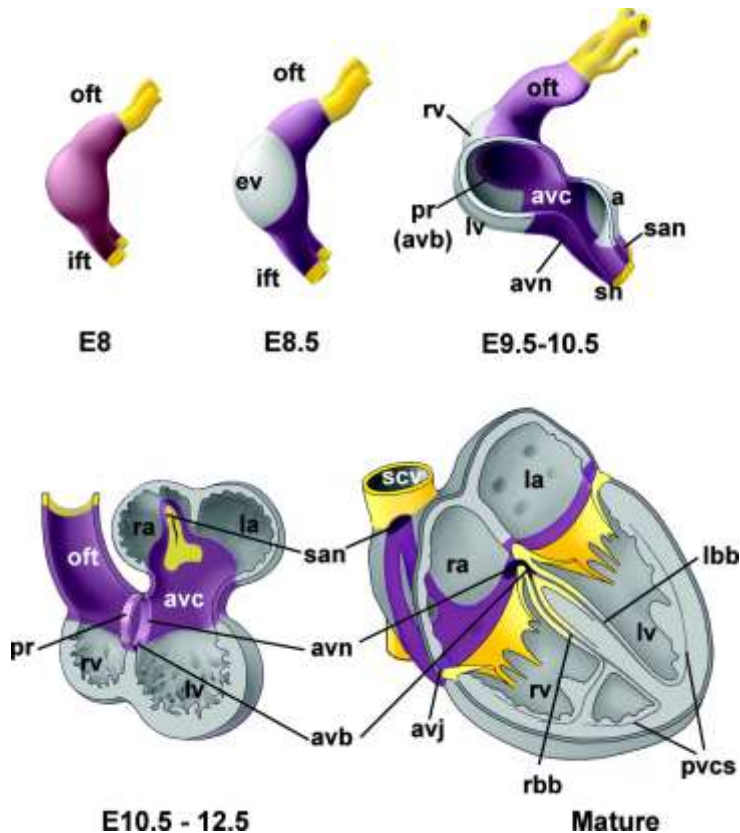


MOST REPTILES

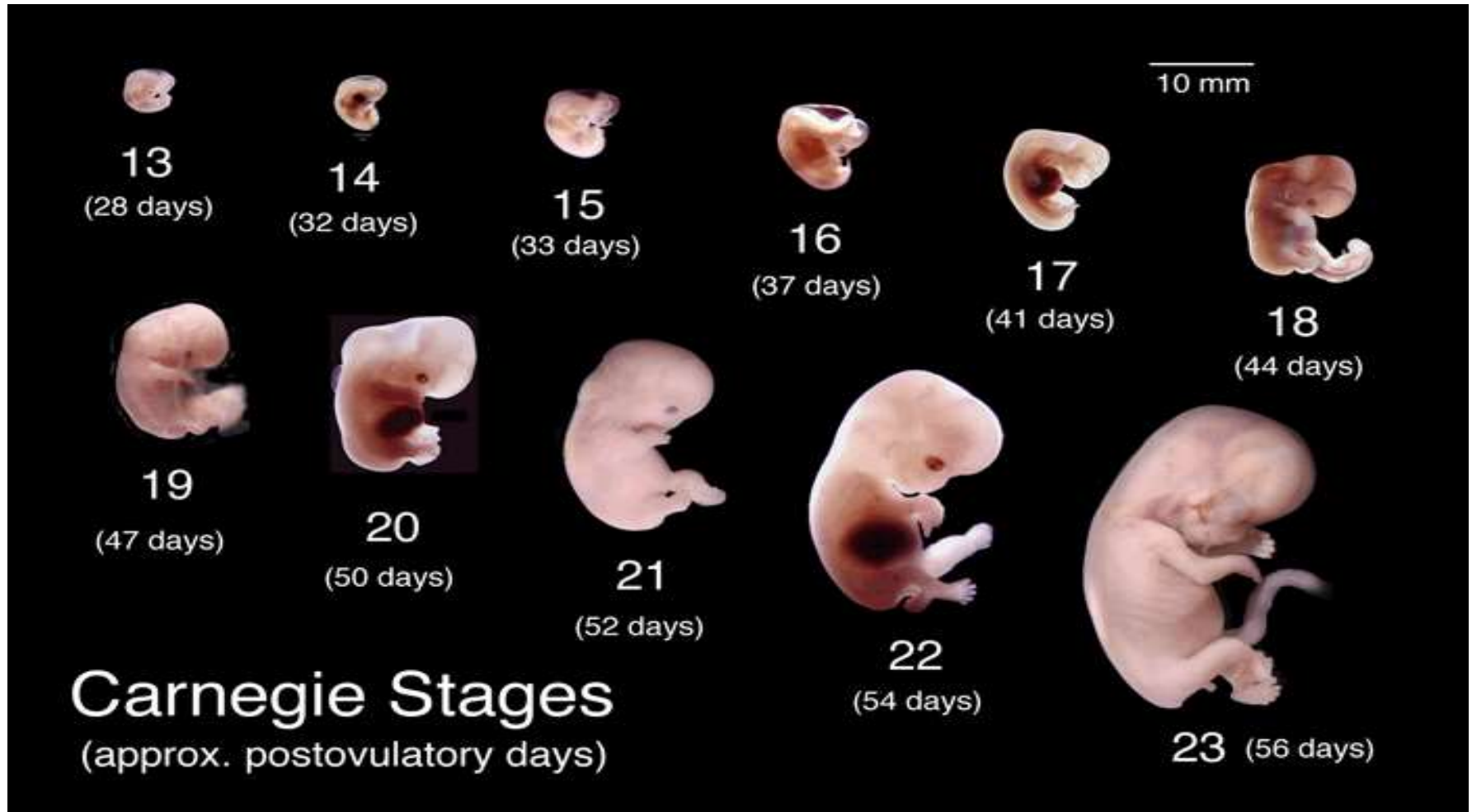
CROCODILIANS, BIRDS,  
AND MAMMALS

# Traits of distant ancestor ?

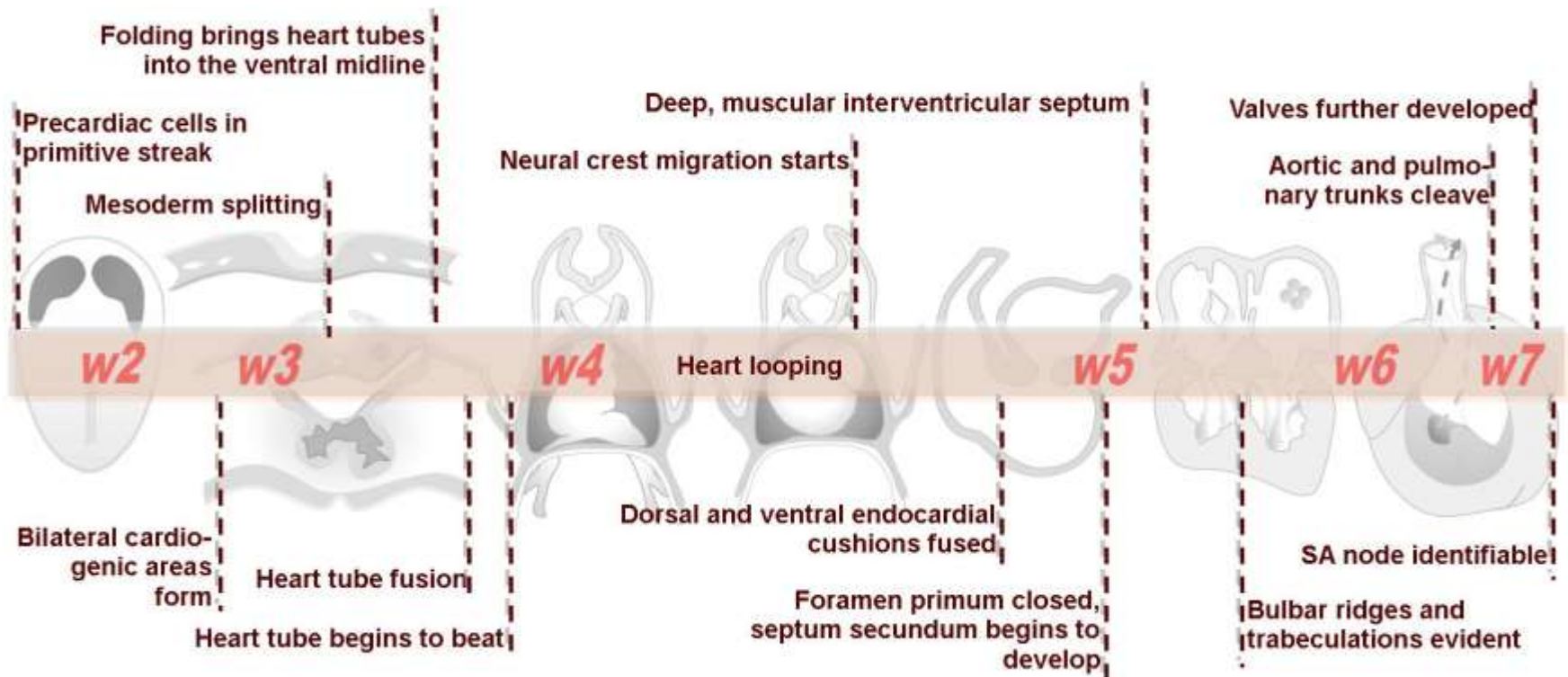
“ontogeny recapitulates phylogeny”



# Embryologie

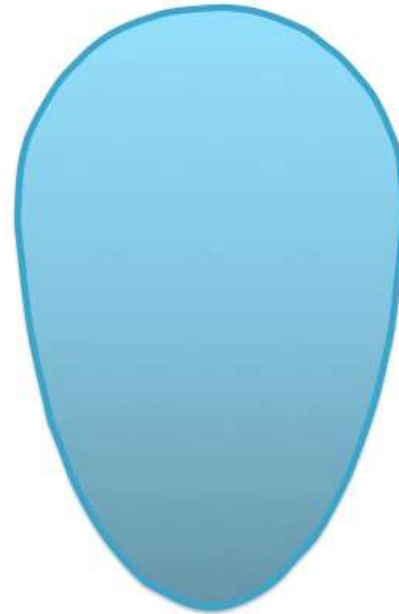


# Embryologie



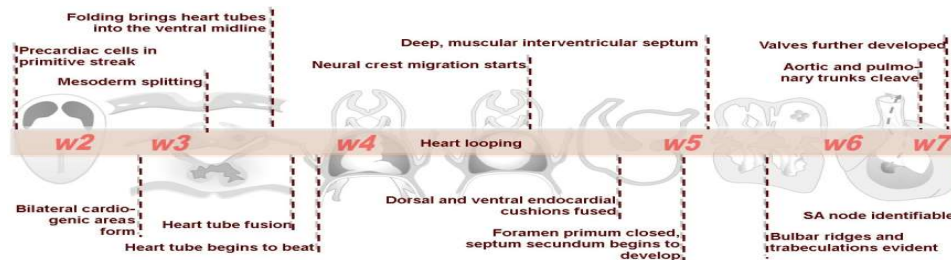


# Heart fields



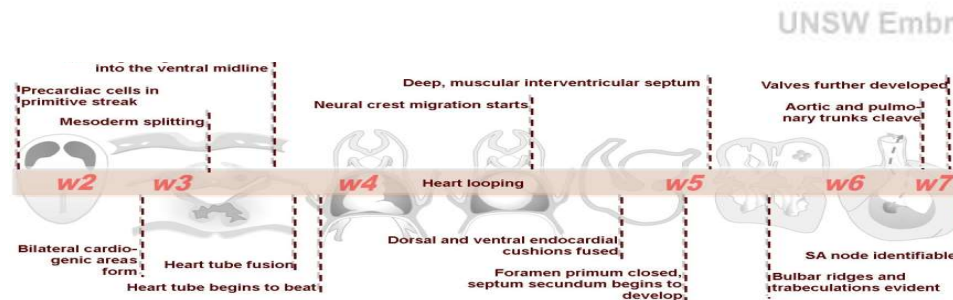
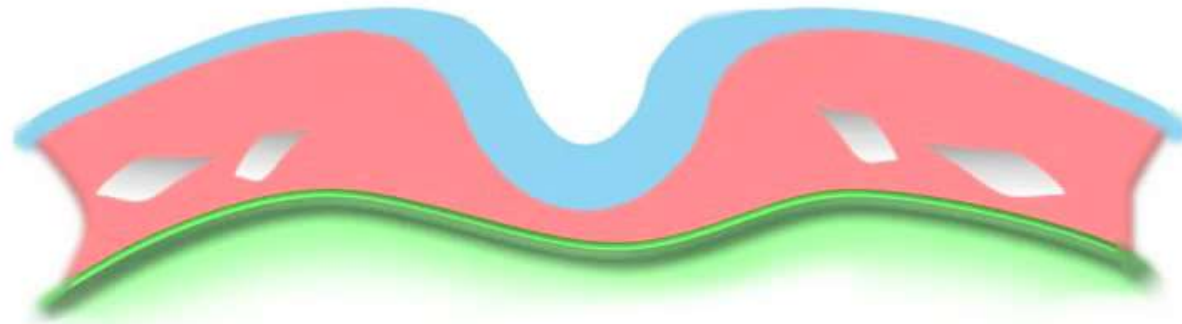
**Epiblast**  
18 days, dorsal surface

UNSW Embryology



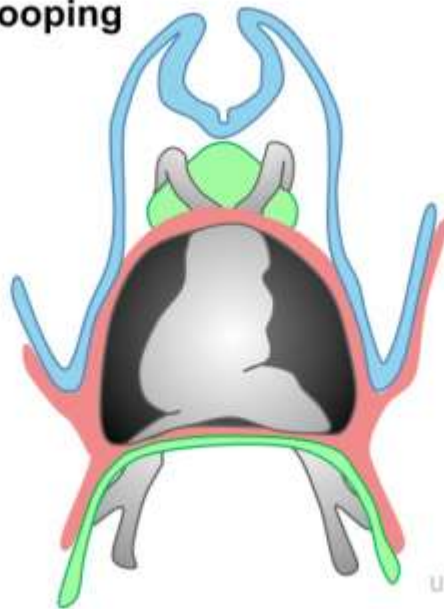
# Endocardiac heart tubes

## Folding and Fusion of the Heart Tubes

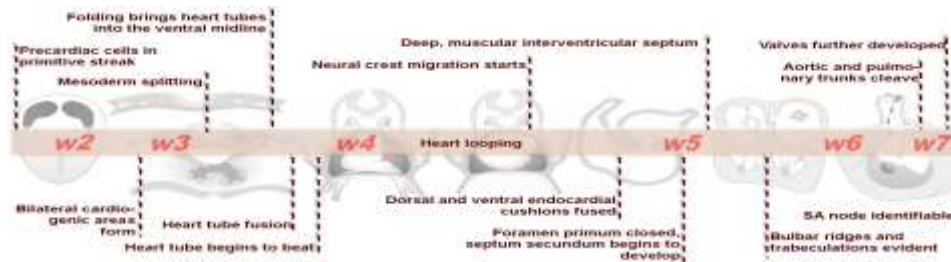
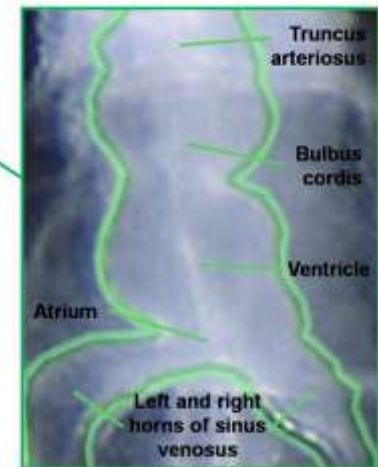


# Cardiac looping

## Cardiac Looping

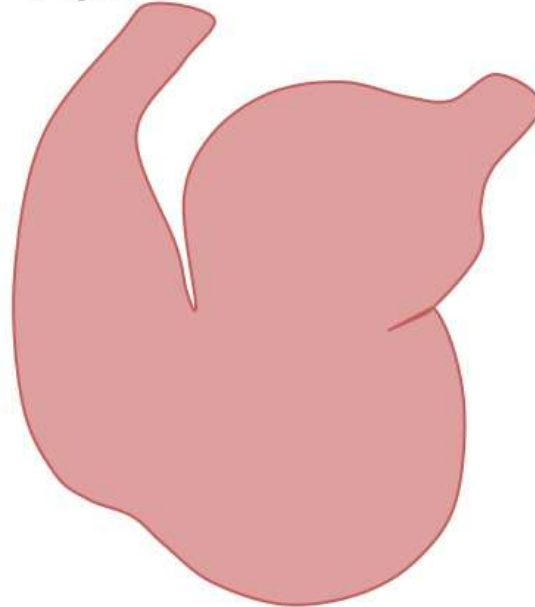


UNSW Embryology

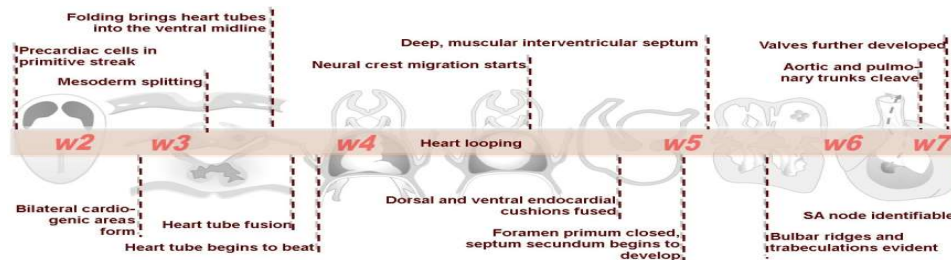


# Cardiac septation

## AV Canal Septation



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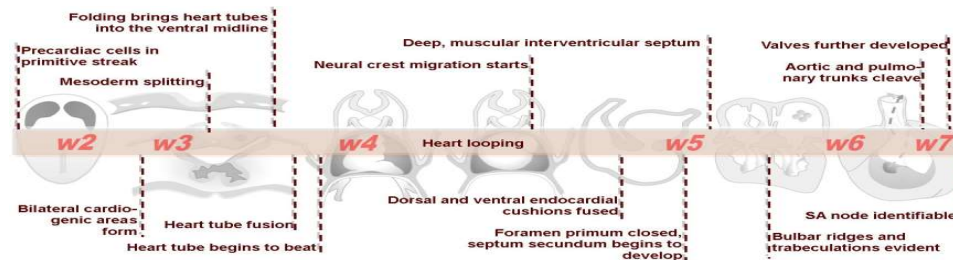


# Cardiac septation

## Atrial and Ventricular Septation

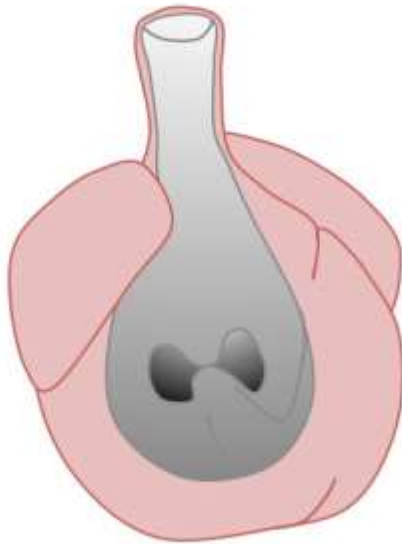


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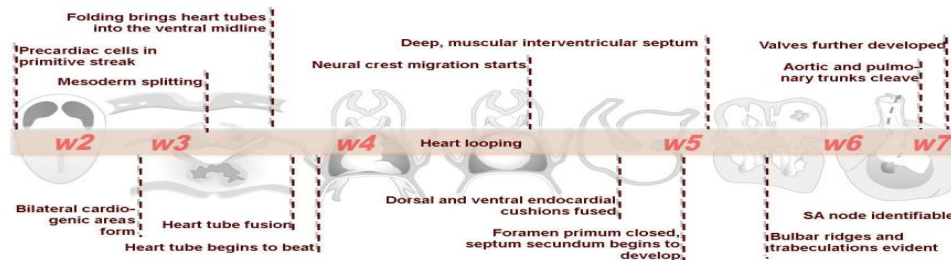
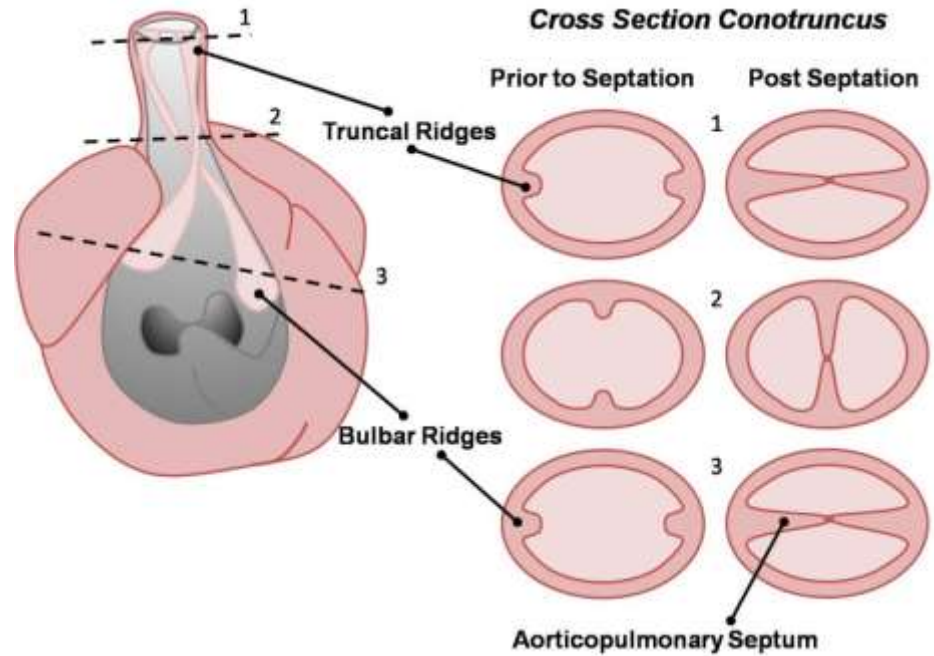


# Outflow tract

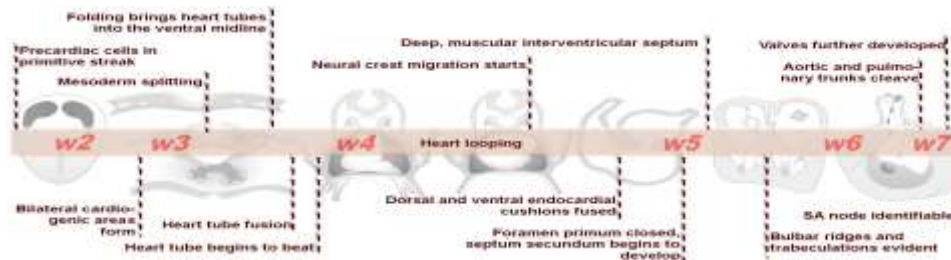
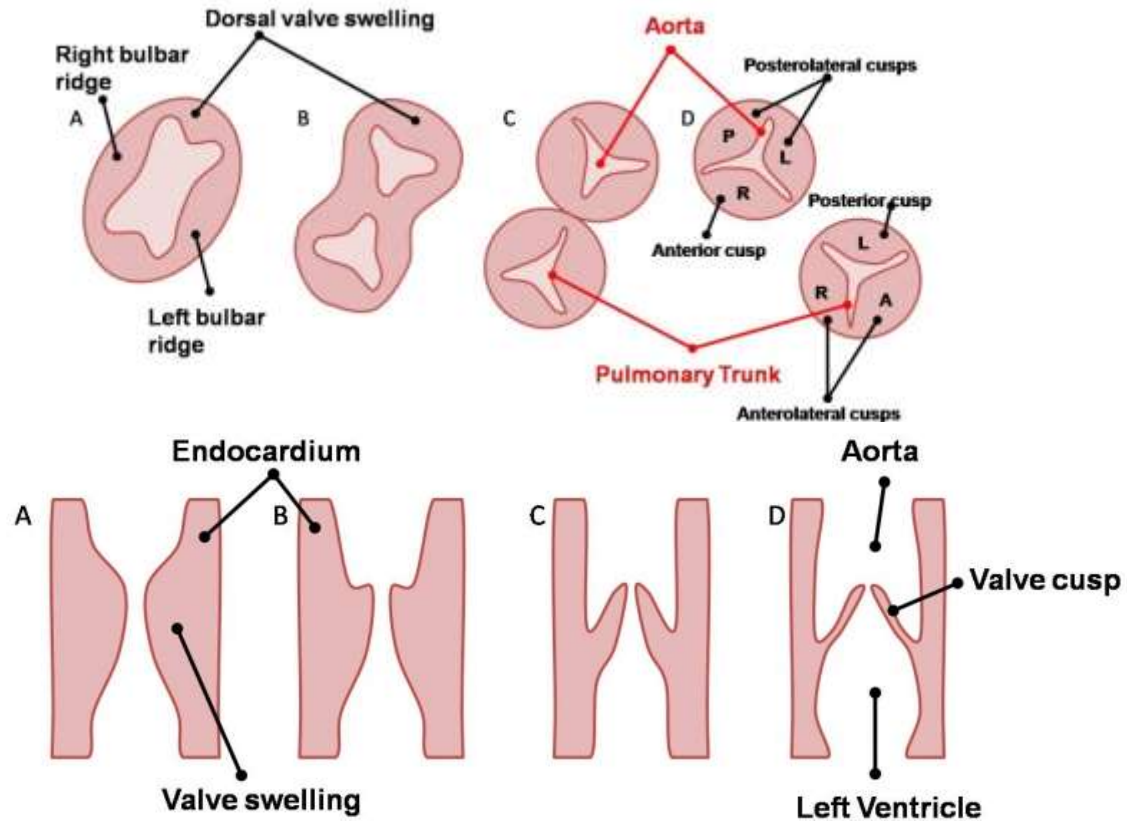
## Outflow Tract Division



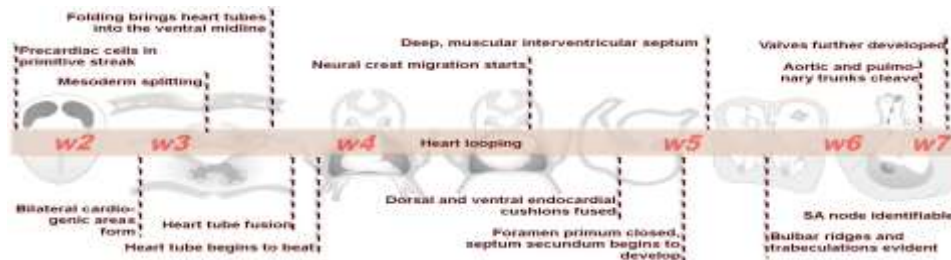
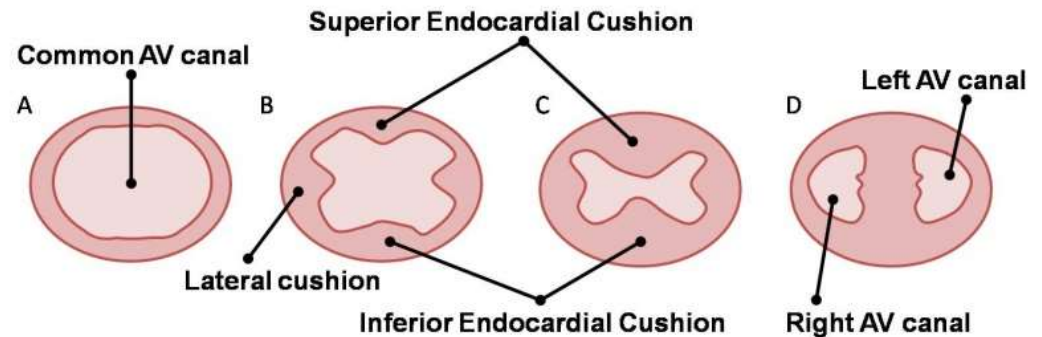
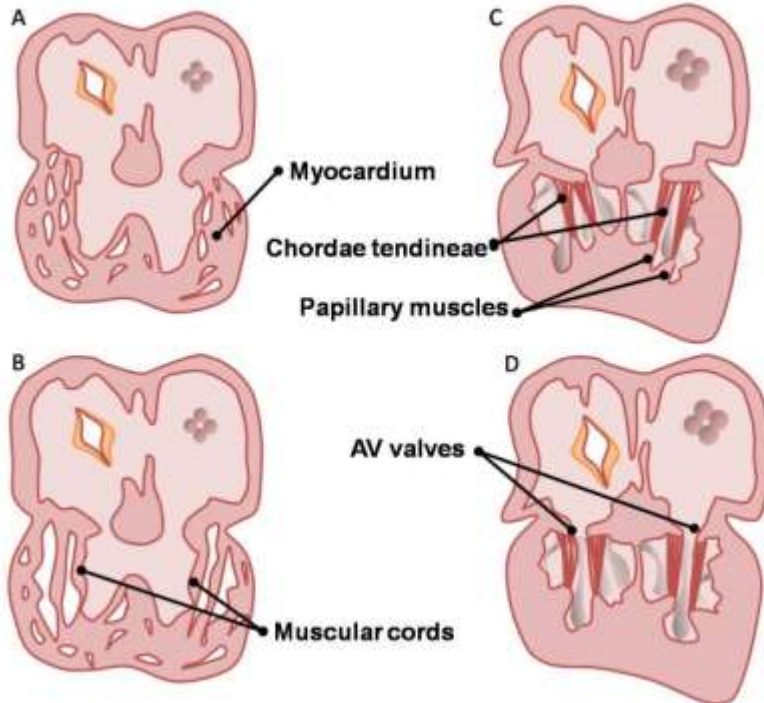
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# Cardiac valves

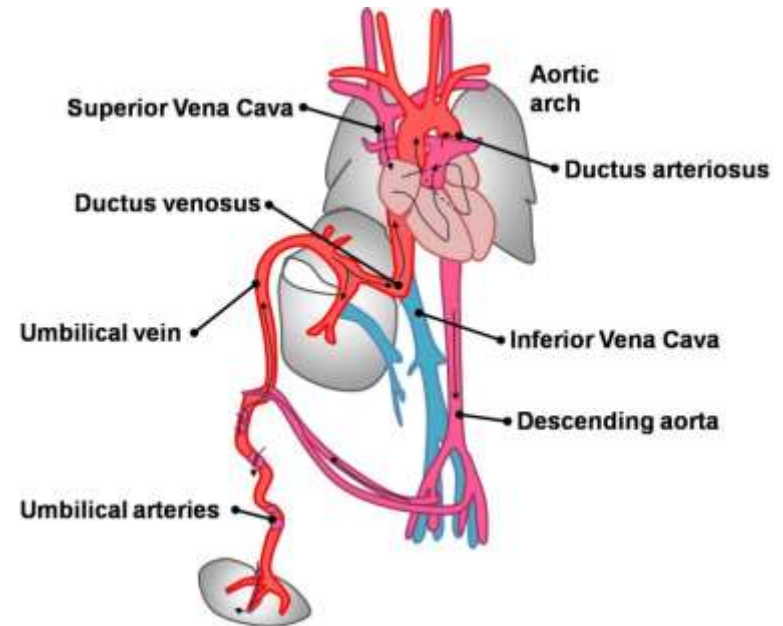
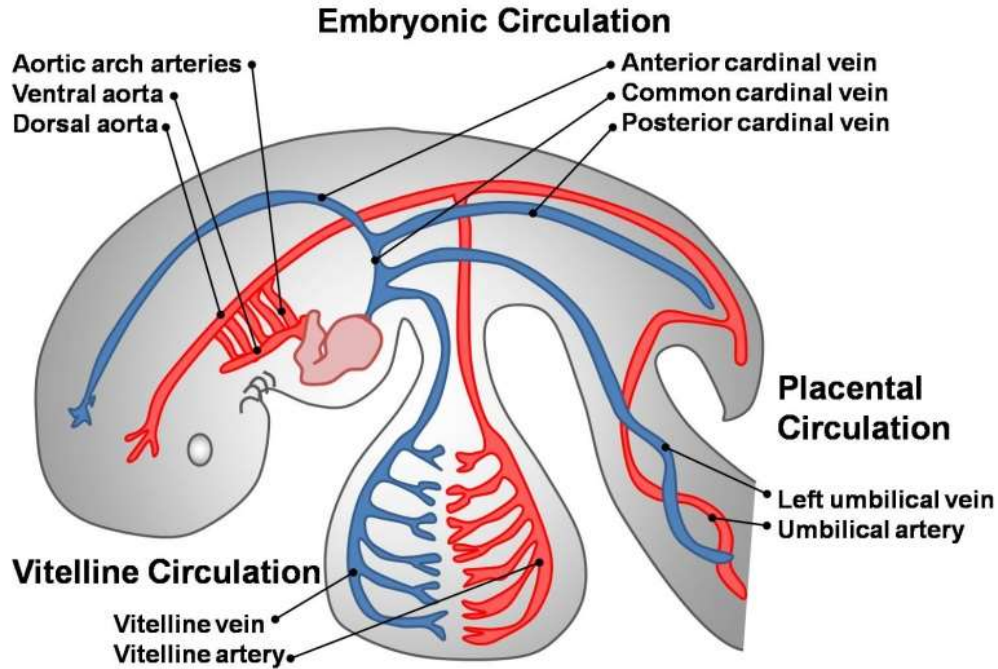


# Cardiac valves

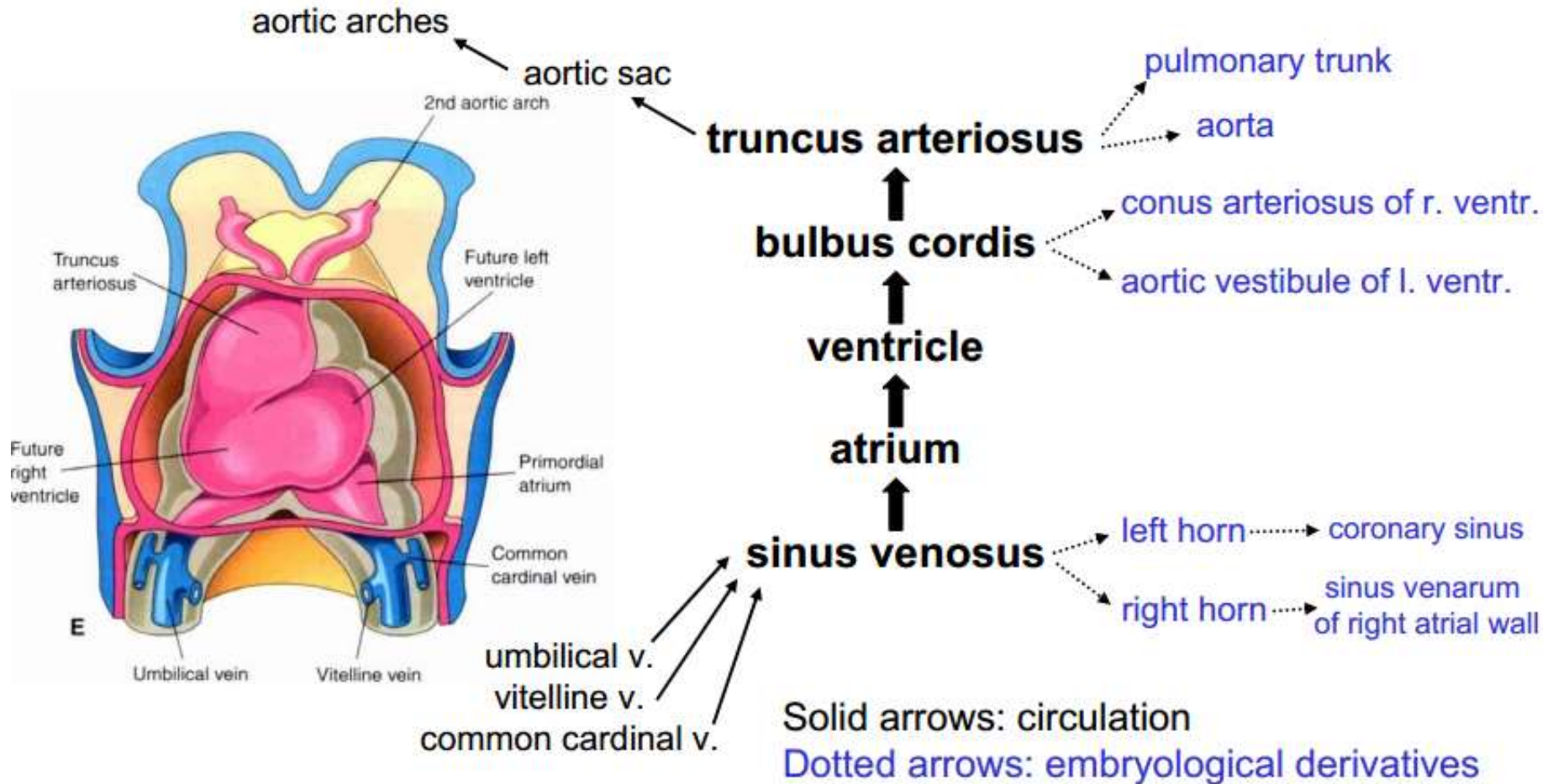




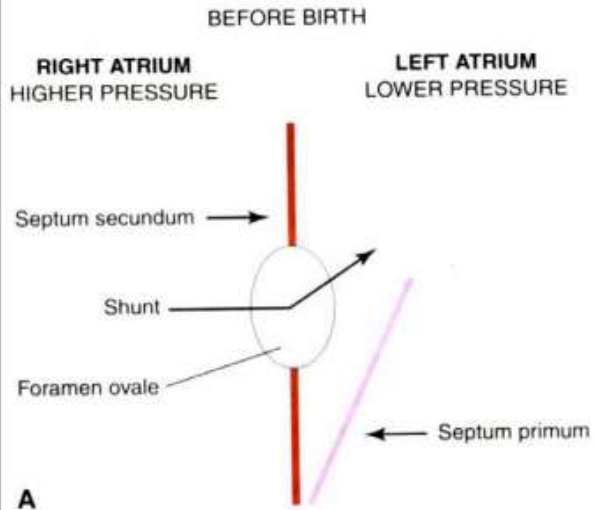
# Foetal circulation



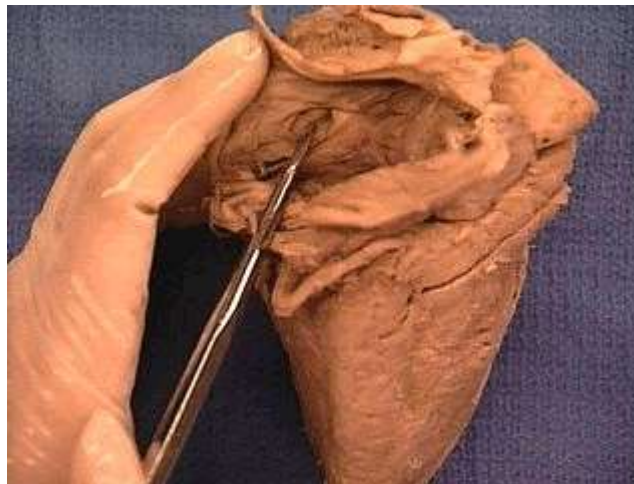
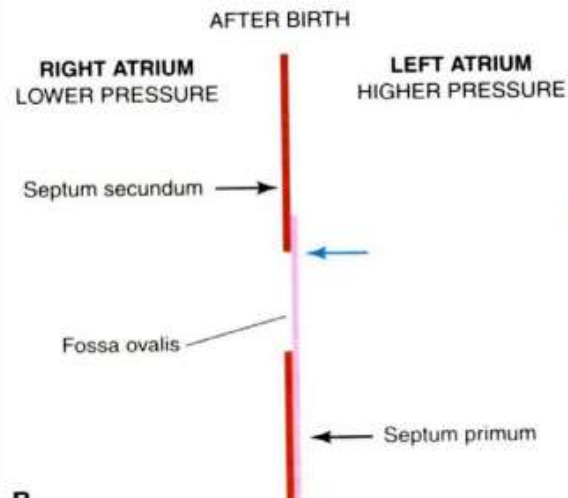
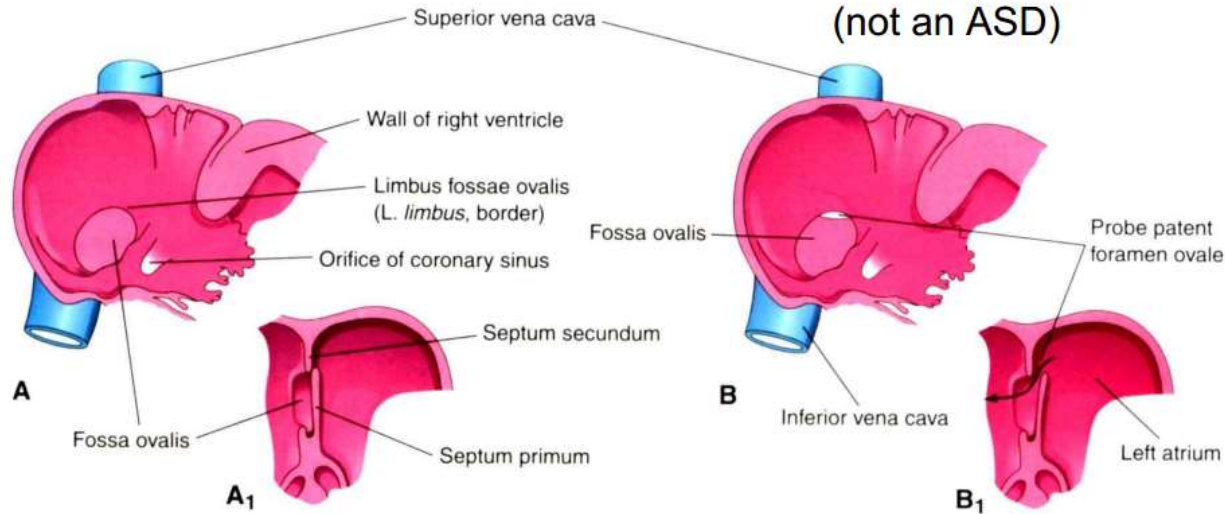
# Foetal circulation



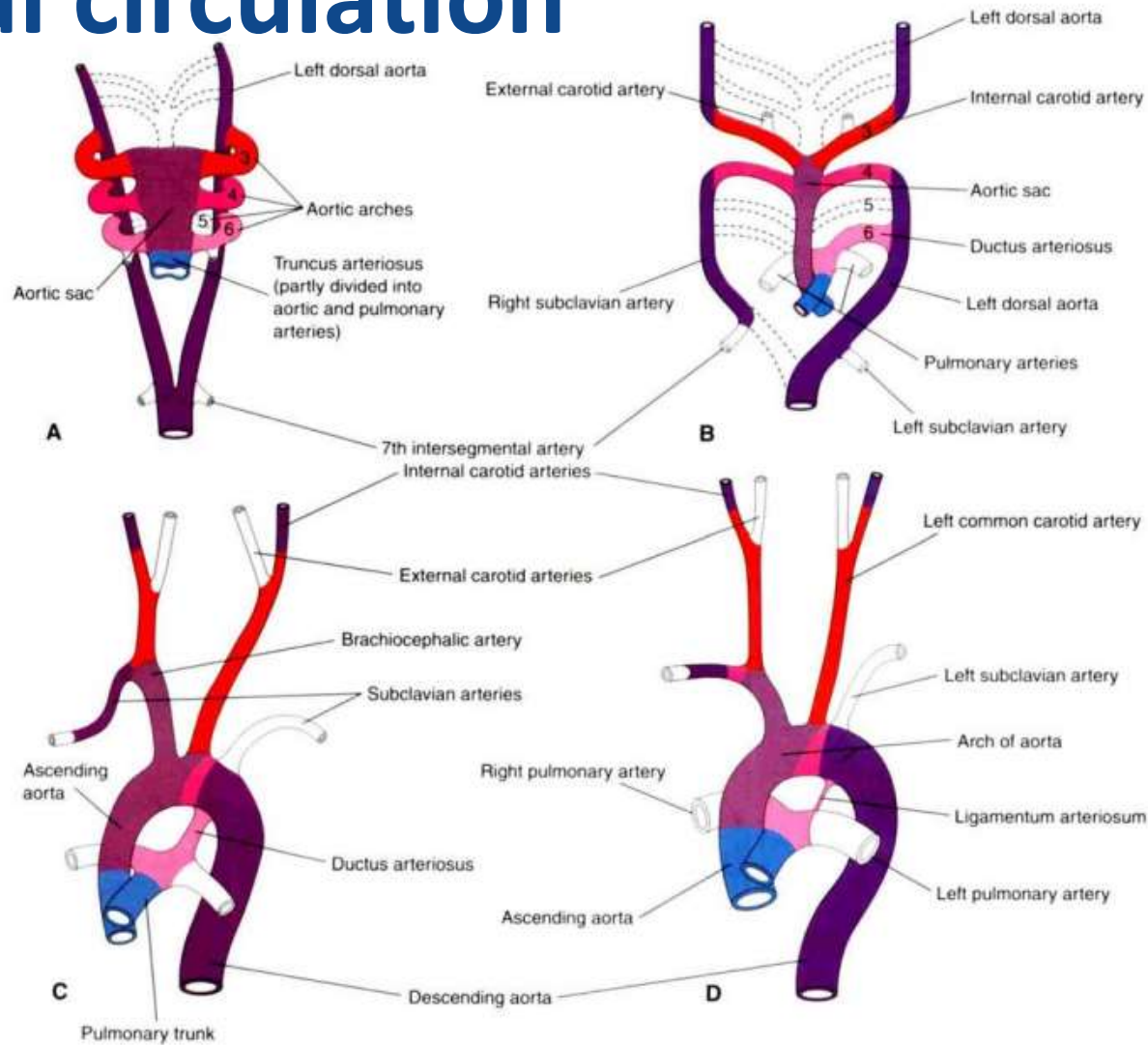
# Foetal circulation



postnatal



# Foetal circulation



# Congenitale hartafwijkingen

