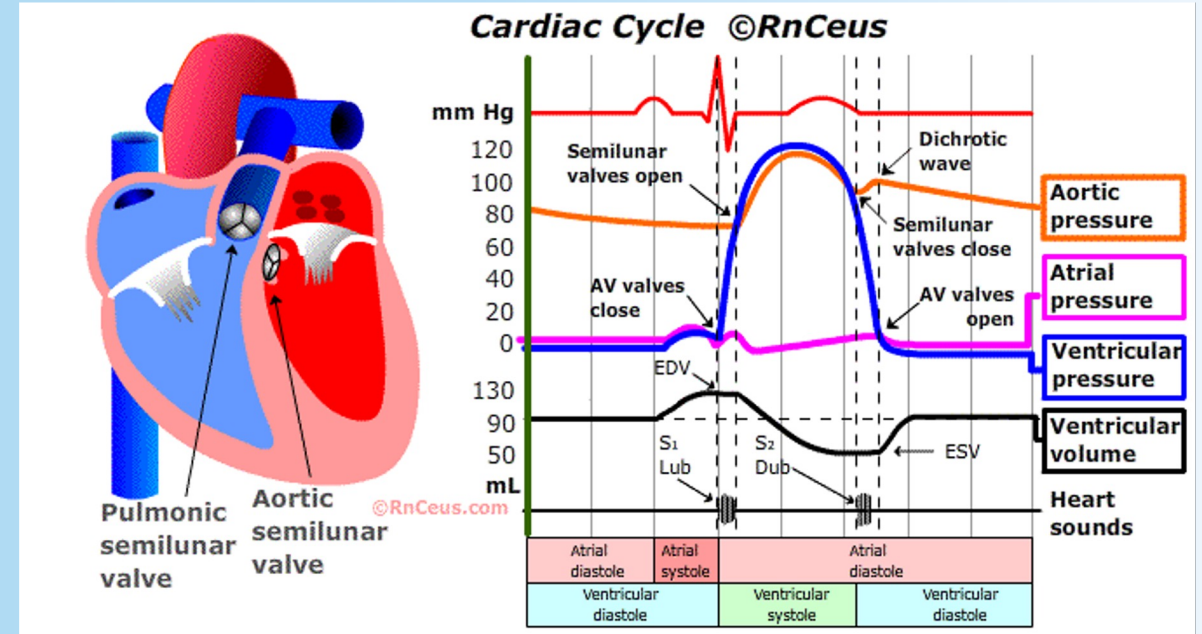


The Cardiac Cycle

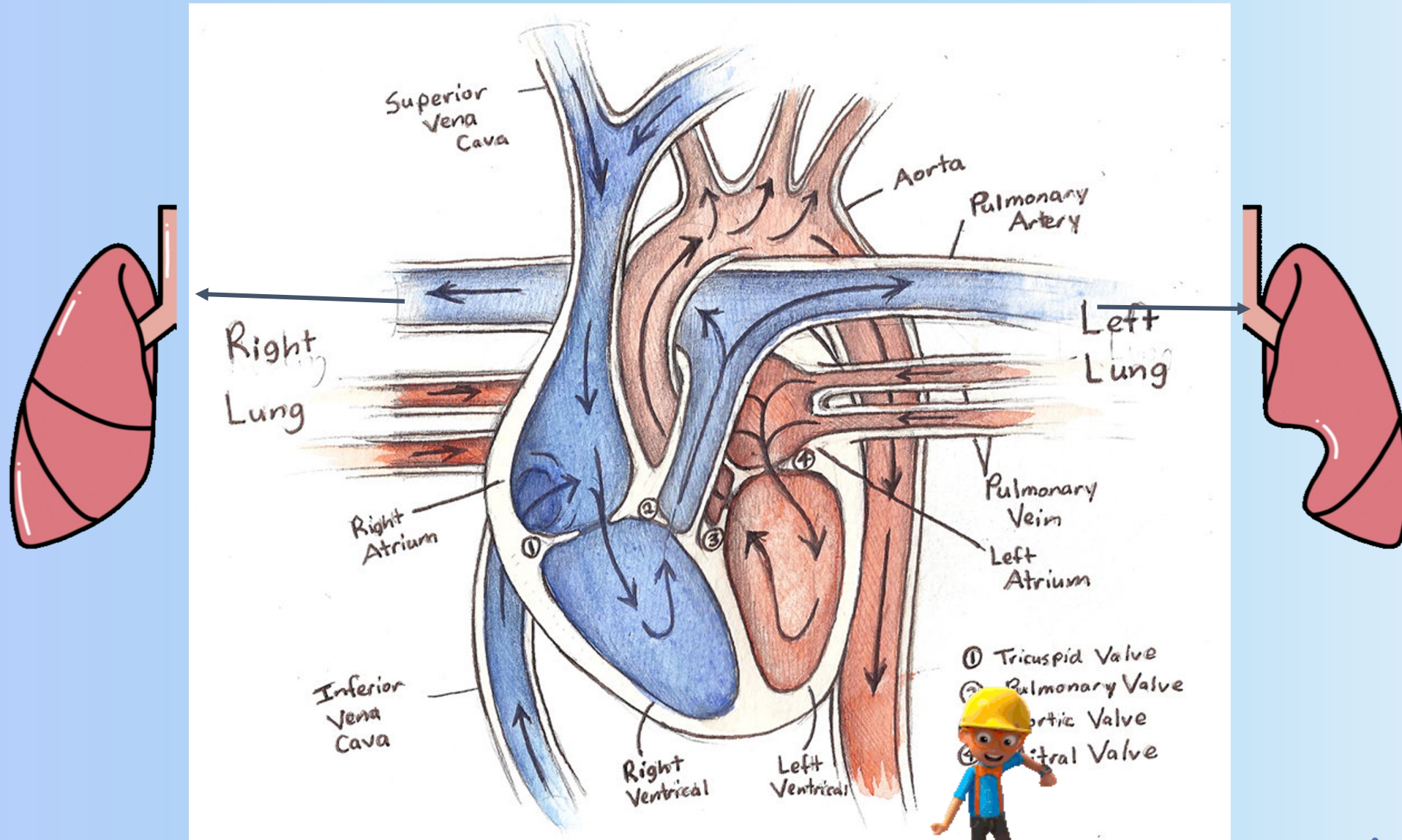
By Michelle Kaminski

Overview

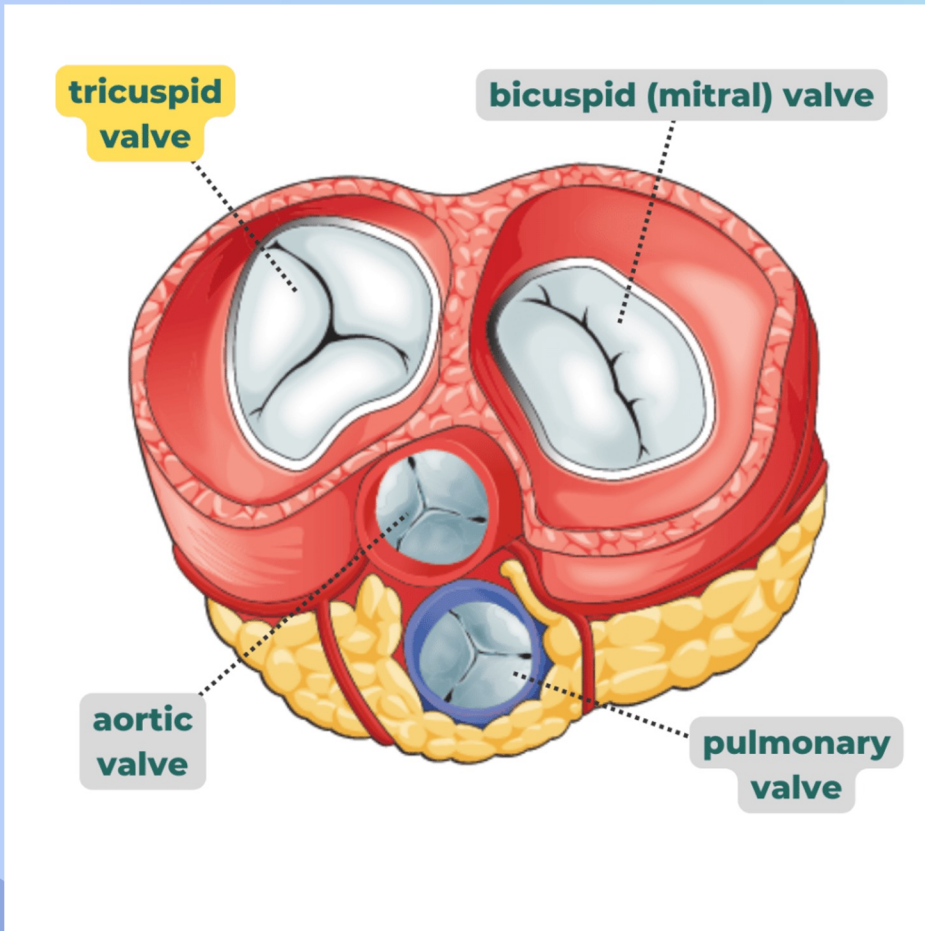
- Anatomy review
- Phases of the Cardiac Cycle
- Pressure Volume loop
- Heart Sounds
- Wiggers Diagram



Quick Anatomy review



Heart Valves

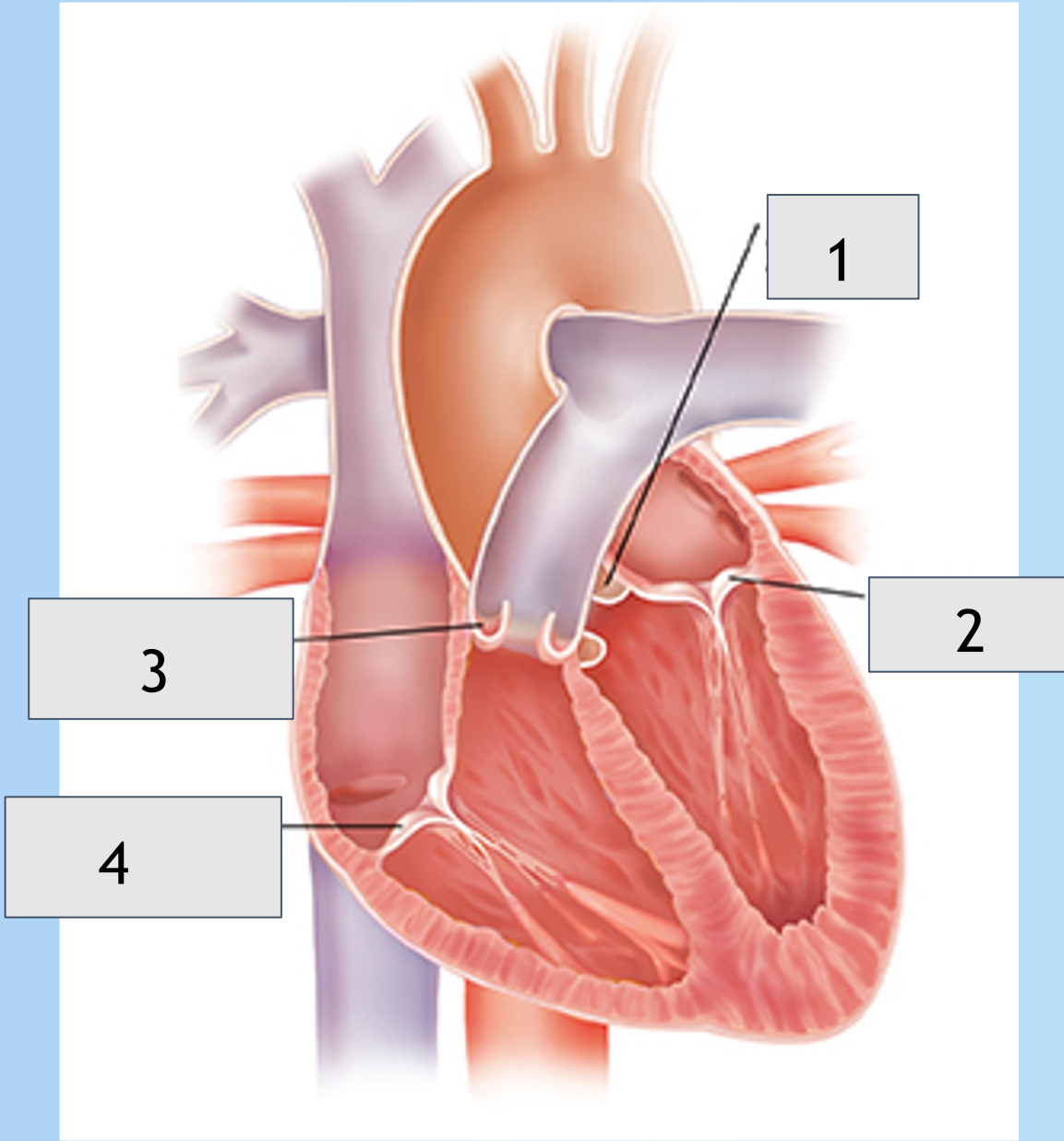


Atrioventricular Valves:

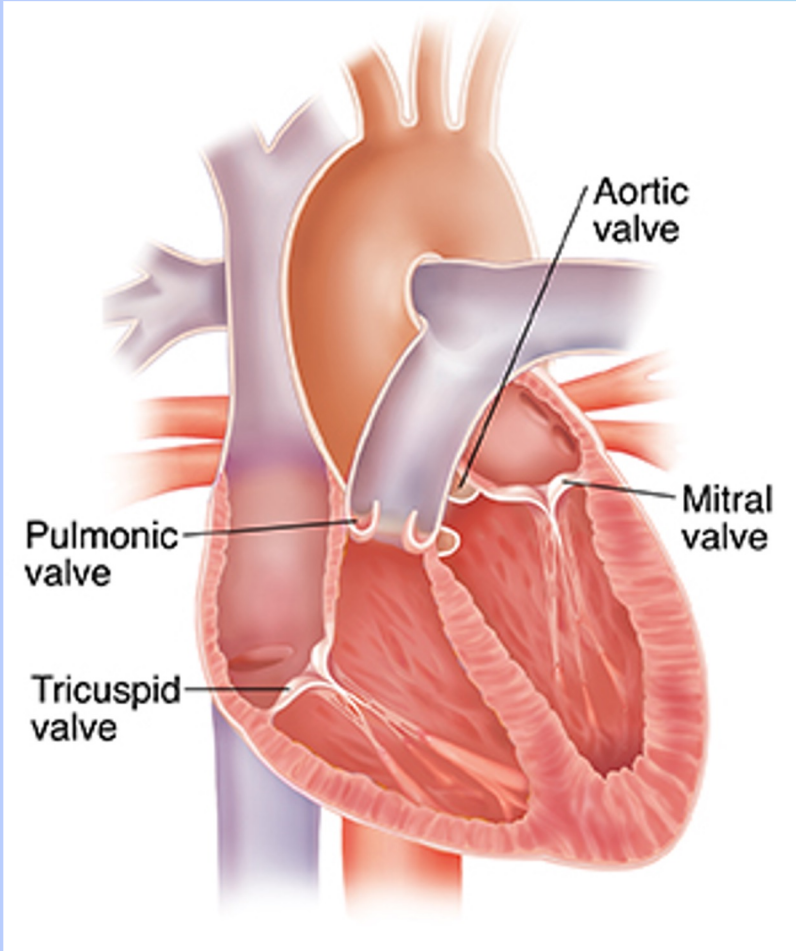
- Tricuspid valve
 - From right atrium into right ventricle
- Bicuspid Valve (Mitral Valve)
 - From left atrium to left ventricle

Semilunar Valves

- Pulmonary Valve
 - From right ventricle to pulmonary artery into lungs
- Aortic Valve
 - From left ventricle into aorta and into the rest of the body



Tricks to remember :)



Atrioventricular valves

MitralLLL – LLLLeft side of the heart

(Bi/tri)Cuspid = The cusps between atria and ventricles

SemiLunar Valves – LUNAR

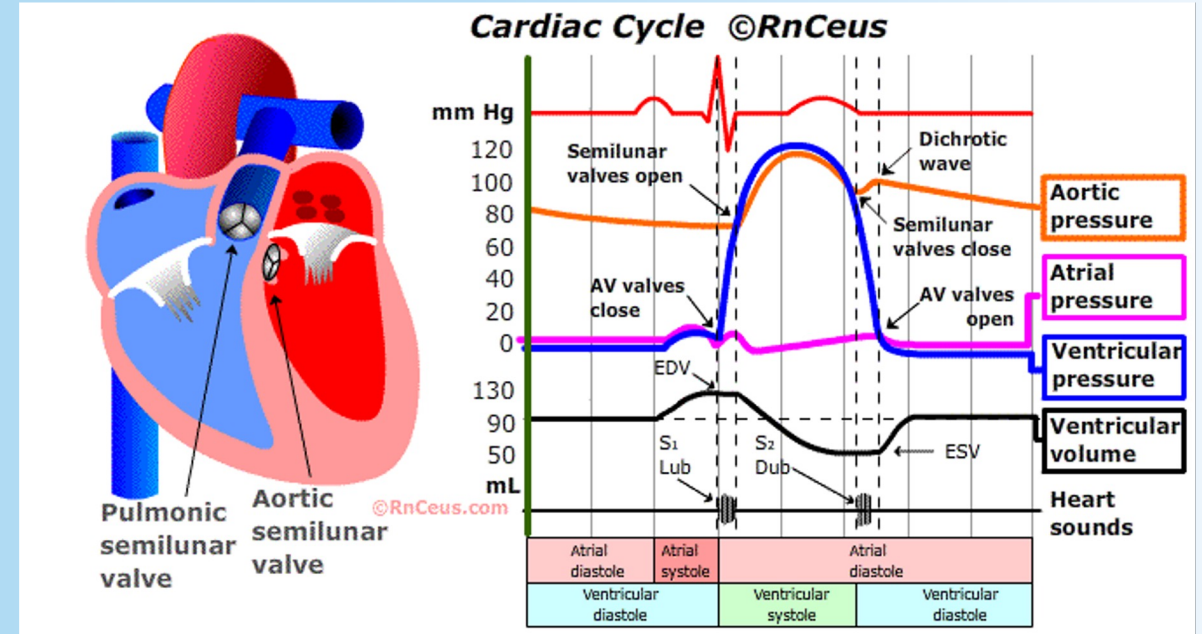
- Think of the moon for outside as semilunar valves lead blood flow outside of the heart
- Lunars Lead Away with Arteries



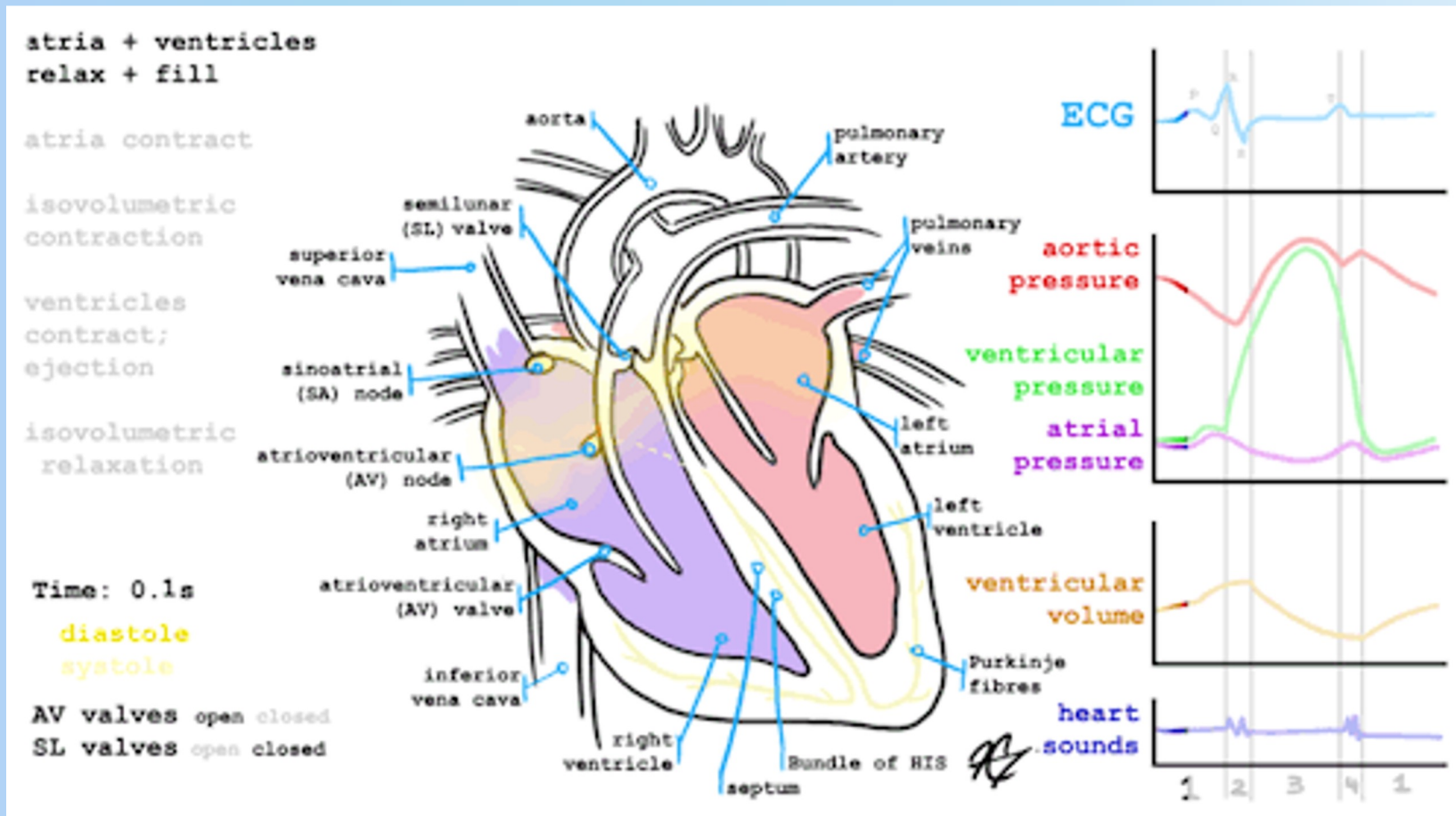
Man on the moon- Kidcudi (2024 anatomy remastered)

Overview

- ~~Anatomy review~~
- Phases of the Cardiac Cycle
- Pressure Volume loop
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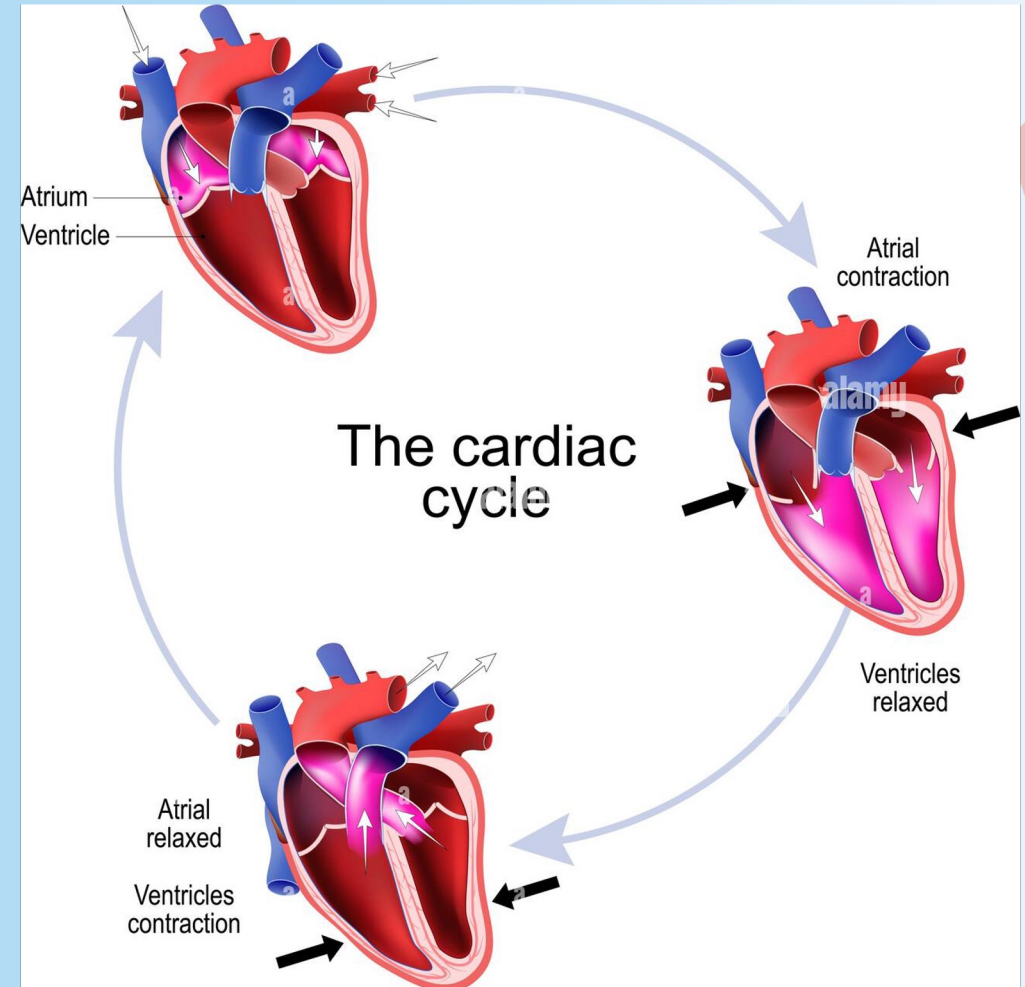


Phases of Cardiac Cycle



Simplify it first!

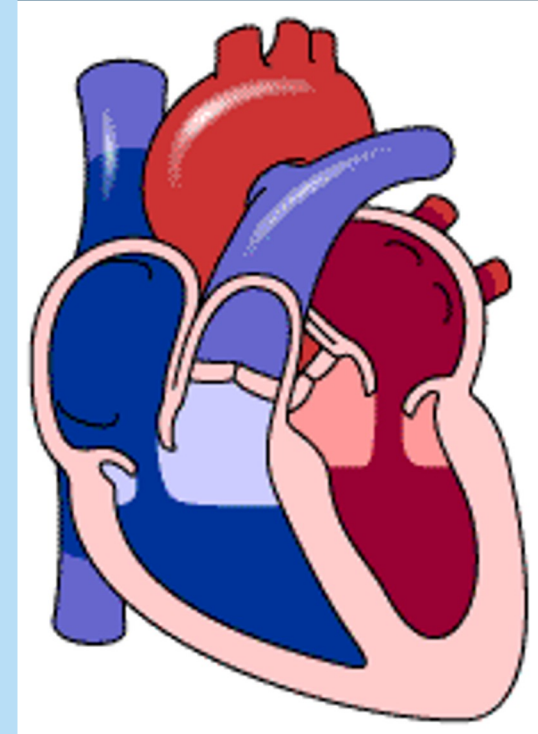
- Atrial Systole
- Isovolumetric Contraction
- Ventricular Systole (Ventricular Ejection)
- Isovolumetric relaxation
- Ventricular filling
 - Passive and Active



Down to the Details

Atrial Systole

- Contraction of Atria fills the ventricles to its full capacity, the active filling of the ventricles
- “The Final Push” : Only accounts for the last 10%-20% of volume
- Ventricular Volumes are Maximal
 - this is where to measure your EDV
 - EDV = End diastolic volume
 - Volume remaining in left ventricle after diastole

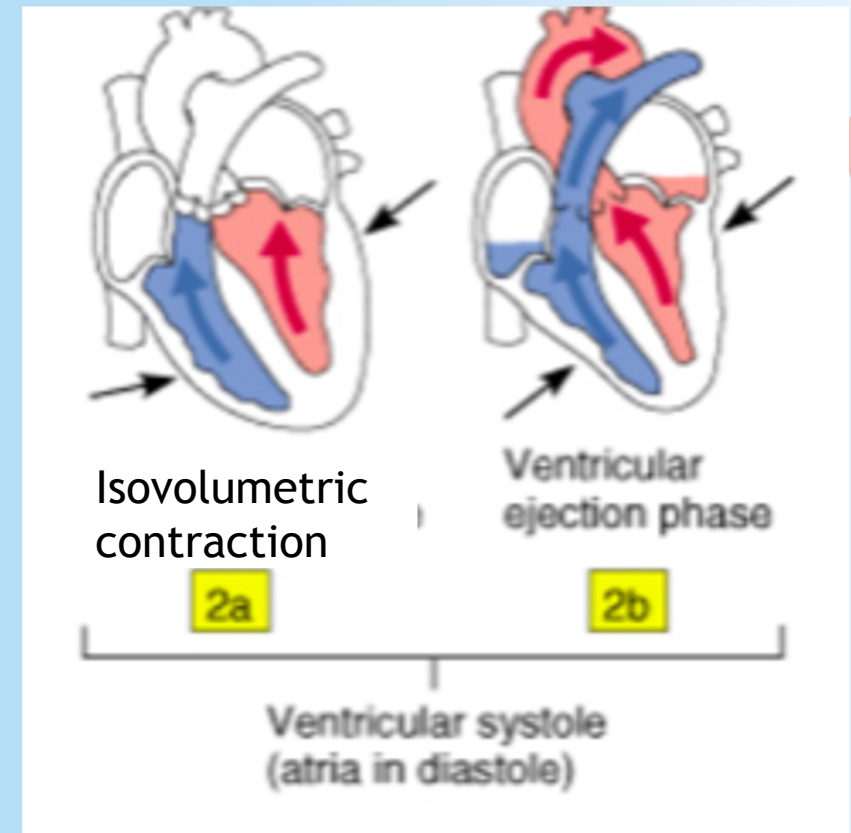


Down to the Details

Isovolumetric contraction

- Isovolumetric = all valves are closed and there is no change in ventricular volume
- Ventricles are starting to contract = $\uparrow\uparrow$ in pressure of the ventricles
- Transition state between closure of the *Mitral and Tricuspid (AV) valves* and the opening of the *Semilunar valves*

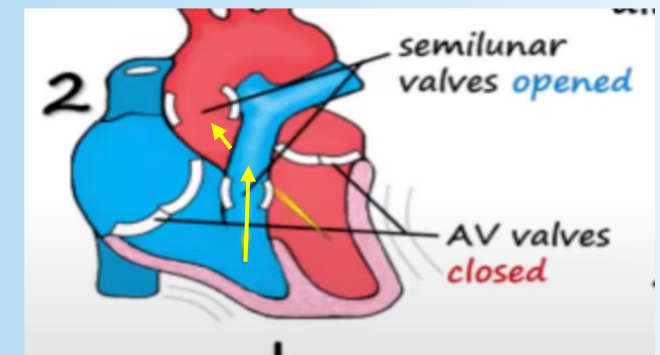
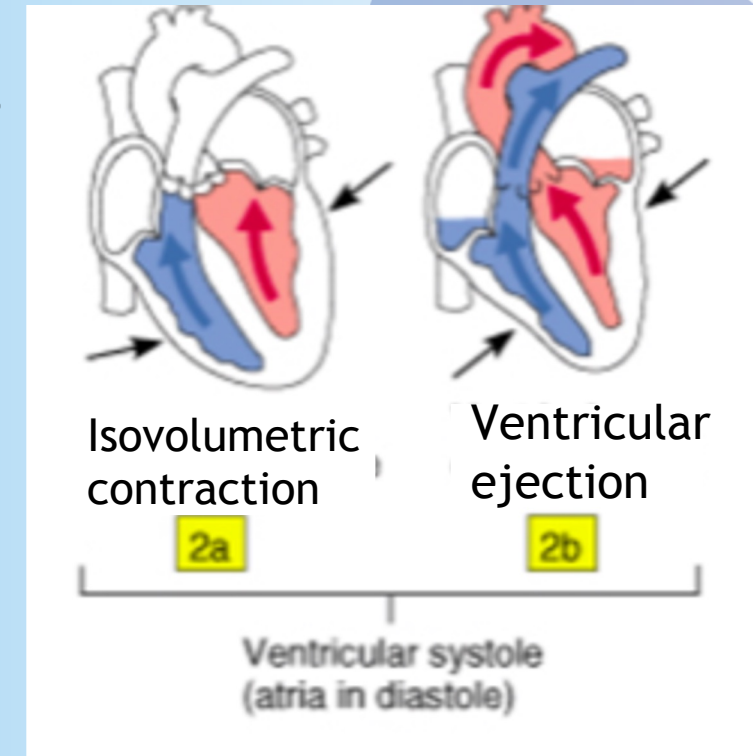
Closure of the AV valves give us our first heart sound
“Lubb”



Down to the Details

Ventricular Ejection (Ventricular Systole)

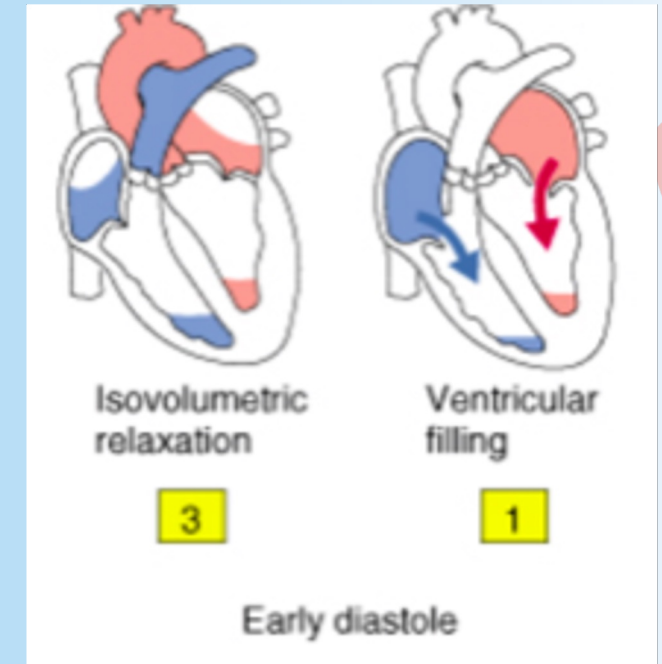
- Rapid ejection
 - Rapid $\uparrow\uparrow\uparrow$ in pressure = semilunar valves open
 - Large pressure gradient
 - Ventricles \gg Aorta and pulmonary artery
 - Most of stroke volume is ejected here
- Reduced Ejection
 - Ejection slows down - Small pressure gradient is pushing the blood
 - ESV should be measured here
 - ESV = end systolic volume
 - volume remaining in ventricle after systole



Down to the details

Isovolumetric Relaxation

- ALL VALVES HAVE CLOSED
- Ventricles have relaxed, pressure is ↓
 - pressure gradient flipped
 - Aortic + Pulmonary arteries >> Ventricles
- Semilunar valves close to prevent backflow of blood back into ventricles
 - small backflow occurs

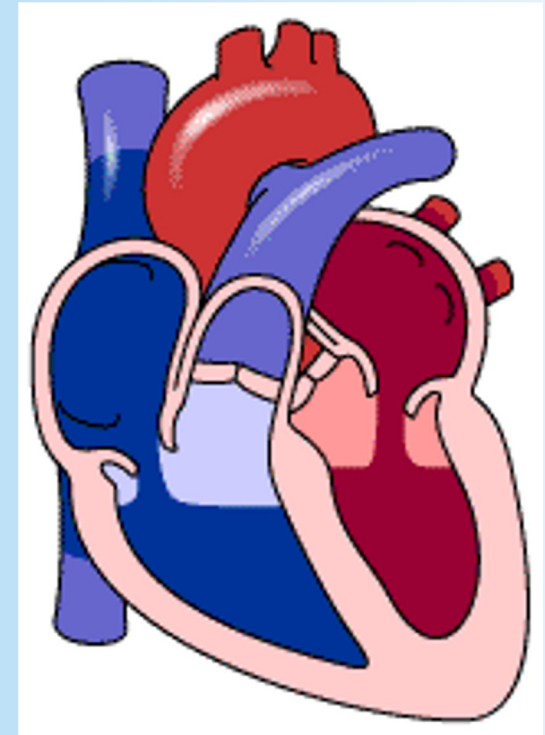


Closing of semilunar valves causes second heart sound “dubb”

Down to the details

Ventricular Filling

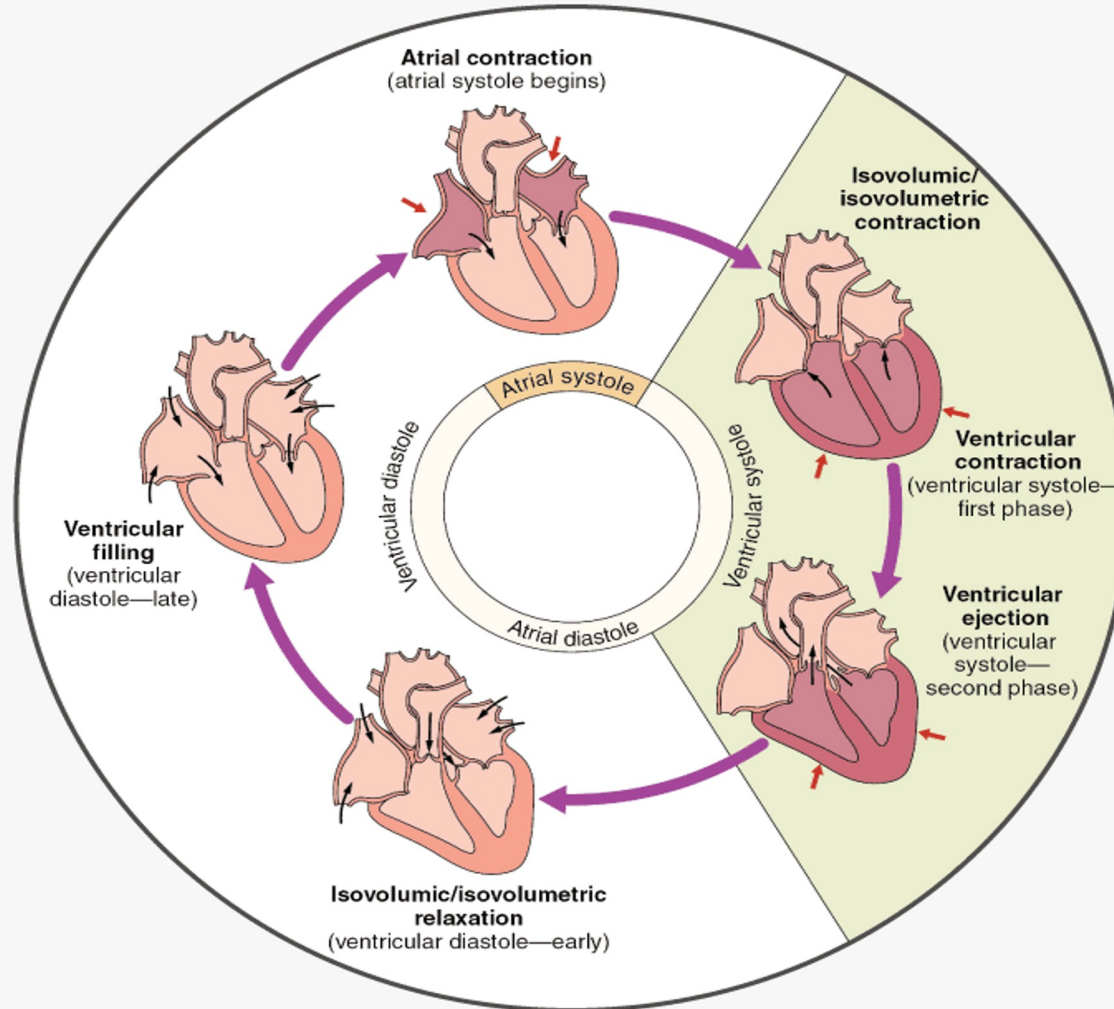
- AV valves have opened
- Passive (1st $\frac{1}{3}$ of time)
 - First rapid passive influx of blood into ventricles
 - Blood merely flowing through the atria into ventricles
 - Fills up 80%-90% of ventricle
- Diastasis (2nd $\frac{1}{3}$ of time)
 - Middle stage of ventricular diastole
 - Still passive influx into ventricle but it has slowed
 - Atria have not contracted yet



And now we are back at Atrial systole again.....

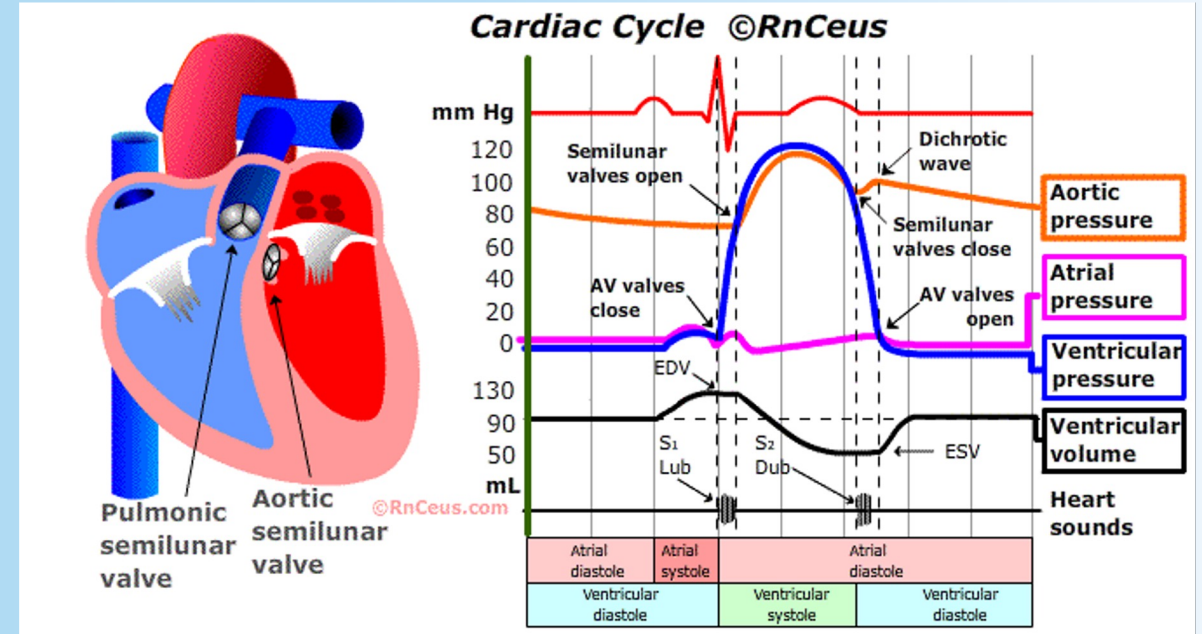
Put it All Together!

CARDIAC CYCLE

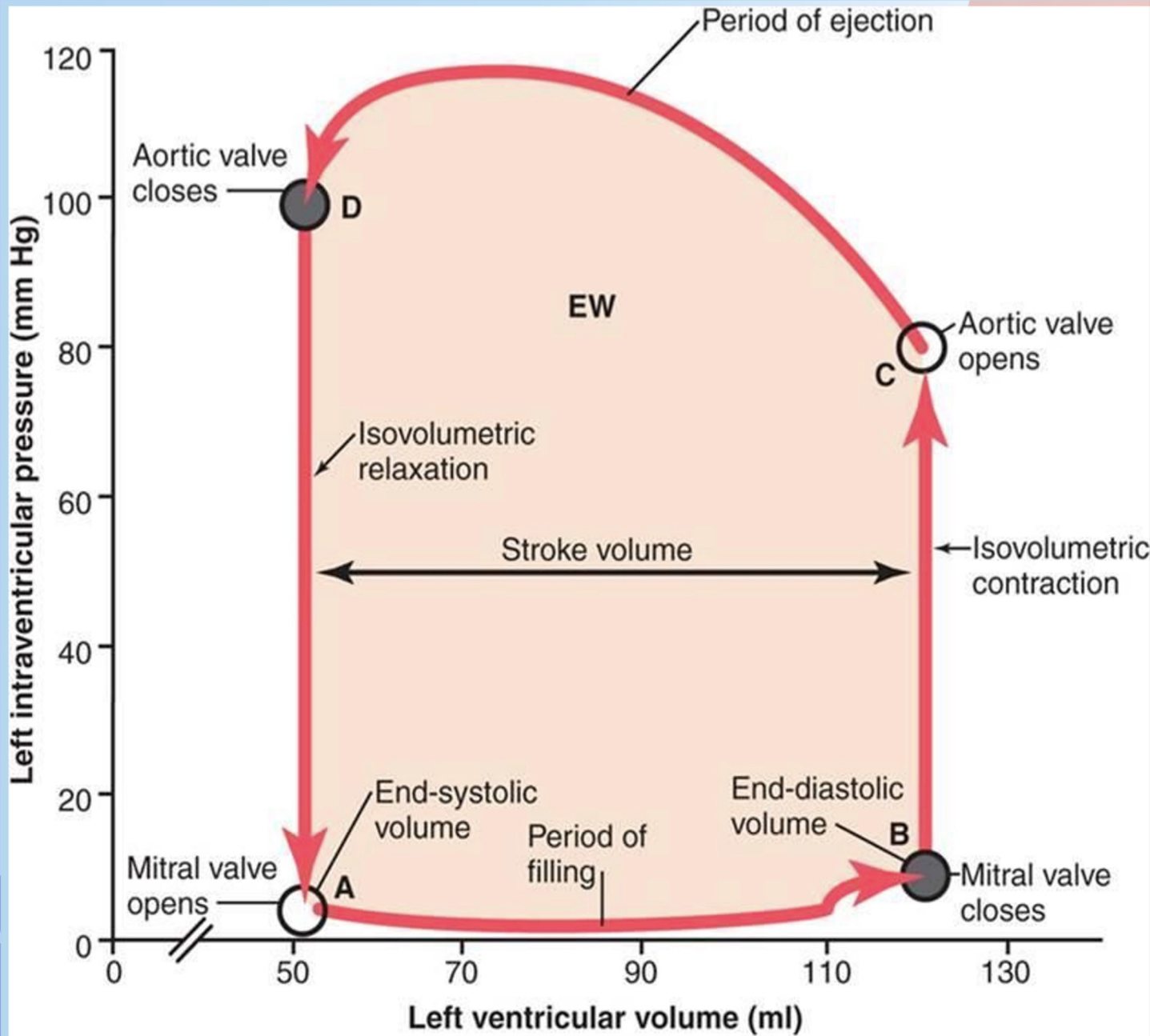


Overview

- ~~Anatomy review~~
- ~~Phases of the Cardiac Cycle~~
- Pressure Volume loop
- Heart Sounds
- Wiggers Diagram



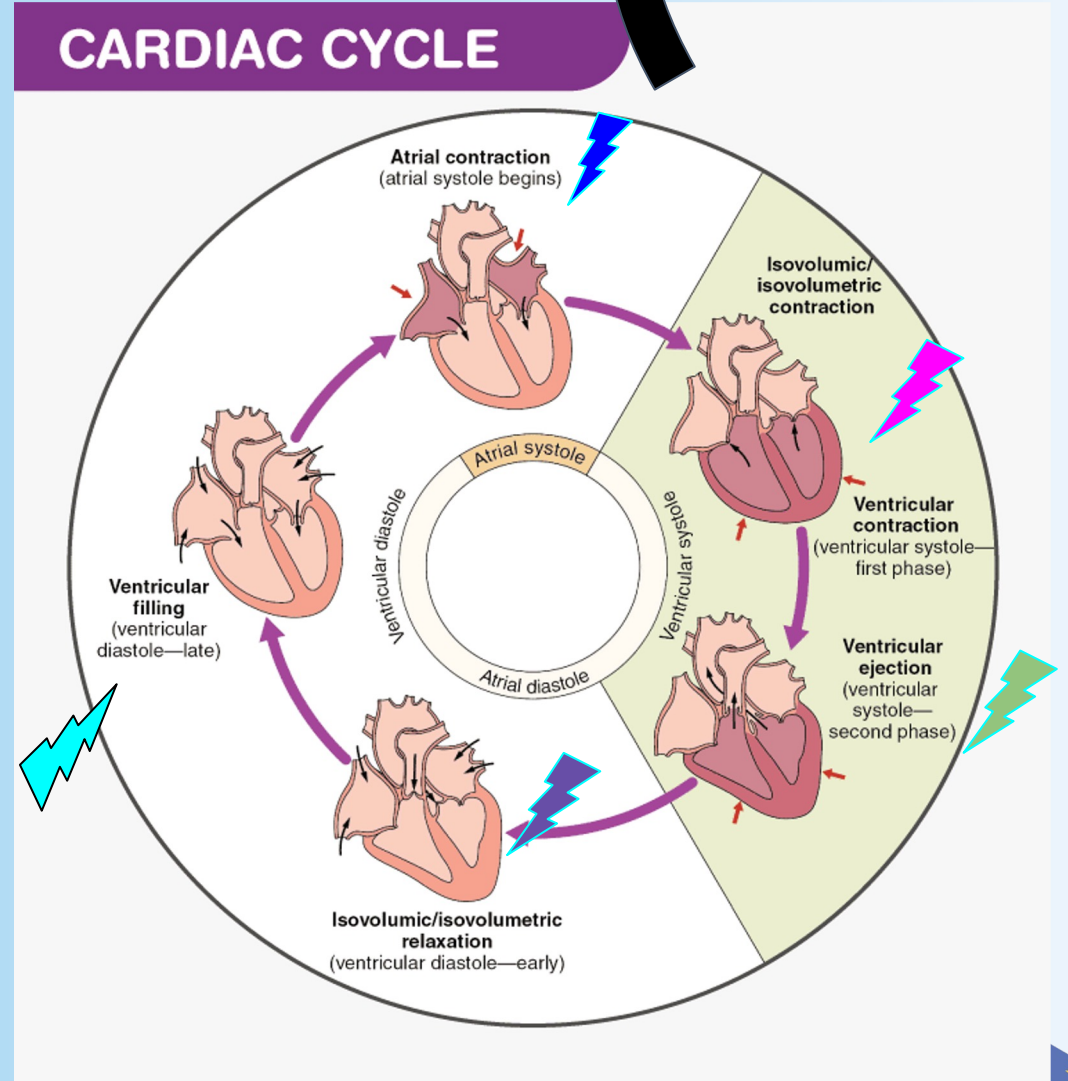
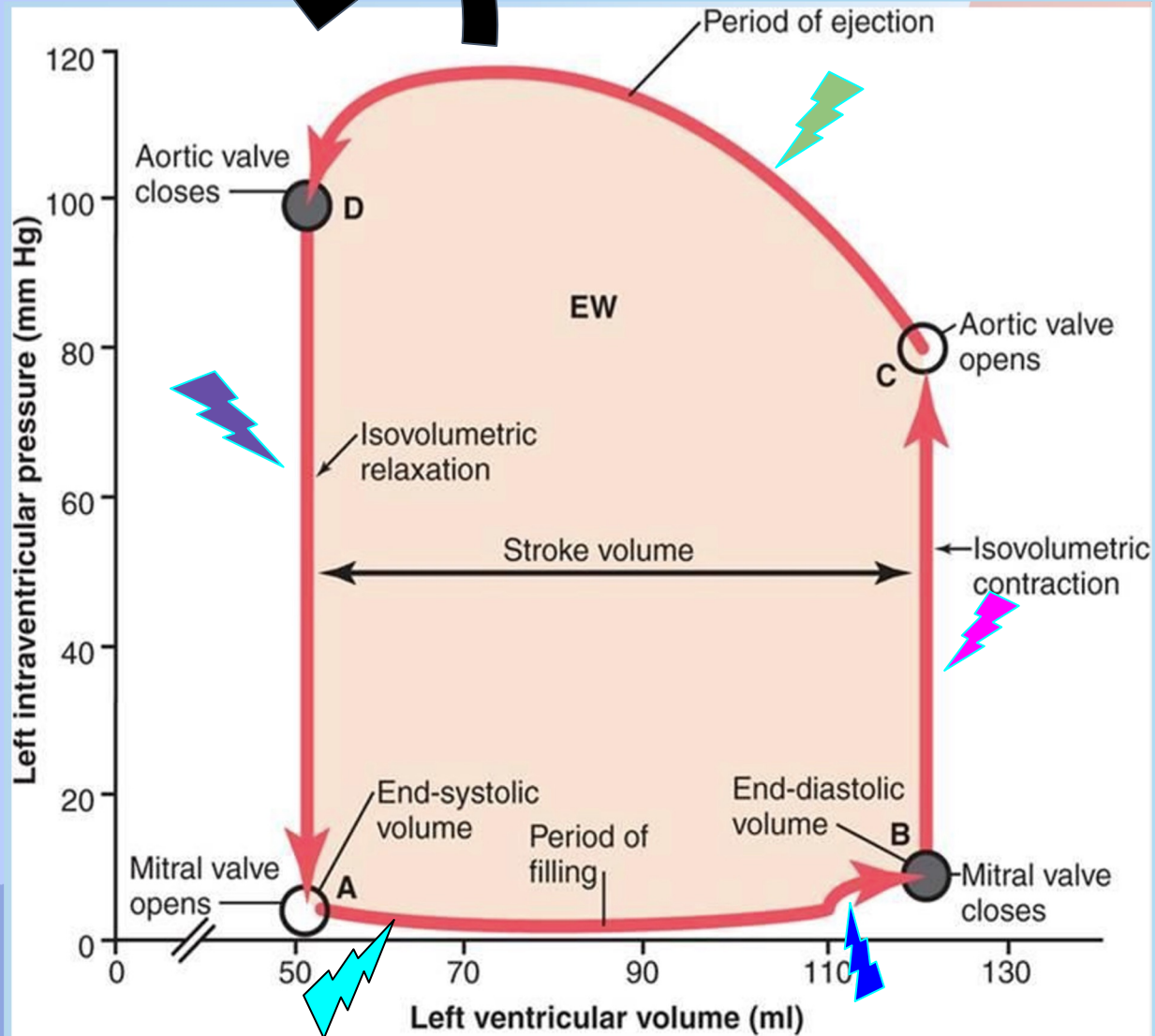
Pressure Volume Loop



Differences between pressure and volume

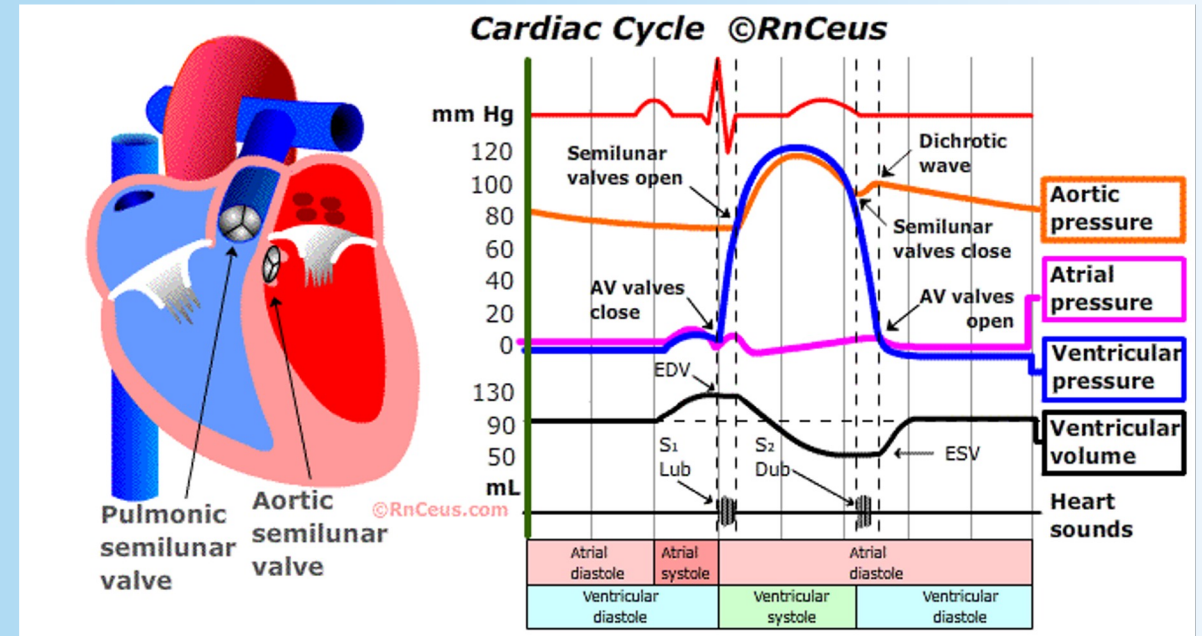
- Point A
 - Mitral valve just opened (AV valves are open)
 - Ventricles are filling
- Point B
 - Mitral valve closed
 - Ventricles begin to contract
 - Pressure builds
- Point c
 - Pressure high enough to open Aortic valve
 - Ventricles are going to contract fully and eject
- Point D
 - Ventricles finished the ejection
 - Pressure gradient flips and aortic valve closes

Pressure Volume Loop

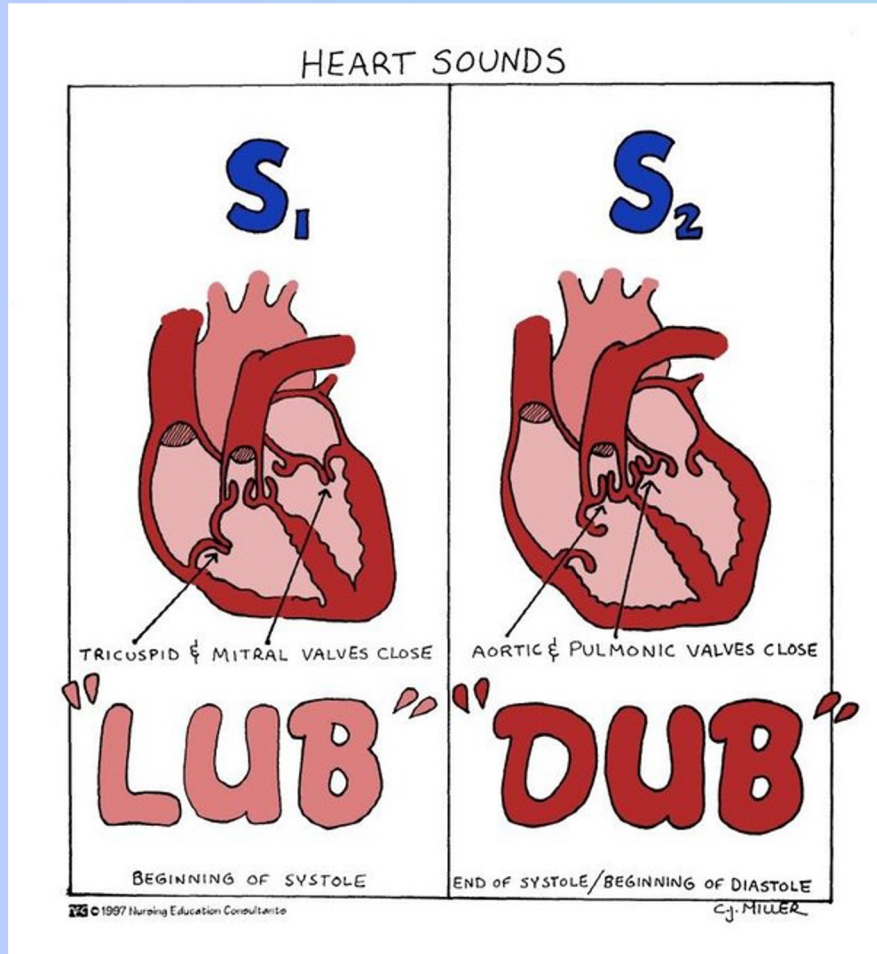


Overview

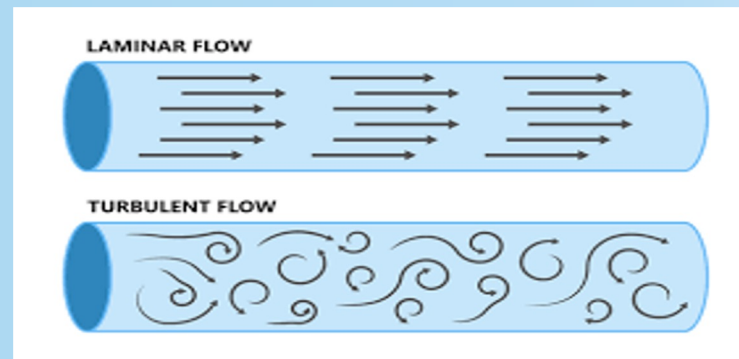
- ~~Anatomy review~~
- ~~Phases of the Cardiac Cycle~~
- ~~Pressure Volume loop~~
- Hearts Sounds
- Wiggers Diagram



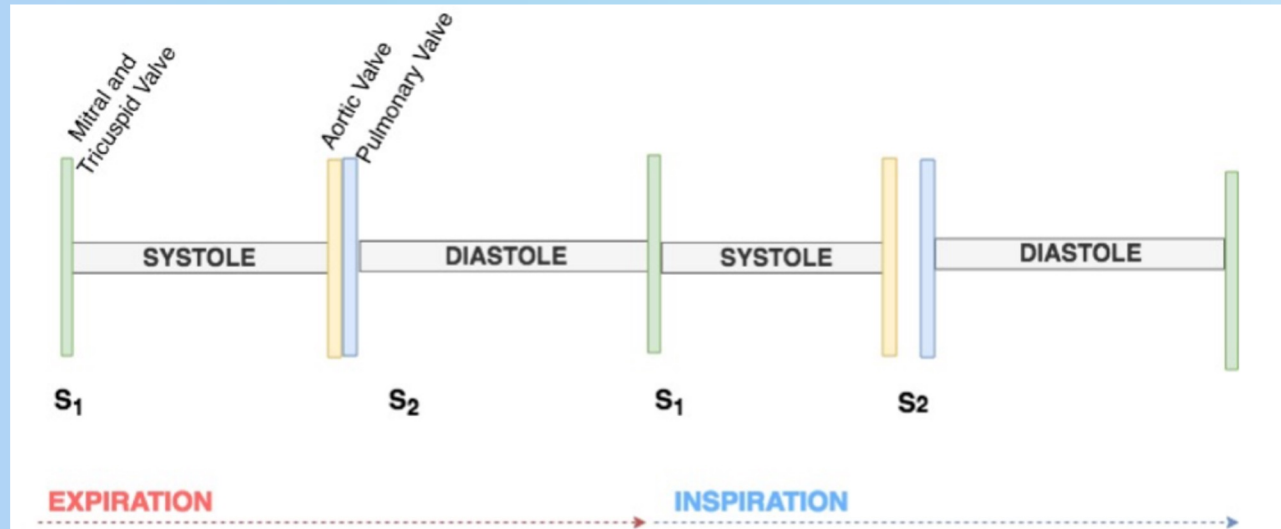
Heart Sounds



- Heart sounds occur from the turbulence in blood flow from the closing of the valves
- S₁
 - Atrioventricular valves close
- S₂
 - Semilunar valves close



Heart Sounds

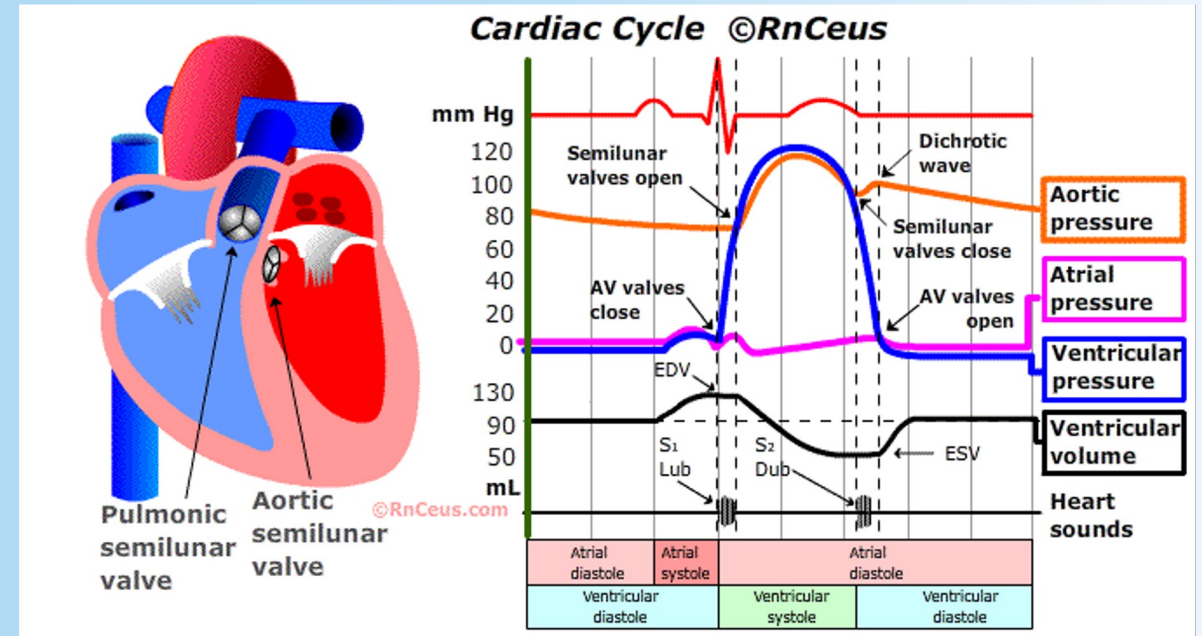


II. Pathological heart sounds

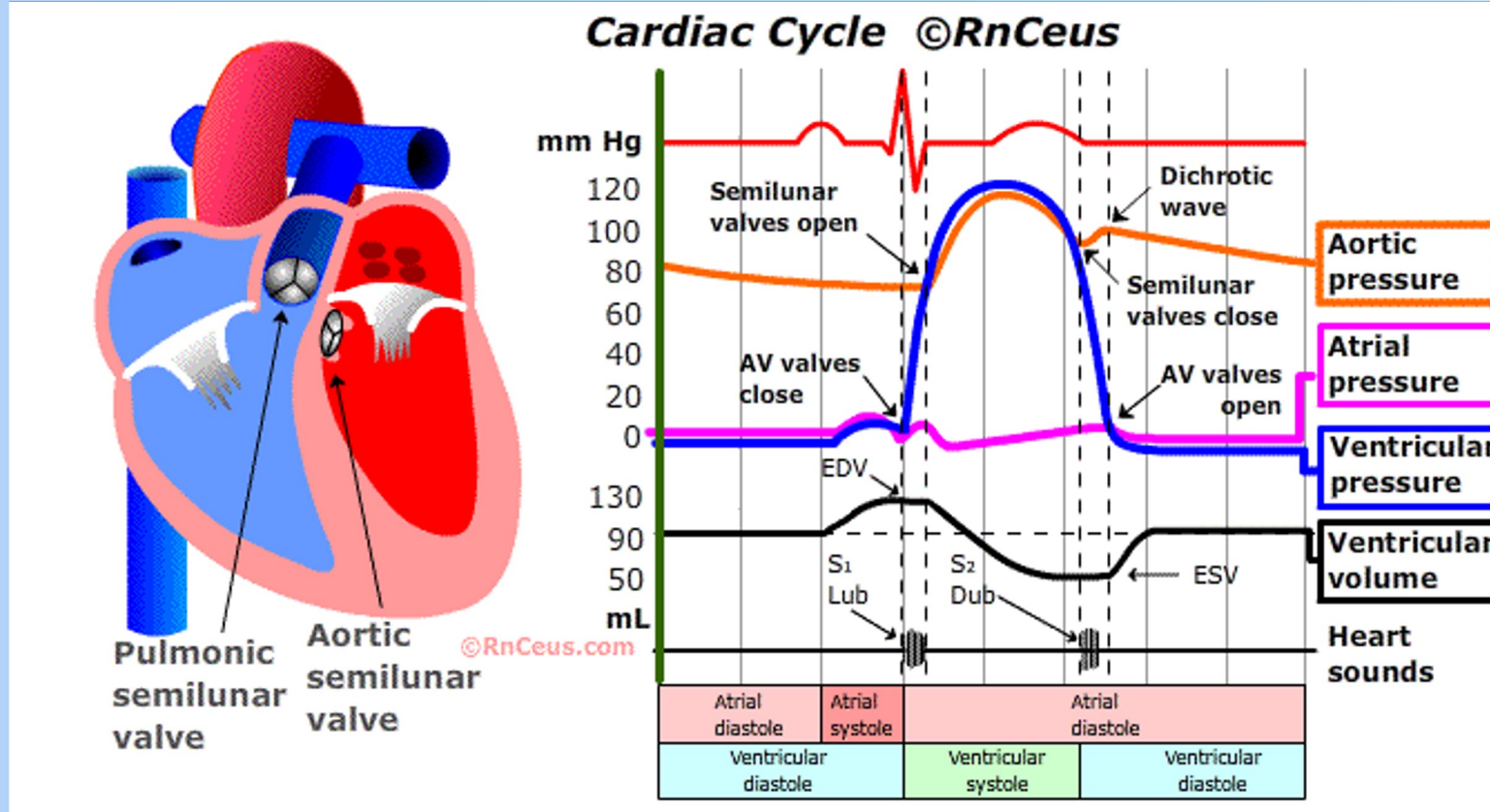
	S ₃	S ₄
Phase of the cardiac cycle	Early diastole	Late diastole
Mechanical event	Passive filling of the left ventricle	Active filling of the left ventricle
Caused by	Rapid, turbulent blood flow entering the left ventricle during early diastole	Vibration of the stiff wall of the left ventricle during atrial contraction
Comments	<ul style="list-style-type: none"> - Normal finding in children and athletes - Indicates volume overload in adults 	Implies hypertrophy of the left ventricle

Overview

- ~~Anatomy review~~
- ~~Phases of the Cardiac Cycle~~
- ~~Pressure Volume loop~~
- ~~Hearts Sounds~~
- Wiggers Diagram

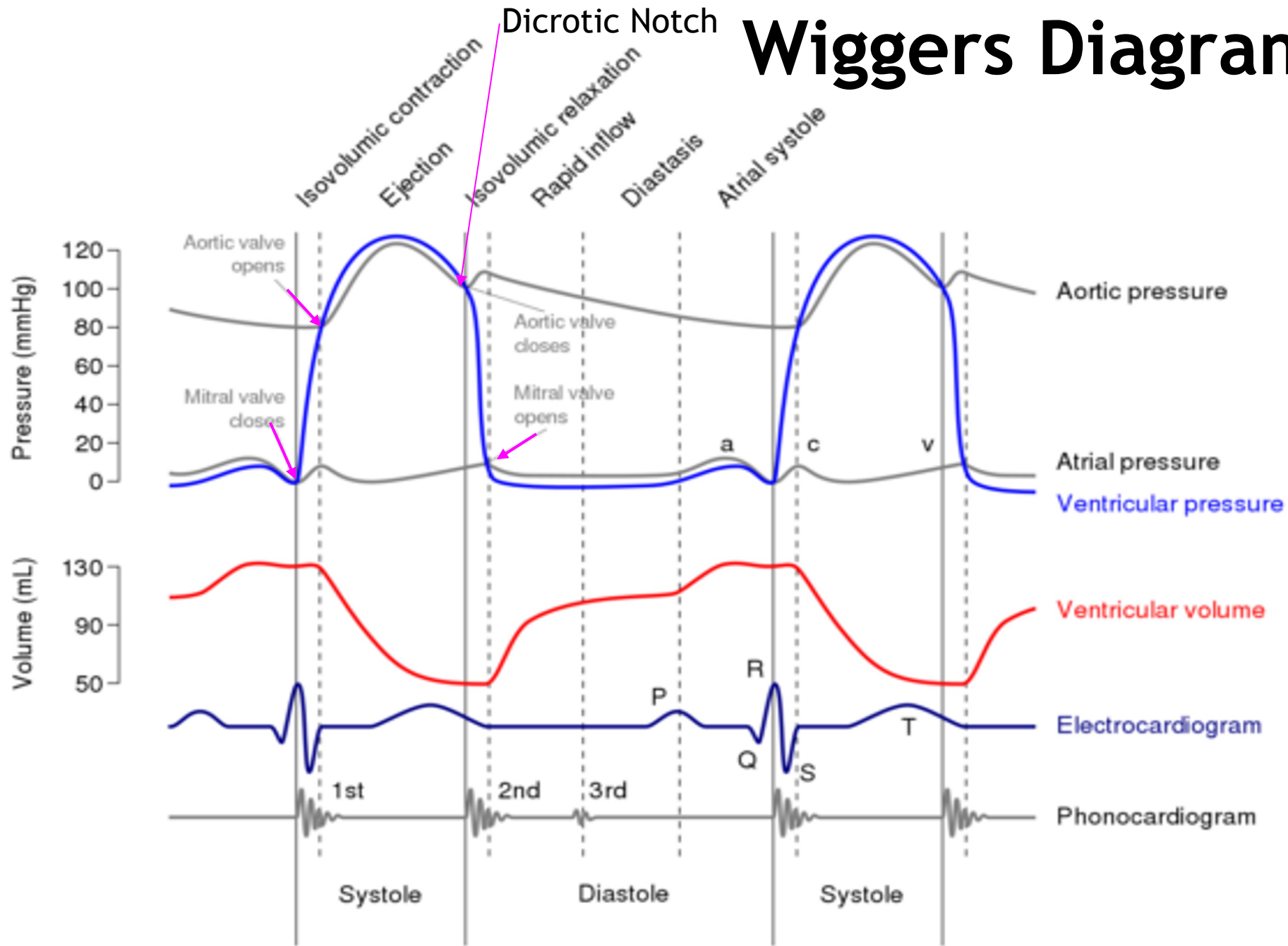


Wiggers Diagram



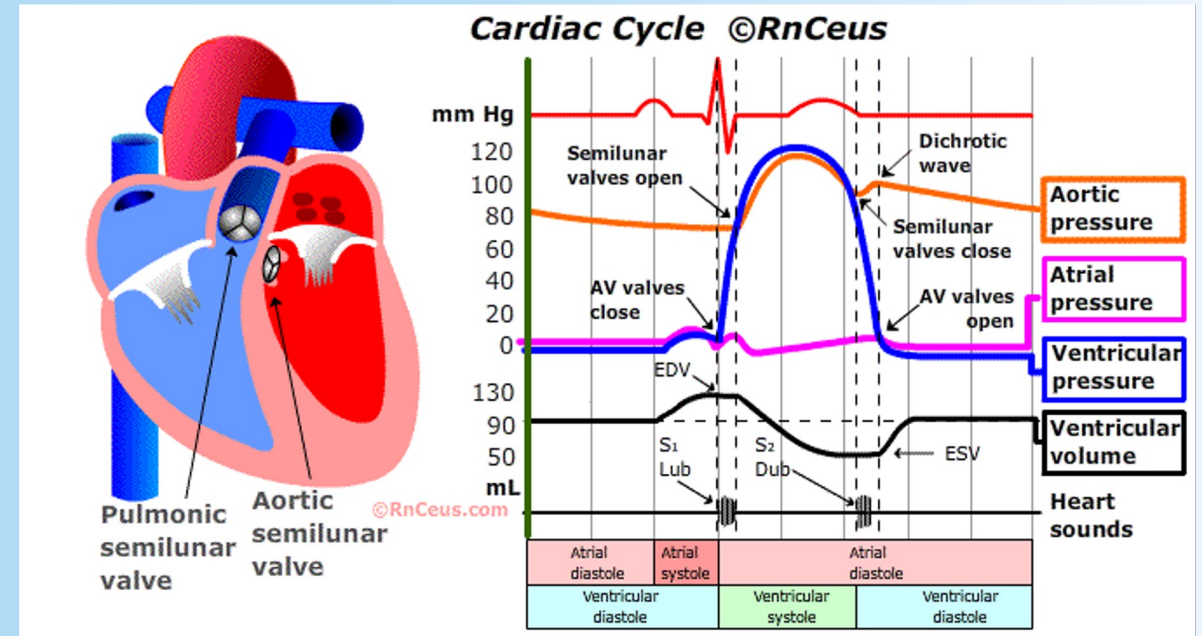
Wiggers Diagram

Dicrotic Notch



Overview

- ~~Anatomy review~~
- ~~Phases of the Cardiac Cycle~~
- ~~Pressure Volume loop~~
- ~~Hearts Sounds~~
- ~~Wiggers Diagram~~



WOOCLAP!