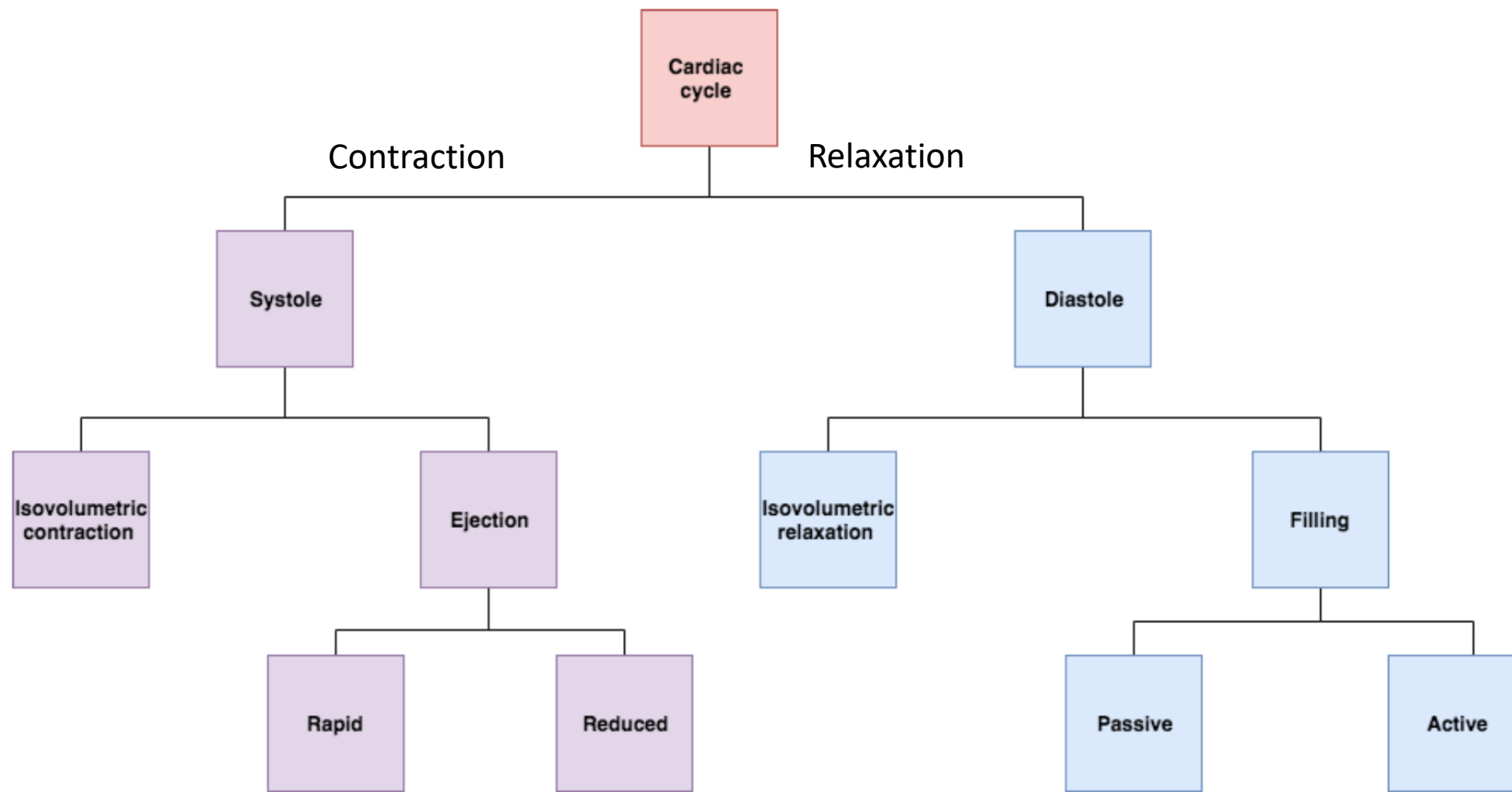
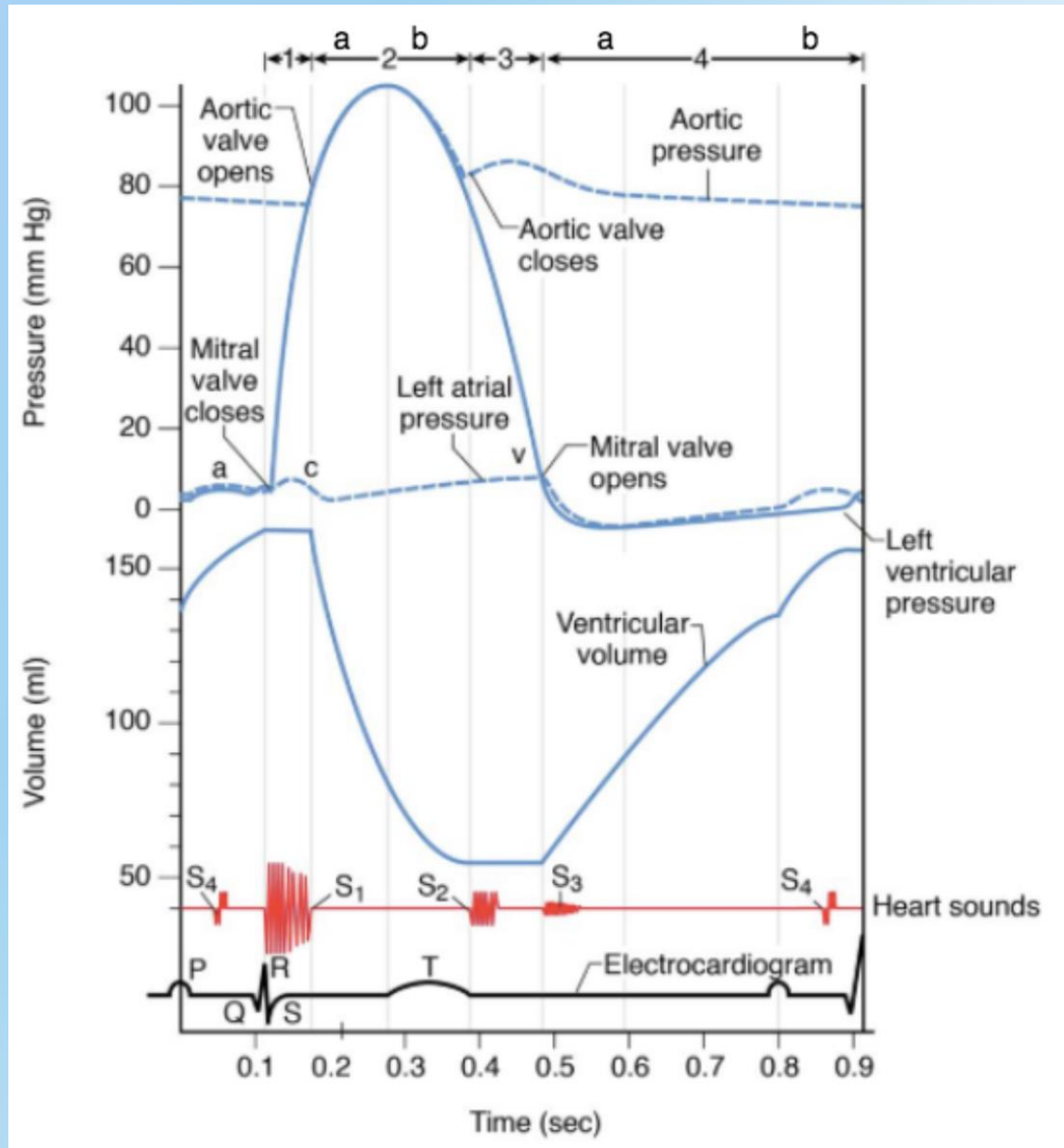


Cardiac Cycle

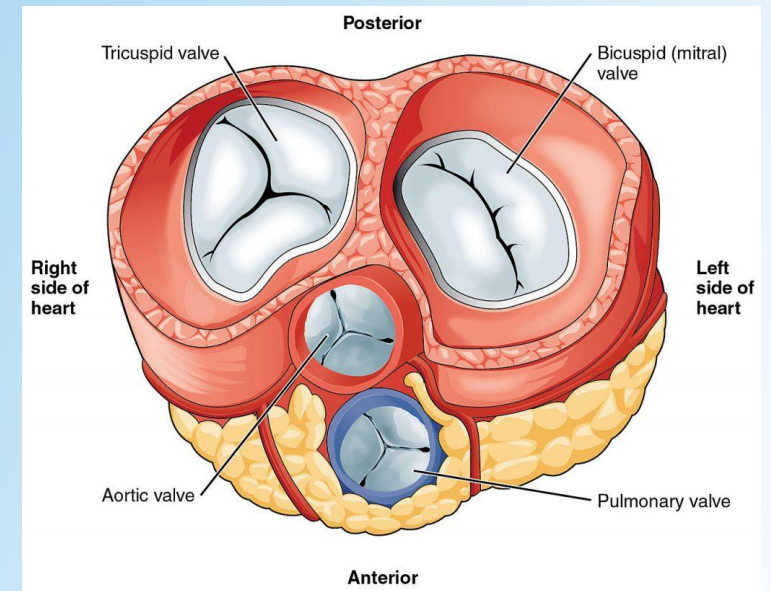


Our goal:



Key points:

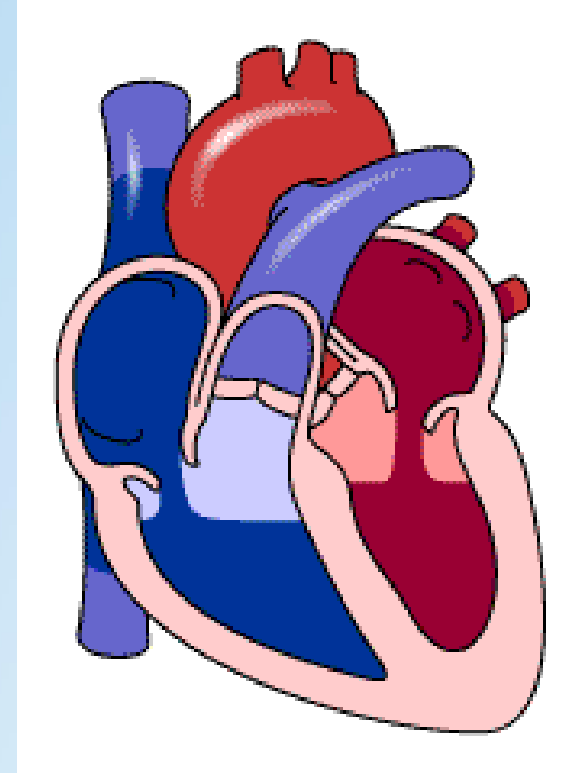
- Valve anatomy:
 - The mitral and tricuspid valves are AV valves
 - Aortic and pulmonic valves are semilunar valves
- Effects of pressure on valve opening and closure:
 - There is ALWAYS a pressure difference between heart chambers
 - This change in pressure causes valves to open/ close
- Heart sounds (physiologic) are produced by the closing of valves
- Isovolumetric phases
 - All valves are closed, therefore there is no change in volume



Cardiac cycle

Atrial systole, then...

1. Isovolumetric ventricular contraction
2. Ventricular ejection
 1. Rapid
 2. Reduced
3. Isovolumetric ventricular relaxation
4. Ventricular filling
 1. Passive
 2. Active

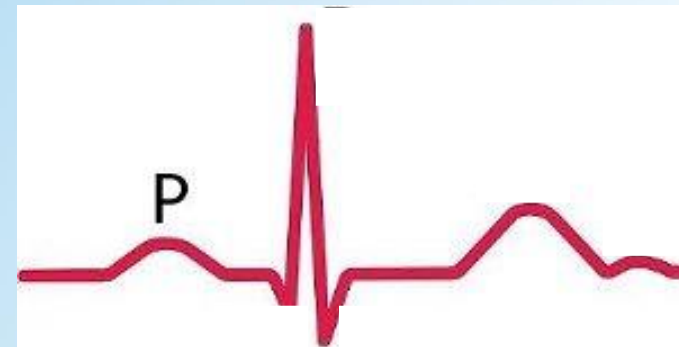
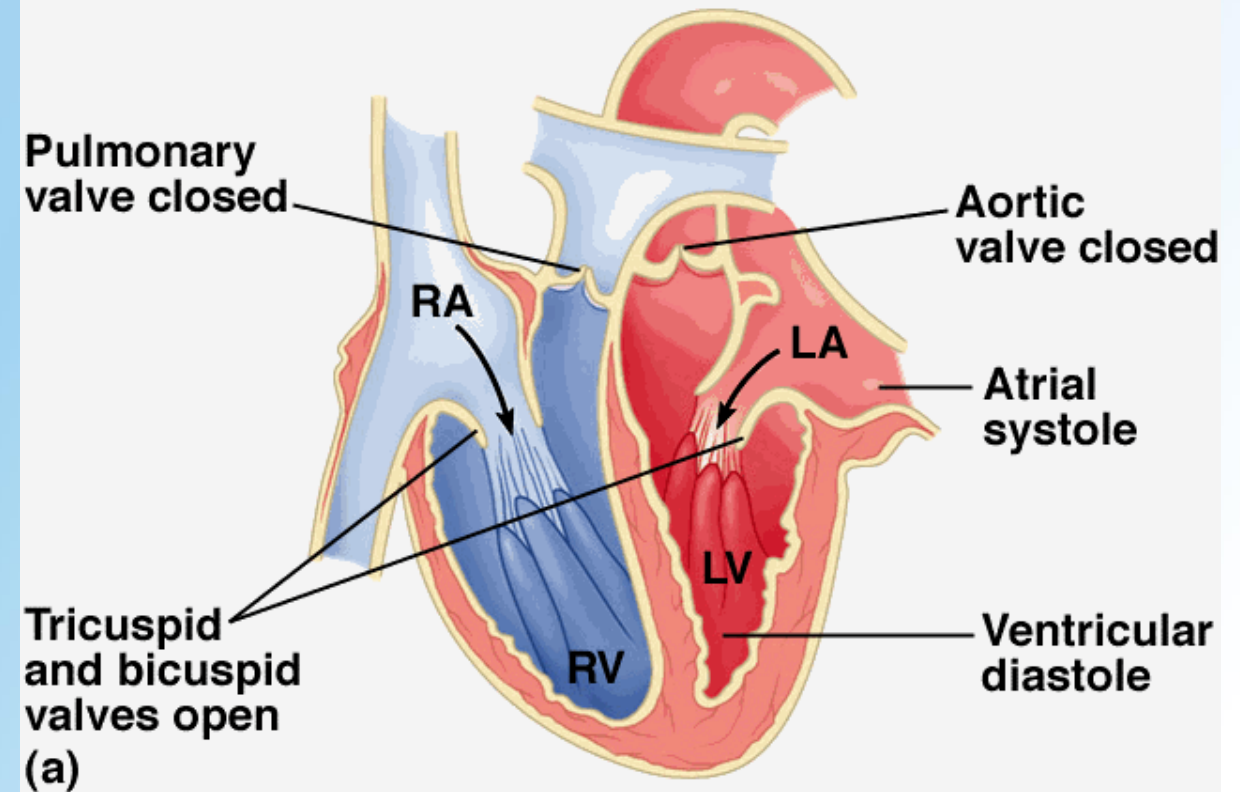


Atrial systole

- Contraction of the left atrium
- Mitral valve is open
 - Passive ventricular filling precedes atrial systole
- Preceded by P wave on ECG

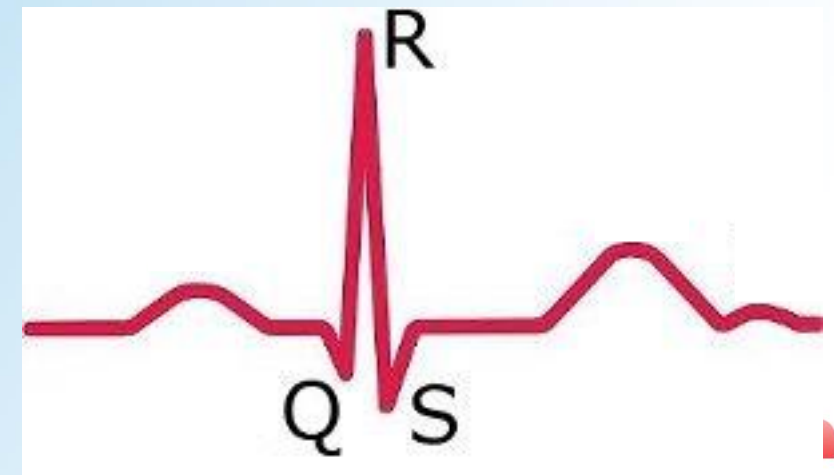
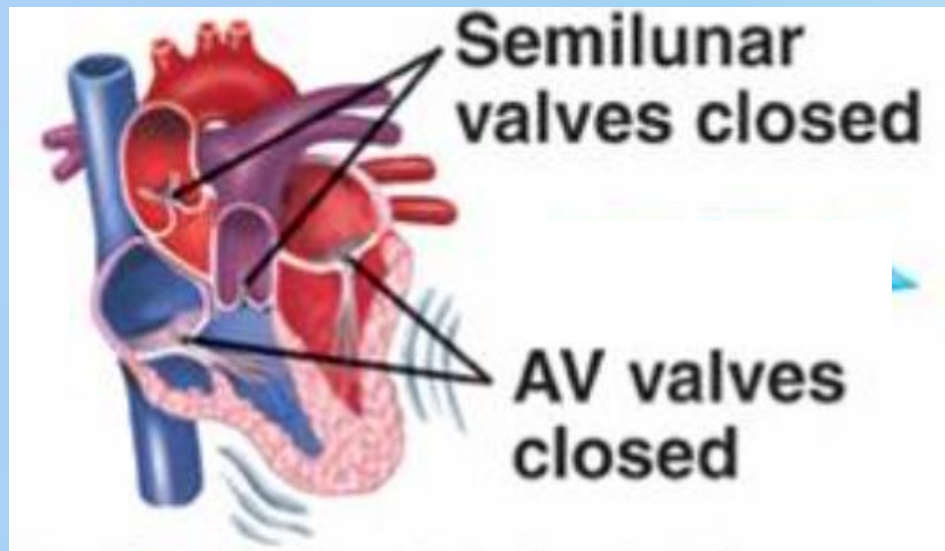
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Atrial Systole



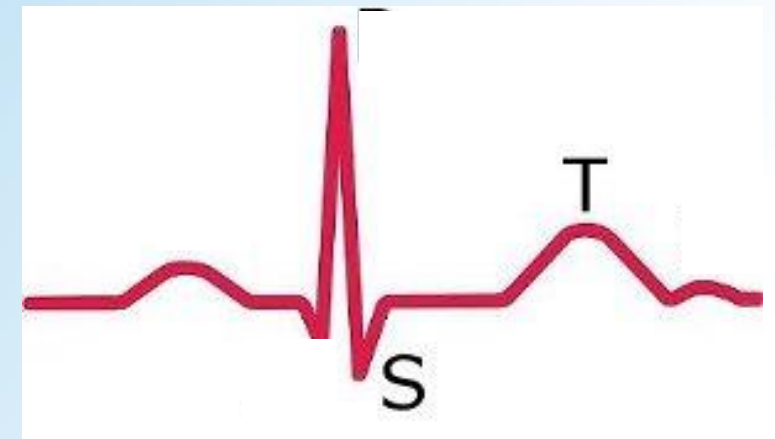
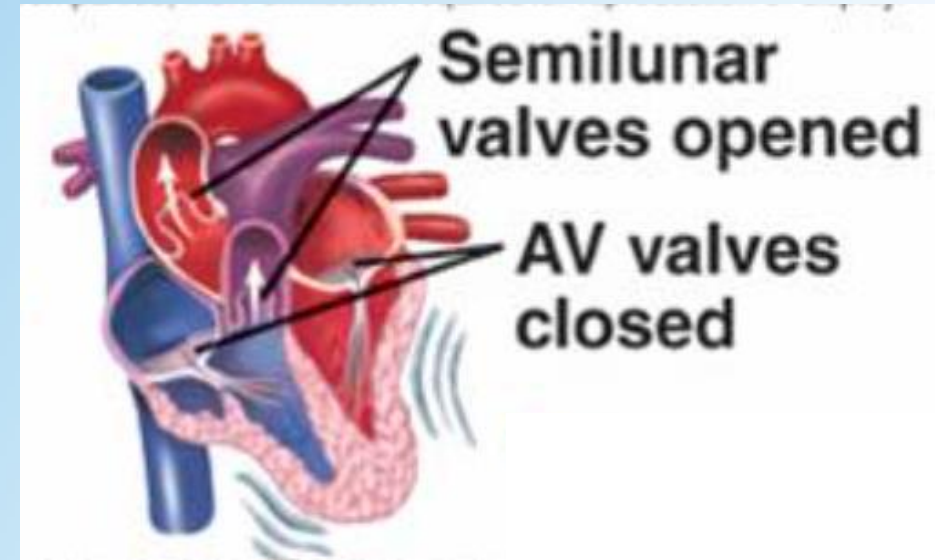
Isovolumetric ventricular contraction

- Begins during QRS complex
- Ventricular volume stays the same; pressure increases
- Closes mitral valve (S1)



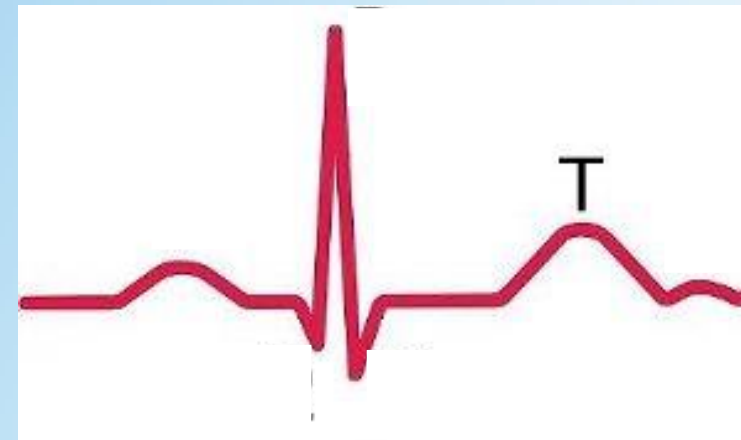
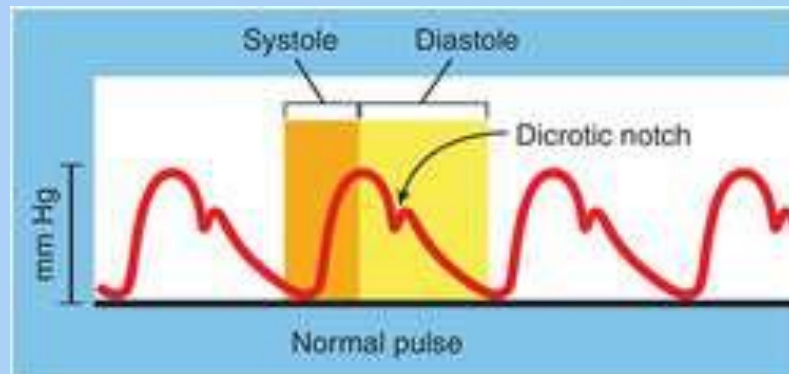
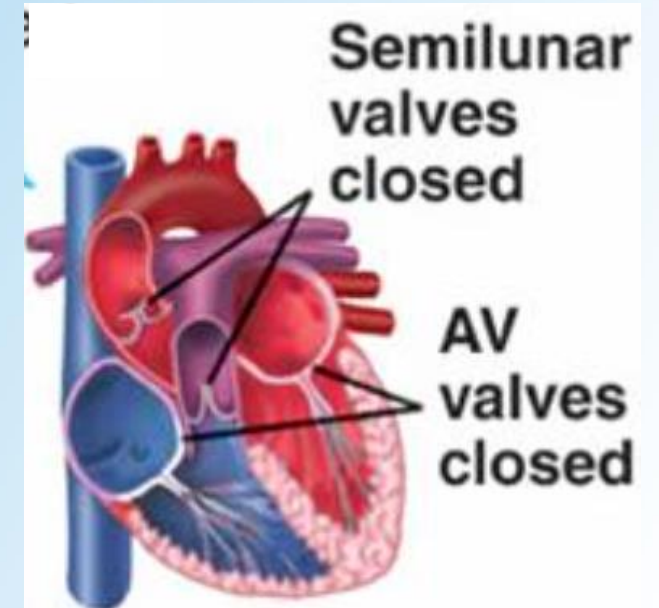
Ventricular ejection

- Rapid ejection
 - ST segment
 - Large pressure gradient
 - Most of stroke volume is ejected here
 - Aortic valve opens when ventricular pressure becomes greater than aortic pressure
 - Atria begin to fill for next cardiac cycle
- Reduced ejection
 - T wave
 - Ventricles are no longer contracting
 - Small pressure gradient/ volume ejection
 - ESV = 50mL



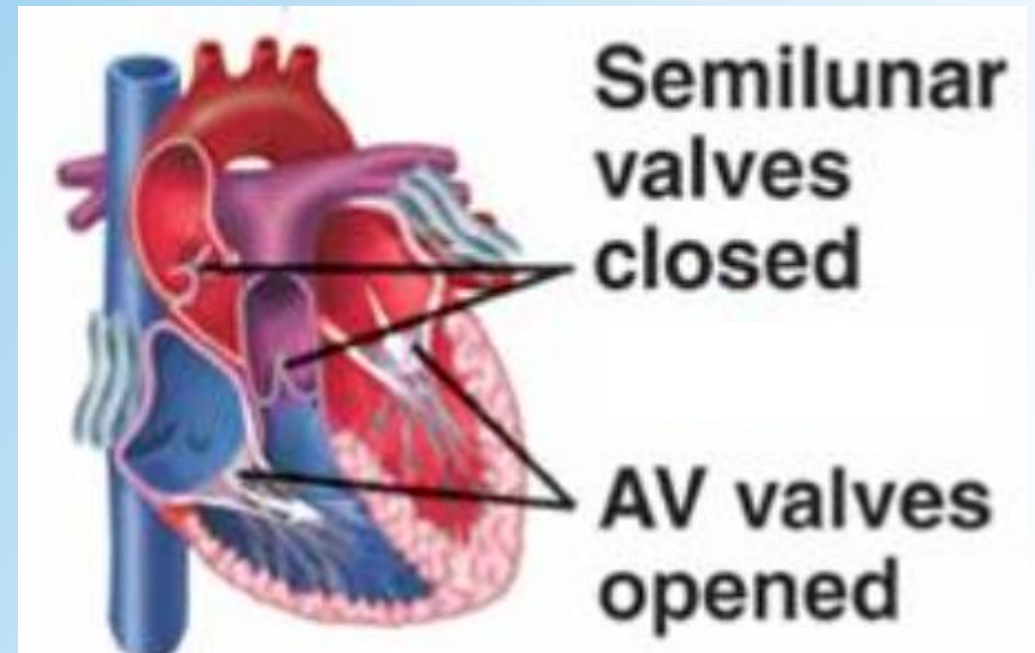
Isovolumetric ventricular relaxation

- End of T wave
- Ventricles are fully repolarized
- Left ventricular pressure decreases
- Aortic valve closes (S2)
 - *Incisura, AKA dicrotic notch*



Ventricular filling

- **Passive (*rapid*)**
 - Mitral valve opens
 - Ventricular volume largely increases
 - Ventricular pressure remains low
- **Active (*Reduced*)**
 - *Diastasis*
 - P wave
 - Atrial systole
 - Longest phase of cardiac cycle
 - EDV = 120mL



Review: physiologic heart sounds

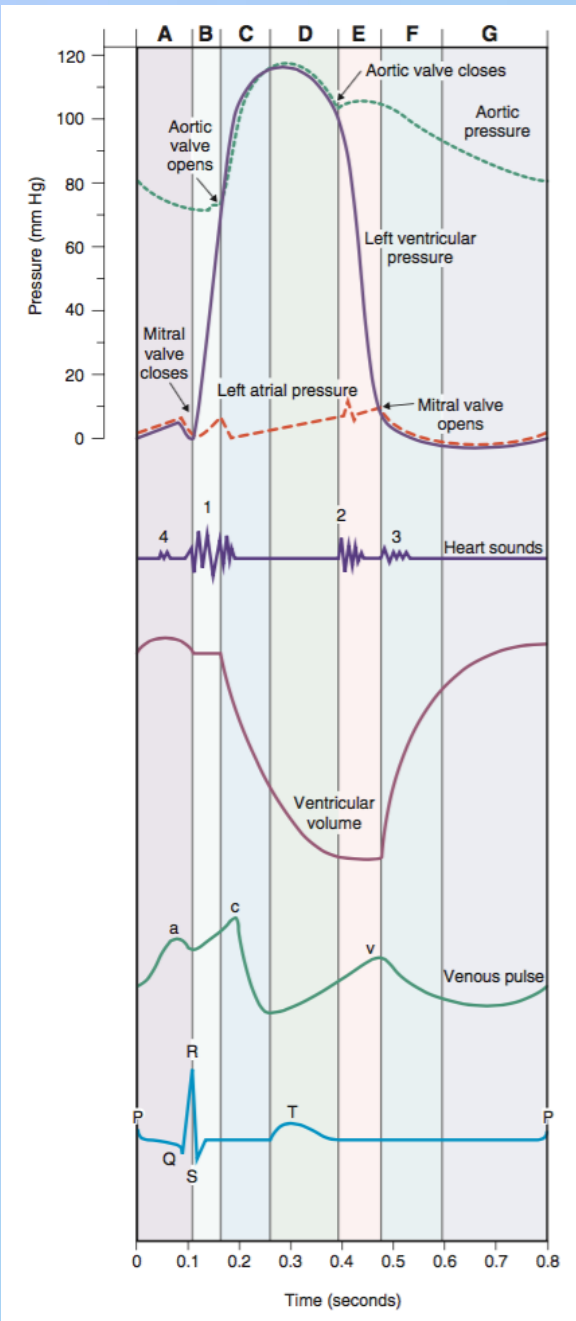


	S₁	S₂
Caused by	- Closure of the atrioventricular valves (<i>mitral and tricuspid</i>)	- Closure of the semilunar valves (<i>aortic and pulmonary</i>)
Phase of the cardiac cycle	- Systole	- Diastole
Mechanical event	- Isovolumetric ventricular contraction	- Isovolumetric ventricular relaxation
Splitting	- No	- Yes ¹

¹ Inspiration increases venous return to the right ventricle, resulting in increased blood volume. The right ventricle has to eject more blood, which will delay the closure of the pulmonary valve relative to the aortic valve (*see the figure below*)

Pathologic heart sounds

	S₃	S₄
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	- Normal finding in children and athletes - Indicates volume overload in adults	- Implies hypertrophy of the left ventricle



An ECG marks electrical events – this marks electrical AND mechanical events

atria + ventricles relax + fill

atria contract

isovolumetric contraction

ventricles contract; ejection

isovolumetric relaxation

Time: 0.1s

diastole

systole

AV valves open closed

SL valves open closed

ECG

aortic pressure

ventricular pressure

atrial pressure

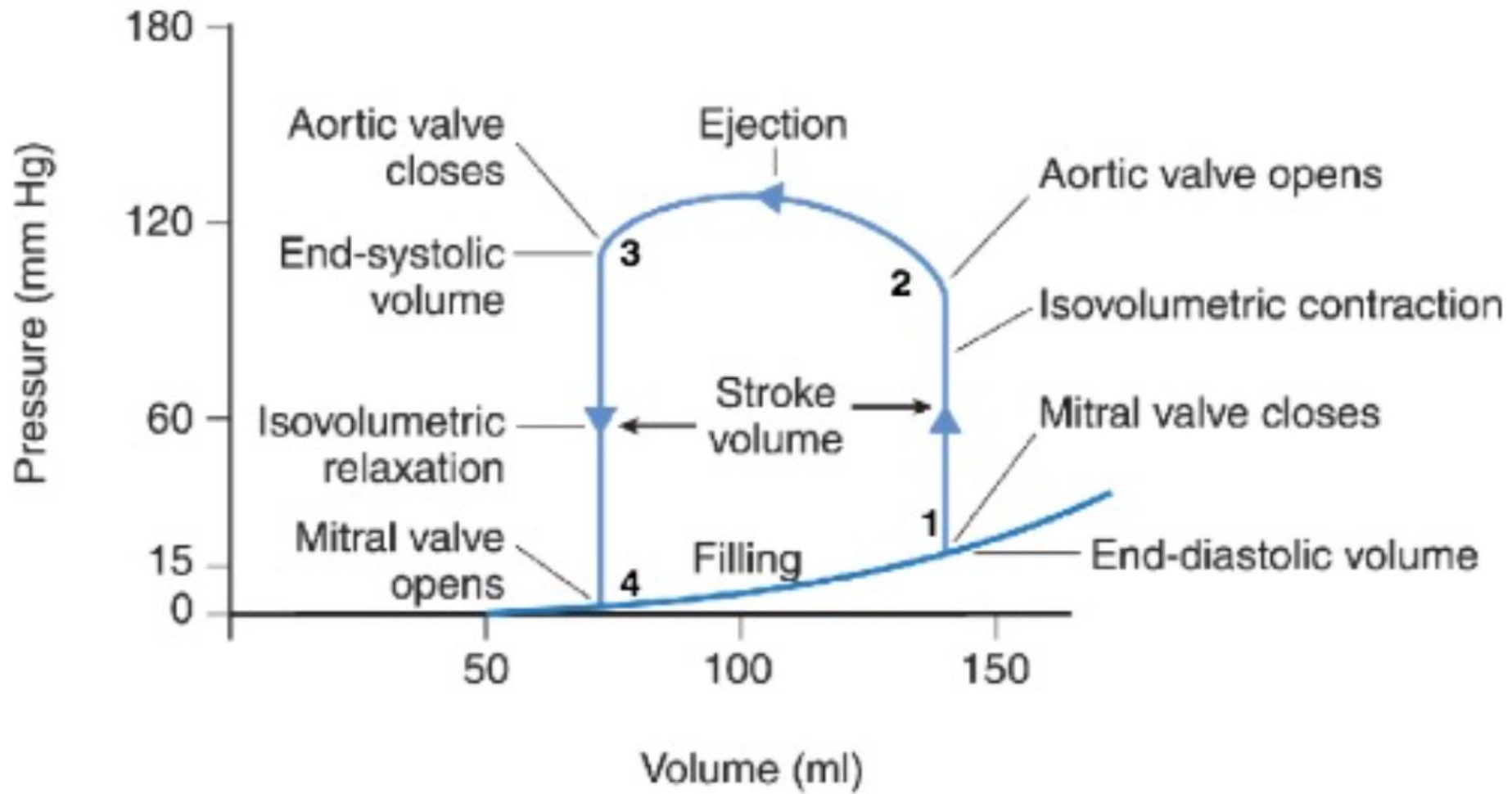
ventricular volume

heart sounds

1 2 3 4 1

Pressure-Volume Loop

- Putting it all together 😊
- To the board!



Thank you for your attention 😊

