



Western
UNIVERSITY • CANADA

Tutorial 11

Sections 009/010

TA: Greydon Gilmore
Physiology 2130
Nov 26th, 2019

Your TA reminding you...

- **2nd Peerwise assignment (1.5%)**
 - **Post 2 MC questions:** due Nov 27th @ midnight
 - **Answer 5 MC questions:** due Nov 29th @ midnight
 - **Valid content:** autonomic nervous system, muscle and cardiovascular physiology
- **2nd Quiz (1%)**
 - **Opens:** Dec 2nd @ 4pm
 - **Closes:** Dec 3rd @ 4pm
- **2nd Midterm (15%)**
 - **When:** Dec 19th @ 9am-10am
 - **Room Assignments:**
 - **ABBA-GANE:** Alumni Hall 15
 - **GHAB-POSA:** Alumni Hall 201
 - **PRIM-WOOD:** Alumni Hall Stage
 - **WU-ZIA:** Somerville House 2316
 - **Review session:** Monday Dec 16th from 6-8pm (Auditorium B University Hospital)

Today

- Group work activity
- Learning Catalytics Question
- Cardiovascular anatomy

Group Work

Teach each other the cardiac cycle using the flip chart paper provided! Each member should teach one part of the cycle to the rest of the group.

- If you don't fully understand that's okay, try your best!
- You can refer to your notes
- Please take a picture and send me an email:
 - greydon.gilmore@gmail.com

Cardiac Cycle

Atrial Systole (Atrial Contraction)

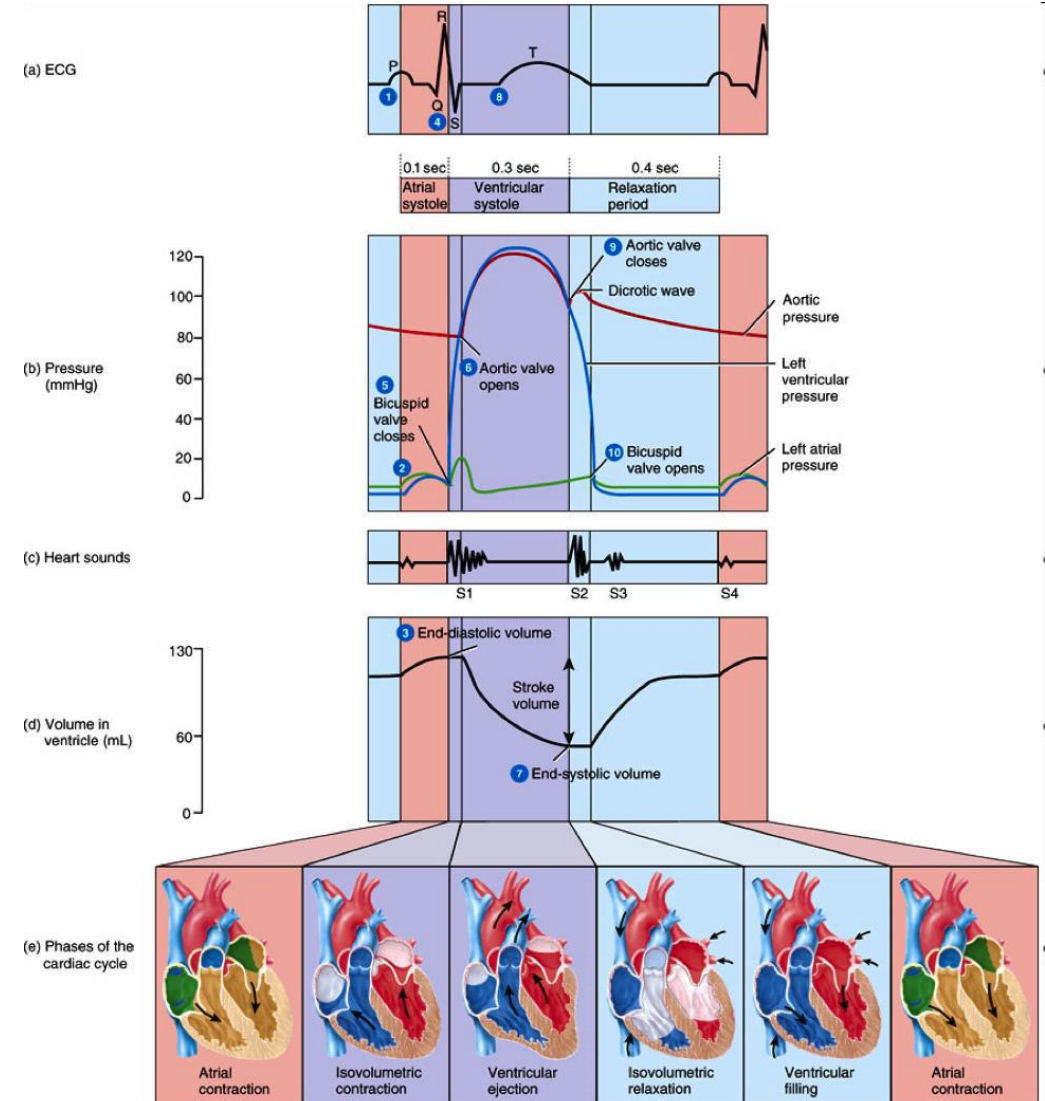
- P-wave: Atria contract
- Pressure: Atria > Ventricles
- AV valve already open
- Blood (30%) fills ventricles to EDV

Early Ventricular Systole (Isovol. Contraction)

- QRS: Ventricles begin to contract
- Pressure: Aorta > Ventricles > Atria
- AV valve close
- No change in volume

Ventricular Systole (Ventricular Ejection)

- Ventricles finish contracting
- Pressure: Ventricles > Aorta
- Aortic valve open
- Blood leaves ventricles to ESV
- T-wave



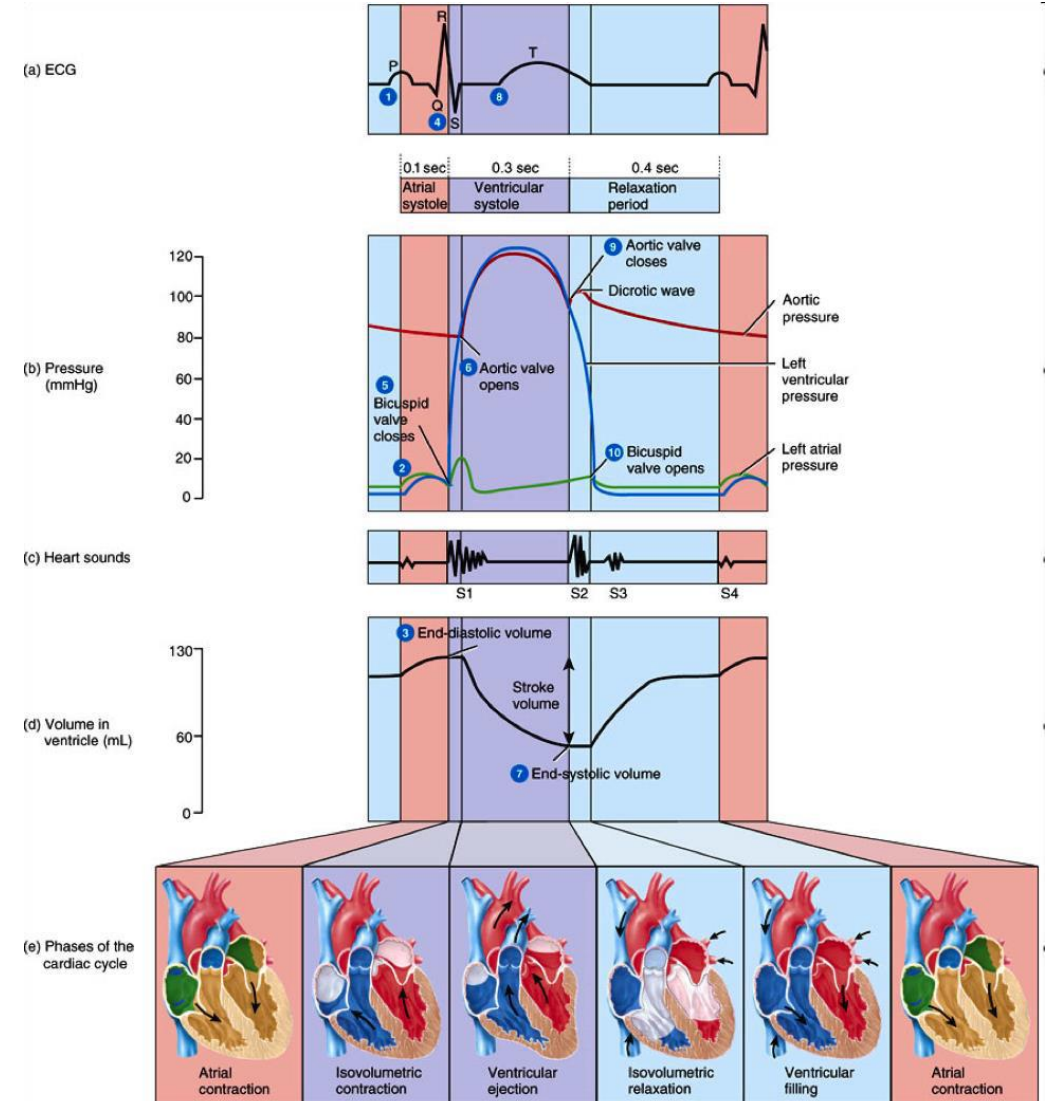
Cardiac Cycle

Early Ventricular Diastole (Isovol. Relaxation)

- Ventricles relax
- Pressure: Aorta > Ventricles > Atria
- Aortic valve close
- No change in volume

Late Ventricular Diastole (Ventricular Filling)

- Ventricles finish relaxing
- Pressure: Atria > Ventricles
- AV valve open
- Blood (70%) fills ventricles



Learning Catalytic Question

The Cardiovascular System: General Function, Organization and Anatomy

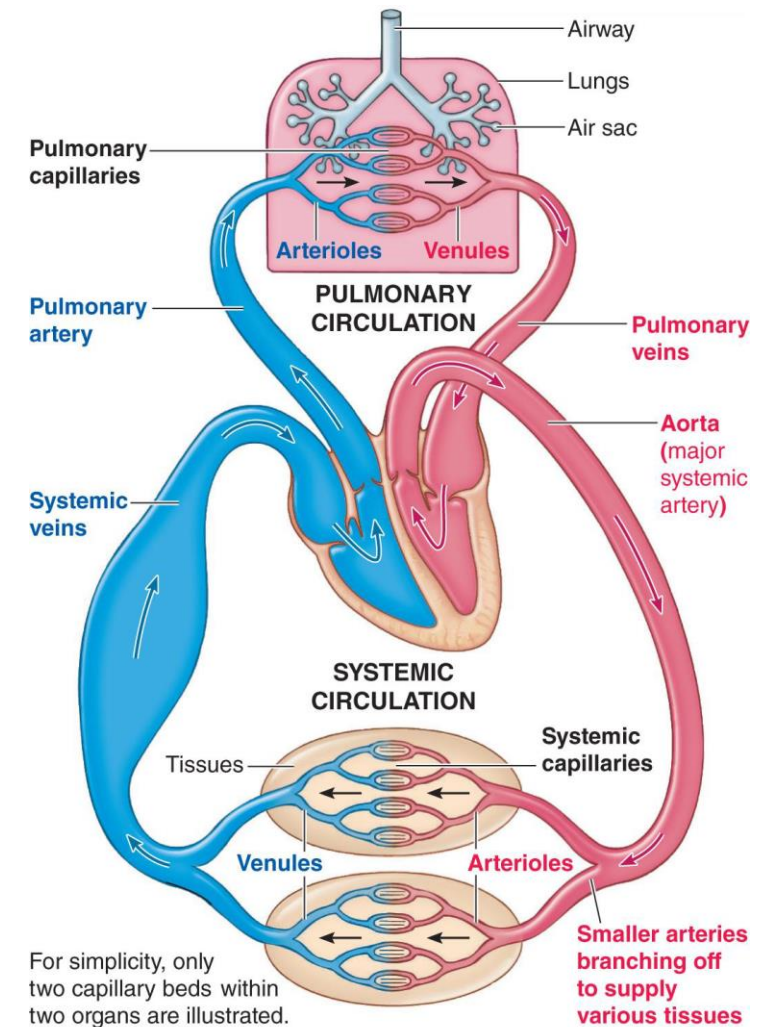
Chapter 7: Professor Stavraky

Functions of the cardiovascular system

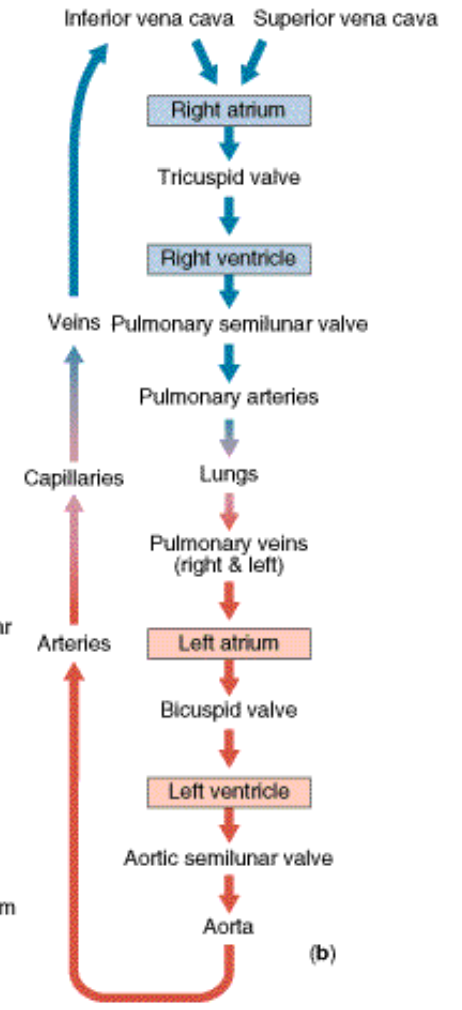
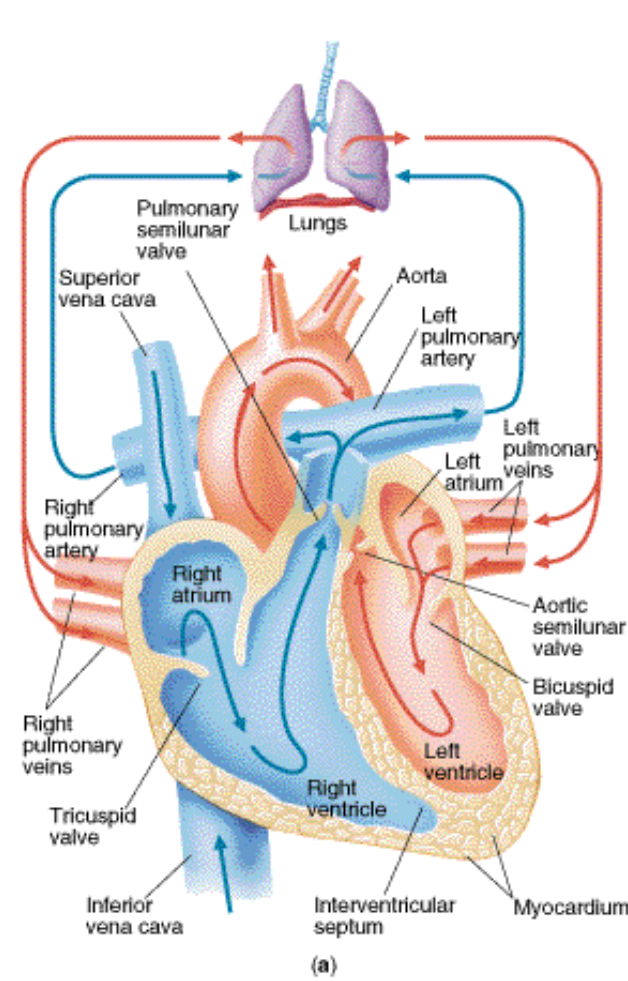
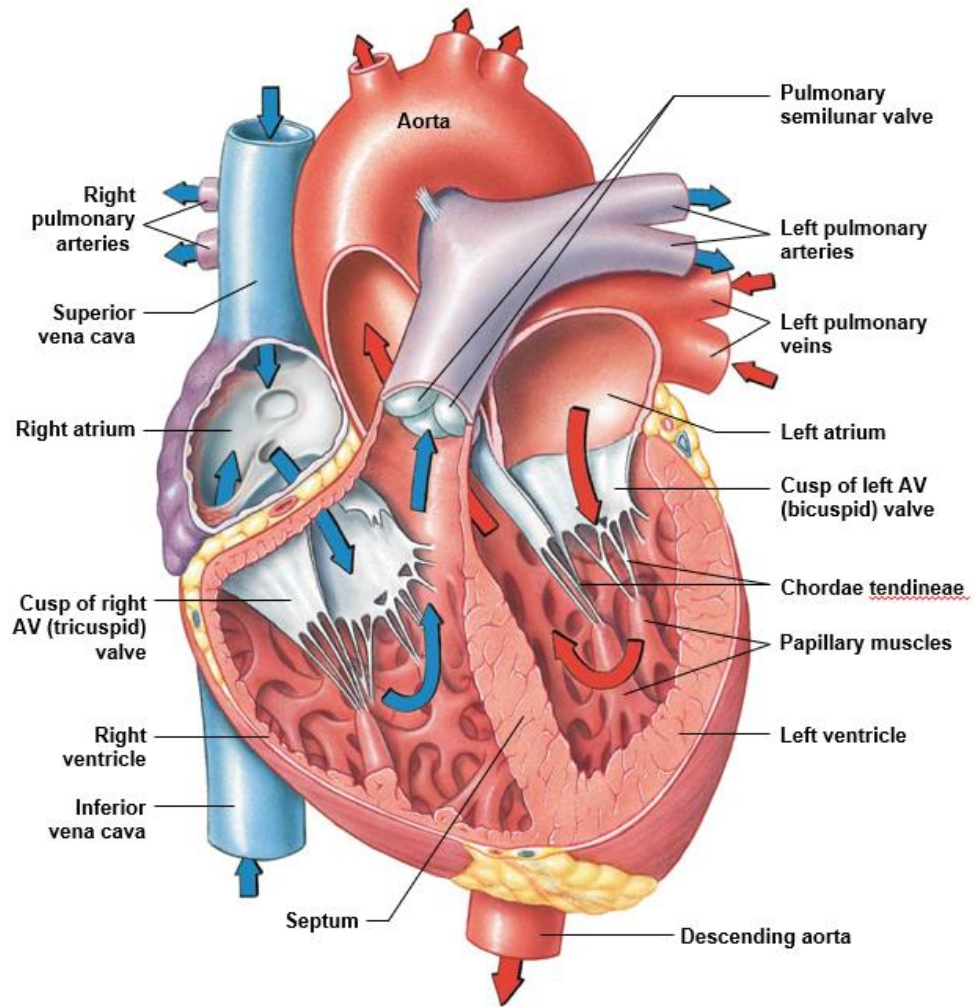
1. Transports **oxygen** and **nutrients**
2. Removes **carbon dioxide** and **waste**
3. Regulates **body temperature** and **pH**
4. Transports and distributes **hormones** throughout the body

Blood volume distribution

- Total Blood Volume (TBV) = 5 liters
- Heart and Pulmonary circ. = 15%
- Systemic arteries/arterioles = 10%
 - distribution vessels
- Systemic capillaries = 5%
 - exchange vessels
- Systemic veins/venules = 70%
 - capacitance vessels
 - low pressure, require valves to stop backflow



Heart Flow



The _____ supply blood to the heart muscle itself.

- a. coronary arteries
- b. coronary veins
- c. pulmonary arteries
- d. pulmonary veins

The _____ supply blood to the heart muscle itself.

- a. coronary arteries
- b. coronary veins
- c. pulmonary arteries
- d. pulmonary veins

Which of the following is the correct sequence for the spread of cardiac action potentials?

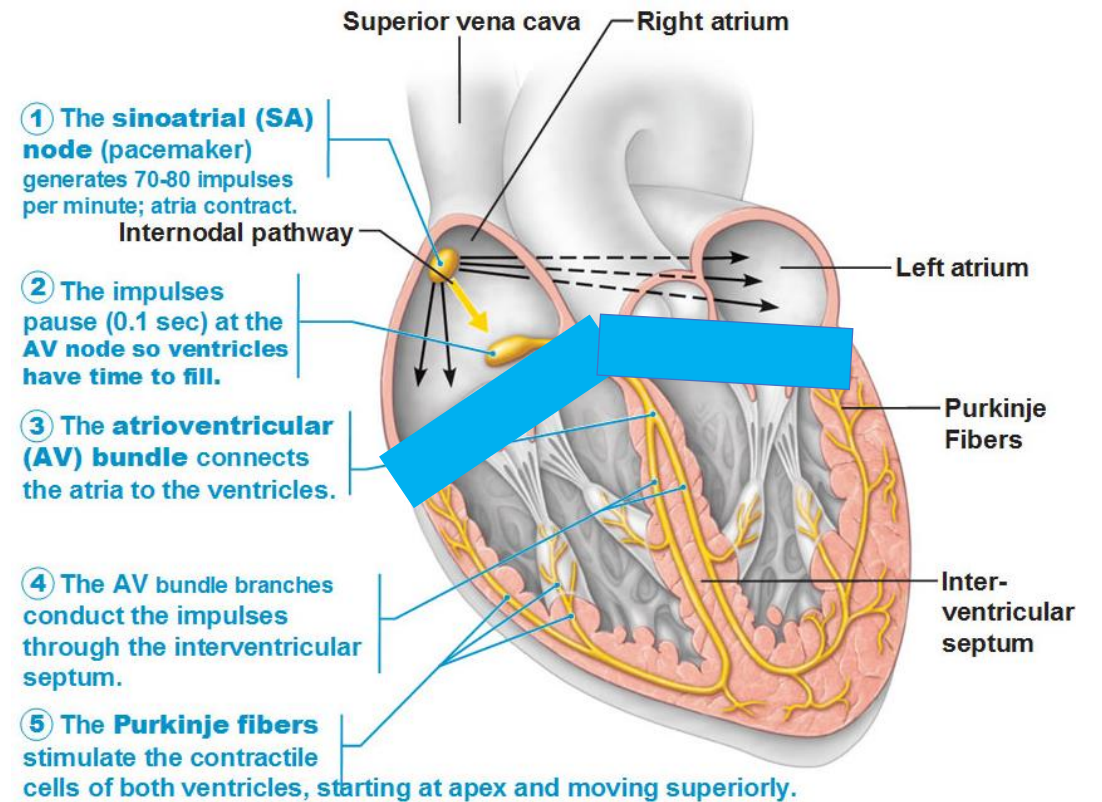
- a. SA node → internodal pathways → AV node → AV bundle → bundle branches → Purkinje fibers
- b. SA node → AV node → internodal pathways → AV bundle → bundle branches → Purkinje fibers
- c. SA node → internodal pathways → AV node → bundle branches → AV bundle → Purkinje fibers
- d. SA node → internodal pathways → AV node → AV bundle → Purkinje fibers → bundle branches

Which of the following is the correct sequence for the spread of cardiac action potentials?

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Significance Action Potential Direction

- **SA Node**
 - Located in right atrial wall below opening of superior vena cava
 - “Pacemaker” of heart, controlling rate of heart beat
- **AV Node**
 - Located in interatrial septum (floor of right atrium)
 - Electrical relay station, slowing the electrical current from SA node by 1/10th of second
 - This allows atria to contract first, then ventricles
- **Conducting cells**
 - Interconnect the two nodes and distribute stimulus throughout myocardium

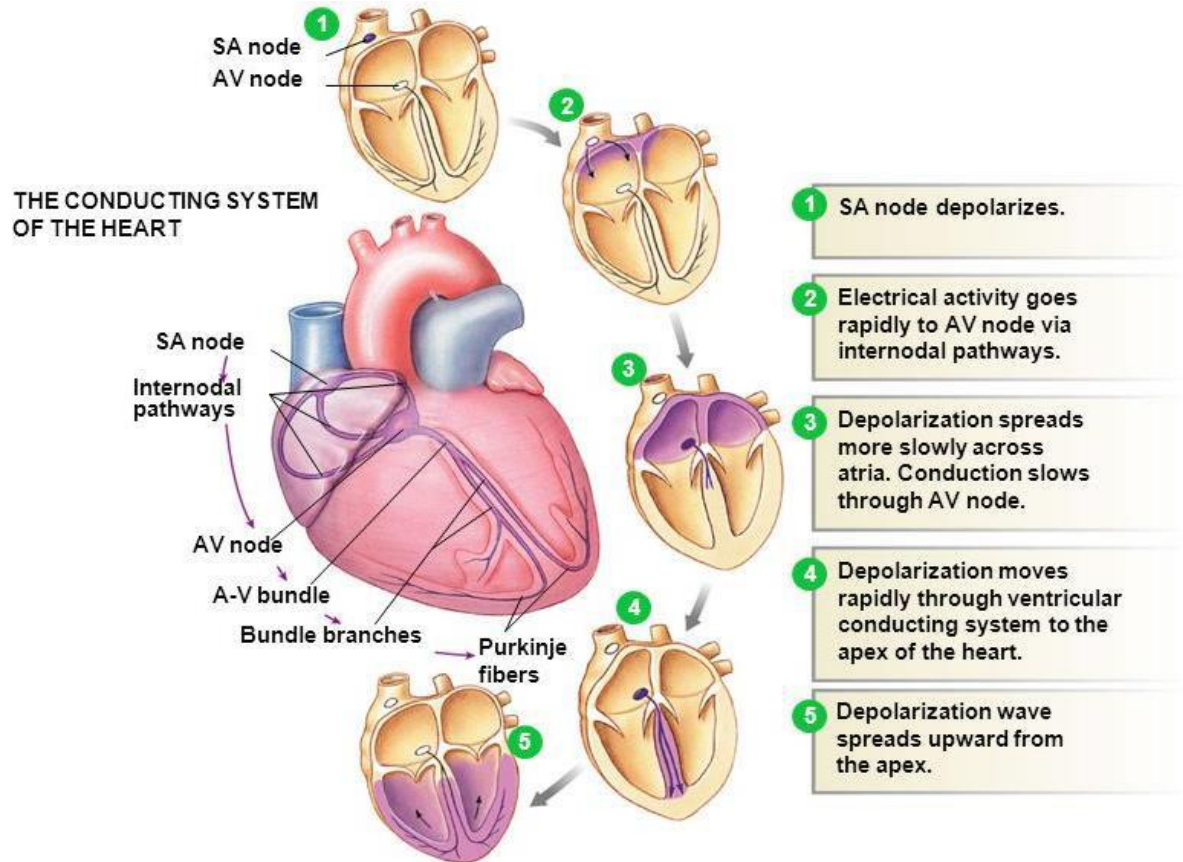


AV Ring electrically isolates atria from ventricles so they contract separately

Significance Action Potential Direction

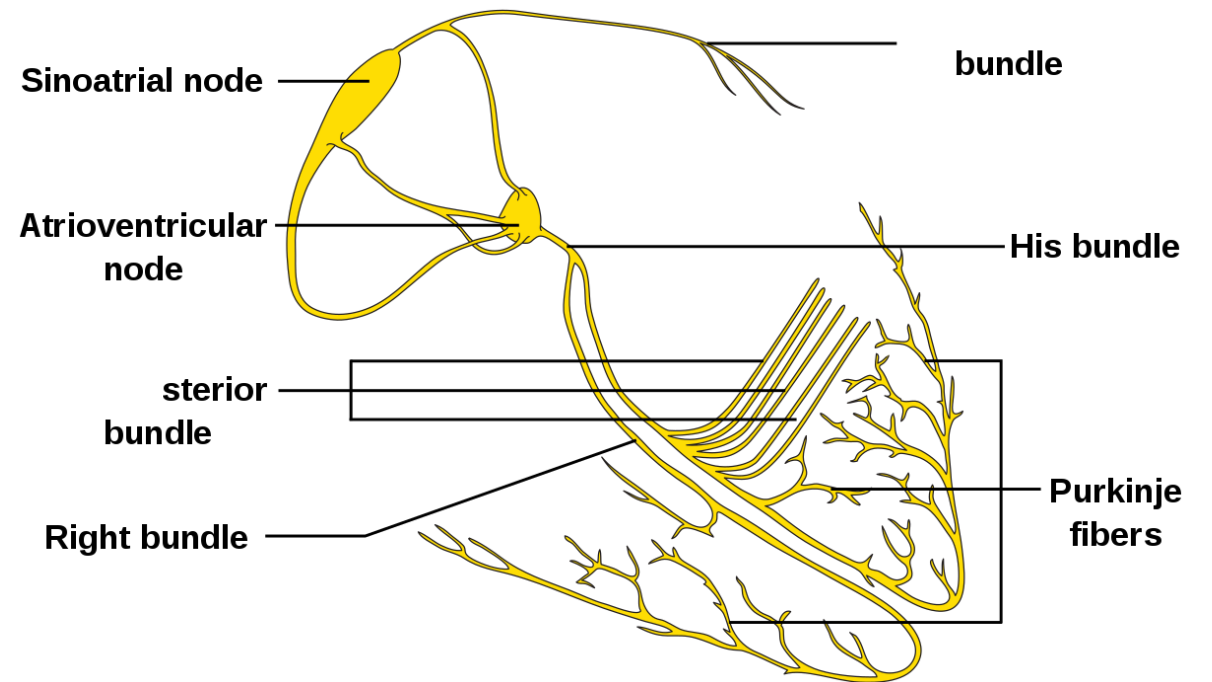
Significance of AP propagation (p.198):

1. Allows atria to contract first then ventricles contract
2. Atria muscles contract from top to bottom to push blood down into ventricles. Ventricular muscles contract from bottom to top in order to eject blood up and into vessels (pulmonary artery and aorta).

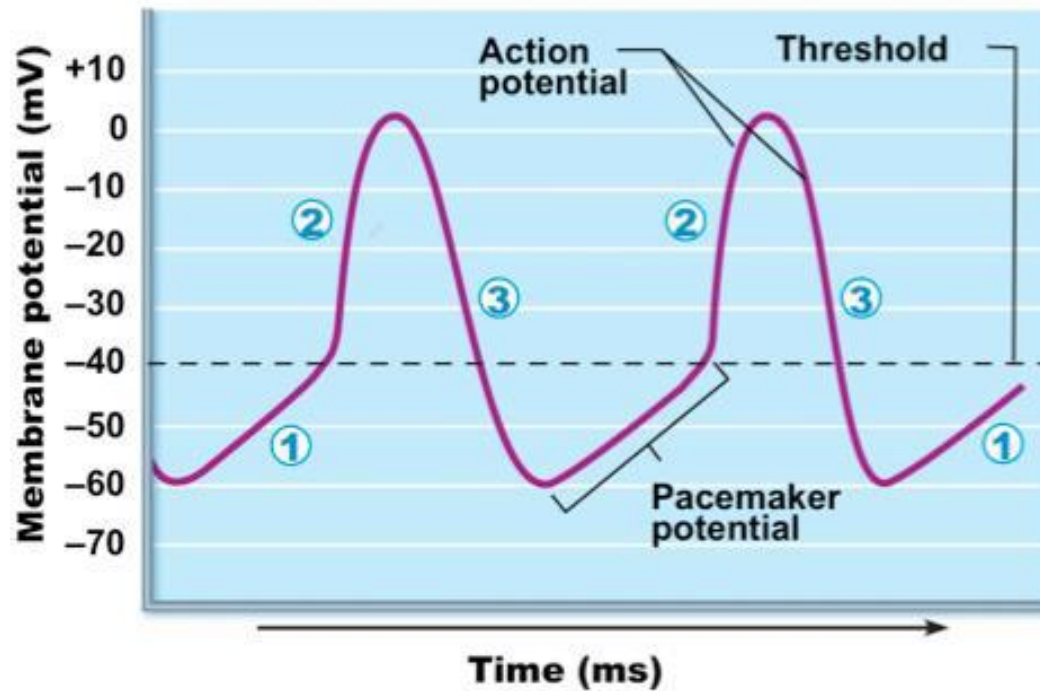


Signal Flow

- **SA Node:** Pacemaker of the heart
 - How does it generate fast spontaneous APs?
 - Permeability to Na^+ and Ca^{2+}
 - Permeability to K^+
 - These properties naturally bring the cell to threshold



SA Node Action potential



- 1 Pacemaker potential** This slow depolarization is due to both opening of Na^+ channels and closing of K^+ channels. Notice that the membrane potential is never a flat line.
- 2 Depolarization** The action potential begins when the pacemaker potential reaches threshold. Depolarization is due to Ca^{2+} influx through Ca^{2+} channels.
- 3 Repolarization** is due to Ca^{2+} channels inactivating and K^+ channels opening. This allows K^+ efflux, which brings the membrane potential back to its most negative voltage.

Compare/Contrast – Action Potentials

	Action Potential	Cardiac AP
RMP	RMP = -70 mV	RMP = ~-60 mV
Threshold	Threshold = -55 mV	Threshold = -40 mV
Stimulus	Graded Potential	Slow Leak (Na ⁺ /Ca ²⁺)
Depol. Channels	Depolarization = VG Na ⁺	Depolarization = VG Ca ²⁺
Repol. Channels	Repolarization = VG K ⁺	Repolarization = VG K ⁺
Hyperpol.	Hyperpolarization = Leak channels	N/A

Cardiac Cycle

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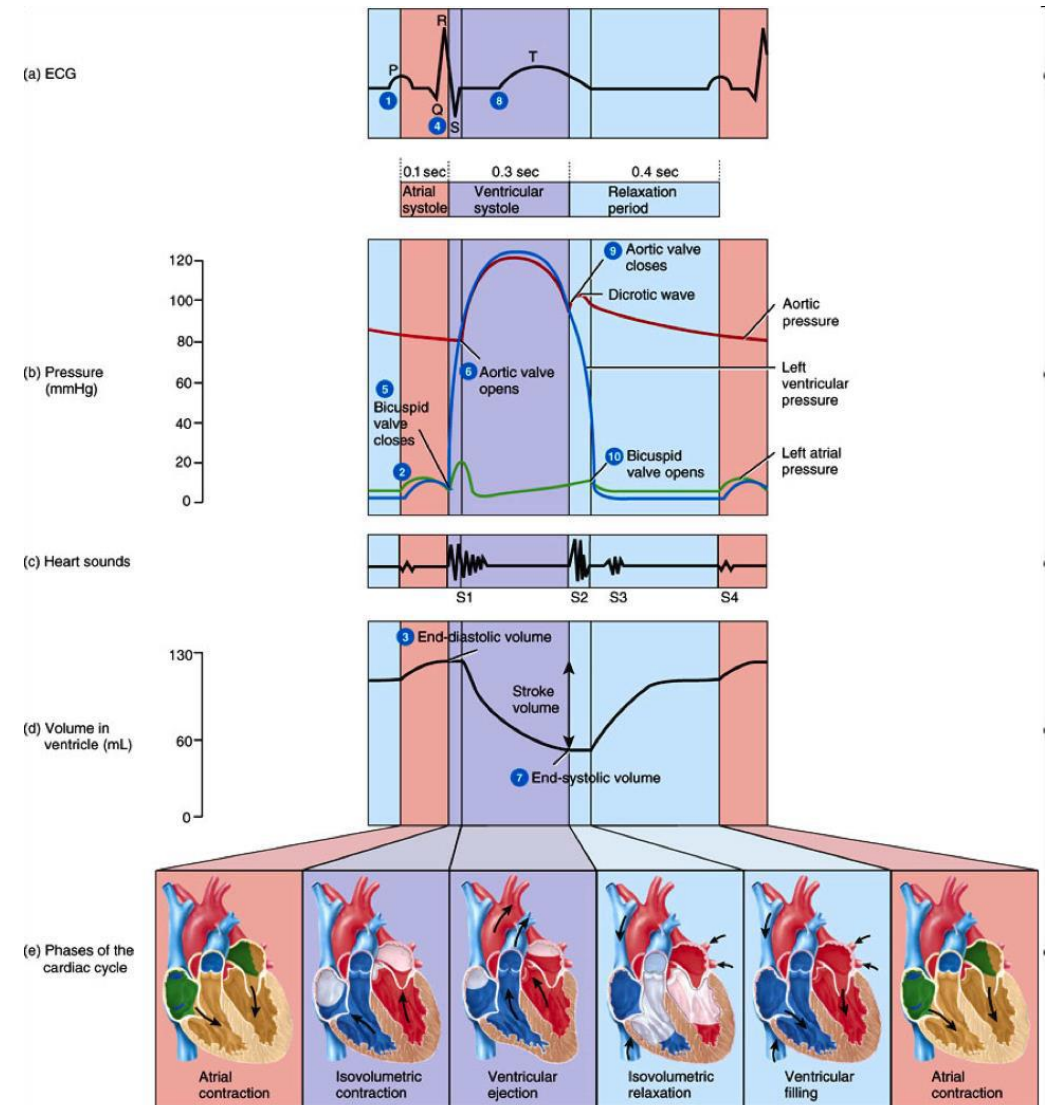
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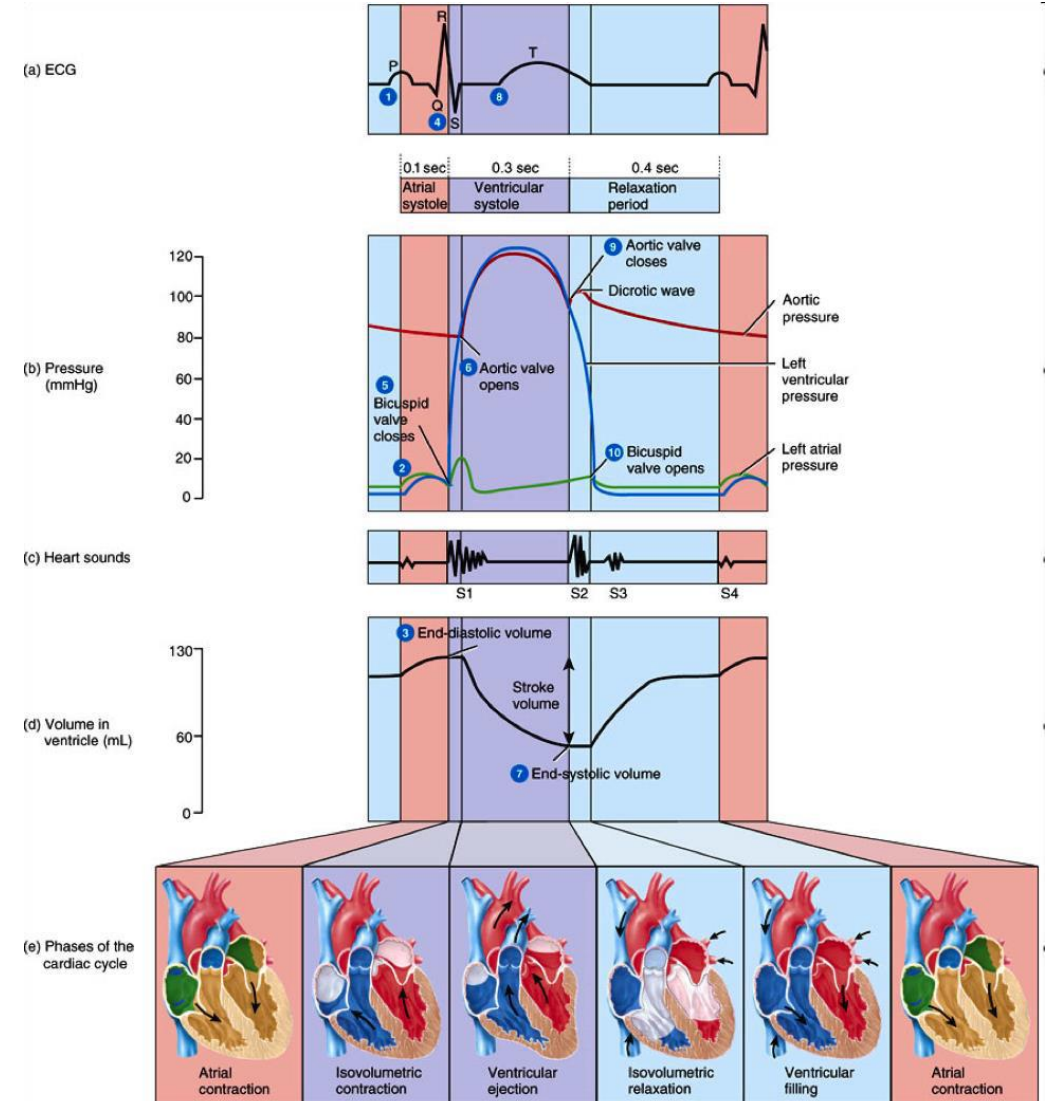
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Next Tutorial (Dec 3rd)

- More Cardio physiology!

What Questions Do You Have?

You can ask in the **Owl forums** as well!

Also anonymously ask questions in the **online dropbox!!**