



DOA BELAJAR

رَضِيتُ بِاللَّهِ رَبًّا وَبِالْإِسْلَامِ دِينًا وَبِمُحَمَّدٍ نَبِيًّا وَرَسُولًا
رَبِّي زِدْنِي عِلْمًا وَارْزُقْنِي فَهْمًا

“Kami ridho Allah SWT sebagai Tuhanku, Islam sebagai agamaku, dan Nabi Muhammad sebagai Nabi dan Rasul, Ya Allah, tambahkanlah kepadaku ilmu dan berikanlah aku kefahaman”



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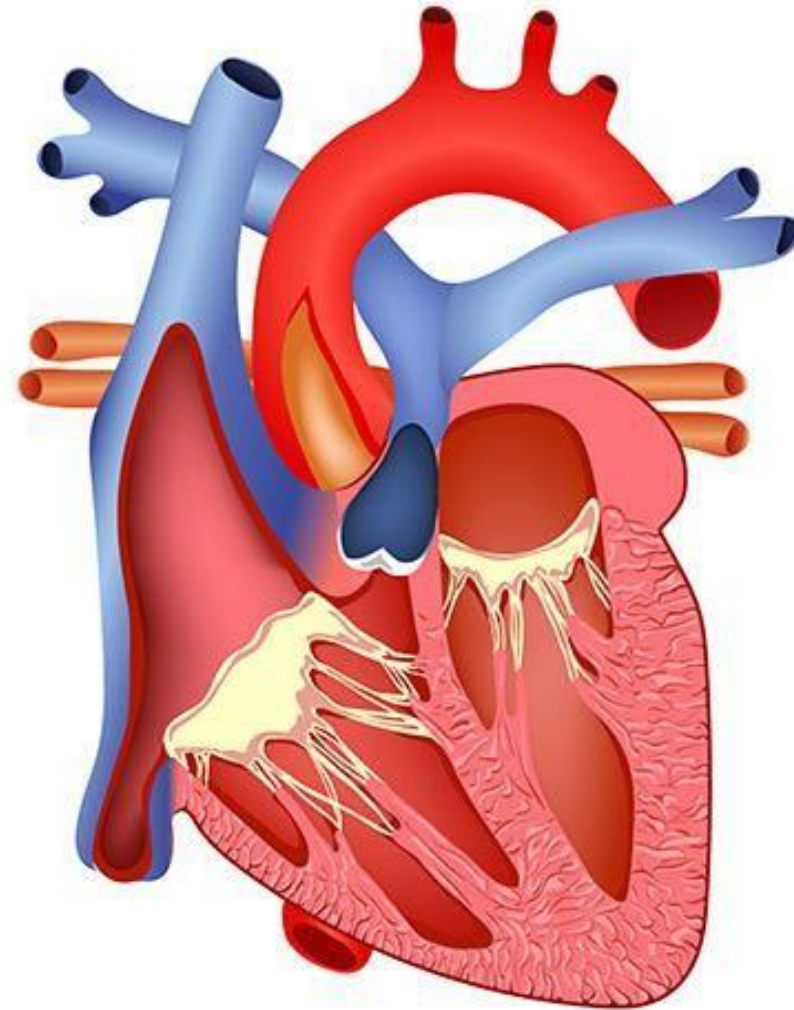
Electrical Activity of the Heart

Dr. Hanum Enggar Pradini, MMR



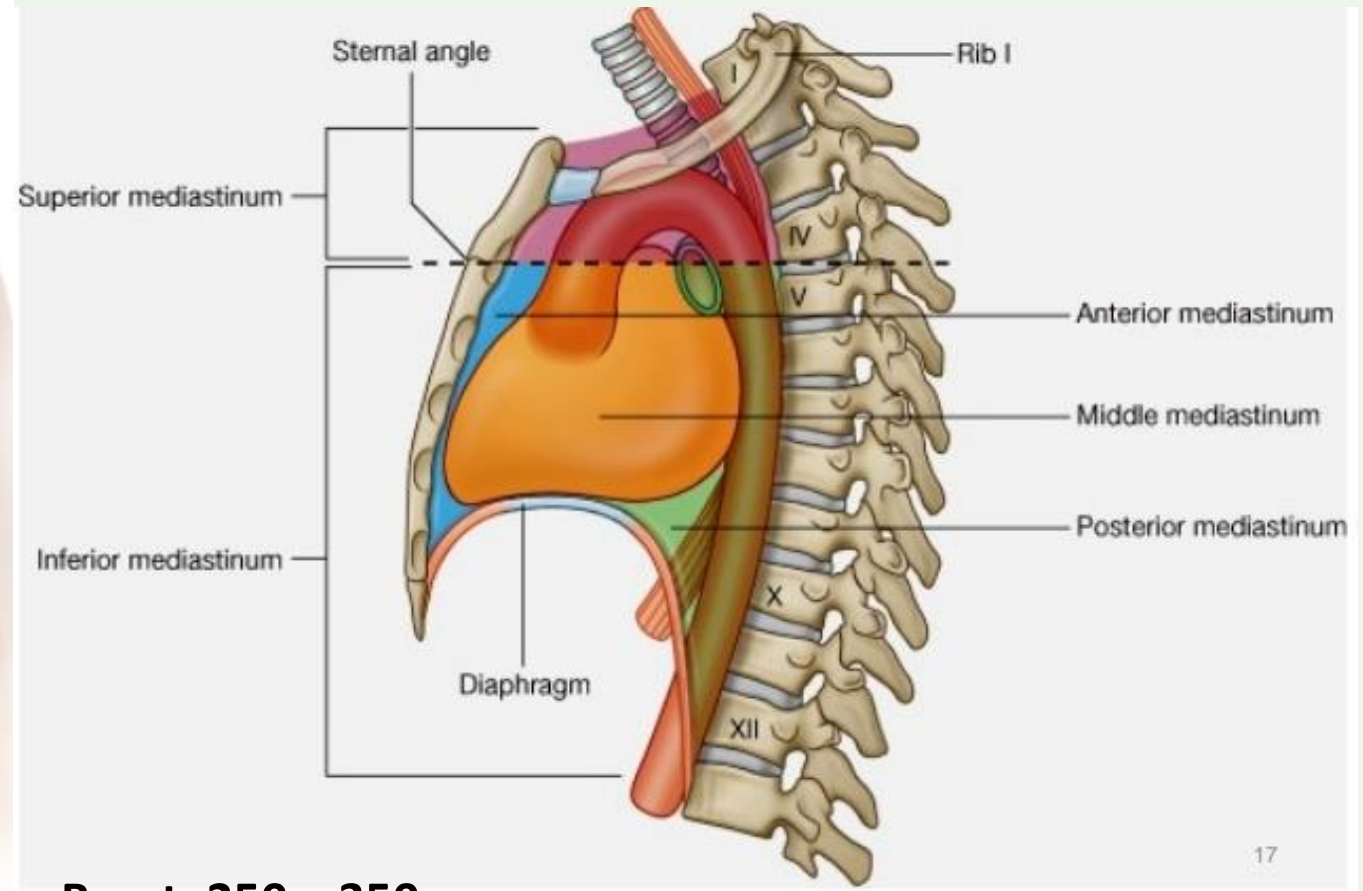
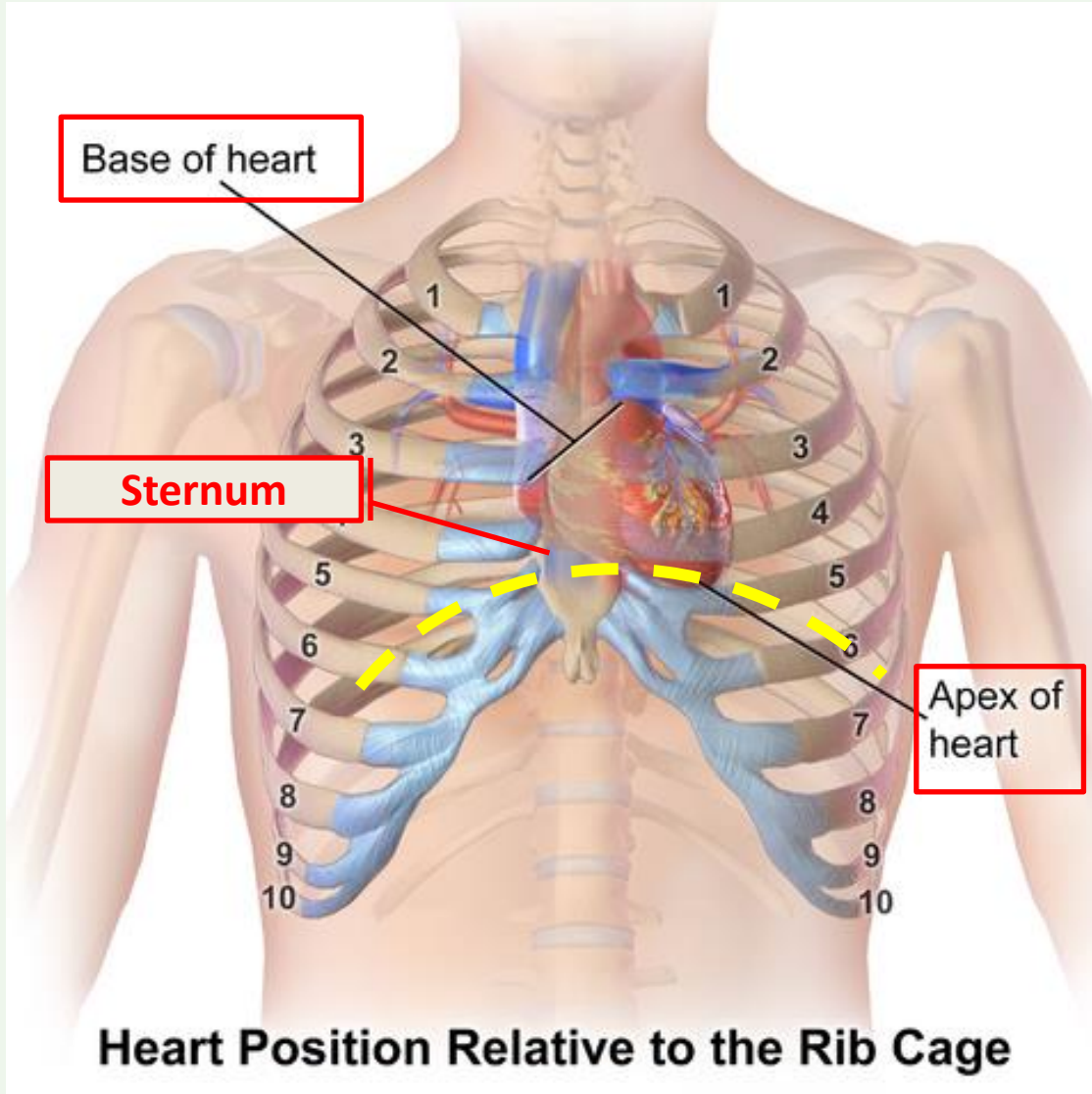
Learning Objective

- To Review anatomy of the heart
- To understand the physiology of cardiac muscle
- To understand the electrical activity of the heart
- To review the cardiac cycle



Anatomy

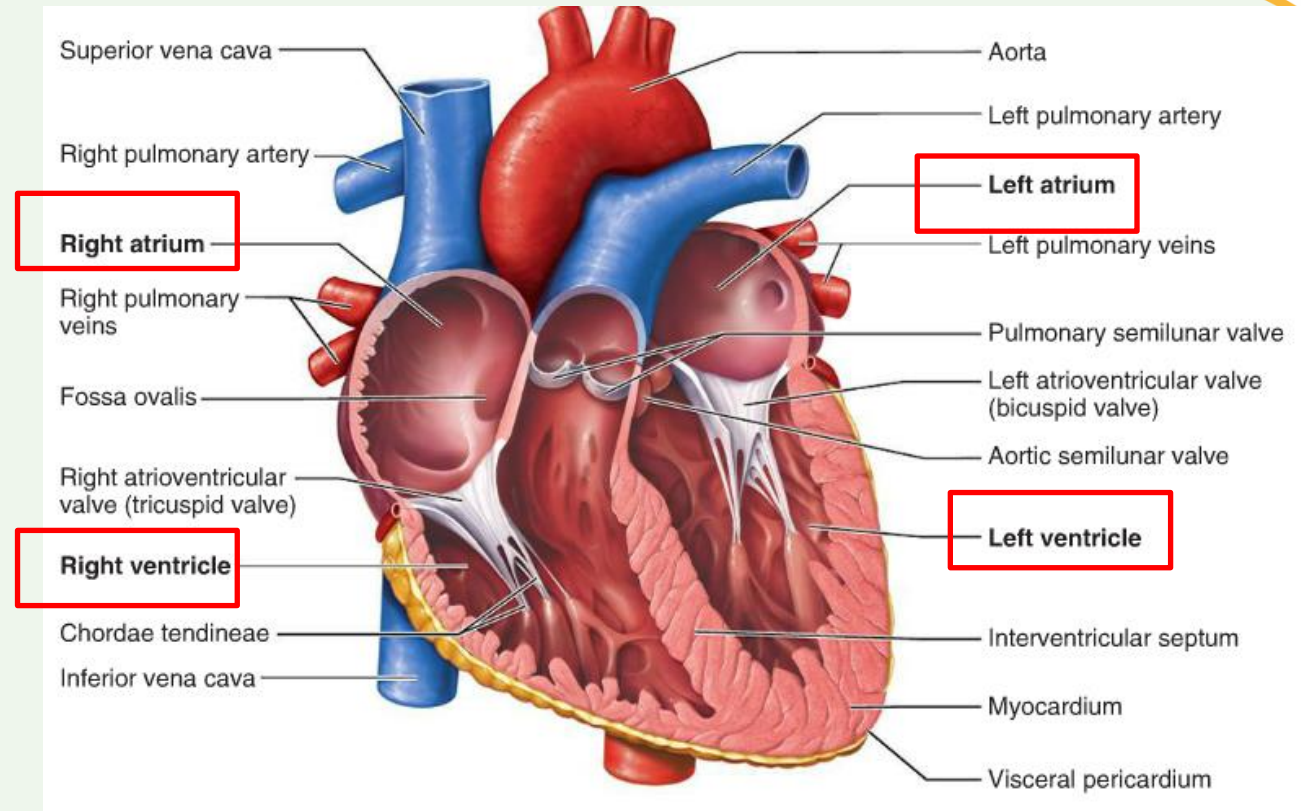
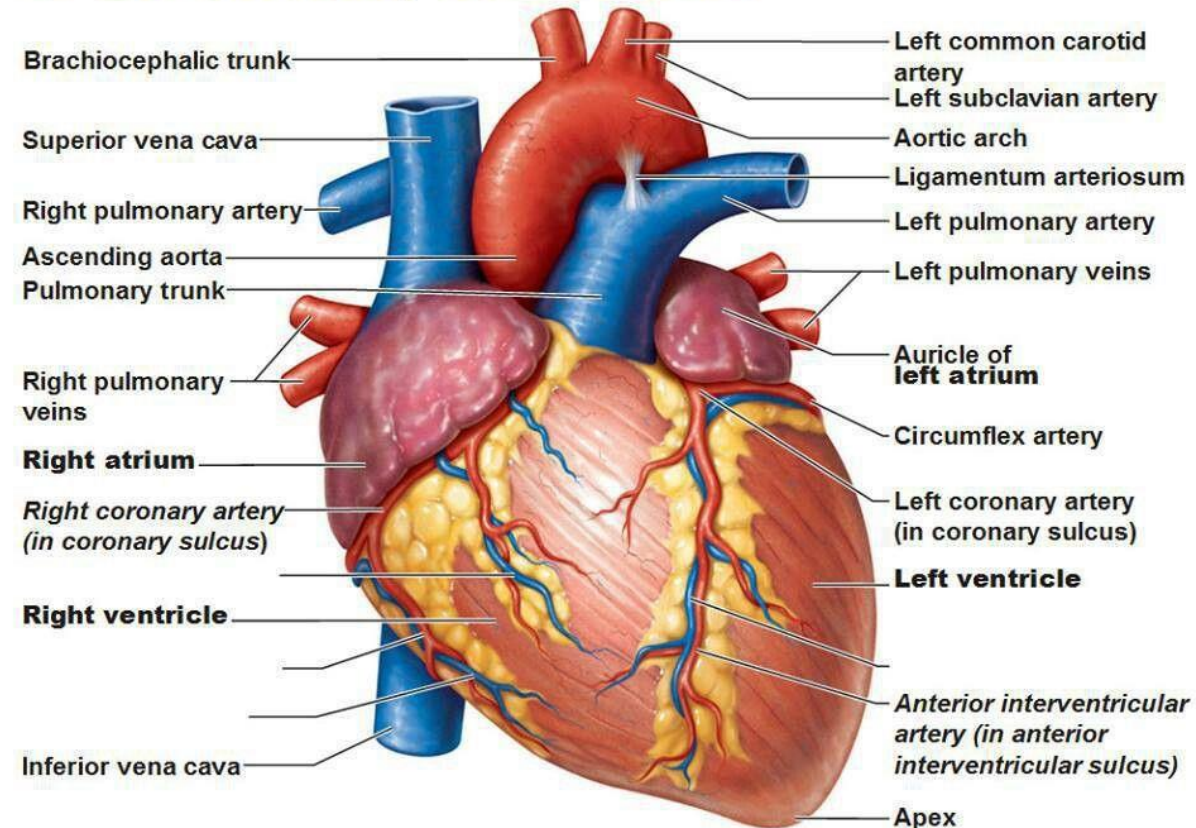
HEART POSITION

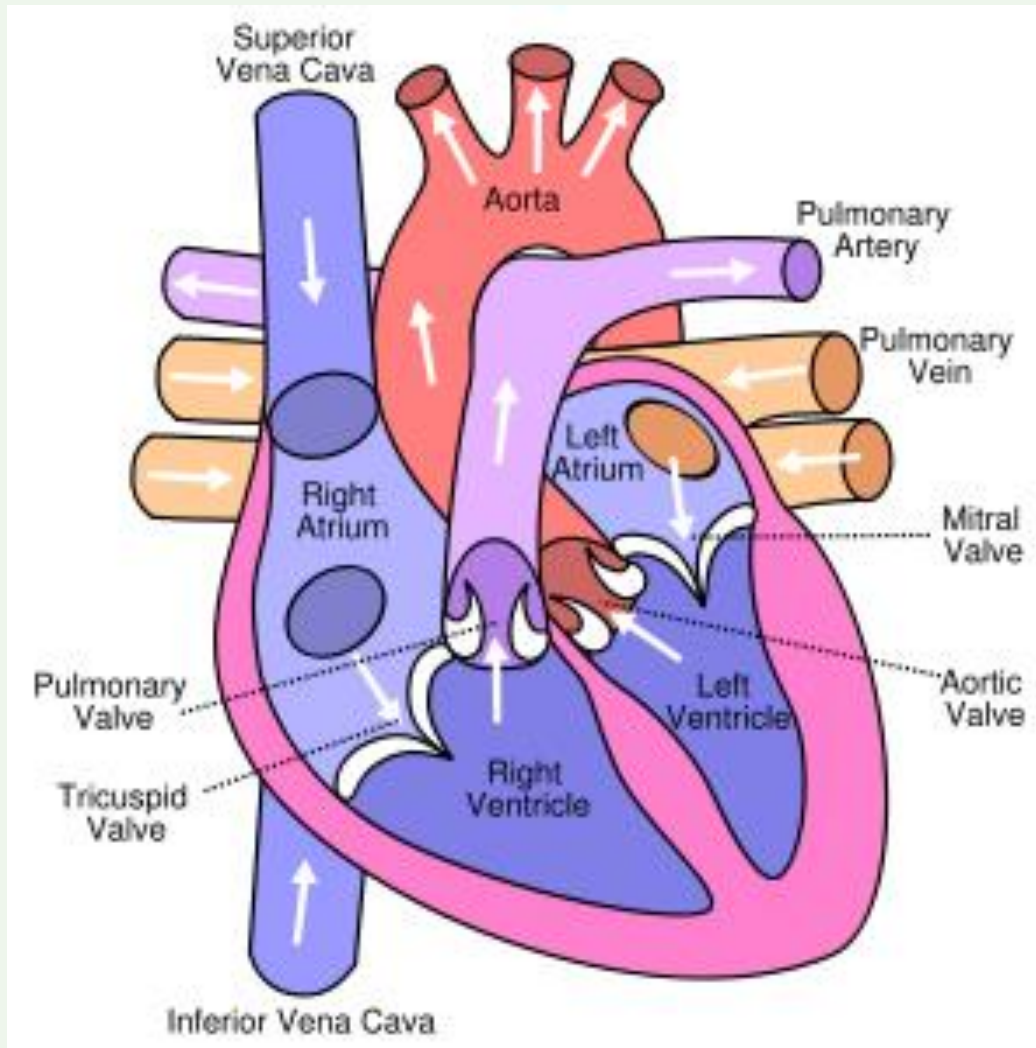


Berat: 250 – 350 gram

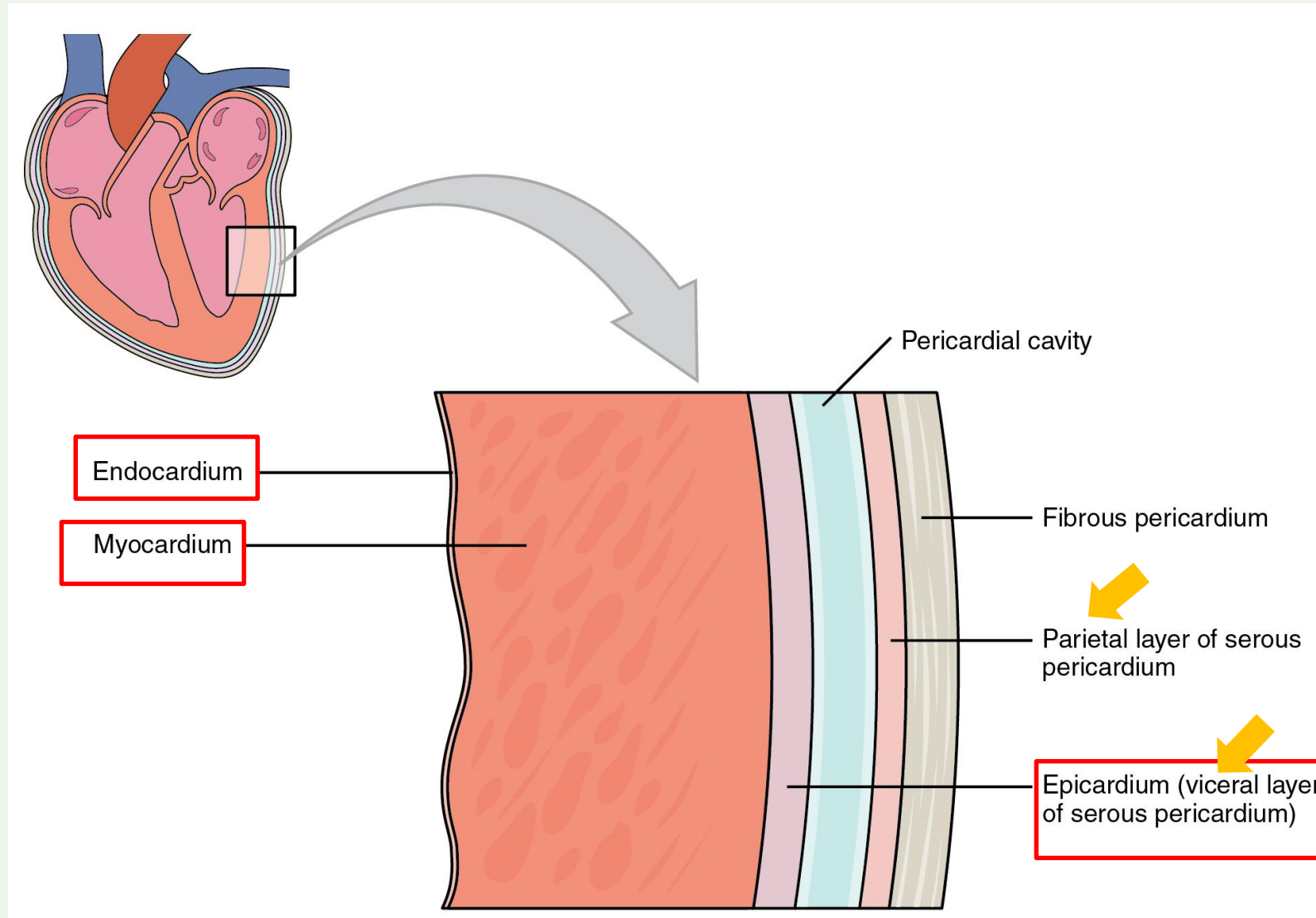
Debaran apeks / ictus cordis / punctum maximum

Gross Anatomy of the Heart **Anterior view**





Heart Wall





HEART ANATOMY

- **Consist of 4 chambers and 4 valves:**
 - Right atrium
 - Left atrium
 - Right ventricle
 - Left ventricle

- **Heart is influenced by the **autonomic** nerve system.**
 - **Sympathetic** → atrial, ventricle and arteria coronaria
 - **Parasympathetic** → pacemaker cells

The **heart wall** is comprised of 3 layers:

- the outer **epicardium**
- the middle **myocardium**
- the inner **endocardium**

Cardiac Conduction system

60-100x/mnt

Sinotrial Node
(SAN)

Right Atrium

40-60x/mnt

Atrioventricular Node
(AVN)

Right Ventricle

Right Bundle Branch
(RBB)

Left Atrium

HIS bundle

Left Bundle
Branch (LBB)

Left Ventricle

20-40x/mnt

Purkinje Fibers
(PF)

PACEMAKER

CARDIAC CONDUCTION
SYSTEM

MYOCARDIUM

Two types of cardiac **muscle cells**:

1. Ordinary/**contractile**/worker cell
 - Up to **95-99%** of heart muscle cell
 - Structurally/biochemically similar to skeletal muscle

2. Specialized / **autorhythmic** cell
 - Remaining **1-5%**
 - Initiation and transportation of electrical impulses
 - **Pacemaker** potential → automaticity of the specialized cell (ability to depolarize spontaneously).



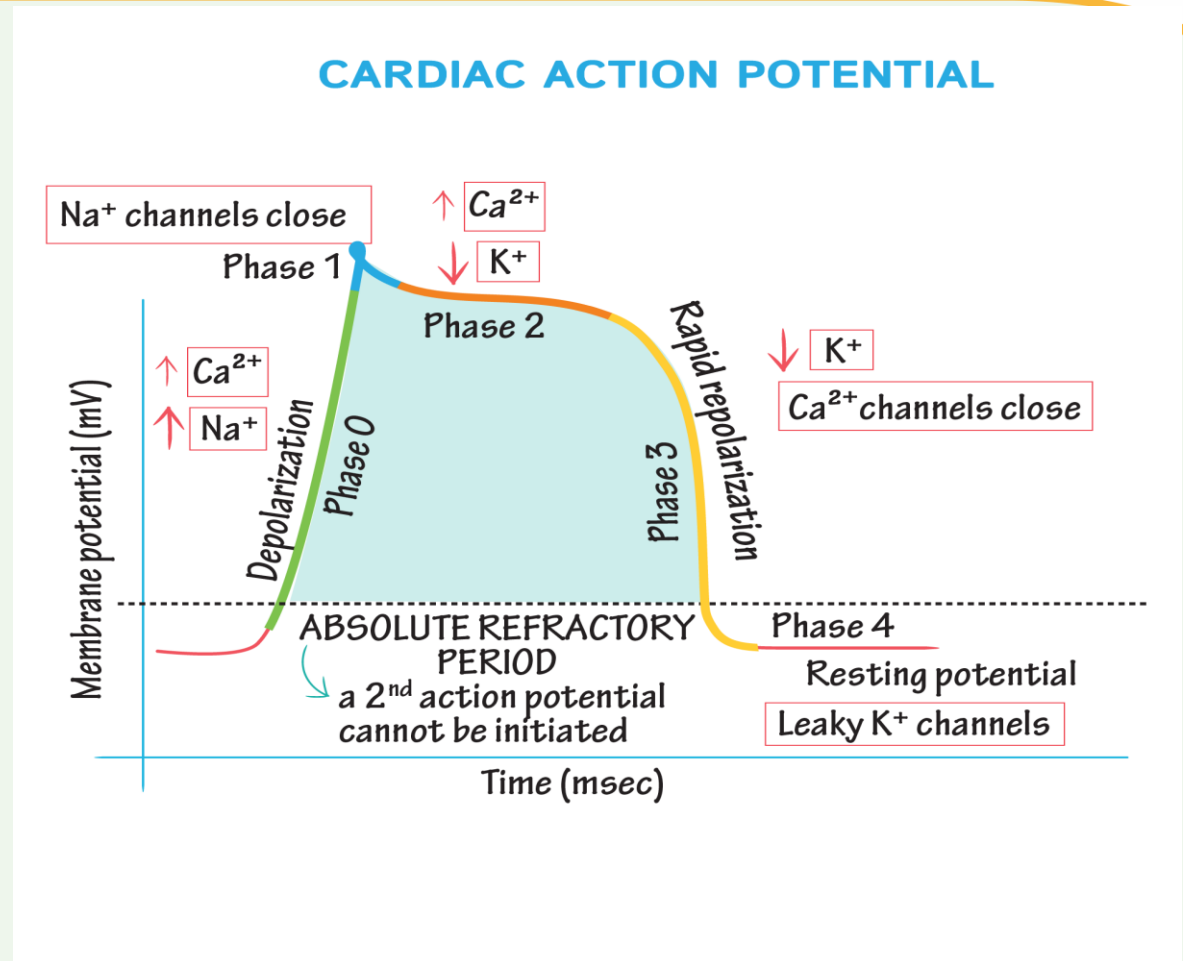
Action Potential

- Process → electrical impulse increase the threshold → cause a muscle contraction
- Both cells have different potential action.
- Potential action from autorhythmic cell → depolarization wave to the ordinary cell via 'gap junction' → cardiac contraction.
- Key components:
 1. Na^+ channel
 2. Ca^{2+} channel
 3. K^+ channel



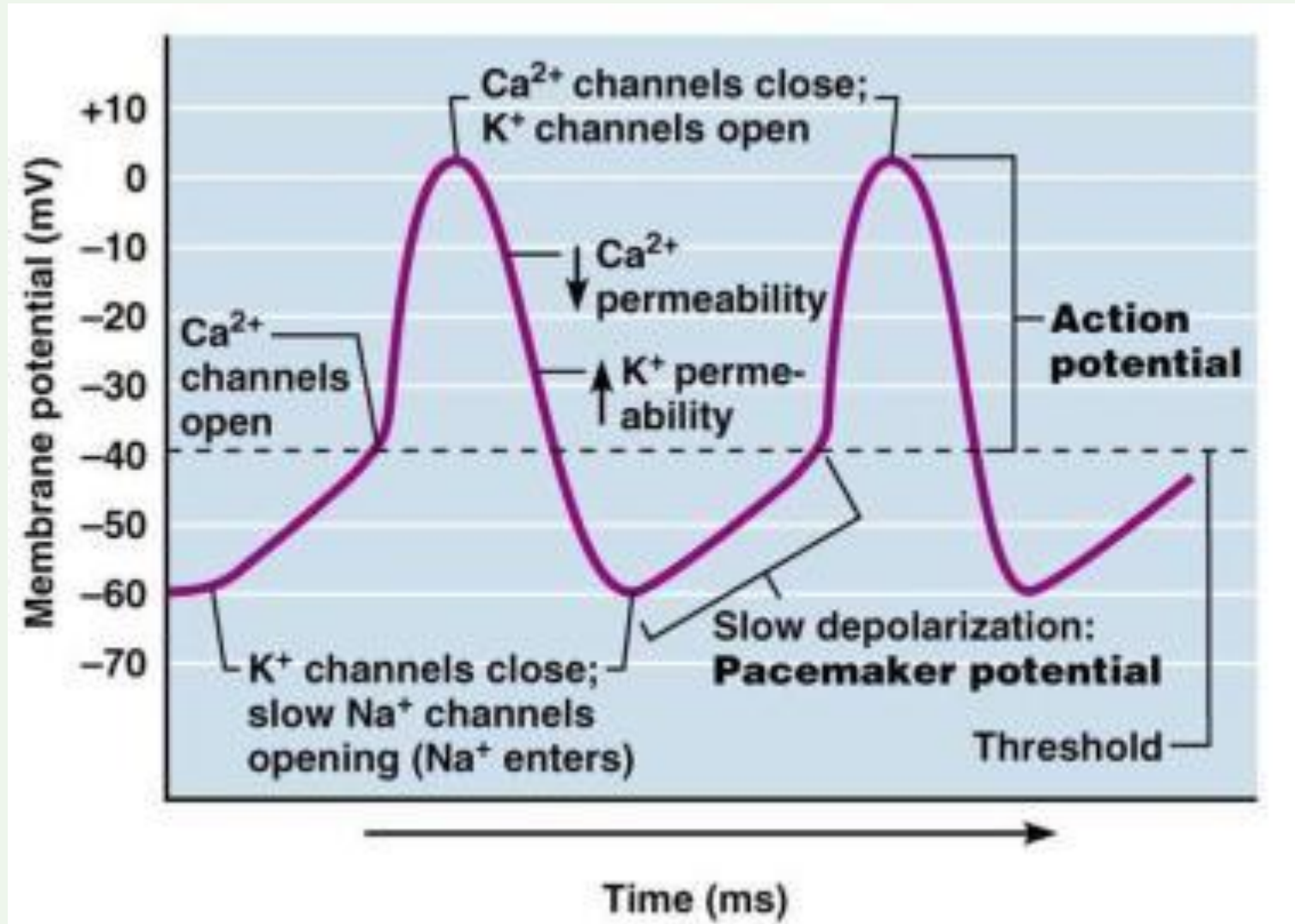
Action Potential-Contractile Cell

- Depends on the potential action of the **autorhythmic** cell.
- Positive ion from autorhythmic cell is transferred via gap junction and induced voltage changes
- 4 Phase:
 1. Depolarization
 2. Plateau
 3. Repolarization
 4. Resting potential



Action Potential- Autorhythmic Cell

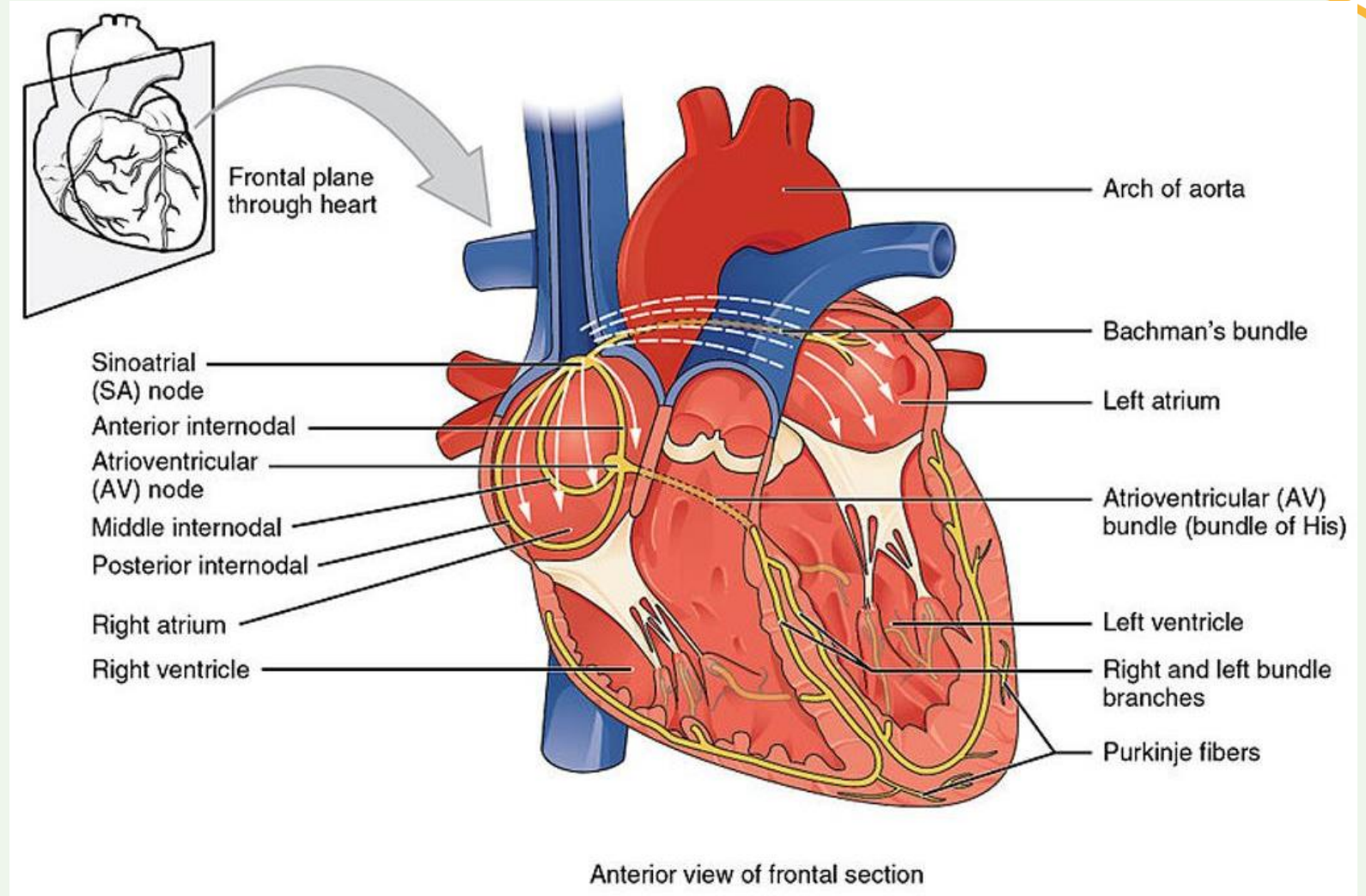
- Self-Induce action potential
- 3 Phase:
 1. pacemaker potential
 2. depolarization
 3. repolarization



CARDIAC CONDUCTION SYSTEM

The Pacemaker Cell

- 4 pacemaker cells:
 1. SA node
 2. AV node
 3. Bundle of HIS
 4. Purkinje fibers
- EKG helps to monitor normal heart electrical activity





The Pacemaker Cell

In 1907, Keith and Flack found SA node in the superior **posterolateral** of the right atrial wall.

- SA node: small, thin, ellipse 3x15x1mm.

AV node is located in **posterior** wall of the right atrial.

- AV node : a gateway impulse to bundle HIS and Purkinje fibers.

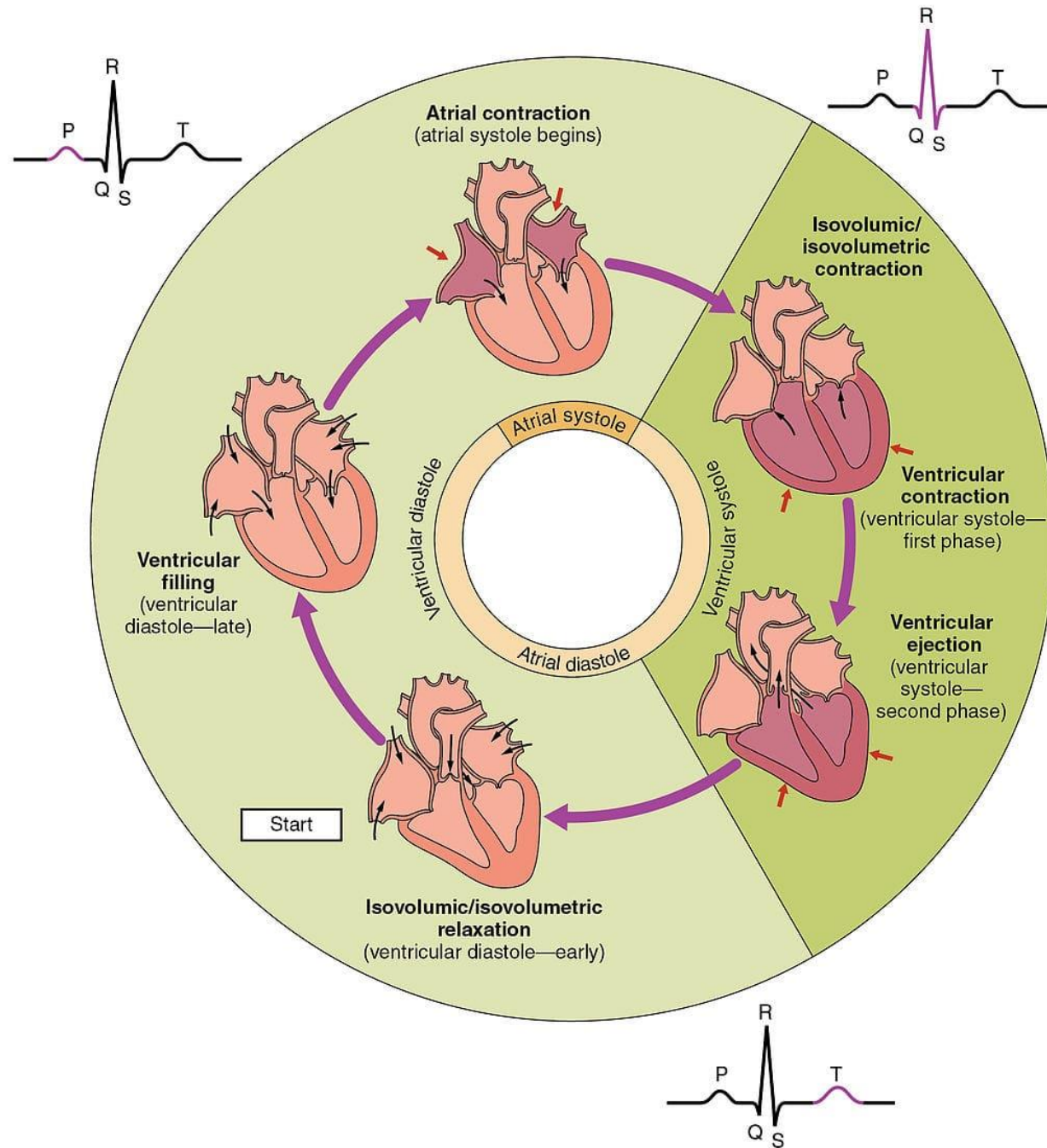


HEART CYCLE

- Consist of a period of **diastole** (relaxation) and **systole** (contraction).
- Phase:
 - ✓ **Isovolumic contraction/isovolumetric** → pressure rise without volume change
 - ✓ **Ejection**
 - ✓ **Isovolumic relaxation** → pressure down without volume change



HEART CYCLE





QUIZ

1. Ceritakan secara singkat elektrivitas jantung!
2. Jantung memiliki Ruang.
3. Apa itu EKG?



Take Home Message

- Peacemaker cells are SA node, AV node, bundle of HIS, and purkinje fibers.
- Peacemaker cells produce potential action to make the heart working properly as a pump.
- Electricity of the heart is a key to understand EKG.
- EKG helps to monitor the electrical activity of the heart.



REFERENCES

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PENUTUP BELAJAR

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

اللَّهُمَّ أَرِنَا الْحَقَّ حَقًّا وَارْزُقْنَا اتِّبَاعَهُ ۖ وَأَرِنَا الْبَاطِلَ بَاطِلًا وَارْزُقْنَا اجْتِنَابَهُ

Ya Allah Tunjukkanlah kepada kami kebenaran sehingga kami dapat mengikutinya,

Dan tunjukkanlah kepada kami keburukan sehingga kami dapat menjauhinya.



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