Chapter 20

The Heart

Openstax: Chapter 19

Chapter 20 Learning Outcomes
After completing Chapter 20, you will be able to:
1. Identify and describe the interior and exterior anatomy of the heart.
2. Describe the path of blood through the heart and out of the heart.
3. Explain the cardiac conduction system.
4. Describe the process and purpose of an electrocardiogram.
5. Explain the cardiac cycle.
6. Calculate cardiac output and explain factors that can influence heart rate and stroke volume.

Learning Outcome 1: Identify and describe the interior and exterior anatomy of the heart.

Martini: **20-1 The Heart, pg. 686**
***Openstax*: 19.1 Heart Anatomy, pg. 788**

Fun Fact: the heart is formed and begins to beat in the fourth week of gestation.

1. What is the function of the heart?
Functions as _____

_____

Location of the Heart

1. Name the body cavity where the heart is located: _____

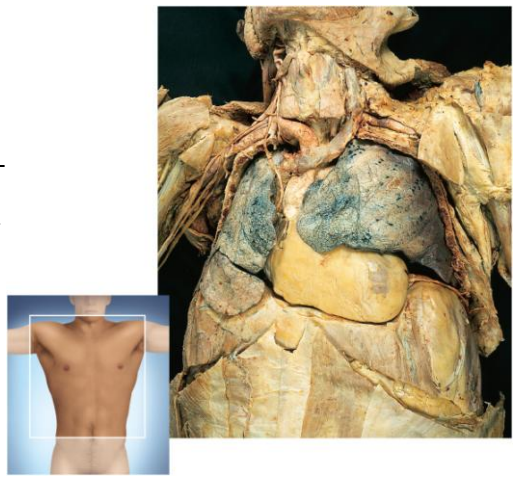
_____

1a. The heart is bordered laterally by the _____

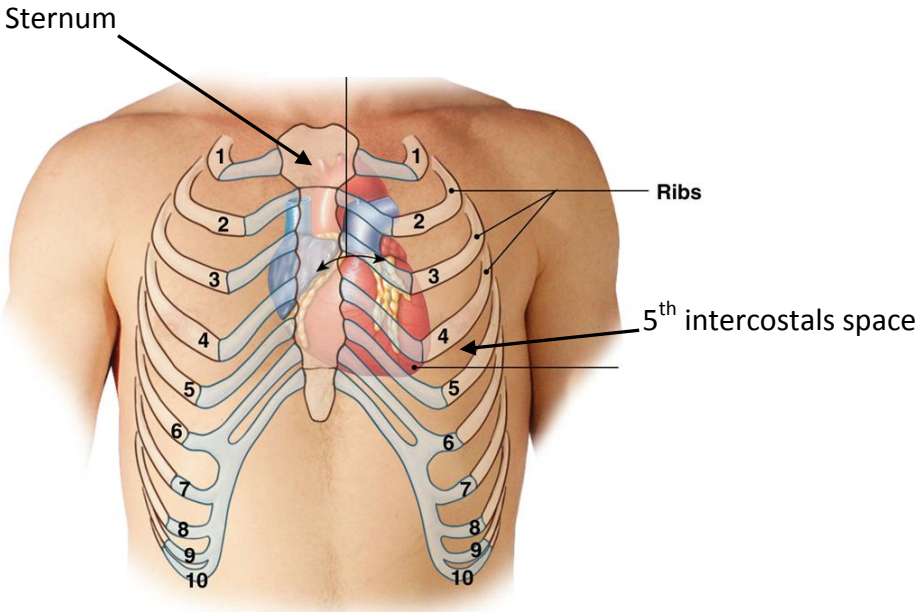
1b. The heart is directly posterior to the _____

1c. About two-thirds of the heart lies _____

_____



2. Label in the figure below: the *base* of the heart, the *apex* of the heart AND describe each one (include the location of each with respect to the ribs).



Martini, Fig. 20-2 Openstax, Fig. 19.2

3. The heart size varies with body size:

An average adult's heart is: _____ cm long (____ in)

_____ cm wide (____ in)

_____ cm thick (____ in)

4. Average mass of the adult heart:

Female's heart: _____ grams (____ oz)

Male's heart: _____ grams (_____ oz)

The Pericardium

1. Name the loose-fitting sac surrounding the heart: _____

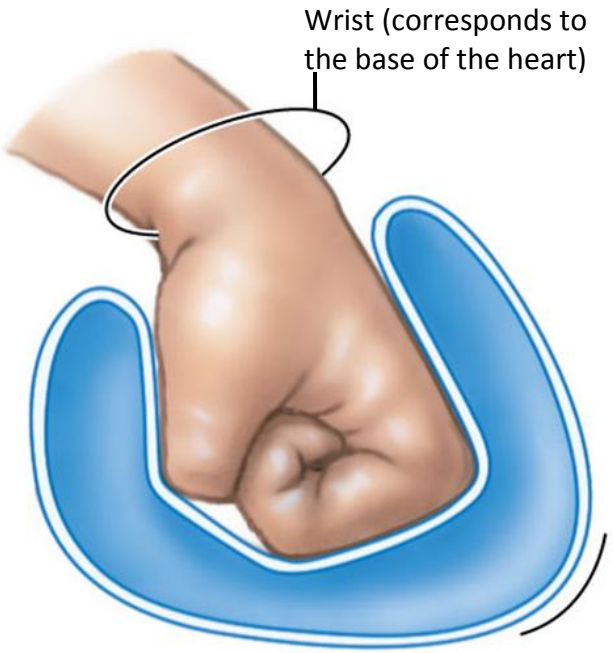
2. The pericardium is made of two layers:

LABEL:
visceral pericardium (epicardium) and parietal pericardium

Balloon = pericardium
Closed Fist = heart
Wrist = base of heart

Martini: Fig. 20.2(c)

Openstax: Fig. 19.5



3. The inner layer of the pericardium is called _____

NOTE: The visceral pericardium is also called the *epicardium*
The visceral pericardium (epicardium) covers the heart!

4. At the base of the heart, the visceral pericardium turns back upon itself to form the outer layer of the pericardium:_____

5. Name the cavity found between the visceral pericardium and parietal pericardium: _____

5a) What does the pericardial cavity contain? 15-50 mL of_____fluid.

What is the function of the *pericardial fluid*? _____

_____

_____

6. Inflammation (caused by infection) of the pericardium is called _____

Layers of the Heart Wall

1. The wall of the heart has **3** distinct layers:

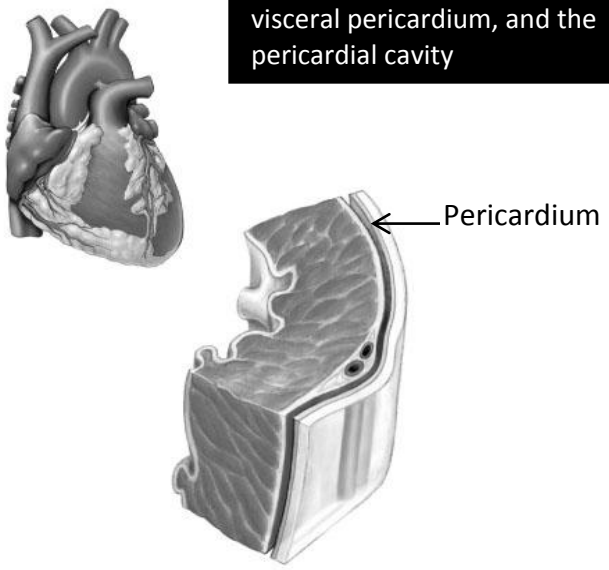
1. outer layer_____
2. middle layer_____
3. inner layer_____

LABEL the 3 layers of the heart wall.

Martini: Fig. 20-4

Openstax: Fig. 19.5

ALSO label: parietal pericardium, visceral pericardium, and the pericardial cavity



2. Fill in Table 1: The Heart Wall

Layer	Composition (tissue type/s)	Function
Outermost Layer: **Epicardium** (same as visceral pericardium)		
Middle Layer: **Myocardium** **95% of the heart wall**		
Innermost Layer: **Endocardium**		

? **Review About The Heart Wall:**

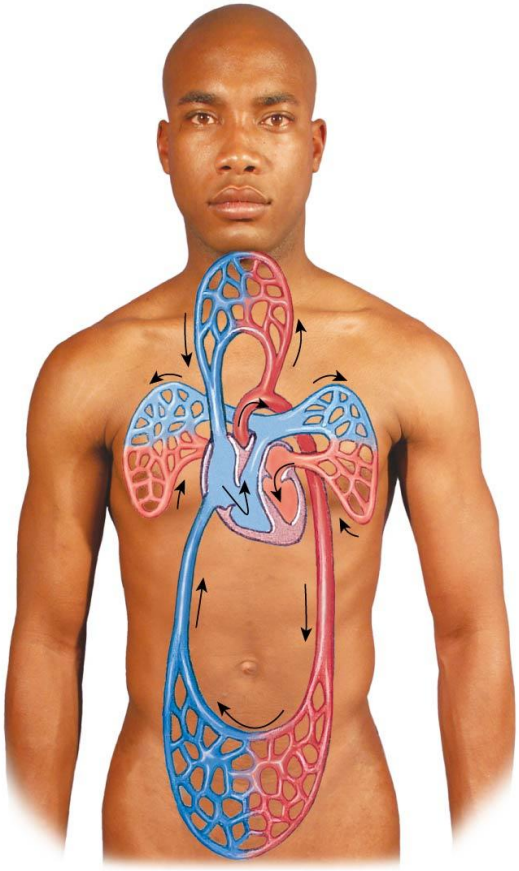
1. Choose One: Which of the heart wall layers is the visceral pericardium?
   a) myocardium b) endocardium c) epicardium

2. Which of the heart wall layers lines all the heart chambers and the heart valves? _____

3. Which of the heart wall layers is also continuous with the inner lining of the blood vessels? _____

Chambers of the Heart

1. The heart has four hollow chambers (cavities):



Atrium = singular Atria = plural

2. Describe the general function of atria:

Right Atrium: receives **deoxygenated blood** returning from _____

Left Atrium: receives **oxygenated blood** returning from _____

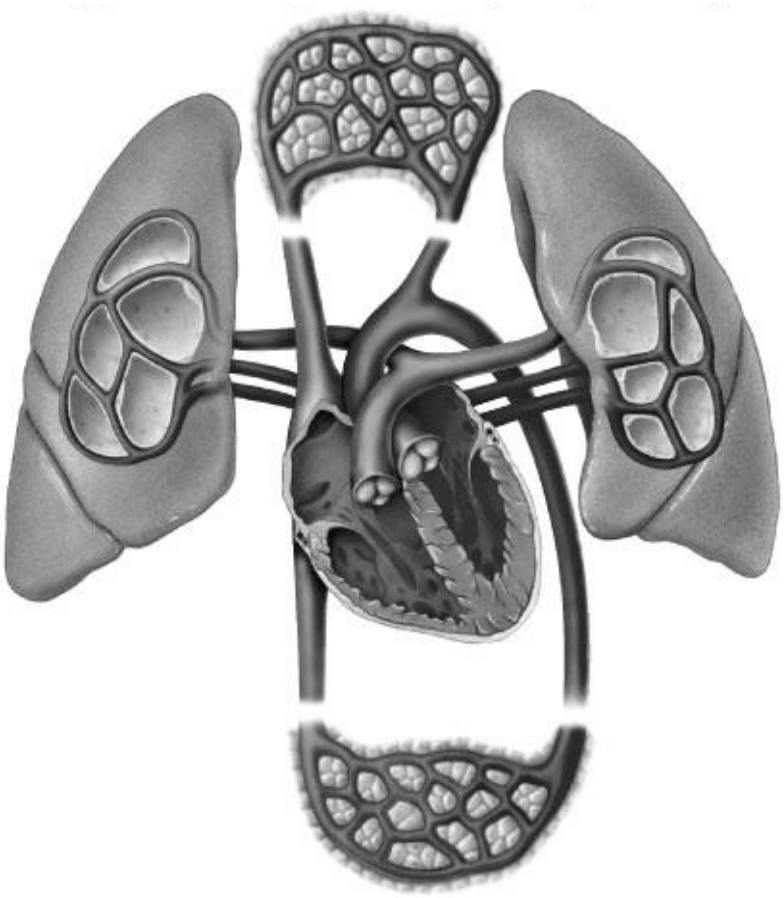
3. Describe the general function of ventricles:

Right Ventricle: pumps **deoxygenated blood** out of the heart to _____

Left Ventricle: pumps **oxygenated blood** out of the heart to _____

? Which ventricle has the thickest myocardium? _____
WHY the ventricle that you named above has the thickest myocardium? (

REVIEW: label the four chambers of the heart



Internal Anatomy and Organization

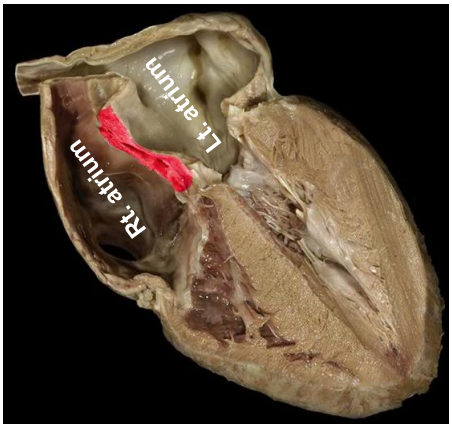
Martini: Fig. 20-6

Openstax: Fig. 19.9

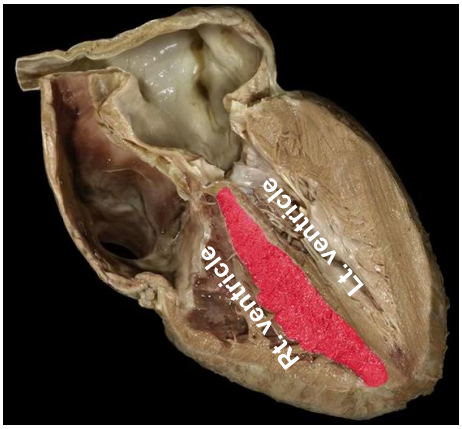
1. The internal walls separating the heart chambers are:

1a. Describe the interatrial septum:
Muscular wall separating _____

_____



1b. Describe the interventricular septum



Muscular wall separating

_____

_____

Heart Valves

1. Describe the general function of the heart valves:

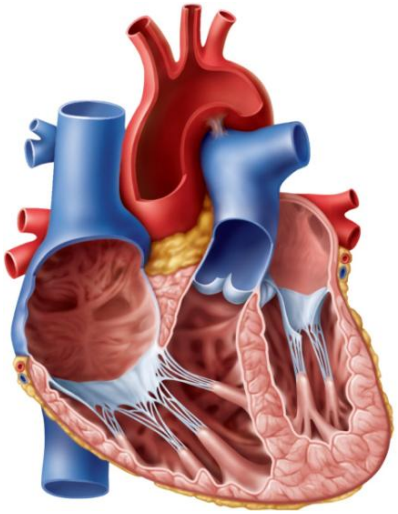
2. List the 4 heart valves:

1. _____
2. _____
3. _____
4. _____

3. Describe the function and location for each heart valve:

Tricuspid Valve

3a. Location of the tricuspid valve?

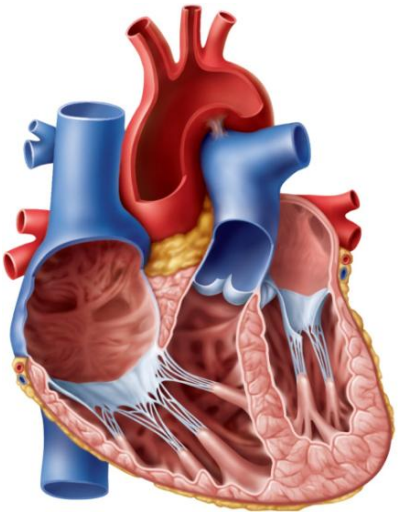


Label the tricuspid valve

3b. What is the function of the tricuspid valve?
Prevents return of deoxygenated blood from _____
to the _____ when the right ventricle contracts

Pulmonary Valve

3c. Location of the pulmonary valve?

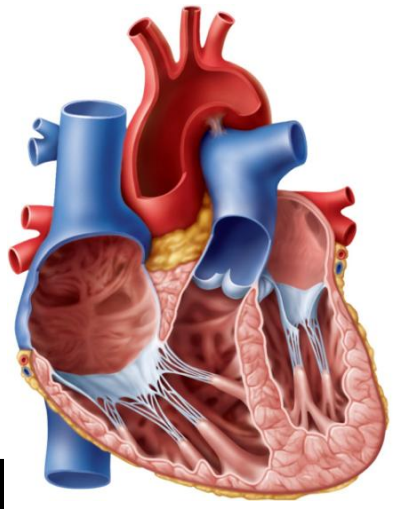


Label the pulmonary valve

3d. What is the function of the pulmonary valve? Prevents return of deoxygenated blood from _____ to the _____ when the right ventricular relaxes.

Biscupid or Mitral Valve

3e. Location of the bicuspid or mitral valve?

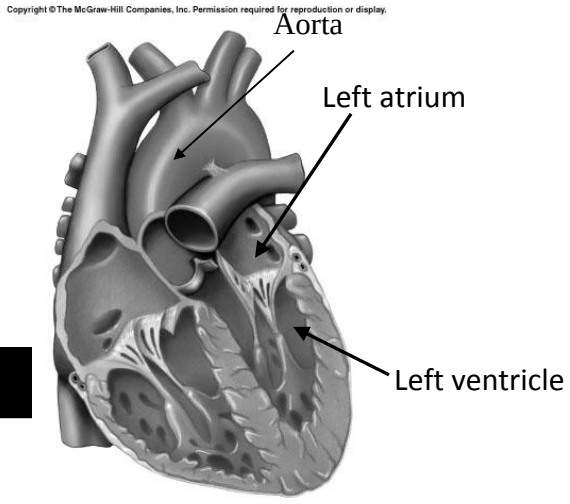


Label the bicuspid or mitral valve

3f. What is the function of the bicuspid (mitral) valve? Prevents return of oxygenated blood from _____ to the _____ when the left ventricle contracts.

Aortic Valve

3g. Location of the aortic valve?

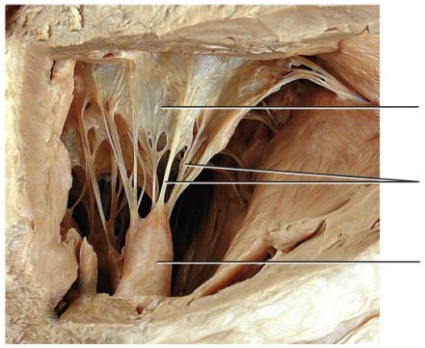


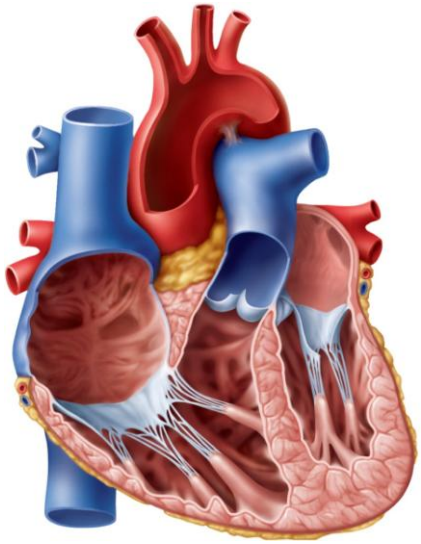
Label the aortic valve

3h. What is the function of the aortic valve? Prevents return of oxygenated blood from the _____to the _____ when the left ventricle relaxes.

7

4. Describe what are Chordae tendineae:
-Attach ONLY to _____
_____





Label the chordate tendineae

Learning Outcome 2: Describe the path of blood through the heart and out of the heart.

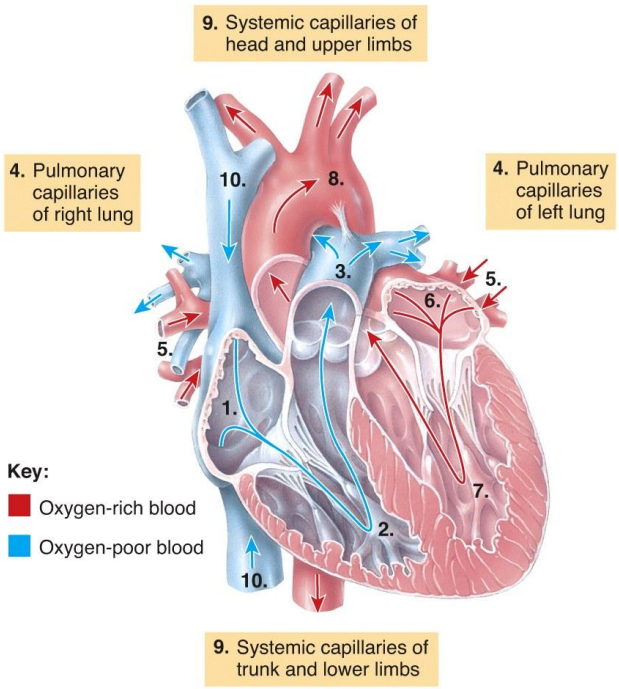
Martini: Internal Anatomy & Organization, pg. 689 [See also Fig. 20-6(a)]
Openstax: Chambers and Circulation through the heart, pg. 791

1. There are two distinct but linked blood circulations in the human body:

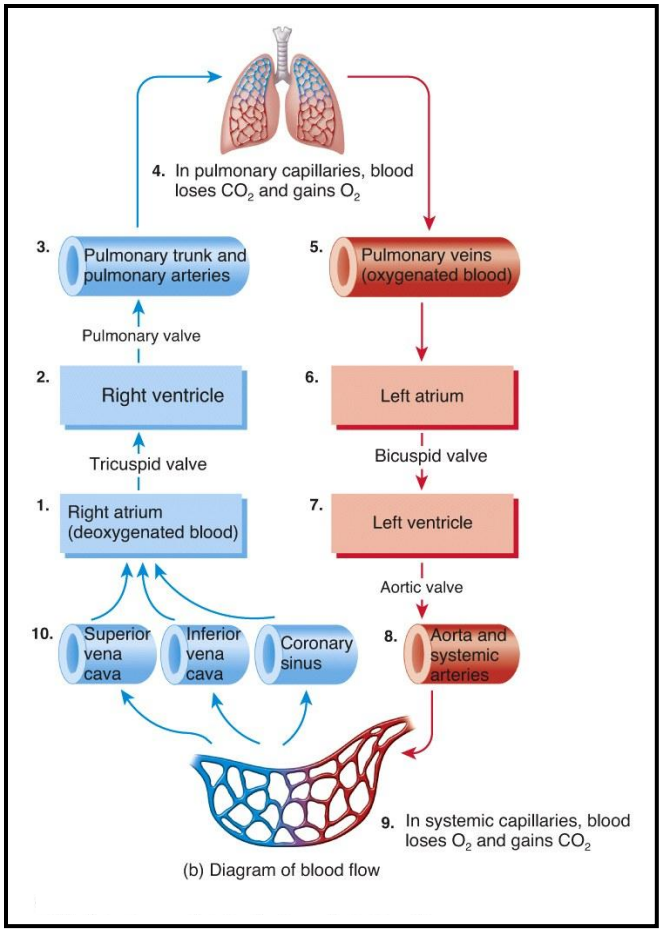
2. Describe the *pulmonary circulation*:
Transports_____
_____

3. Describe the *systemic circulation*:
Transports _____
_____
_____

4. Circulation of Blood through the Heart



(a) Path of blood flow through heart



(b) Diagram of blood flow

See: Martini: Fig 20-6

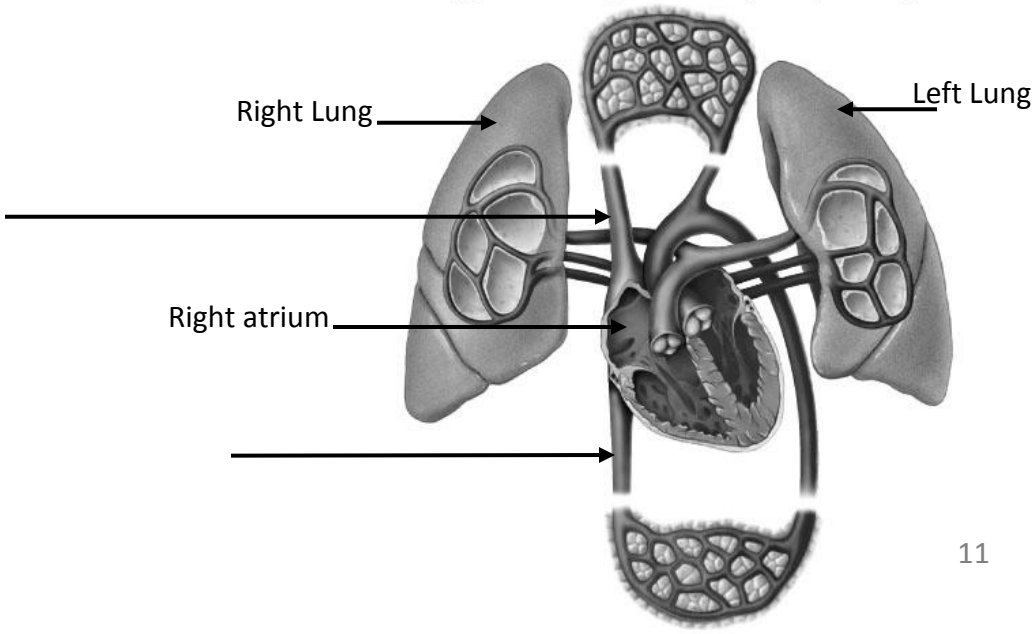
See Openstax: Fig 19.4

4a. **Deoxygenated blood** with high amounts of carbon dioxide reaches the right atrium through 2 large veins:

A. _____

B. _____

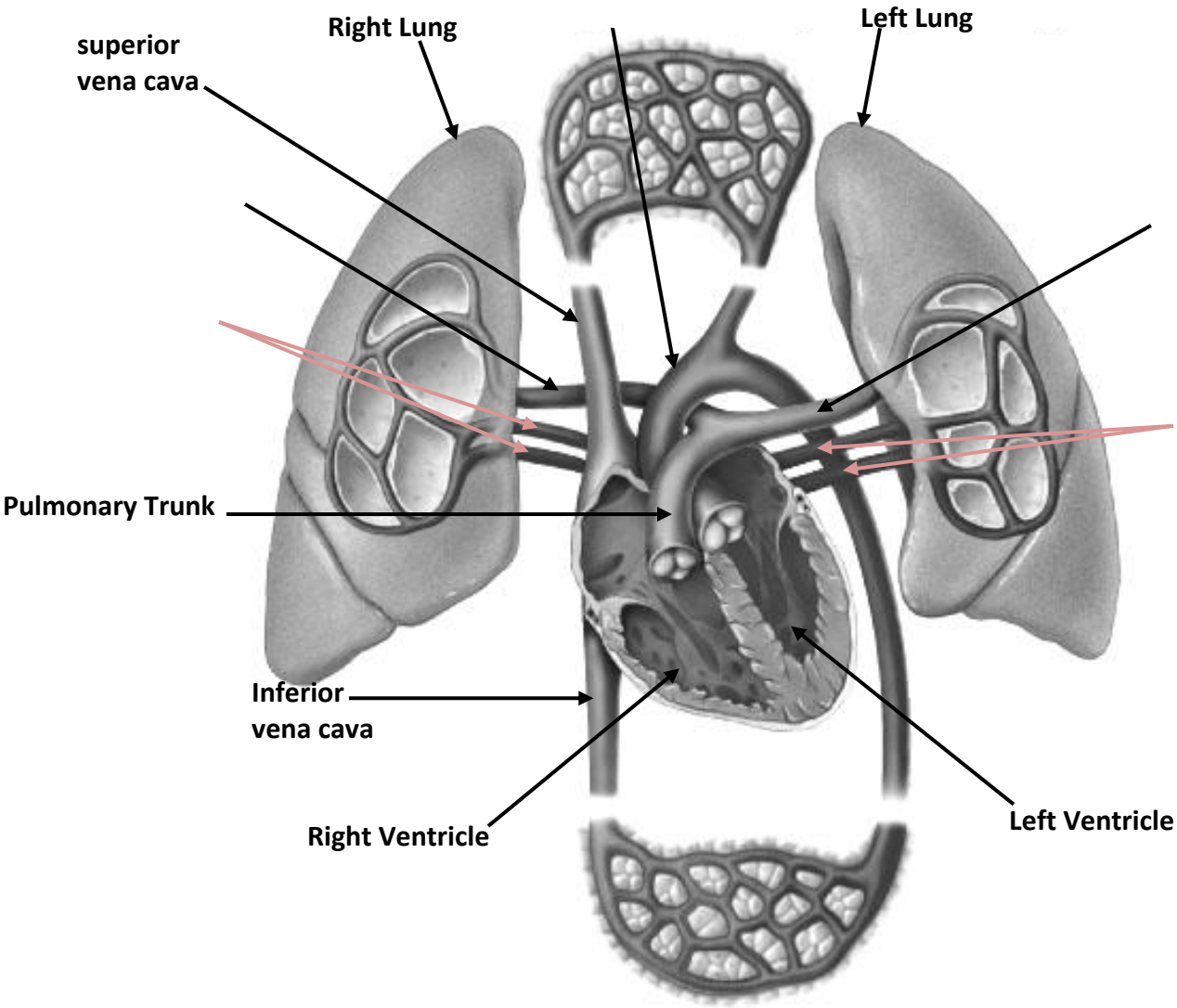
NOTE:
Superior Vena Cava brings deoxygenated blood from upper body parts to the right atrium of the heart. Inferior Vena Cava brings deoxygenated blood from lower body parts to the right atrium of the heart.



IN ADDITION, a small vein from the myocardium also drains **deoxygenated blood** in the right atrium. Name this small vein: _____

4b. From the right atrium, **deoxygenated blood** flows to which heart chamber?

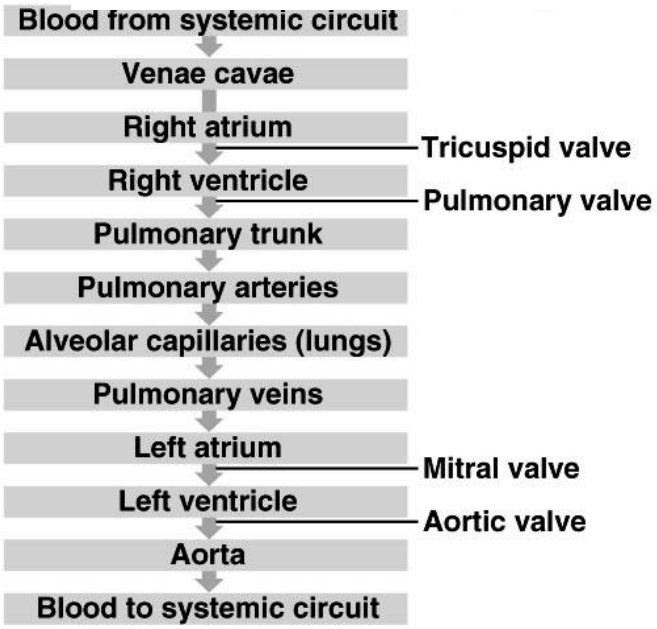
4c. Trace the path of blood from the right ventricle until it comes out of the heart through the aorta: Use the figure below to trace the path of blood through the heart:



4d. Blood that has been oxygenated at the lungs returns to the heart through the _____ veins. Name the heart chamber where pulmonary veins empty their oxygenated blood to: _____. **Oxygenated blood** then is pumped from the left atrium to the left _____.

4e. When left ventricle fills with blood, it contracts to pump **oxygenated blood** out of the heart to the body through which blood vessel? _____

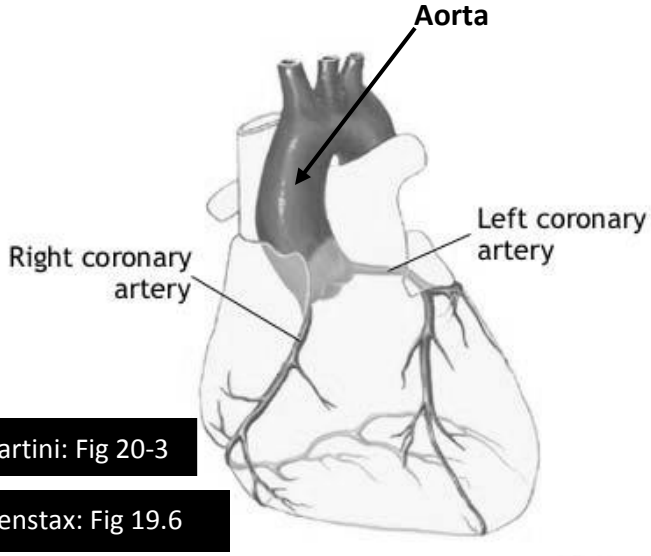
Pathway of blood through the heart: Review



Coronary Circulation: Martini, pg. 695 Openstax, pg. 805

1. What is the coronary circulation?

2. Name the two arteries supplying **oxygenated blood** to the tissues of the heart wall:



3. The coronary arteries are the first arteries branching from the _____

See: Martini: Fig 20-3

See Openstax: Fig 19.6

Martini: Fig. 20-9

Openstax: Fig. 19.15

4. Describe the right coronary artery.

4a. follows the _____

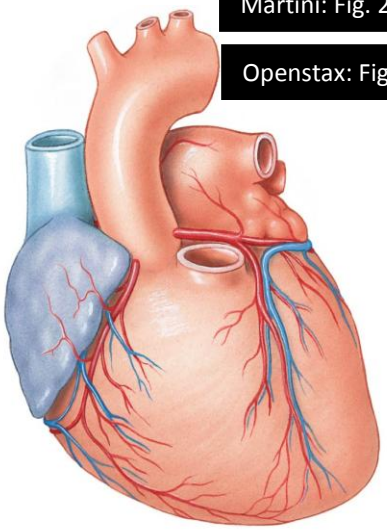
4b. Inferior to the right atrium, the right coronary artery gives rise to one or more:

4c. The right coronary artery continues across the posterior surface of the heart to give rise to the:

_____

The posterior interventricular artery runs towards:

_____



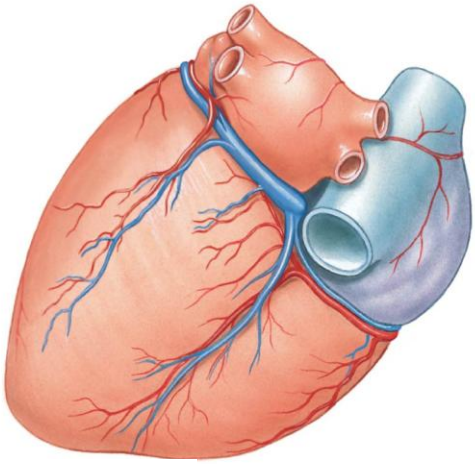
Anterior

4d. Areas of the heart receiving **oxygenated blood** from the right coronary artery:

5. Describe the left coronary artery.

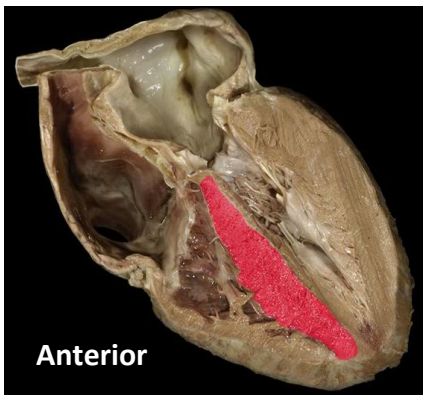
5a. Two main branches of left coronary artery:

5b. The left coronary artery supplies blood to:



Posterior

REVIEW: label the interventricular septum



Interior view of the heart

NOTE: small branches from the anterior interventricular artery interconnect with small branches from the posterior interventricular artery forming: _____

An anastomosis is an area where _____

_____

6. Cardiac Veins

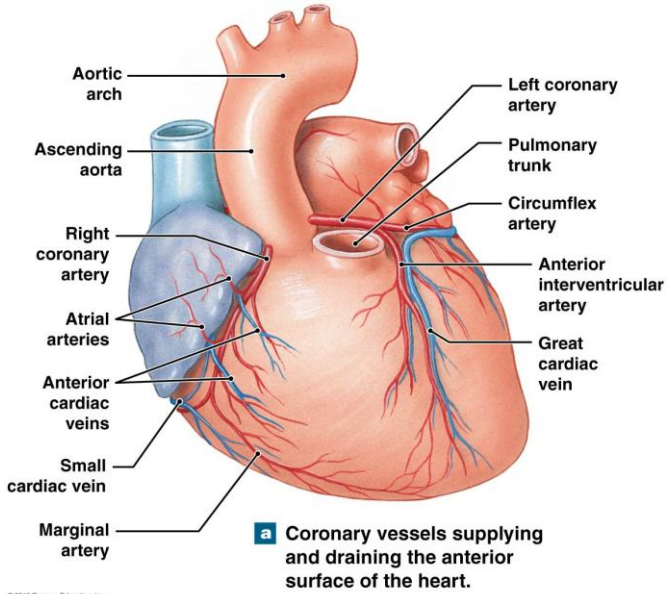
6a. begins on the anterior surface of ventricles along the _____

_____

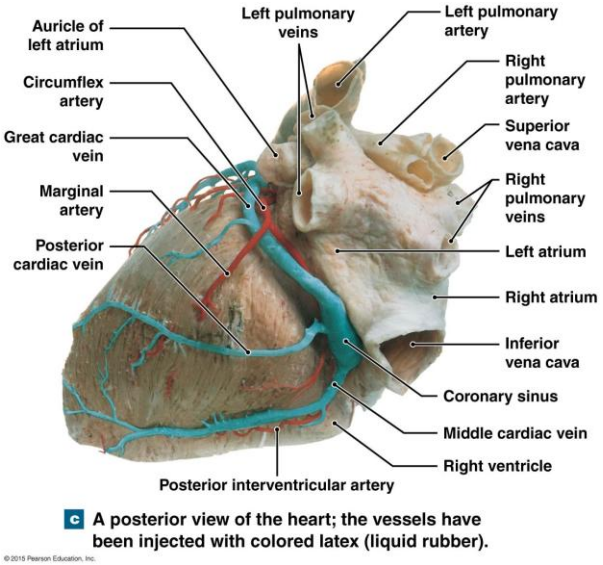
6b. Eventually flows along the _____

_____

_____



a Coronary vessels supplying and draining the anterior surface of the heart.



c A posterior view of the heart; the vessels have been injected with colored latex (liquid rubber).

Martini: Fig. 20-9

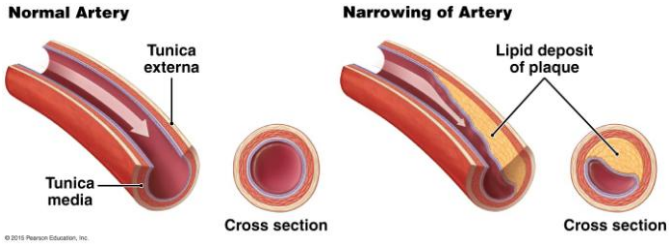
Openstax: Fig. 19.15

6c. The coronary sinus empties deoxygenated blood directly in to the _____

6d. The great cardiac vein receives deoxygenated blood from _____

_____

7. What is coronary artery disease (CAD)?



7a. What causes CAD?

7b. One of the first symptoms of CAD is commonly _____

7c. What is myocardial infarction (MI) or heart attack?

Learning Outcome 3: Explain the cardiac conduction system.

Martini: The Conducting System, pg. 697
Openstax: Conducting System of the Heart, pg. 811

1. Describe the cardiac contraction or _____:

-A _____ contraction of the heart
-The entire heart contracts in series:
First _____
Then _____
-The heart beats about _____

2. List the two types of cardiac muscle cells involved in a normal heart beat

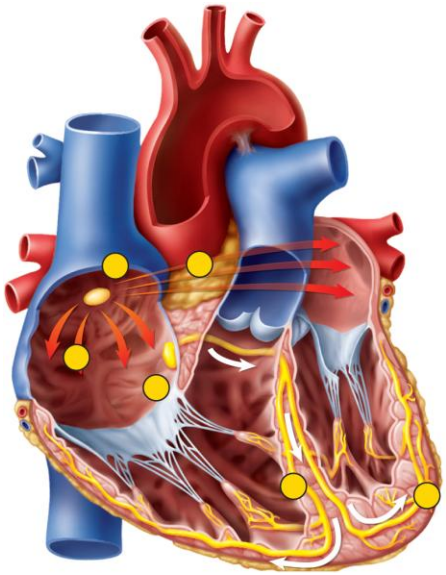
3. Describe the conducting system of the heart.
A system of specialized cardiac muscle cells that:

-start and distribute _____

_____

4. Name the **5** structures that make up the conduction system of the heart:
a.
b.
c.
d.
e.

Label the Conducting System of the Heart:



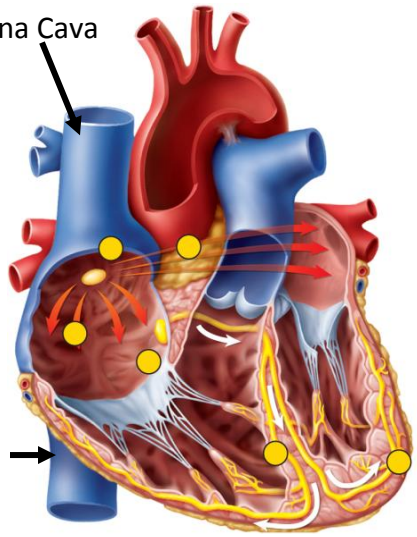
Martini: Fig. 20-11

Openstax: Fig. 19.18

5. Describe each component of the conducting system of the heart.

Sinoatrial (SA) Node

Location:



Label the SA node

Function of the SA node:

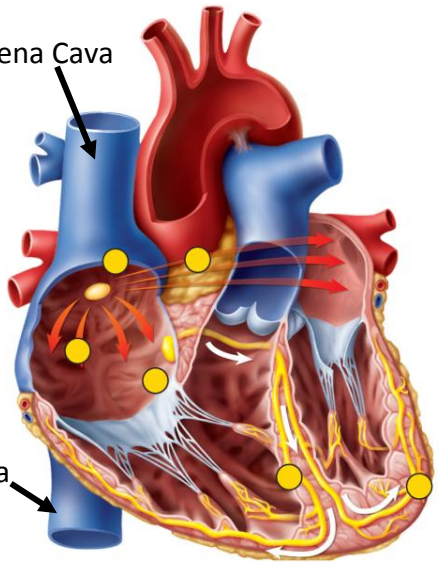
SA node's nickname:_____

Arrival of the electrical signal from the SA node to the AV node takes about ___ msec

In **1 minute**, the SA node fires about 80-100 times per minute to initiate a heart beat each time. Therefore, there are about 80-100 heart beats per minute.

Atrioventricular (AV) Node

Location:



Function of the AV node:

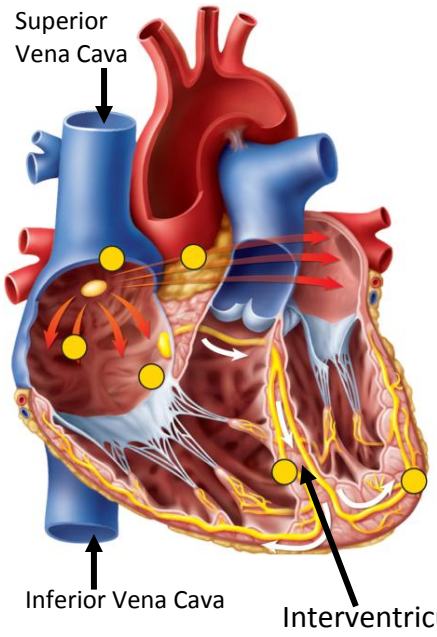
From the AV node, the cardiac impulse is transmitted to the AV bundle.

Atrioventricular (AV) Bundle or Bundle of His
Location:

AV Bundle divides into two _____

_____

Function of AV bundle and AV bundle branches:



Purkinje Fibers
Location:

Function of Purkinje fibers:

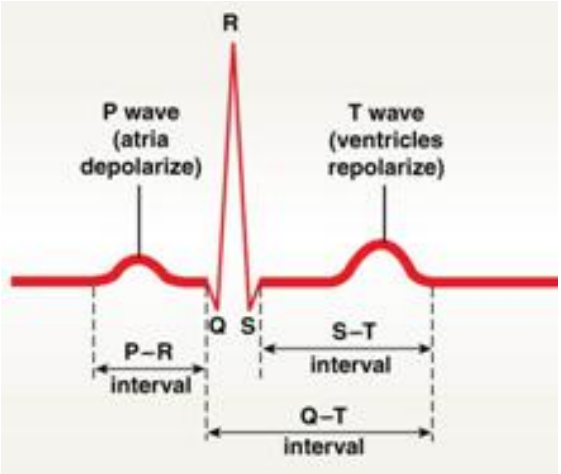
The total time elapsed from the beginning of the electrical signal at the SA node until full contraction of ventricles is: _____msec

Learning Outcome 4: Describe the process and purpose of an electrocardiogram.

Martini: The Electrocardiogram, pg. 702
Openstax: Electrocardiogram, pg. 815

1. What is an electrocardiogram (ECG or EKG)?

2. Normal ECG:



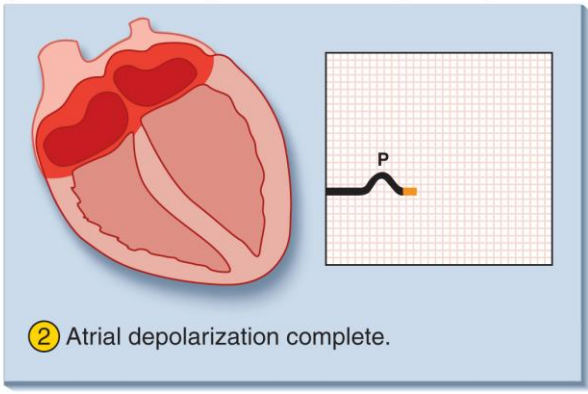
3. Describe the recordings in an ECG.

3a. P wave

3ai. Produced when the _____

3aii. _____ (cardiac cells become positive charged)

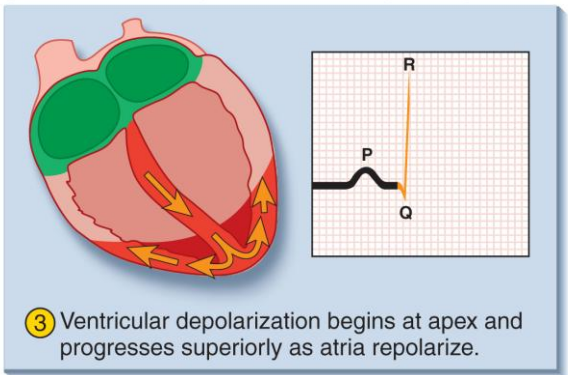
3aiii. Atrial contract (systole) about _____

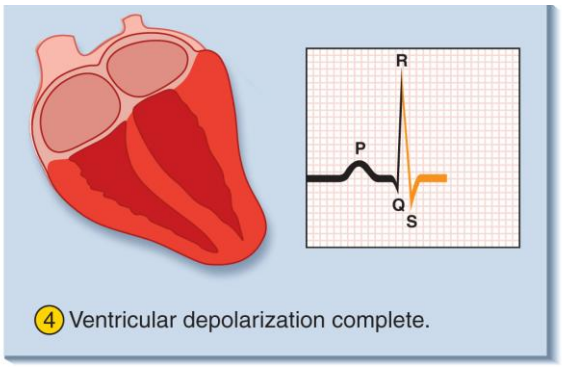


3b. QRS Complex

3bi. Ventricular _____

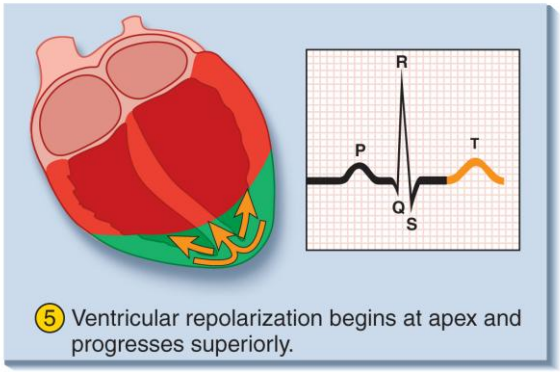
3bii. Why is the QRS segment bigger than the P wave?

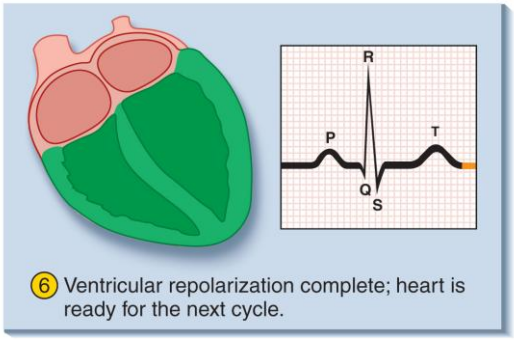




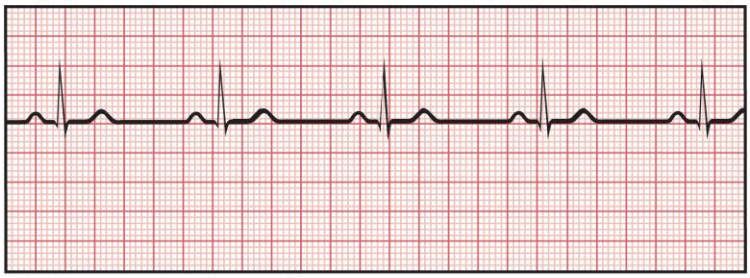
3c. T Wave

3ci. Ventricular _____

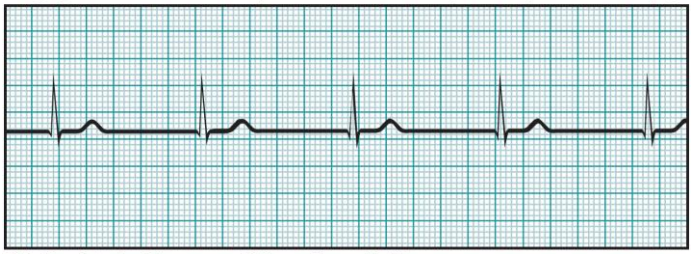




4. Abnormal Electrocardiograms

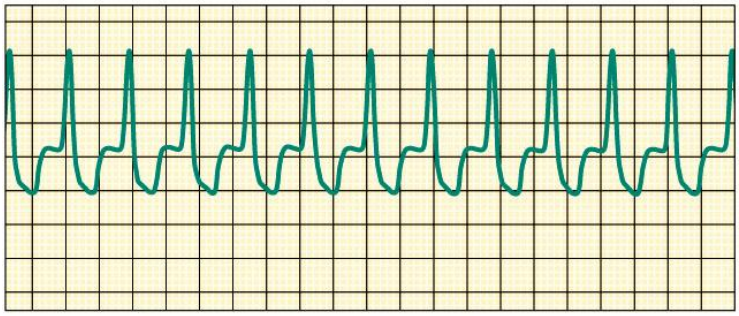


(a) Sinus rhythm (normal)



(b) Nodal rhythm—no SA node activity

Tachycardia



Bradycardia

<u>Heart Sounds</u> ("Lubb-Dupp" sound)

1. Listening to the heart is a technique called _____

2. "<u>Lubb" sound</u>- First Heart Sound (S_1)

2a. The "Lubb" sound occurs when _____

2b. What causes the "Lubb" sound? closing of the _____

3. "<u>Dupp" sound</u>- Second Heart Sound (S_2)

3a The "Dubb" sound occurs during _____

3b. What causes the "Dubb" sound? Closing of the _____

4. What is a *heart murmur*? _____

_____

Learning Outcome 5: Explain the cardiac cycle.

READ Openstax: 19.3 Cardiac Cycle pg. 822-824

Understand:

1. What is the cardiac cycle.
2. Pressure and flow in the cardiac cycle
3. Phases of the cardiac cycle
4. Relationship between the cardiac cycle and ECG

Learning Outcome 6: Calculate cardiac output and explain factors that can influence

Martini: 20-4 Cardiac Output, pg. 711

Openstax: Cardiac Output, pg. 826

1. What is Cardiac Output (CO)?

Volume of blood ejected from _____

_____

2. Calculating Cardiac Output (CO):

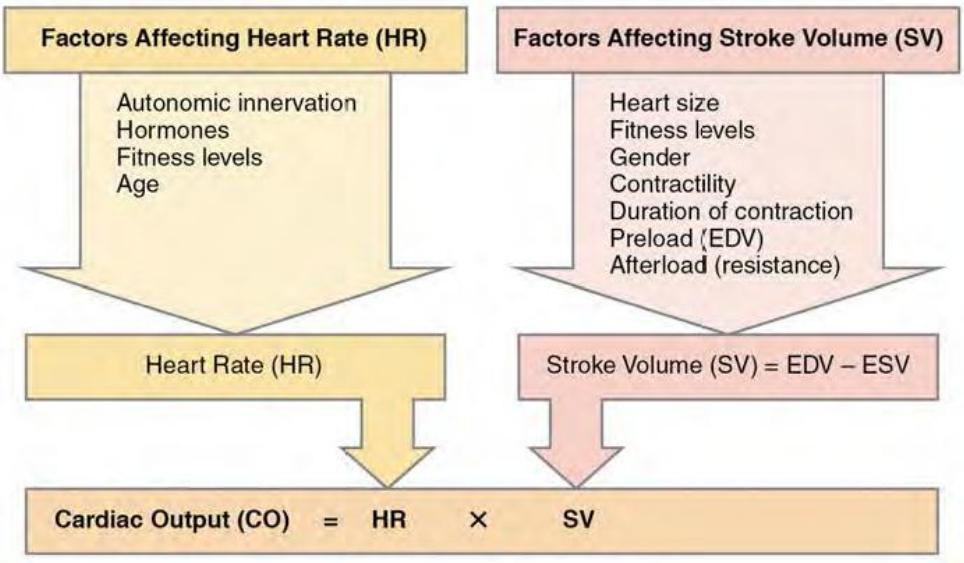
3. Example - Calculate the CO of a typical resting adult male (70 kg or 150 lb):
SV = 70 ml/beat HR is 75 beats/min

3a. Cardiac output is an indication of _____

_____

3b. List factors affecting cardiac output:

Openstax: Fig. 19.31



Test Your Knowledge…

1. Blood exits the heart through…
a. veins b. arteries c. venules d. arterioles

2. Valves prevent a backup of blood flow in the following vessels…
a. arteries b. veins c. arterioles d. capillaries

3. Blood enters the heart through…
a. atria b. septum c. ventricles d. myocardium

4. The proctective covering of the heart is called the…
a. epicardium b. pericardium c. myocardium d. endocardium

5. Atria pump blood across these valves:
a. pulmonary b. aortic c. pulmonary d. mitral & tricuspid

6. Blood from the *LEFT* ventricle enters the:
a. aorta b. pulmonary artery c. pulmonary vein d. inferior vena cava

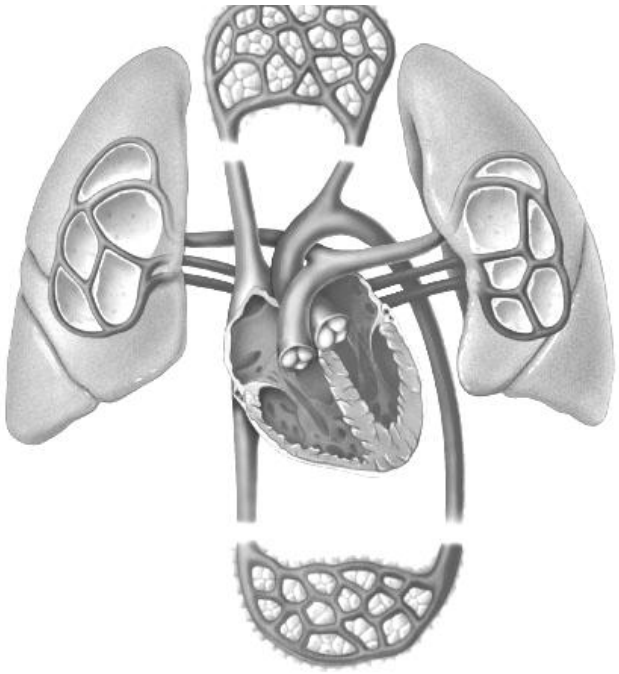
7. Which component of the electrical conduction system initiates the heartbeat?
a. the atrioventricular node
b. the sinoatrial node
c. the bundle of His
d. the Purkinje fibers

8. The volume of blood leaving the heart per minute is called…
a. stroke volume b. cardiac output c. heart rate d. cardias ischemia

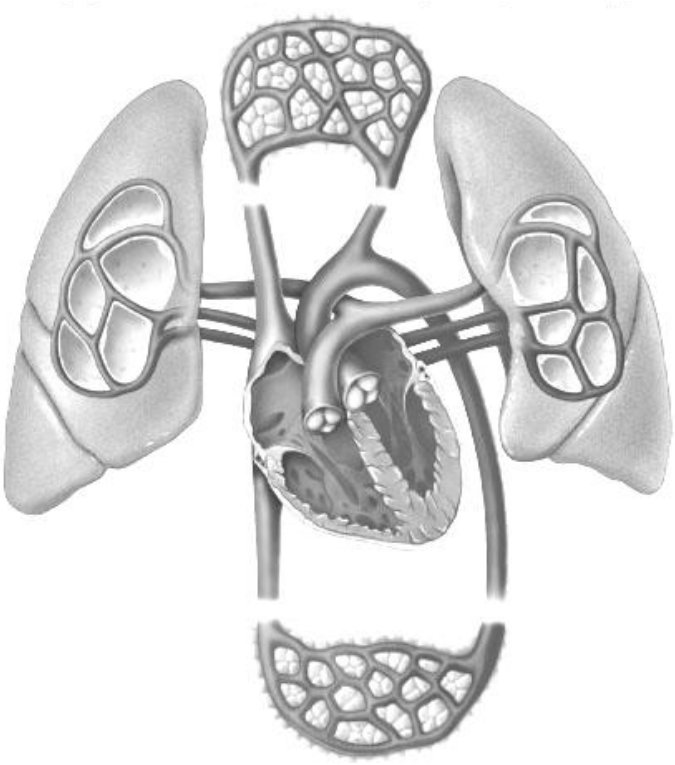
9. Parasympathetic nerve stimulation would have the following effect on the heart:
a. increase the stroke volume
b. decrease heart rate
c. increase blood pressure
d. increase the cardiac output

10. Discuss the size, position, and location of the heart in the thoracic cavity.

11. Name and locate the chambers and valves of the heart.



12. Trace the flow of blood through the heart.



13. Identify, locate, and describe the functions of each of the following structures:
SA node, AV node, AV bundle, Purkinje fibers.