

Gross Anatomy of the heart



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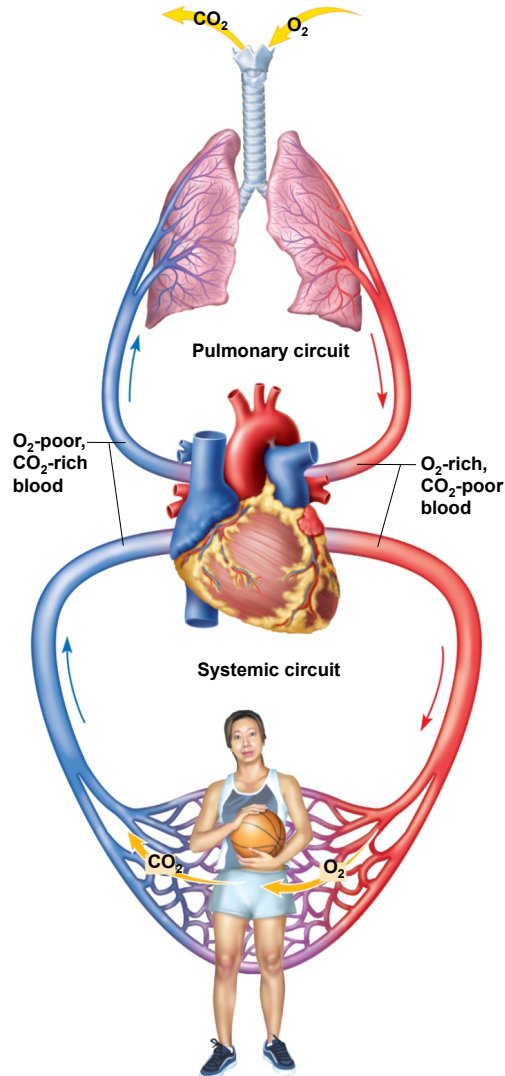
LEARNING OUTCOMES

As a result of the lesson you will be able to:

- ❑ *Distinguish between the pulmonary circuit and systemic circuit ;*
- ❑ *Describe the general location, size, and shape of the heart;*
- ❑ *Describe and Identify the coverings, the surface anatomy, tissue layers and internal features of the heart and associated great vessels;*
- ❑ *Identify and Trace the coronary circulation.*
- ❑ *Describe the the pathway blood through the heart and Explain the operation of the heart valves.*

Cardiovascular System Circuit

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- left side of heart
 - fully oxygenated blood arrives from lungs via pulmonary veins
 - blood sent to all organs of the body via aorta
- right side of heart
 - lesser oxygenated blood arrives from inferior and superior vena cava
 - blood sent to lungs via pulmonary trunk

Figure 19.1

Position, Size, and Shape

- heart located in mediastinum, between lungs
- **base** – wide, superior portion of heart, blood vessels attach here
- **apex** - inferior end, tilts to the left, tapers to point
- 3.5 in. wide at base, 5 in. from base to apex and 2.5 in. anterior to posterior; weighs 10 oz.

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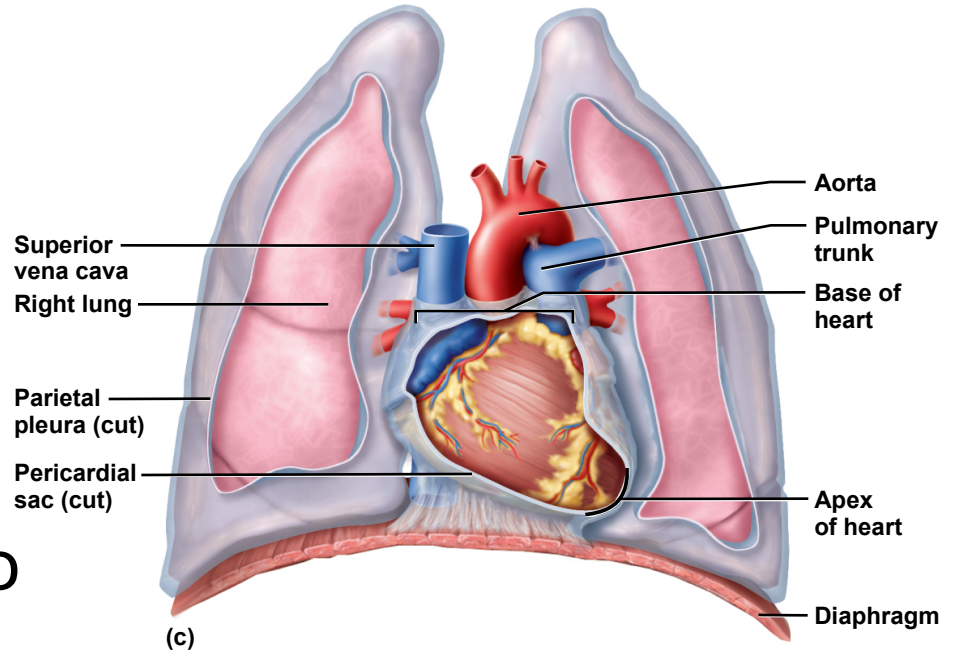
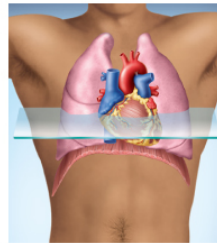
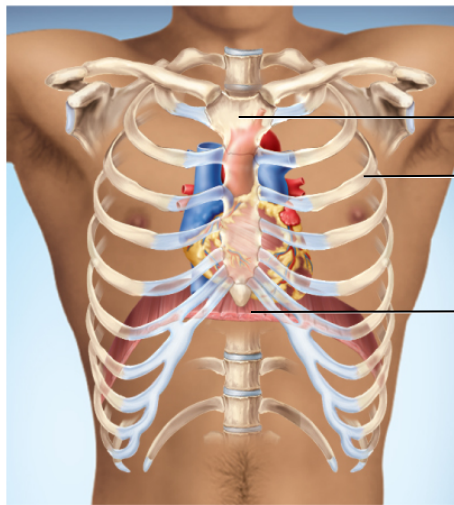


Figure 19.2c

Heart Position

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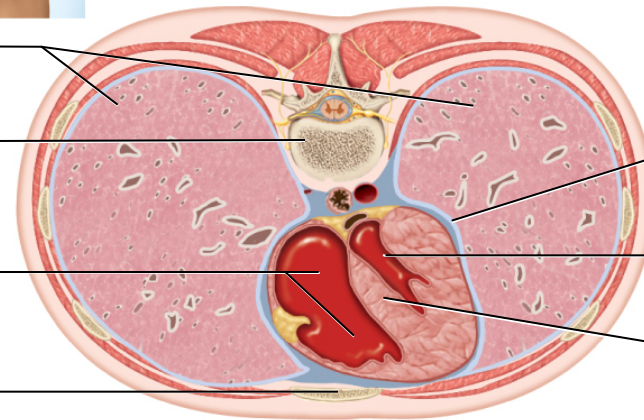
Lungs

Thoracic
vertebra

Right
ventricle

Sternum

Posterior



Anterior

(b)

(a)

Figure 19.2 a-b

Pericardium

- **pericardium** - double-walled sac (pericardial sac) that encloses the heart
 - allows heart to beat without friction, provides room to expand, yet resists excessive expansion
 - anchored to diaphragm inferiorly and sternum anteriorly
- **parietal pericardium** – outer wall of sac
 - superficial **fibrous layer** of connective tissue
 - a deep, thin **serous layer**
- **visceral pericardium (epicardium)** – heart covering
 - serous lining of sac turns inward at base of heart to cover the heart surface
- **pericardial cavity** - space inside the pericardial sac filled with 5 - 30 mL of pericardial fluid
- **pericarditis** – inflammation of the membranes
 - painful friction rub with each heartbeat

Pericardium and Heart Wall

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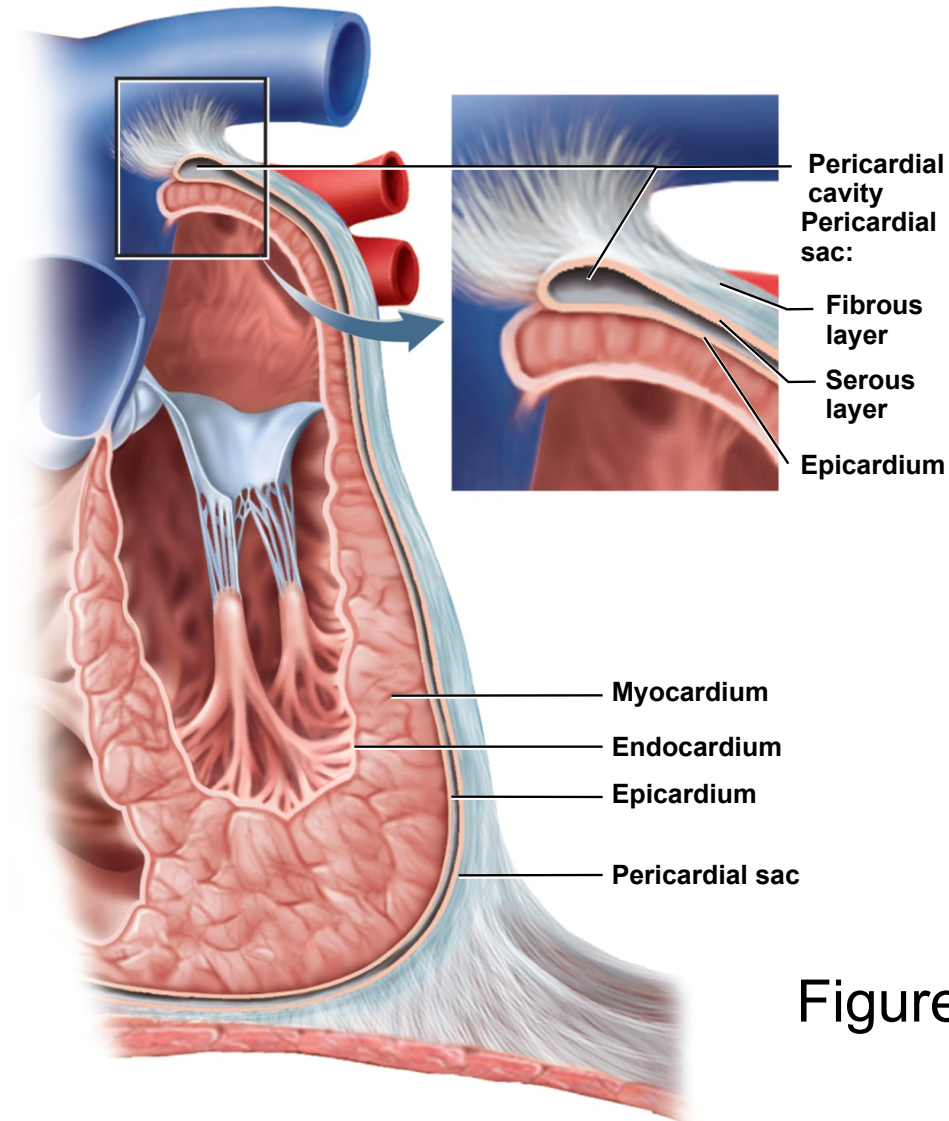
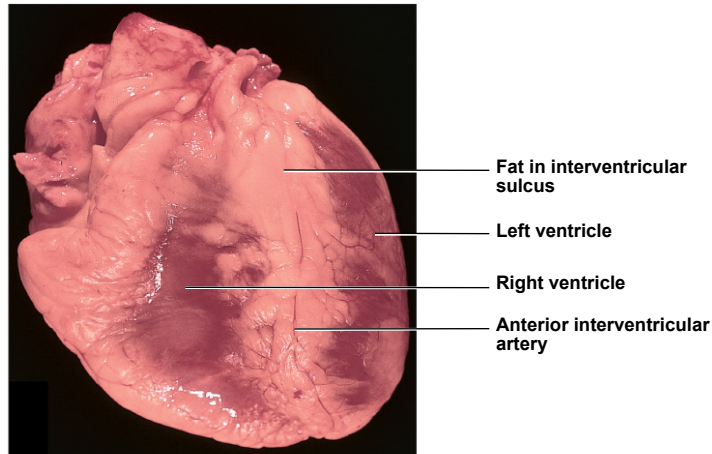


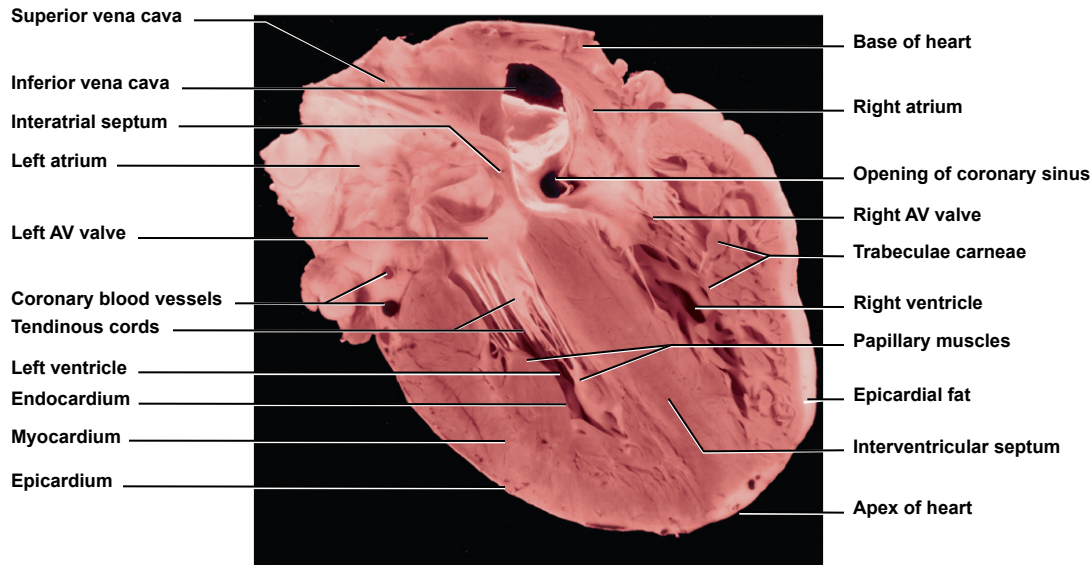
Figure 19.3

Cadaver Heart

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(a) Anterior view, external anatomy



(b) Posterior view, internal anatomy

Figure 19.4 a-b

Heart Wall

- **epicardium** (visceral pericardium)
 - serous membrane covering heart
 - adipose in thick layer in some places
 - coronary blood vessels travel through this layer
- **endocardium**
 - smooth inner lining of heart and blood vessels
 - covers the valve surfaces and continuous with endothelium of blood vessels
- **myocardium**
 - layer of **cardiac muscle** proportional to work load
 - muscle spirals around heart which produces wringing motion
 - **fibrous skeleton of the heart** - framework of **collagenous and elastic fibers**
 - provides structural support and attachment for cardiac muscle and anchor for valve tissue
 - electrical insulation between atria and ventricles important in timing and coordination of contractile activity

Heart Chambers

- **four chambers**
 - **right and left atria**
 - two superior chambers
 - receive blood returning to heart
 - auricles (seen on surface) enlarge chamber
 - **right and left ventricles**
 - two inferior chambers
 - pump blood into arteries

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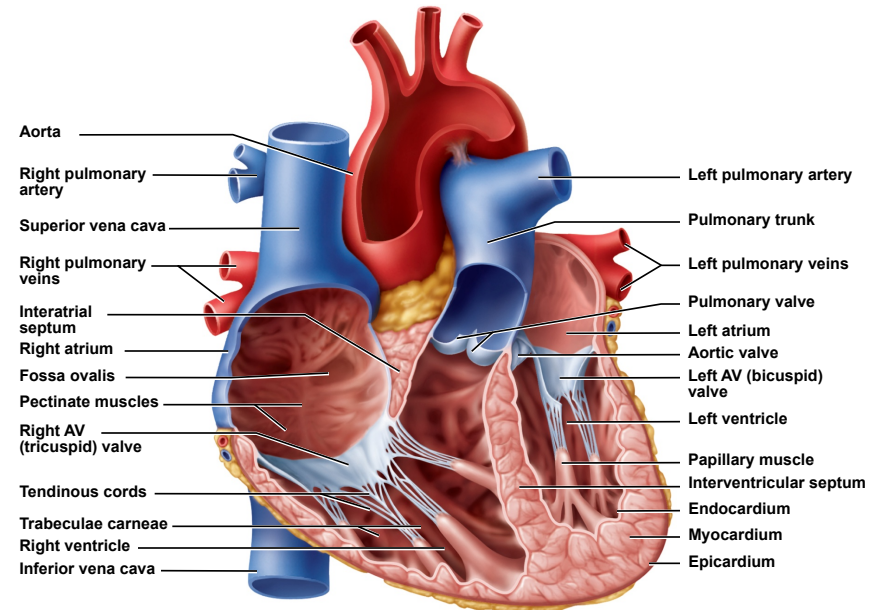


Figure 19.7

External Anatomy - Anterior

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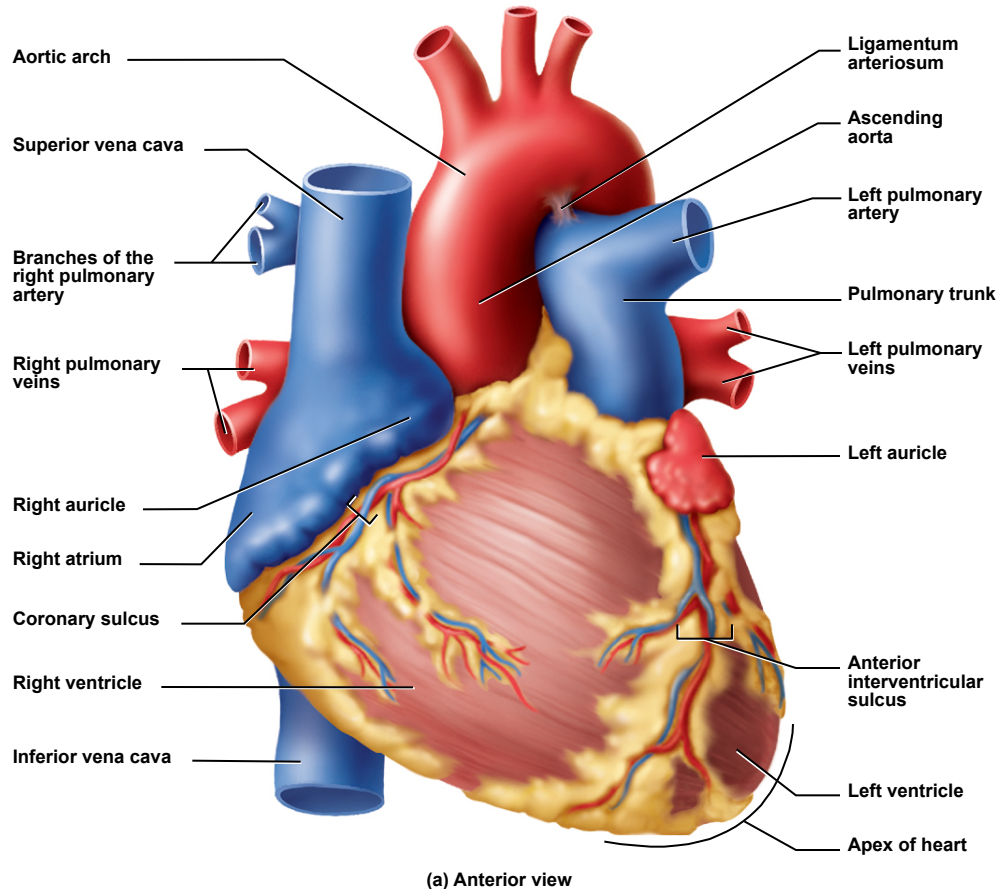
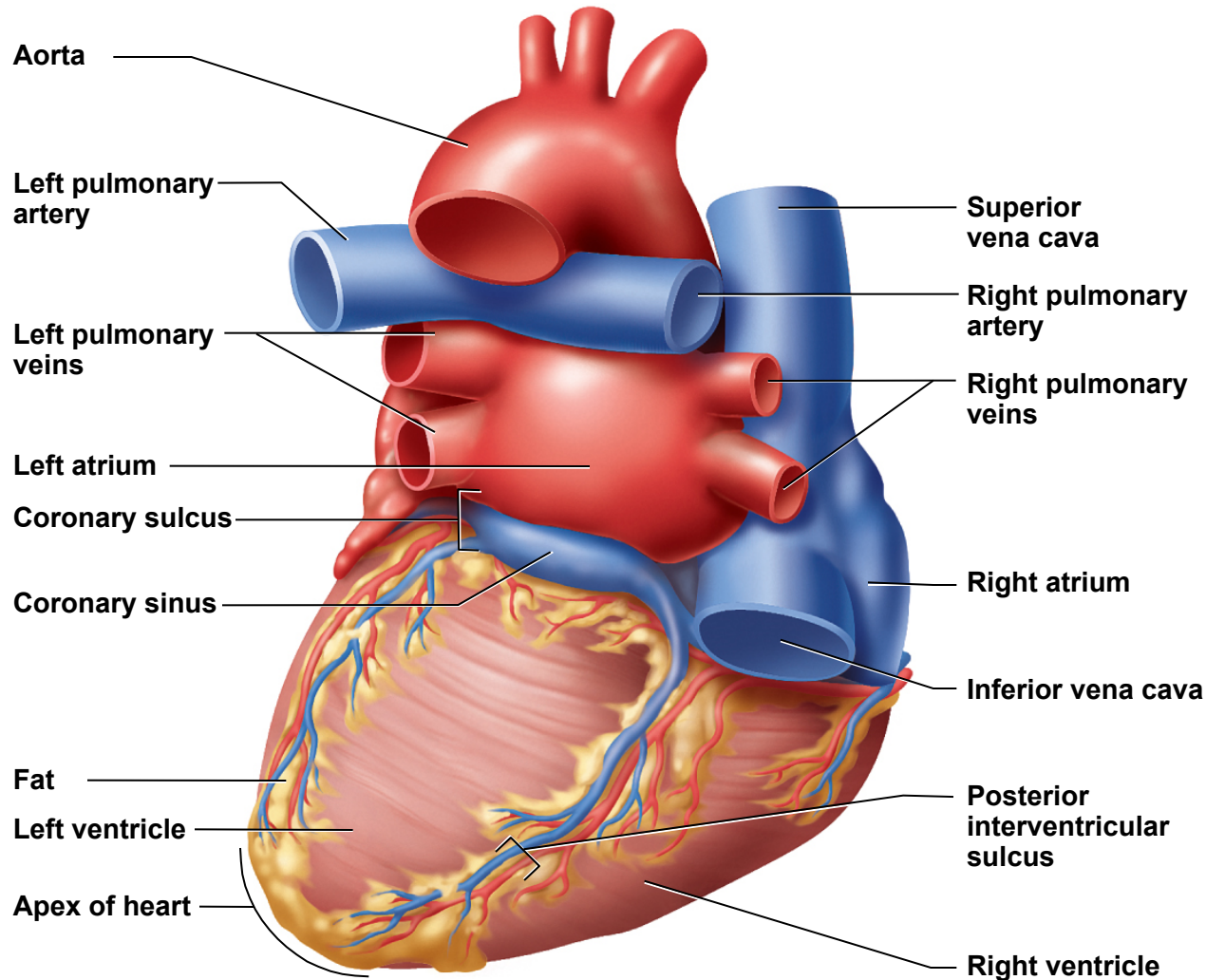


Figure 19.5a

- **atrioventricular sulcus** - separates atria and ventricles
- **interventricular sulcus** - overlies the interventricular septum that divides the right ventricle from the left
- **sulci contain coronary arteries**

External Anatomy - Posterior

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(b) Posterior view

Figure 19.5b

Heart Chambers - Internal

- **interatrial septum**
 - wall that separates atria
- **pectinate muscles**
 - internal ridges of myocardium in right atrium and both auricles
- **interventricular septum**
 - muscular wall that separates ventricles
- **trabeculae carneae**
 - internal ridges in both ventricles

Internal Anatomy - Anterior

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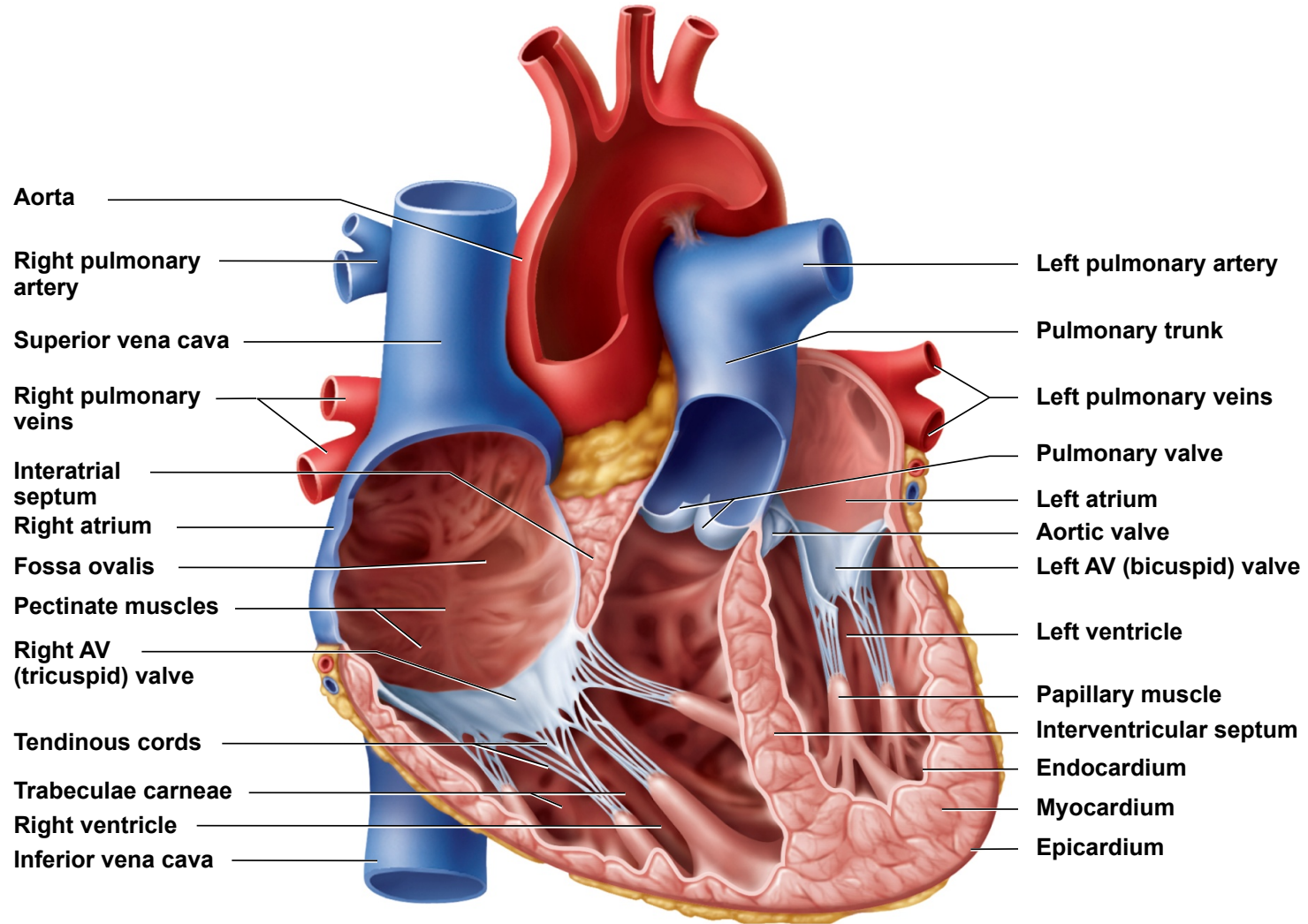


Figure 19.7

Heart Valves

- valves ensure a one-way flow of blood through the heart
- **atrioventricular (AV) valves** – controls blood flow between atria and ventricles
 - **right AV valve** has 3 cusps (**tricuspid valve**)
 - **left AV valve** has 2 cusps (**mitral or bicuspid valve**)
 - **chordae tendineae** - cords connect AV valves to **papillary muscles** on floor of ventricles
 - prevent AV valves from flipping inside out or bulging into the atria when the ventricles contract
- **semilunar valves** - control flow into great arteries – open and close because of blood flow and pressure
 - **pulmonary semilunar valve** - in opening between right ventricle and pulmonary trunk
 - **aortic semilunar valve** in opening between left ventricle and aorta

Heart Valves

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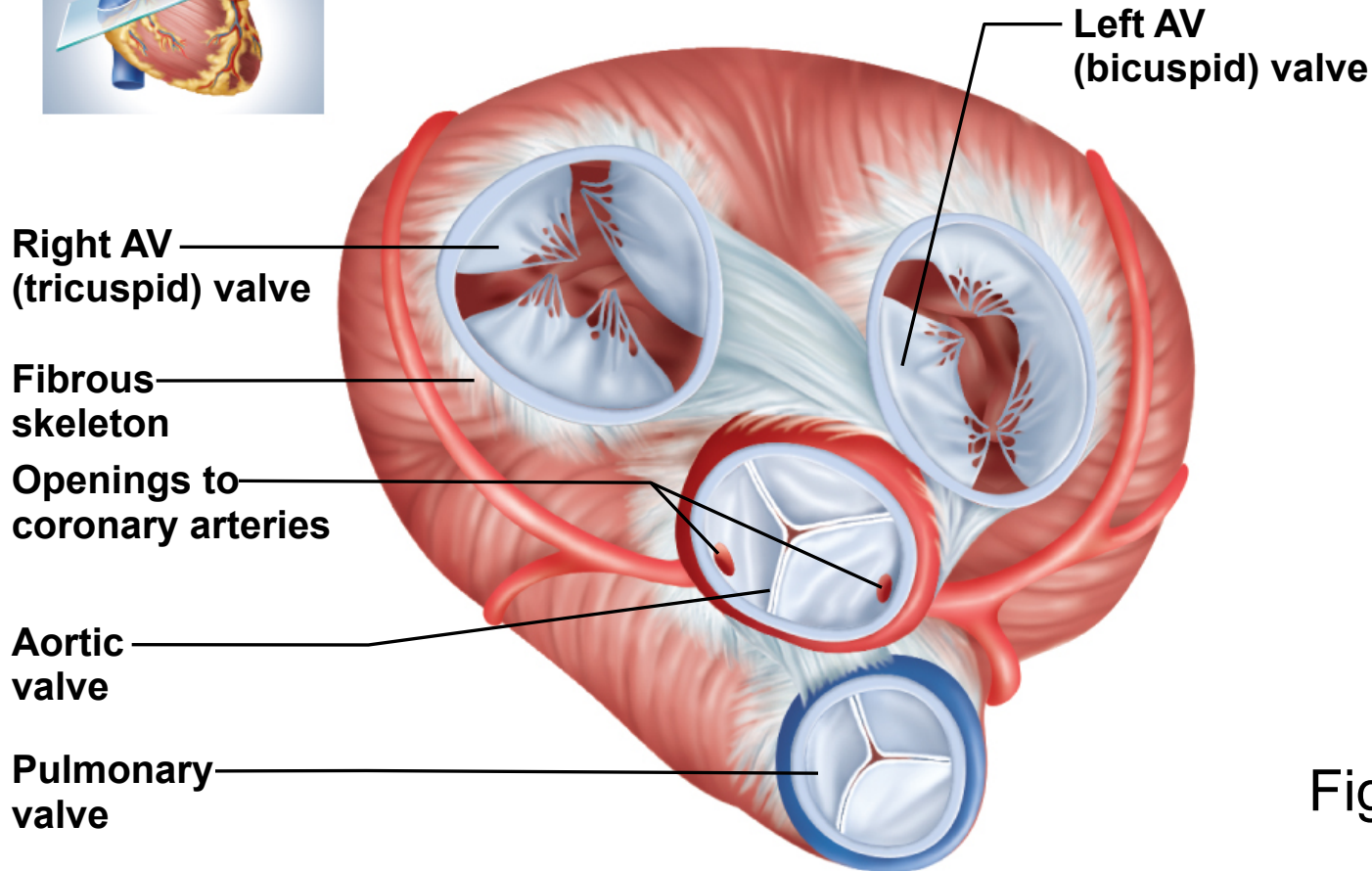
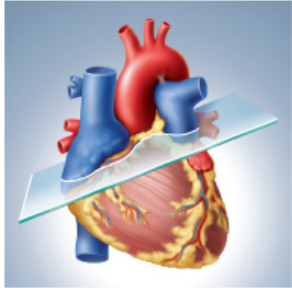


Figure 19.8a

(a)

Endoscopic View of Heart Valve

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(b)

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Figure 19.8b

Heart Valves

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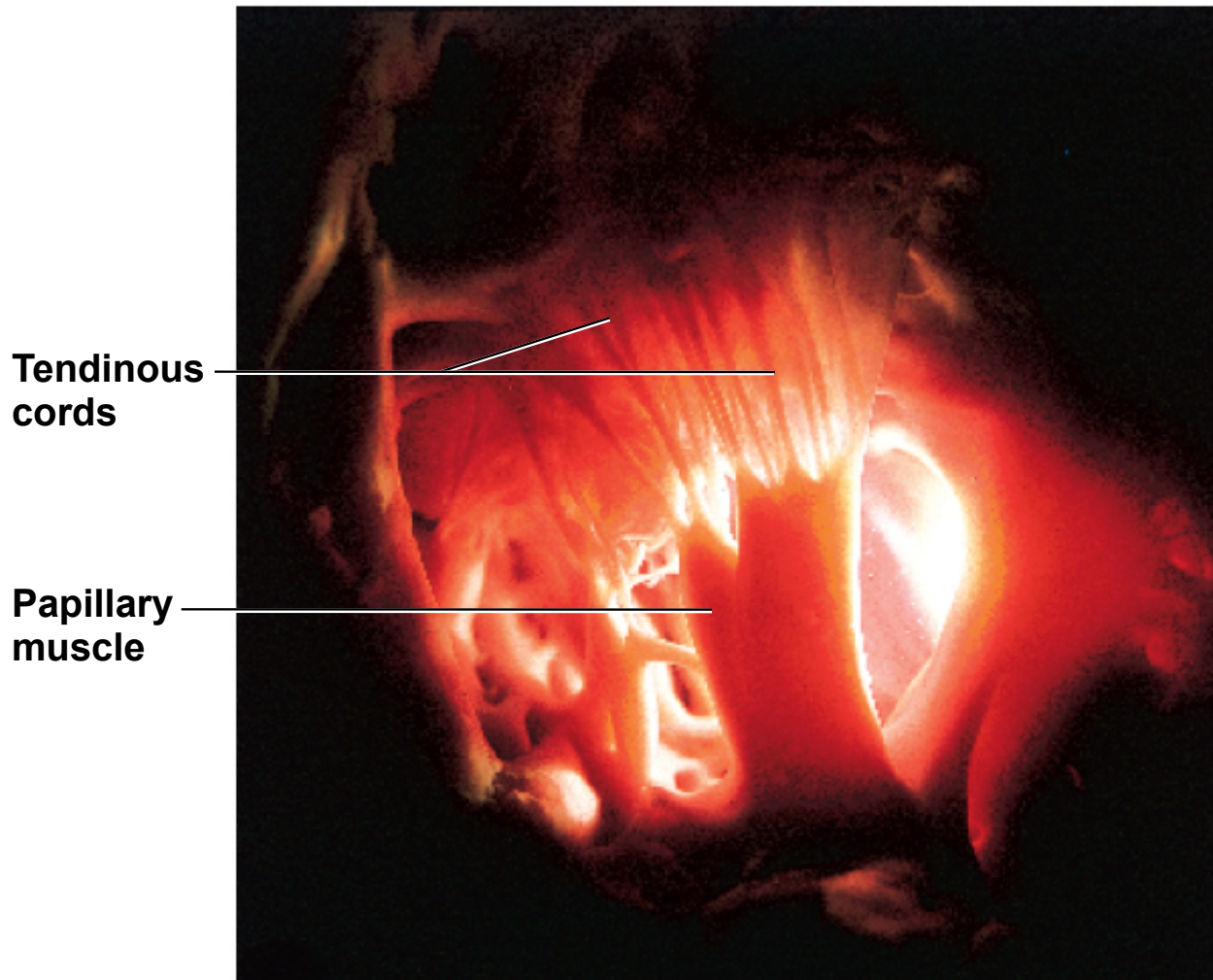


Figure 19.8c

(c)

AV Valve Mechanics

- ventricles relax
 - pressure drops inside the ventricles
 - semilunar valves close as blood attempts to back up into the ventricles from the vessels
 - AV valves open
 - blood flows from atria to ventricles
- ventricles contract
 - AV valves close as blood attempts to back up into the atria
 - pressure rises inside of the ventricles
 - semilunar valves open and blood flows into great vessels

Blood Flow Through Heart

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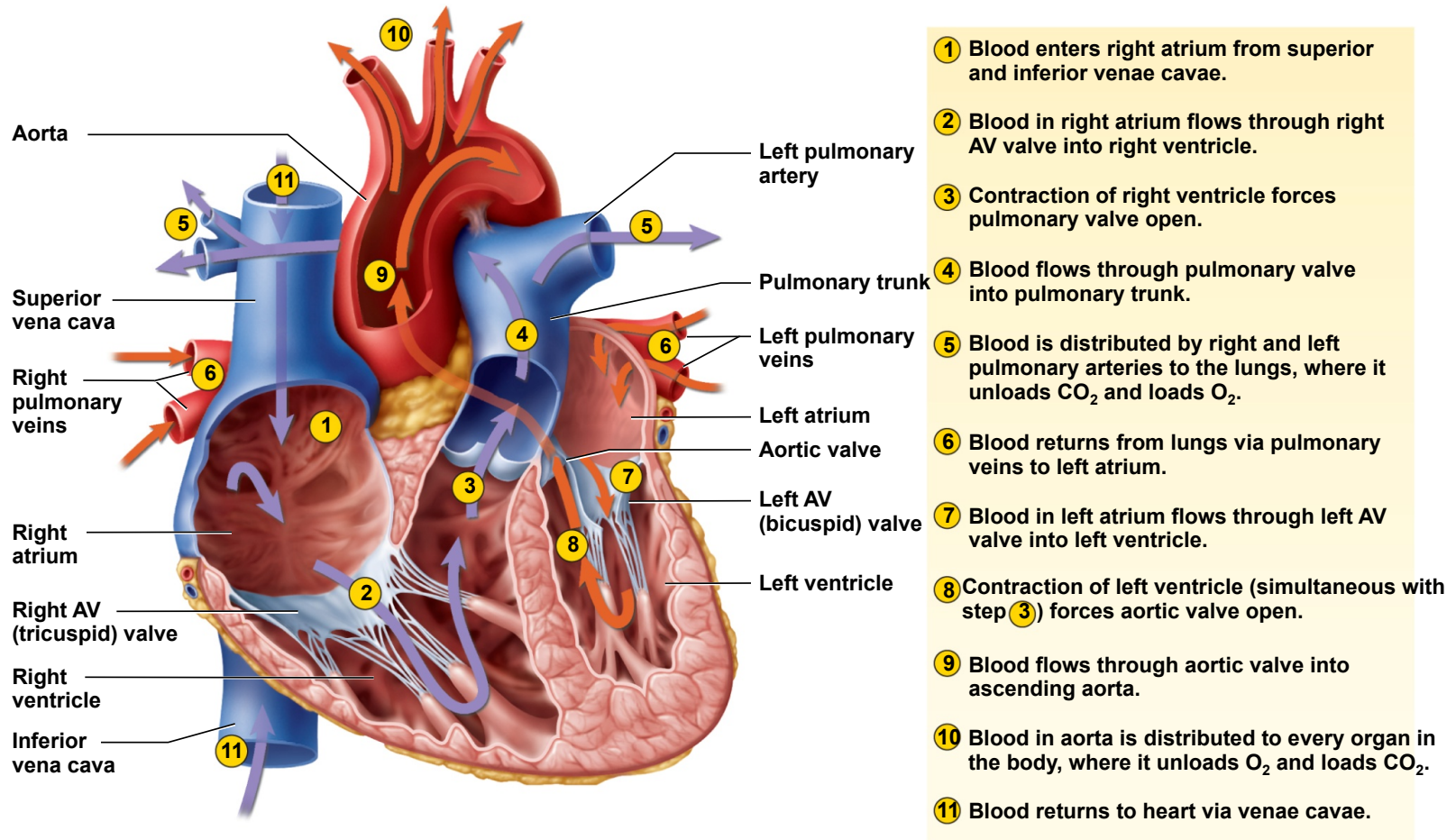


Figure 19.9

blood pathway travels from the right atrium through the body and starting point

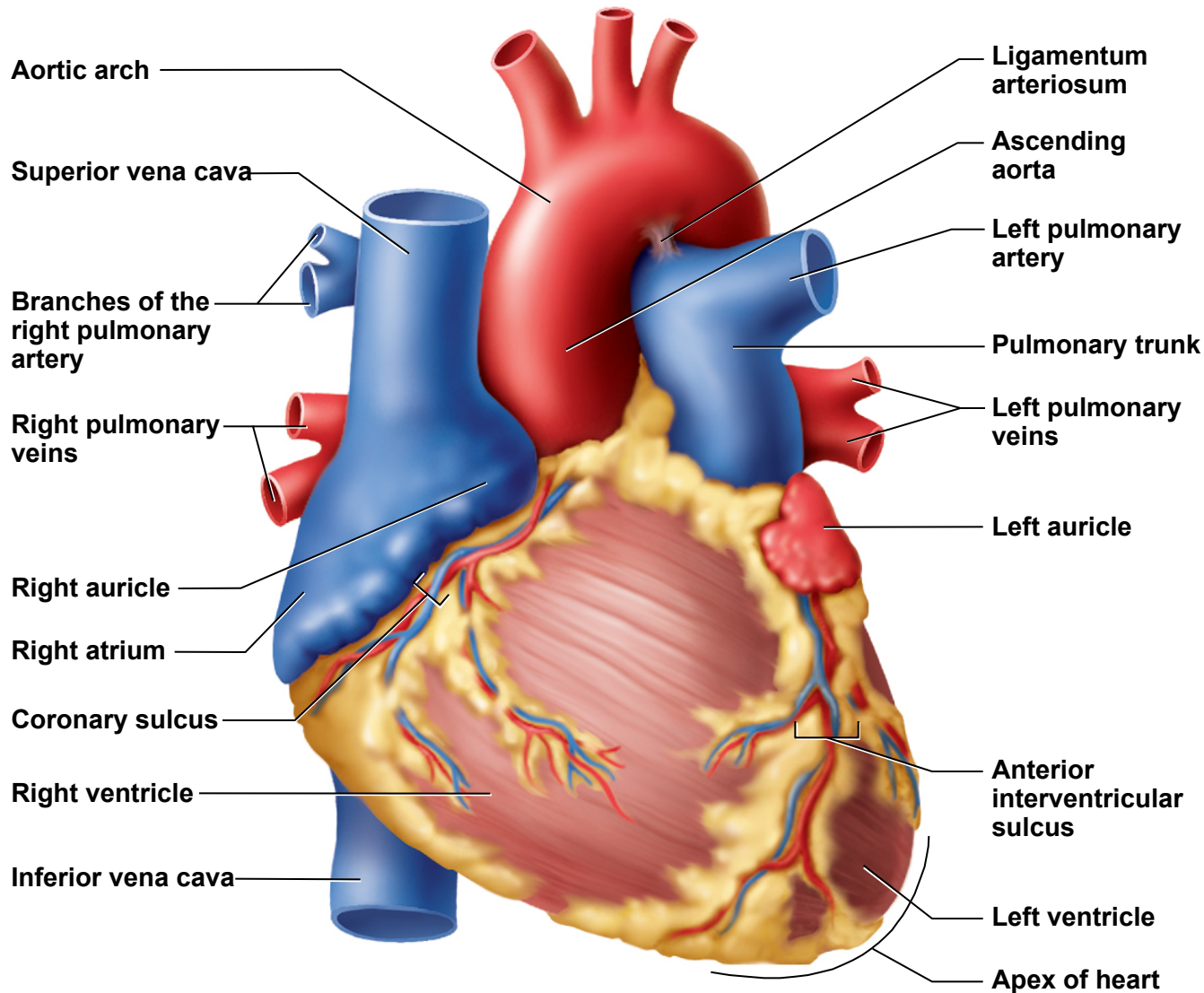
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Coronary Circulation

- 5% of blood pumped by heart is pumped to the heart itself through the coronary circulation to sustain its strenuous workload
 - 250 ml of blood per minute
 - needs abundant O₂ and nutrients
- **left coronary artery (LCA)** branch off the ascending aorta
 - **anterior interventricular branch**
 - supplies blood both ventricles and anterior two-thirds of the interventricular septum
 - **circumflex branch**
 - passes around left side of heart in coronary sulcus
 - gives off **left marginal branch** and then ends on the posterior side of the heart
 - supplies left atrium and posterior wall of left ventricle
- **right coronary artery (RCA)** branch off the ascending aorta
 - supplies right atrium and sinoatrial node (pacemaker)
 - **right marginal branch**
 - supplies lateral aspect of right atrium and ventricle
 - **posterior interventricular branch**
 - supplies posterior walls of ventricles

Coronary Vessels - Anterior

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(a) Anterior view

Figure 19.5a

Coronary Vessels - Posterior

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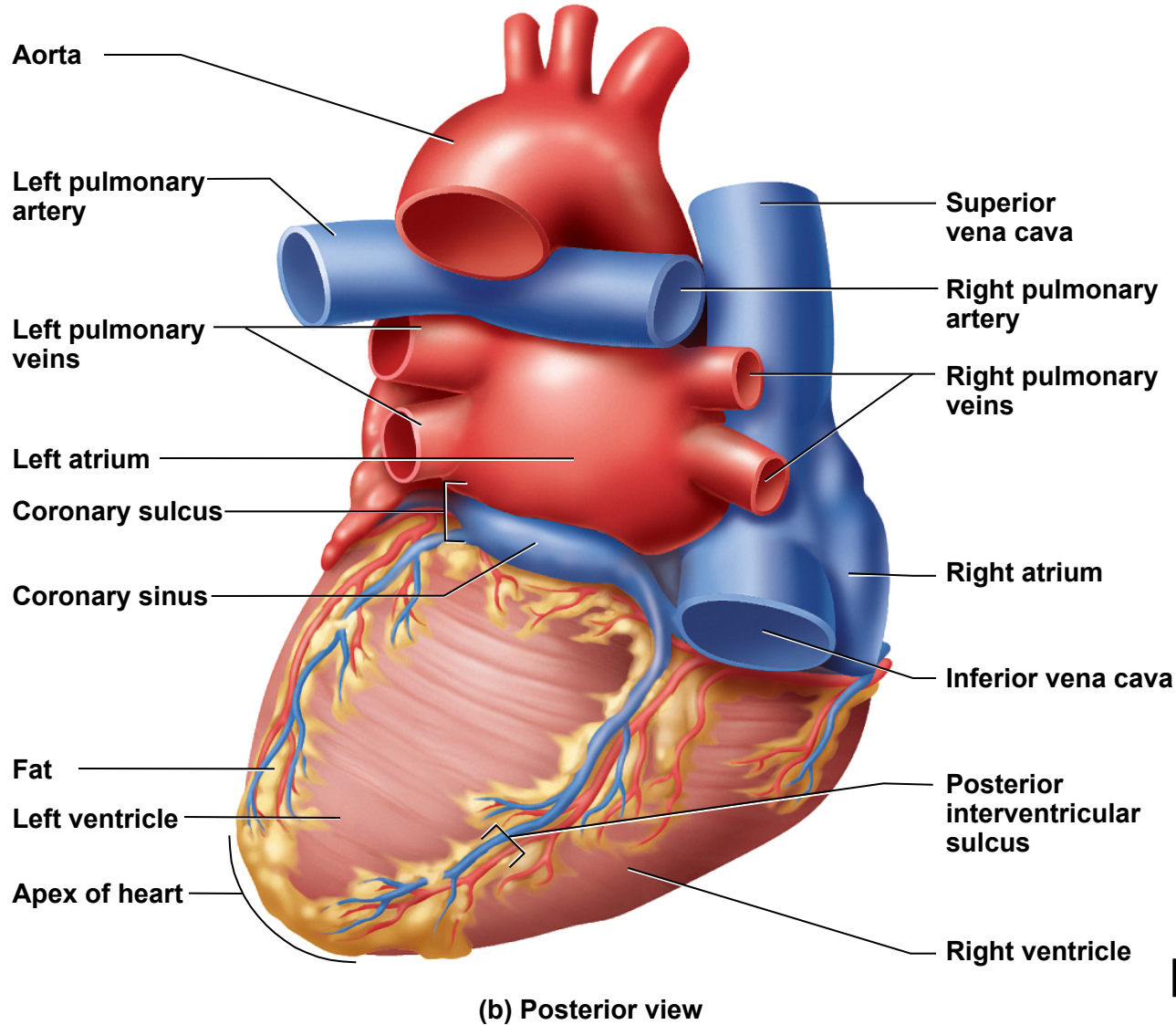


Figure 19.5b

Coronary Blood Flow

- **myocardial infarction (MI)** (heart attack)
 - interruption of blood supply to the heart from a blood clot or fatty deposit (atheroma) can cause death of cardiac cells within minutes
 - some protection from MI is provided by **arterial anastomoses** which provides an alternative route of blood flow (**collateral circulation**) within the myocardium
- blood flow to the heart muscle during ventricular contraction is slowed, unlike the rest of the body
- three reasons:
 - contraction of the myocardium compresses the coronary arteries and obstructs blood flow
 - opening of the aortic valve flap during ventricular systole covers the openings to the coronary arteries blocking blood flow into them
 - during ventricular diastole, blood in the aorta surges back toward the heart and into the openings of the coronary arteries
 - blood flow to the myocardium increases during ventricular relaxation

Angina and Heart Attack

- **angina pectoris** – chest pain from partial obstruction of coronary blood flow
 - pain caused by ischemia of cardiac muscle
 - obstruction partially blocks blood flow
 - myocardium shifts to anaerobic fermentation producing lactic acid stimulating pain
- **myocardial infarction** – sudden death of a patch of myocardium resulting from long-term obstruction of coronary circulation
 - atheroma (blood clot or fatty deposit) often obstruct coronary arteries
 - cardiac muscle downstream of the blockage dies
 - heavy pressure or squeezing pain radiating into the left arm
 - some painless heart attacks may disrupt electrical conduction pathways, lead to fibrillation and cardiac arrest
 - silent heart attacks occur in diabetics & elderly
 - MI responsible for about half of all deaths in the United States

Venous Drainage of Heart

- 5 -10% drains directly into heart chambers, right atrium and right ventricle, by way of the **thebesian veins**
- the rest returns to right atrium by the following routes:
 - **great cardiac vein**
 - travels along side of anterior interventricular artery
 - collects blood from anterior portion of heart
 - empties into coronary sinus
 - **middle cardiac vein** (posterior interventricular)
 - found in posterior sulcus
 - collects blood from posterior portion of heart
 - drains into coronary sinus
 - **left marginal vein**
 - empties into coronary sinus
- **coronary sinus**
 - large transverse vein in coronary sulcus on posterior side of heart
 - collects blood and empties into right atrium