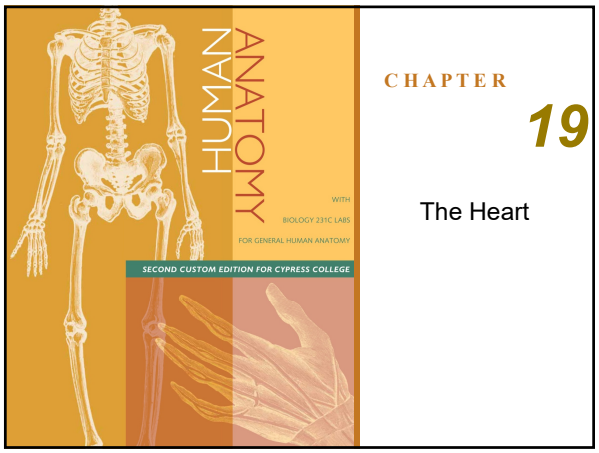

1

The Heart

- A muscular double pump
  - **Pulmonary circuit** – takes blood to and from the lungs
  - **Systemic circuit** – vessels transport blood to and from body tissues
    - **Atria** – receive blood from the pulmonary and systemic circuits
    - **Ventricles** – the pumping chambers of the heart

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The Pulmonary and Systemic Circuits

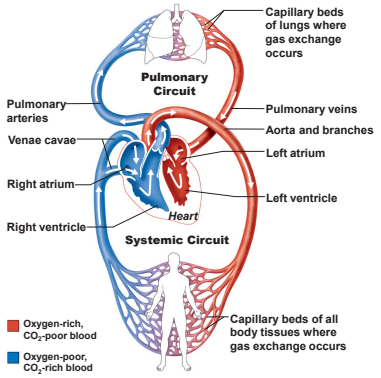

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Figure 19.1

3

Location of the Heart in the Thorax

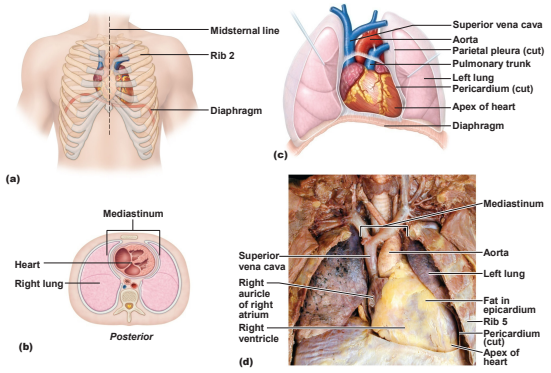

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Figure 19.2

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Structure of the Heart – Coverings

- **Pericardium**
  - Fibrous pericardium – strong layer of dense connective tissue
  - Serous pericardium – formed from two layers

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Layers of the Heart Wall

- **Epicardium** – visceral layer of the serous pericardium
- **Myocardium** – consists of cardiac muscle
  - Muscle arranged in circular and spiral patterns
- **Endocardium** – endothelium resting on a layer of connective tissue
  - Lines the internal walls of the heart

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Layers of the Pericardium and of the Heart Wall

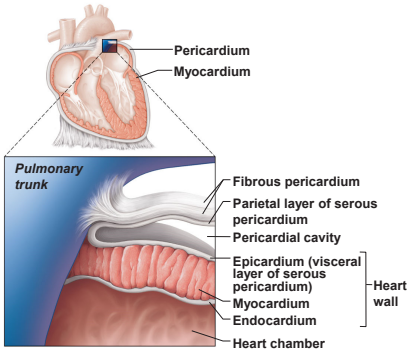

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Figure 19.3

7

Heart Chambers

- **Internal divisions**
  - Atria and ventricles
  - Interventricular and interatrial septa
- **External markings**
  - Coronary sulcus
  - Anterior and posterior interventricular sulcus

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Gross Anatomy of the Heart

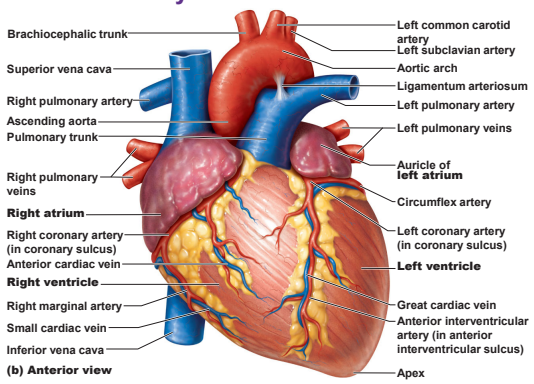

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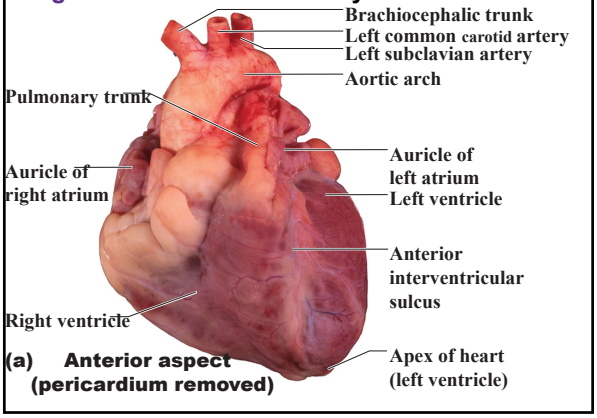
Figure 19.5b

9

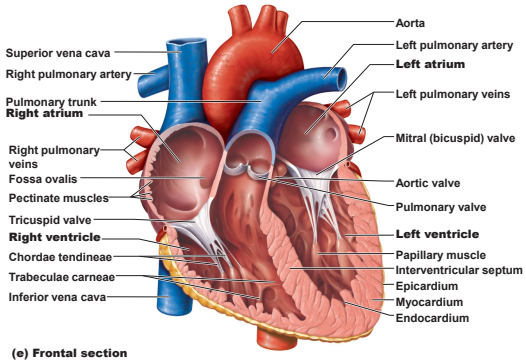
Figure 19.5a Gross anatomy of the heart.



(a) Anterior aspect (pericardium removed)

10

Heart Chambers



(e) Frontal section

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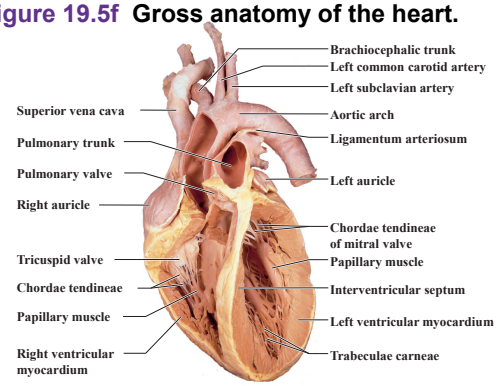
Figure 19.5e

11

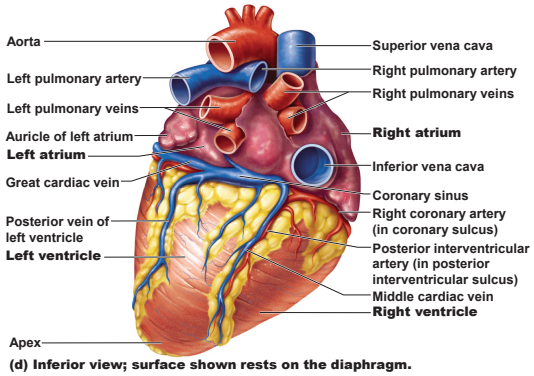
Figure 19.5f Gross anatomy of the heart.



(f) Photograph; view similar to (e)

12

Inferior View of the Heart



(d) Inferior view; surface shown rests on the diaphragm.

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Figure 19.5d

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Pathway of Blood Through the Heart

- Begin oxygen-poor blood in the superior and inferior venae cavae
  - Go through pulmonary and systemic circuits

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Pathway of Blood Through the Heart

- Beginning with oxygen-poor blood in the **superior** and **inferior venae cavae**
  - Go through pulmonary and systemic circuits
  - A blood drop passes through all structures *sequentially*
    - Atria contract together
    - Ventricles contract together

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Blood Flow Through the Heart

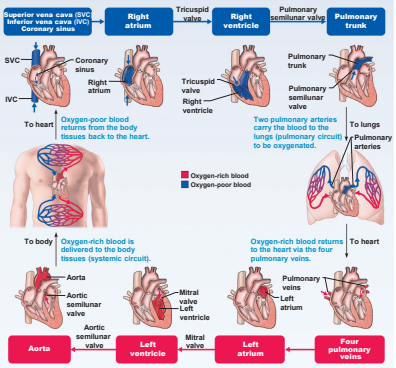

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Figure 19.10

16

Fibrous Skeleton

- Surrounds all four valves
  - Composed of dense connective tissue
- Functions
  - Anchors valve cusps
  - Prevents overdilation of valve openings
  - Main point of insertion for cardiac muscle
  - Blocks direct spread of electrical impulses

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17

Heart Valves—Valve Structure

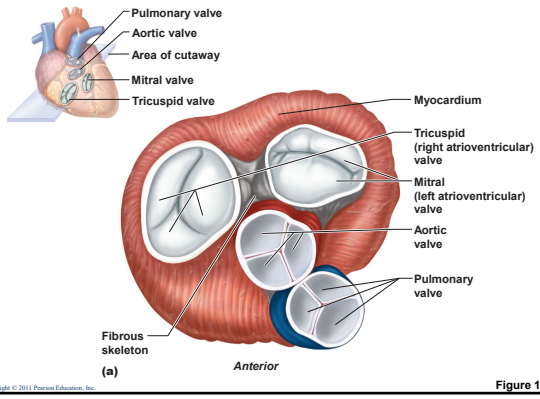

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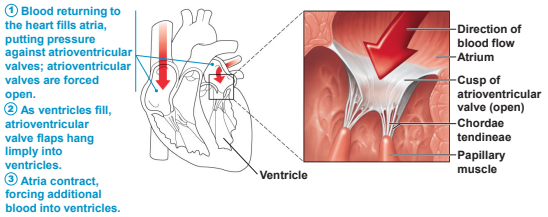
Figure 19.6a

18

Function of the Atrioventricular Valves



(a) AV valves open; atrial pressure greater than ventricular pressure

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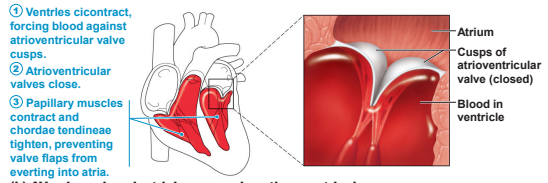
Figure 19.7a

19

Function of the Atrioventricular Valves



(b) AV valves closed; atrial pressure less than ventricular pressure

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Figure 19.7b

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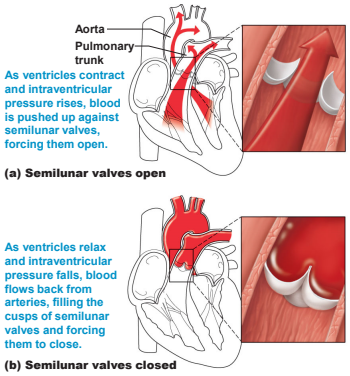
Function of the Semilunar Valves



(a) Semilunar valves open

(b) Semilunar valves closed

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Figure 19.8

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Heart Sounds

- **"Lub-dup"** – sound of valves closing
- First sound **"lub"** – the AV valves closing
- Second sound **"dup"** – the semilunar valves closing

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Heart Sounds

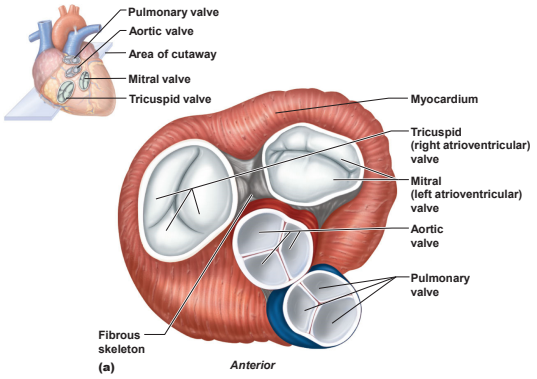

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Figure 19.6a

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Microscopic Anatomy of Cardiac Muscle

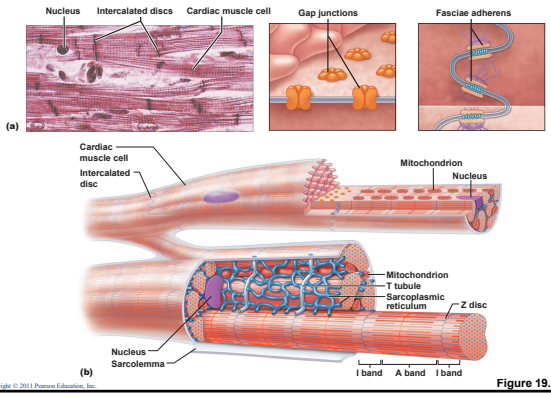

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Figure 19.12

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Cardiac Muscle Tissue

- **Intercalated discs**—*complex junctions*
  - Adjacent sarcolemmas interlock
  - Possess three types of cell junctions
    - *Desmosomes*
    - *Fasciae adherans*—long desmosome-like junctions
    - *Gap junctions*

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Heartbeat

- 70–80 beats/minute at rest
- **Systole** – contraction
- **Diastole** – expansion/relaxation
- **Systole and diastole** also refer to:
  - Stage of heartbeat when ventricles contract and expand

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26

Conducting System

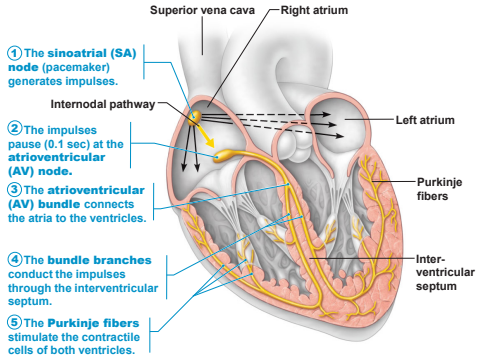

Figure 19.14

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Innervation

- Heart rate is altered by *external controls*
- Nerves to the heart include
  - **Visceral sensory fibers**
  - Parasympathetic branches of the **vagus nerve**
  - **Sympathetic fibers**—from cervical and upper thoracic chain ganglia

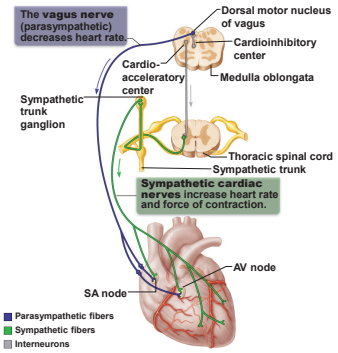

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Figure 19.15

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Blood Supply to the Heart

- **Functional blood supply**
  - Coronary arteries
- **Arise from the aorta**
  - Located in the coronary sulcus
  - Main branches
    - Left and right coronary arteries

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Blood Supply to the Heart

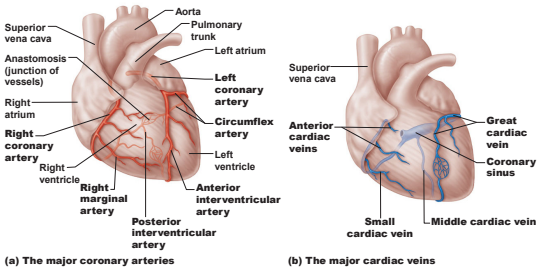

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Figure 19.16

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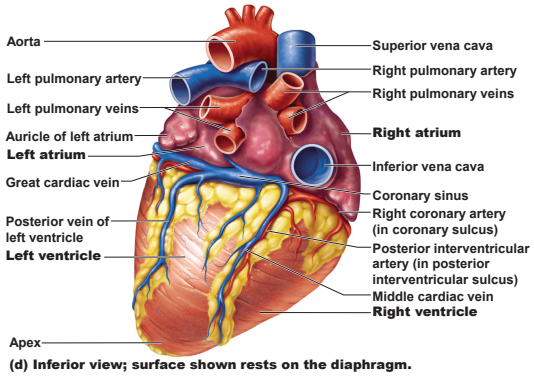
Posterior View of the Heart



(d) Inferior view; surface shown rests on the diaphragm.

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Figure 19.5d

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Disorders of the Heart

- **Coronary artery disease**
  - Atherosclerosis – fatty deposits
  - Angina pectoris – chest pain
  - Myocardial infarction – blocked coronary artery
  - Silent ischemia – no pain or warning

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Disorders of the Heart

- **Heart failure**
  - Progressive weakening of the heart
  - Cannot meet the body's demands for oxygenated blood
- **Congestive heart failure** – heart enlarges
  - Pumping efficiency declines
- **Cor pulmonale**
  - Enlargement and potential failure of the right ventricle

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Disorders of Conduction

- **Ventricular fibrillation**
  - Rapid, random firing of electrical impulses in the ventricles
- **Atrial fibrillation**
  - Multiple waves of impulses randomly signal the AV node
  - Signals ventricles to contract quickly and irregularly

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