The Heart: Conduction System

- Intrinsic conduction system (nodal system)
  - Heart muscle cells contract, without nerve impulses, in a regular, continuous way
  - Contraction is initiated by the sinoatrial (SA) node (pacemaker)
  - Sequential stimulation occurs at other autorhythmic cells
- Heart Conduction Pathway

Sinoatrial (SA) node → Atrioventricular (AV) node → Atrioventricular bundle → Bundle branches → Purkinje fibers

- Purkinje fibers cause myocardium to contract
Heart Contractions

Figure 11.5

Superior vena cava
Sinoatrial (SA) node (pacemaker)
Atrioventricular (AV) node
Right atrium
Bundle branches
Purkinje fibers

Left atrium
Atrioventricular (AV) bundle (bundle of His)
Purkinje fibers
Interventricular septum
The Heart: Cardiac Cycle

- Cardiac Cycle—Events of one heartbeat
  - Atria contract simultaneously
  - Atria relax, then ventricles contract
    - Systole = ventricular contraction
    - Diastole = ventricular relaxation
Filling of Heart Chambers – the Cardiac Cycle

1. Mid-to-late diastole (ventricular filling)
2. Early diastole
3. Ventricular systole (atria in diastole)
The Heart: Cardiac Output

- Cardiac output (CO)
  - Amount of blood pumped by each side of the heart in one minute
  - $CO = (\text{heart rate } [HR]) \times (\text{stroke volume } [SV])$
- Stroke volume (SV)
  - Volume of blood pumped by each ventricle in one contraction
The Heart: Regulation of Heart Rate

- Stroke volume usually remains relatively constant
  - Starling’s law of the heart – the more that the cardiac muscle is stretched, the stronger the contraction
- Changing heart rate is the most common way to change cardiac output
The Heart: Regulation of Heart Rate

- Increased heart rate
  - Sympathetic nervous system
    - Crisis
    - Low blood pressure
  - Hormones
    - Epinephrine
    - Thyroxine
  - Exercise
  - Decreased blood volume
The Heart: Regulation of Heart Rate

- Decreased heart rate
  - Parasympathetic nervous system
  - High blood pressure or blood volume
  - Decreased venous return