1

2 **Location of the Heart**

- Hollow muscular organ
- Located in the middle of the thoracic cavity
- Surrounded by pericardium
- Attached to thorax via great vessels

3 **Location of the Heart**

- Apex (bottom)
  - Formed by tip of left ventricle
- Base (top)
  - Approximately 2nd intercostal space
- Anterior surface
  - Consists primarily of right ventricle
- Inferior (diaphragmatic) surface
  - Formed by right and left ventricles, predominantly left

4

5 **Size and Shape of the Heart**

- Cone-shaped muscular organ
- Adult heart is approximately:
  - 5 inches (12 cm) long
  - 3.5 inches (9 cm) wide
  - 2.5 inches (6 cm) thick
  - About the size of a man's fist

6

7 **Heart Chambers**

- The heart is divided into four cavities or chambers
- Functions as a two-sided pump
  - Two upper chambers = right and left atria
  - Two lower chambers = right and left ventricles

8 **Heart Chambers**

- Right side of the heart
  - Low-pressure system
  - Pumps venous blood to the lungs
- Left side of the heart
  - High-pressure system
  - Pumps arterial blood into the systemic circulation

9 **Atria**

- Thin-walled, low-pressure chambers that receive blood
- Interatrial septum separates right and left atria
- "Atrial kick"

10 **Ventricles**

- Pump blood to lungs and systemic circulation
- Interventricular septum separates right and left ventricles
- Left ventricle
  - High-pressure chamber

11 **Layers of the Heart**

- The heart wall is made up of three tissue layers:
  - Endocardium
  - Myocardium
  - Epicardium

12 **Layers of the Heart**

- Endocardium
  - Innermost layer
  - Lines inner chambers, valves, chordae tendineae, and papillary muscles
  - Continuous with innermost layer of arteries, veins, and capillaries

13

14 **Layers of the Heart**

- Myocardium
  - Middle layer
  - Thick, muscular layer
  - Responsible for pumping action

15 **Layers of the Heart**

- Epicardium
  - Also called the visceral layer of the serous pericardium
  - External layer of the heart
  - Includes blood capillaries, lymph capillaries, nerve fibers, and fat

16 **Layers of the Heart**

- Pericardium
  - Double-walled sac that encloses the heart
  - Fibrous parietal pericardium
    - Rough outer layer of the pericardial sac
  - Serous pericardium
  - Pericardial space
    - Contains approximately 10 mL of serous fluid

17 **Cardiac Muscle**

- Walls of the heart are formed by cardiac muscle fibers
  - Sarcolemma
  - Myofibrils

18

19 **Cardiac Muscle**

- Each sarcomere contains two types of protein filaments: actin and myosin

20 **Cardiac Muscle**

- Cardiac muscle fibers fit together tightly at junctions called intercalated disks
  - Intercalated disks form gap junctions
    - Function as electrical connections
    - Allow cells to conduct electrical impulses rapidly

21 **Valves of the Heart**

22 **Heart Valves**

- Heart contains four valves
  - Two sets of atrioventricular (AV) valves
  - Two sets of semilunar valves
- Function
  - Ensure blood flows in one direction through heart chambers
  - Prevent backflow of blood

23 **Atrioventricular (AV) Valves**

- AV valves separate atria from ventricles
- Tricuspid valve
  - Lies between right atrium and right ventricle
  - Consists of three separate leaflets

- Larger in diameter and thinner than mitral valve

24 **Atrioventricular (AV) Valves**

- Mitral (bicuspid) valve
  - Has only two cusps
  - Lies between left atrium and left ventricle

25 **Atrioventricular (AV) Valves**

- Cusps of AV valves are attached to chordae tendineae
  - "Heart strings"
  - Originate from papillary muscles
  - Serve as anchors

26 **Semilunar Valves**

- Prevent backflow of blood from the aorta and pulmonary arteries into the ventricles during diastole
  - Pulmonic valve
  - Aortic valve

27

28 **Semilunar Valves**

- Pulmonic valve
  - Prevents backflow of blood into right ventricle
- Aortic valve
  - Prevents backflow of blood into left ventricle

29

30 **Blood Flow Through the Heart**

31 **Cardiac Cycle**

- Systole -
  Period during which the chamber is contracting and blood is being ejected

32 **Cardiac Cycle**

- Diastole
  - Period of relaxation during which the chamber is filling

33 **The Heart as a Pump**

- Venous return
  - Most important factor determining amount of blood pumped by heart

34 **Cardiac Output**

- Cardiac output is the volume of blood ejected from the heart over 1 minute
  - Because the ventricles contract almost simultaneously, their cardiac outputs are normally equal

35 **Cardiac Output**

- Cardiac output (CO) equals stroke volume (SV) multiplied by heart rate (HR)
  - CO = SV × HR
- Cardiac output is affected by a change in heart rate *OR* stroke volume

36 **Decreased Cardiac Output**

1
- Cold, clammy skin

- Color changes in skin/mucous membranes
- Dyspnea
- Orthopnea
- Crackles (rales)
2
- Changes in mental status
- Changes in blood pressure
- Dysrhythmias
- JVD
- Fatigue
- Restlessness

37 **Stroke Volume**

- Amount of blood ejected during one contraction
- Dependent on:
  - Preload
  - Afterload
  - Myocardial contractility

38 **Preload**

- Preload is the force exerted by the walls of the ventricles at the end of diastole
- The volume of blood returning to the heart (venous return) influences preload
  - Hypovolemia = decreases preload
  - Heart failure = increases preload

39 **Frank-Starling Law of the Heart**

- Up to a limit, the more a myocardial muscle is stretched, the greater the force of contraction (and stroke volume)
  - Influenced by preload and afterload

40 **Afterload**

- Afterload is the pressure or resistance against which the ventricles must pump to eject blood
  - Increased afterload usually means an increase in the work of the heart

41 **Coronary Circulation**

42 **Coronary Arteries**

- Supply heart with oxygenated blood
- Primary arteries: right and left coronary arteries
  - Coronary artery filling occurs during ventricular relaxation (diastole)

43 **Right Coronary Artery**

44 **Left Coronary Artery**

45 **Coronary Veins**

- Run parallel to coronary arteries
- Drain myocardial blood into right atrium
  - Thebesian veins
  - Anterior cardiac veins
  - Coronary sinus
- Thebesian and anterior cardiac veins are tributaries of coronary sinus