The Cardiovascular System

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

- Ways to increase your heart rate
  - Sympathetic nervous system
    - Crisis
    - Low blood pressure
  - Hormones
    - Epinephrine–increase heart rate, constrict blood vessels and dilates air passages
    - Thyroxine–Thyroid hormone that increases metabolic rate and heart rate
  - Exercise
  - Decreased blood volume

The Heart: Regulation of Heart Rate

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

Blood Vessels: The Vascular System

- Taking blood to the tissues and back
  - Arteries
  - Capillaries
  - Veins

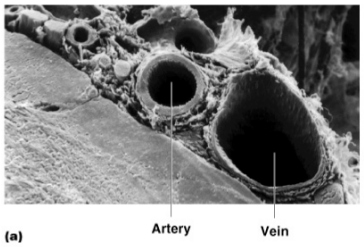

Figure 11.8a

Blood Vessels: Anatomy

- Three layers (tunics)
  - Tunic intima
    - Endothelium
  - Tunic media
    - Smooth muscle
    - Controlled by sympathetic nervous system
  - Tunic externa
    - Mostly fibrous connective tissue

The Vascular System

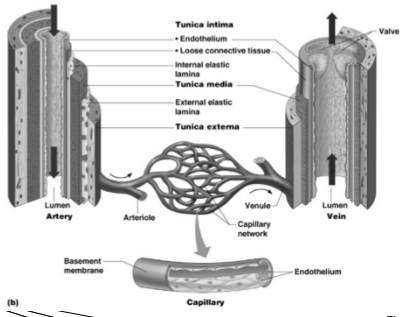

Figure 11.8b

Differences Between Blood Vessel Types

- Walls of arteries are the thickest with smooth muscle to help move blood
- Skeletal muscle "milks" blood in veins toward the heart. Backflow is prevented with valves
- Walls of capillaries are only one cell layer thick to allow for exchanges between blood and tissue

Movement of Blood Through Vessels

- Most arterial blood is pumped by the heart
- Veins use the milking action of muscles to help move blood. Valves in the veins prevent backflow.

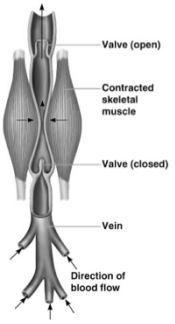

Figure 11.9

Capillary Beds

- Capillary beds allow for an easy exchange between the blood and the body tissues.

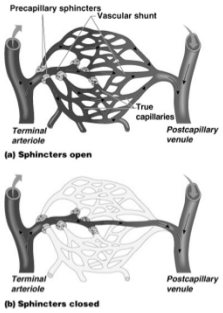

Figure 11.10

Capillary Beds

- True capillaries – exchange vessels
  - Oxygen and nutrients cross to cells
  - Carbon dioxide and metabolic waste products cross into blood

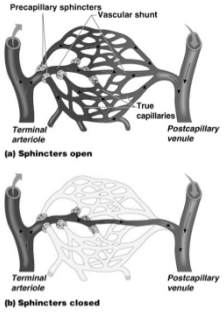

Figure 11.10

Diffusion at Capillary Beds

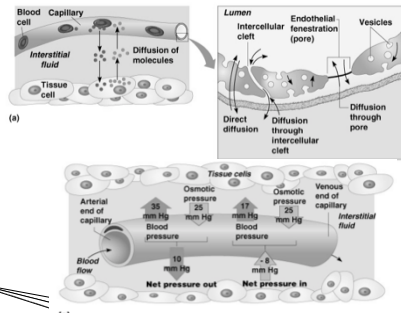

Figure 11.20

Major Arteries of Systemic Circulation

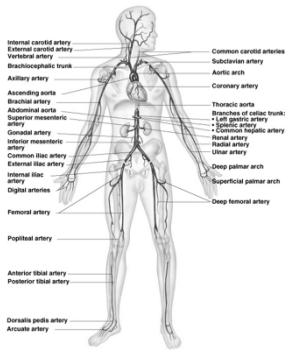

Figure 11.11

Major Veins of Systemic Circulation

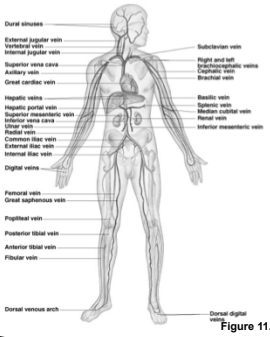

Figure 11.12

Arterial Supply of the Brain

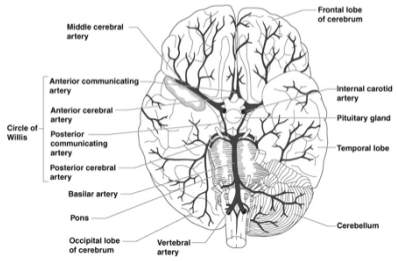

Figure 11.13

Hepatic Portal Circulation

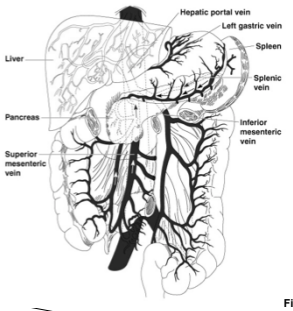

Figure 11.14

Circulation to the Fetus

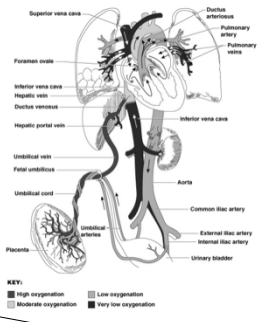

Figure 11.15

Pulse

- Pulse – pressure wave of blood
- Monitored at "pressure points" where pulse is easily palpated
- The average pulse rate is 70–76 beats per minute.

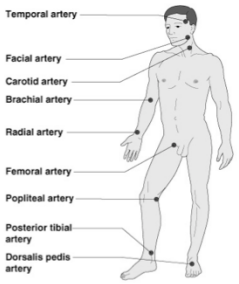

Figure 11.16

Blood Pressure

- Measurements by health professionals are made on the pressure in large arteries
  - Systolic – pressure at the peak of ventricular contraction
  - Diastolic – pressure when ventricles relax
- Pressure in blood vessels decreases as the distance away from the heart increases

Measuring Arterial Blood Pressure

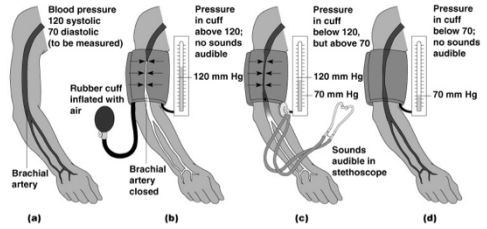

Figure 11.18

Comparison of Blood Pressures in Different Vessels

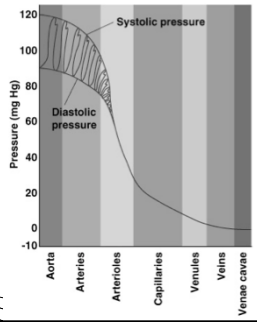

Figure 11.17

Blood Pressure: Effects of Factors

- Neural factors
  - Autonomic nervous system adjustments (sympathetic division)
- Renal factors
  - Regulation by altering blood volume
  - Renin – hormonal control

Blood Pressure: Effects of Factors

- Temperature
  - Heat has a vasodilation effect
  - Cold has a vasoconstricting effect
- Chemicals (prescription drugs)
  - Various substances can cause increases or decreases
- Diet

Factors Determining Blood Pressure

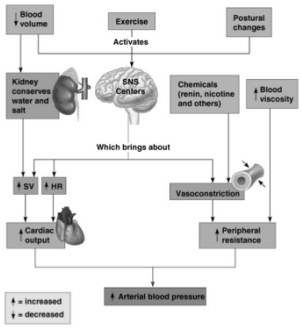

Figure 11.19

Variations in Blood Pressure

- Human normal range is variable
  - Normal
    - 140–110 mm Hg systolic
    - 80–75 mm Hg diastolic
  - Hypotension
    - Low systolic (below 110 mm HG)
    - Often associated with illness
  - Hypertension
    - High systolic (above 140 mm HG)
    - Can be dangerous if it is chronic

Developmental Aspects of the Cardiovascular System

- A simple "tube heart" develops in the embryo and pumps by the fourth week
- The heart becomes a four-chambered organ by the end of seven weeks
- Few structural changes occur after the seventh week

Simple Tube vs. 4 Chambered Heart