

PowerLecture:  
Chapter 38  
Circulation

Section 38.0: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 38.0: CPR and First Aid Simulator
- Section 38.0: You Haven't Lived Until You've Died. Ramsey Flynn. *Esquire*, Dec. 1998.

How Would You Vote?

The following is the question for this chapter. See national results below.

- Should public high school students be required to learn CPR?  
Impacts, Issues: And Then My Heart Stood Still
- Waller recorded the electrical signals from his bulldog's heart
- Signals were transmitted through skin and saltwater to monitoring device  
Impacts, Issues: And Then My Heart Stood Still
- Early in embryonic development, cells that differentiate into cardiac muscle cells start contracting on their own
- These cells set the pace for your heart beat, approximately 70 times per minute

Impacts, Issues: And Then My Heart Stood Still

- *Sudden cardiac arrest* - when the heart abruptly stops beating
- Cardiopulmonary resuscitation (CPR) keeps victims of sudden cardiac arrest alive until automated external defibrillators can be administered

Section 38.1: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 38.1: *On the Motion of the Heart and Blood in Animals*
- Section 38.1: And the Beat Goes On (evolution of the heart). Warren Burggren. *Natural History*, April 2000.

Circulatory System

- Accepts oxygen, nutrients, and other substances from the respiratory and digestive systems and delivers them to cells

- Accepts carbon dioxide and wastes from cells and delivers them to respiratory and urinary systems for disposal

#### Circulatory Systems Velocity of Flow Varies

- Volume of blood flowing through vessels always has to equal heart's output
- Flow velocity is highest in large-diameter transport vessels
- Flow velocity is slowest in capillary beds; blood spreads out into many vessels with greater total cross-sectional area

#### Vertebrate Systems

- Fish
  - Two-chambered heart pumps blood through one circuit
- Amphibians
  - Heart pumps blood through two partially separate circuits
- Birds and mammals
  - Four-chambered heart pumps blood through two entirely separate circuits

#### Flow Analogy

#### Section 38.2: Weblinks and InfoTrac

**See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)**

- Section 38.2: Blood Book
- Section 38.2: How Blood Works
- Section 38.2: Become a Laboratory Investi-gation. Amanda Puckering et al. *Sci-ence Activities*, Winter 2003.

#### Functions of Blood

- Transports oxygen and nutrients to cells
- Carries carbon dioxide and wastes away from cells
- Helps stabilize internal pH
- Carries infection-fighting cells
- Helps equalize temperature

#### Components of Blood Erythrocytes (Red Cells)

- Most numerous cells in the blood
- Transport oxygen and carbon dioxide
- Colored red by oxygen-binding pigment (hemoglobin)
- Have no nucleus when mature

#### Leukocytes (White Cells)

- Function in housekeeping and defense
- Cell types
  - Basophils
  - Eosinophils
  - B lymphocytes

Neutrophils                      T lymphocytes  
Macrophages                    NK cells  
Dendritic cells                 Mast cells

Platelets

- Membrane-bound cell fragments
- Derived from megakaryocytes, which arise from stem cells
- Release substances that initiate blood clotting

#### Blood Cell Development

- Stem cells in bone marrow are unspecialized cells that retain the capacity to divide
- Some daughter cells of stem cells differentiate to form blood cells
- Body must continually replace blood cells

Section 38.3: Weblinks and InfoTrac

**See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)**

- Section 38.3: [Leukemia Society of America](#)
- Section 38.3: [Blood Disorders and Resources](#)
- Section 38.3: [Anemia: That Run-Down Feeling. Shiela Globus. \*Current Health\* 2, Mar. 1999.](#)
- Section 38.3: [When Mono Strikes. Nina Riccio. \*Current Health\* 2, Mar. 2000.](#)

#### Blood Disorders

- Anemias - Too few white cells, or deformed ones
- Polycythemias - Too many red cells
- Leukemias - Cancer suppresses white cell formation
- Mononucleosis - Too many monocytes and lymphocytes

Section 38.4: Weblinks and InfoTrac

**See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)**

- Section 38.4: [Blood Typing Game](#)
- Section 38.4: [Liquid Assets \(converting donor blood into type O\). Lori Oliwenstein. \*Discover\*; Sept. 1993.](#)

#### Blood Type in Transfusions

- Require that donor and recipient have same blood type
- If bloods of incompatible types are mixed, recipient's immune system will attack and destroy donor cells

- This is an agglutination reaction

#### ABO Blood Type

- Type A red cells have one type of marker at surface
- Type B red cells have a different type of marker
- Type AB cells have both markers
- Type O cells have neither marker

#### Blood Type Compatibility

##### Rh Blood Type

- Based on presence or absence of Rh marker on red cells
- Can cause problems during pregnancy
  - If mother is Rh negative,
  - has previously carried Rh positive child,
  - is carrying fetus that is Rh positive
- Mother's antibodies can attack fetal cells

#### Section 38.5: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 38.5: The Heart—A Cardiovascular Exploration
- Section 38.5: Introduction to the Cardiovascular System. Mina Chung et al. *Alcohol Health & Re-search World*, Summer 1990.

#### Human Heart Is a Double Pump

- Partition separates heart into left and right sides
- Each pumps blood through a different circuit

#### Pulmonary Circuit

Short loop that oxygenates blood

#### Systemic Circuit

Longer loop that carries blood to and from body tissues

#### Hepatic Portal System

- Carries blood from capillaries in digestive organs to capillaries in the liver
- Allows liver to detoxify substances from digestive tract before they are carried to the body

#### Major Vessels

#### Functional Connections Section 38.6: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 38.6: How Your Heart Works
- Section 38.6: The Ultimate Muscle; Clue: You Flex It 100,000 Times a Day. Dawn Welch. *Bicycling*, May 1991.

#### Location of the Heart Four Chambers

- Each side has two chambers
  - Upper atrium
  - Lower ventricle
- Valves between atria and ventricles

#### Heart Anatomy

#### Cardiac Cycle

#### Conduction and Contraction

- SA node in right atrium is pacemaker
- Electrical signals cause contraction of atria
- Signal flows to AV node and down septum to ventricles

#### Section 38.7: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 38.7: Climate, Altitude, and Blood Pressure. Joel Hanna. *Human Biology*, Aug. 1999.

#### Blood Vessels

- Arteries: main transporters of oxygenated blood
- Arterioles: diameter is adjusted to regulate blood flow
- Capillaries: diffusion occurs across thin walls

#### Blood Pressure

- Highest in arteries, lowest in veins
- Systolic pressure is peak pressure (ventricular contraction)
- Diastolic pressure is the lowest

#### Controlling Blood Pressure

- Cardiac output adjusted by controls over rate and strength of heartbeat
- Total resistance is controlled by vasoconstriction of arterioles
- Baroreceptor response is main short-term control of blood pressure

#### Diffusion Zone

- Capillary beds are the site of exchange between blood and interstitial fluid
- Capillary is a single sheet of epithelial cells

- Flow is slow; allows gasses to diffuse across membranes of blood cells and across endothelium

#### Section 38.8

#### Bulk Flow in Capillary Bed

#### Pressures in Capillary Bed

#### Net Bulk Flow

- Normally, ultrafiltration only slightly exceeds reabsorption
- Fluid enters interstitial fluid and is eventually returned to blood by way of the lymphatic system
- High blood pressure causes excessive ultrafiltration and results in edema

#### The Venous System

- Blood flows from capillaries into venules, then on to veins
- Veins are large-diameter vessels with some smooth muscle in wall
- Valves in some veins prevent blood from flowing backward

#### Section 38.9: Weblinks and InfoTrac

**See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)**

- Section 38.9: [American Heart Association](#)
- Section 38.9: [Heart Disease and Stroke Maps](#)
- Section 38.9: [PBS—To Heal A Heart](#)
- Section 38.9: [The Cholesterol Sweepstakes. Amy Barrett. \*Business Week\*, Oct. 28, 2002.](#)
- Section 38.9: [Can a New Heart Change Your Life—And Your Taste in Music? Thomas Fields-Meyer. \*People Weekly\*, Apr. 4, 2005.](#)

#### Risk Factors for Cardiovascular Disease

- Smoking
  - Genetic factors
  - High cholesterol
  - Obesity
  - Lack of exercise
  - Diabetes mellitus
- Gender (maleness)
  - Old age

#### Hypertension

- Blood pressure above 140/90
- Tends to be genetic
- May also be influenced by diet
- Contributes to atherosclerosis

- “Silent killer” - few outward signs

#### Atherosclerosis

- Arteries thicken, lose elasticity, and fill up with cholesterol and lipids
- High LDL increases risk

#### Arrhythmias

- Bradycardia - slow heart rate
- Tachycardia - 100+ beats/minute
- Atrial fibrillation - irregular heartbeat
- Ventricular fibrillation - uncontrolled contraction of ventricles; quickly fatal

#### Hemostasis

- Blood vessel spasm, platelet plug formation, blood coagulation
- Clotting mechanism
  - Prothrombin is converted to thrombin
  - Fibrinogen is converted to fibrin
  - Fibrin forms net that entangles cells and platelets

#### Section 38.10: Weblinks and InfoTrac

See the **latest Weblinks and InfoTrac articles** for this chapter online or click **highlighted articles below (articles subject to change)**

- Section 38.10: Lymphatic System Overview
- Section 38.10: Confessions of a Lymphomaniac. Hugh O’Neill. *Men’s Health*, July 2001.

#### Lymphatic System

- The circulatory system is leaky
- Some fluid is forced out of the smallest vessels and into the interstitial fluid
- Vessels of the lymphatic system pick up this fluid, filter it, and return it to the circulatory system

#### Lymph Vascular System

- Fluid enters lymph capillaries
- Capillaries merge into lymph vessels
- Lymph vessels converge into ducts that funnel fluid into veins in the lower neck

#### Lymph Nodes

- Located at intervals along lymph vessels
- Act as a filter for lymph
- Contain lymphocytes that can recognize a foreign invader

#### Lymphoid Organs

- Central to the body’s defense

- Tonsils
- Spleen
- Thymus gland