
Topic: Circulatory system

Reading: Chapter 32

Main concepts:

- The main features of the animal circulatory system are: fluid (blood), channels through which the fluid moves (vessels such as arteries and veins), and a pump (the heart).
- Functions of blood:
 - Transport of oxygen and carbon dioxide
 - Transport of waste products
 - Distribution of hormones and nutrients
 - Regulation of body temperature
 - Protection against infection and disease
- Components of blood:
 - Plasma is made up of water, plus proteins such as albumin, globulins, fibrinogens.
 - Red blood cells make up 99% of the cells in the blood. Red blood cells contain hemoglobin, which transports oxygen.
 - White blood cells are part of the immune system, and patrol the blood stream and body tissues, searching for invaders.
 - Platelets are cell fragments that play a role in clot formation.
- In an open circulatory system, as seen in arthropods, a heart circulates fluid within an open body cavity.
- In a closed circulatory system, as seen in vertebrates, a heart circulates blood in a closed loop made up of blood vessels.
- Three types of blood vessels:
 - Arteries move blood away from the heart. Arteries divide into smaller arterioles.
 - Veins carry blood toward the heart. Small venules join to become veins.
 - The smallest blood vessels are capillaries. It is in the capillary bed that materials such as gases and nutrients are exchanged.
- The two-chambered heart in fish moves the blood, but does not separate oxygenated from deoxygenated blood. The three-chambered heart in amphibians and reptiles creates some separation of the blood (the crocodile in particular has a partially-chambered ventricle). The four-chambered heart in mammals keeps oxygenated and deoxygenated blood completely separate. This makes oxygen exchange more efficient and allows for the high oxygen needs of heterotherms ("warm-blooded" animals).
- The heart beat consists of two contractions: the atria contract together, then the ventricles.
- When measuring blood pressure, the systolic pressure is pressure when the heart is contracted. The diastolic pressure is the pressure when the heart is relaxed.
- The sympathetic nervous system increases heart rate during times of stress. The parasympathetic division slows heart rate during times of rest.
- Mammalian blood circulation:
 - Deoxygenated blood arrives from the body through the superior and inferior vena cavae.
 - Deoxygenated blood enters the right atrium, then moves to the right ventricle.
 - Deoxygenated blood leaves the heart through the pulmonary arteries and goes to the lungs.
 - In the lungs, the blood gives up carbon dioxide and takes up oxygen.
 - Oxygenated blood travels from the lungs to the heart through the pulmonary veins.
 - Oxygenated blood enters the right atrium, and moves into the right ventricle.
 - Oxygenated blood leaves the heart through the aorta and is carried to the body.

Common misconceptions:

- Students often learn that arteries carry oxygenated blood and veins carry deoxygenated blood. However, the pulmonary arteries and veins reverse this notion. It is better to remember that arteries carry blood away from the heart and veins carry blood to the heart.
 - Common use of the word "blood," such as "I have Irish blood," gives people the impression that blood plays a role in heredity. This was an old belief, from before the discovery of the principles of genetics, when people believed that traits were inherited by some kind of blending of fluids from both parents. Genetics has
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shown that this is not so. Traits are inherited when sperm and egg, which carry chromosomes with genes for traits, unite.

- Students often believe that blood travels in one continuous loop around the body. In fact, blood vessels create multiple loops to serve different parts of the body. That is, one drop of blood does not circulate completely around the body before returning to the heart. An artery will take it to one part of the body, a vein will bring it back.
- Many students do not relate the role of the heart and the lungs in blood circulation, and forget that blood must go through the lungs to be oxygenated.
- Students often believe that high blood pressure, heart disease, high cholesterol, and similar disorders of the circulatory system are “old people’s” diseases. However, genetics plays a role in all of these disorders, and even young people can have circulatory problems if they have inherited certain genetic tendencies. Also, a poor diet in young people can cause arterial plaques that cause heart disease later in life. Good diet and exercise can reduce the risk of heart problems.

Reading notes:

- Name and describe types of circulatory systems in animals.
- Describe the flow of blood through a two-chambered, three-chambered, and four-chambered heart.
- Name the chambers of the mammalian heart and the major blood vessels going into and out of the heart, and their roles in circulation.
- State the roles of the atrioventricular and semilunar valves and the sinoatrial node.
- Describe how the nervous system affects heart rate.
- Describe the components of blood, including the three cellular components. State the function of each.
- Describe the negative feedback loop that controls the number of red blood cells in the body.
- Name the major types of blood vessels and their functions. Describe the structural differences between arteries and veins.
- Describe the effects of hypertension and atherosclerosis on the heart (HealthWatch section)
- Describe the function of the lymphatic system and how it relates to the circulatory system.

Useful websites:

- “Heart” <http://www.kscience.co.uk/animations/heart.htm> is a simple animation of a beating heart, with labels.
 - “Circulation” http://www.kscience.co.uk/animations/blood_system.htm follows the path of a blood cell through the body, to the heart and lungs, and back again.
 - “Blood cells” <http://www.getbodysmart.com/ap/circulatory/menu/circulatory.html> has tutorials on the various cellular components of blood.
 - “Blood pressure” <http://132.241.10.14/bp/bp.swf> is a tutorial on how to properly take a person’s blood pressure, in case you were curious.
 - “Capillary exchange” <http://highered.mcgraw-hill.com/sites/dl/free/0072464631/291136/Fluidexchange.swf> is an animated tutorial with voiceover that explains how materials move across capillary walls.
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