Human Systems - Circulation - Lesson 4: Regulation of Blood Flow

Cardiac Output

- Cardiac output is the amount of blood that flows from the heart per minute
- The left and right side of the heart pump the same amount of blood
- Two factors affect cardiac output
 - 1. Stroke volume quantity of blood pumped with each heart beat
 - 2. <u>Heart rate</u> number of heart beats *per minute*

Cardiac output = heart rate x stroke volume

- Stronger hearts can pump more blood with each beat
 - O Average stroke volume for a 70 kg person is **70 mL** per beat
- People with better fitness have a higher stroke volume and a lower heart rate
- People of the same size have the same cardiac output
 - o stroke volume and heart rate will be different if level of fitness differs

Table 1 Cardiac Output of Two People

Person	Stroke volume (mL/beat)	Heart rate (beats/min)	Cardiac output (stroke volume × heart rate)
Tom	50	100	5 L
Lee	100	50	5 L

- During exercise the heart rate increases to meet the increased demands for oxygen, nutrients and waste removal
 - Stroke volume des not change
 - o If heart rate increases then cardiac output increases

Blood Pressure

- Blood pressure is the force of the blood on the walls of the arteries
- Blood pressure is measured using a **sphygmomanometer**
 - O A cuff with an air bladder is wrapped around the arm
 - $_{\odot}$ A small pump is used to inflate the air bladder, thereby closing off blood flow through the brachial artery
 - $_{\odot}$ A stethoscope is placed below the cuff and air is slowly released from the bladder until a low-pitched sound can be detected
 - The pressure when this occurs is generated by the ventricles contracting
 - This is the **systolic** pressure
 - o The cuff is then deflated even more, until the sound disappears
 - This represents the pressure in arteries when the heart is relaxed
 - This is called the **diastolic** pressure

 $\underline{http://www.nelson.com/ABbio20-30/teacher/protect/otr/Bio2030OTR/attachments/i_AnimationSimulation/blood_pressure.html}$

- Your blood pressure is reported as two numbers: systolic / diastolic

Table O Pland Property Categories

- O Normal blood pressure is around 120 / 80
- Blood pressure is measured in the units of **mm of Hg**

(for 18 years and older)				
	Blood Pressure (mmHg)			
Category	Systolic	Diastolic		
normal	< 120	< 80		
pre-hypertensive	120 to 139	80 to 89		
hypertensive				
stage 1	140 to 159	90 to 99		
stage 2	≥ 160	≥ 100		

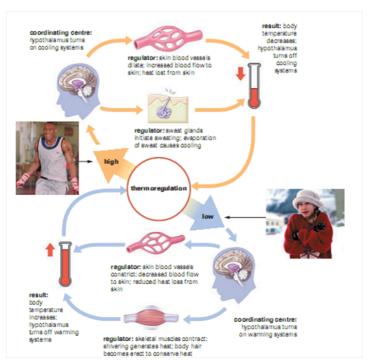
Regulation of Blood Pressure

- Regulation of blood pressure is necessary since both high and low blood pressure can be dangerous
- High pressure can weaken an artery and eventually result in its rupture
- -blood pressure receptors are located in the walls of the aorta and the carotid arteries
- When blood pressure is too high
 - O A stronger signal is sent from receptors to the brain
 - The brain (medulla oblongata) reduces the sympathetic nerve signals and increases the parasympathetic nervous signals
 - This slows the SA node, which makes the heart beat slower, and reduces cardiac output
 - o Ex. After exercising
- When blood pressure is too low
 - O A weaker signal is sent from receptors to the brain
 - O The brain increases sympathetic nerve signals and reduces parasympathetic nervous signals
 - This speeds up the SA node, which makes the heart beat faster, and increases cardiac output
 - o Ex. When you stand up after sitting for a long period of time

Read 'Response of the Circulatory System to Exercise' on pg 331

Regulating Body Temperature

- Thermoregulation is the maintenance of body temperature within a range in which cells can operate normally
- Response to overheating caused by exercise or high environmental temperatures:
 - O Sensors in the brain detect rise in temperature
 - Hypothalamus (part of brain) sends signals to sweat glands to produce sweat
 - Heat is lost through evaporation of sweat
 - O Hypothalamus sends signals to blood vessels in the skin to dilate
 - Heat is lost by the blood to air
 - As a result, body temperature drops and sweating stops and blood vessels constrict again
- Response to a drop in body temperature
 - O Sensors detect a drop in temperature
 - Hypothalamus (part of brain) sends signals to skeletal muscles to contract causing shivering
 - Heat is generated
 - Only effective for short time periods
 - O Hypothalamus sends signals to blood vessels in the skin to constrict
 - Less heat is lost by the blood to air



4