

Chapter 9

Homeostasis and Circulation

Biology 2201

Dynamic Equilibrium



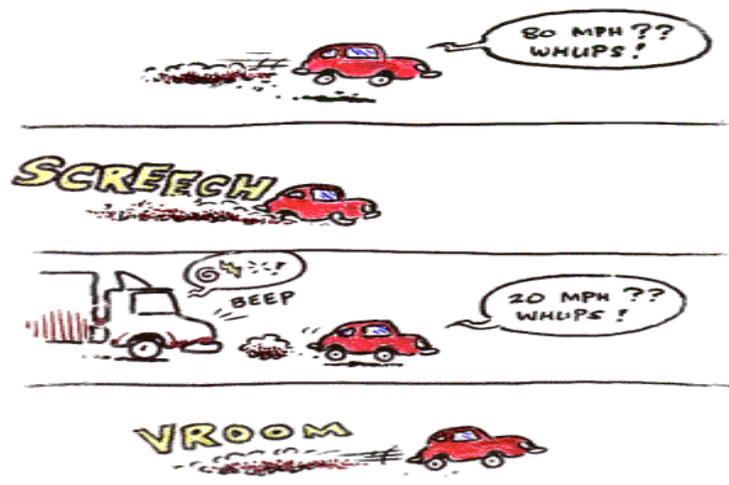
- A state of balance in an environment
- Achieved by internal control mechanisms that counteract outside forces that could change the inside environment (body)

Homeostasis

The steady state of conditions inside a living organism that allows it to function properly

Homeostasis is the dynamic equilibrium of the internal environment of the human body

Not too fast... Not too slow

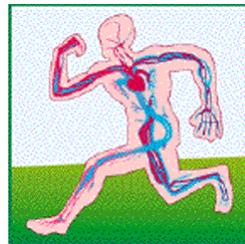


Examples of Homeostasis

- Temperature Regulation
- Food and Water Balance
- Regulation of blood sugar levels
- Regulation of blood calcium levels

Body Systems Involved in Homeostasis:

- Nervous System
- Endocrine System
- Circulatory System*
- Digestive System
- Excretory System



Temperature Regulation

□ Homeotherms

- Warm blooded - body temperature stays relatively constant (Endotherm)
- birds and mammals



□ Poikilotherms

- Cold blooded animals - body temperature fluctuates depending on their environment (Ectotherm)
- Lizards

How is temperature controlled?

□ Behaviourally

- wearing more or less clothing
- Exercising

□ Physiological

- Shivering
- Vasoconstriction
- Vasodilation
- Sweat

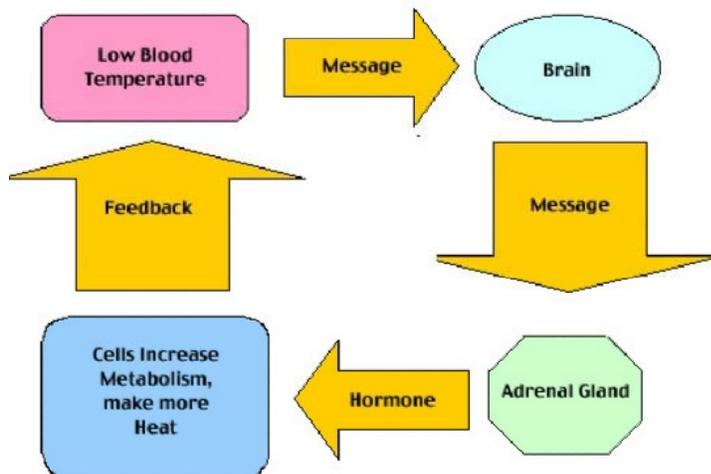


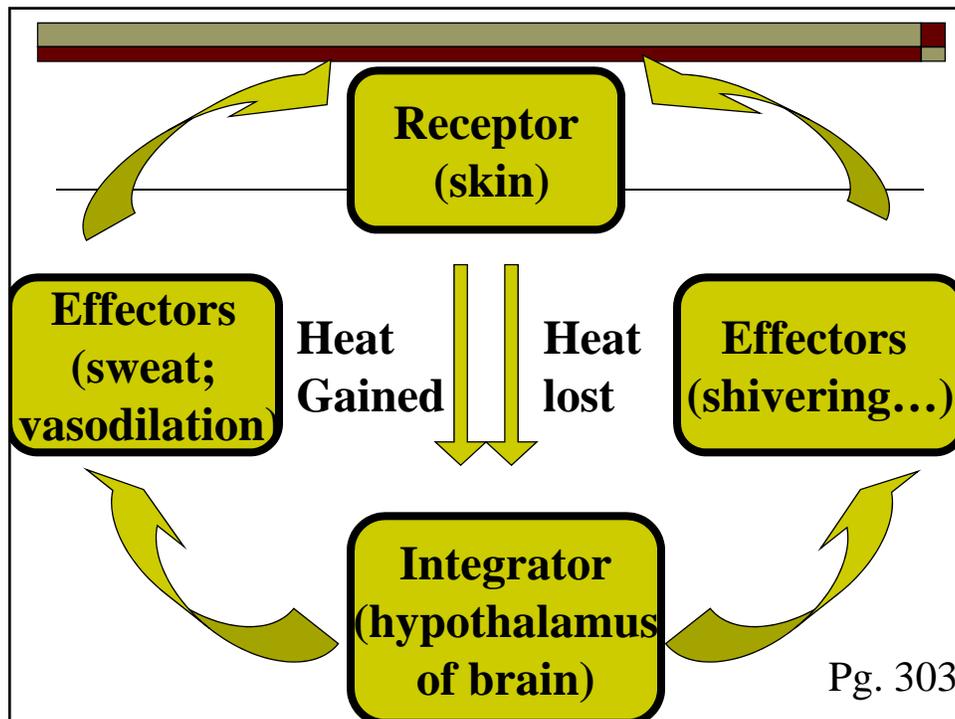
Physiologically - how does it work?

- Negative Feedback Loop
 - Receptor (Skin)
 - Integrator (Brain)
 - Effector (Sweat or shiver))

See Pg. 302-303 in textbook

Negative Feedback Loop Example





Negative Feedback Loop

- A process by which a receptor, an integrator and an effector detects, processes and produces a response to a change in a body constant (for example temperature) so that a reverse affect may take place, enabling the body to stay constant.

Receptors

- Found in every body organ and tissue.**
- Send nerve impulses to the brain as a result of environmental stimulants.**
- They are the first part involved in a negative feedback loop.**

Integrator

- Sends messages to effectors.**
- Acts as a messenger between the brain and muscles or organs**
- An example is the hypothalamus of the brain.**

Effectors

- **Causes a change in internal conditions based on external stimuli**
 - **Sweat glands are an example that enable the body to cool off when they produce sweat.**

What Makes it all Possible?

- **The Circulatory System**
 - **Transporting...**
 - Blood
 - Water
 - Nutrients
 - Hormones
 - Sugars
 - Toxins

Arteries

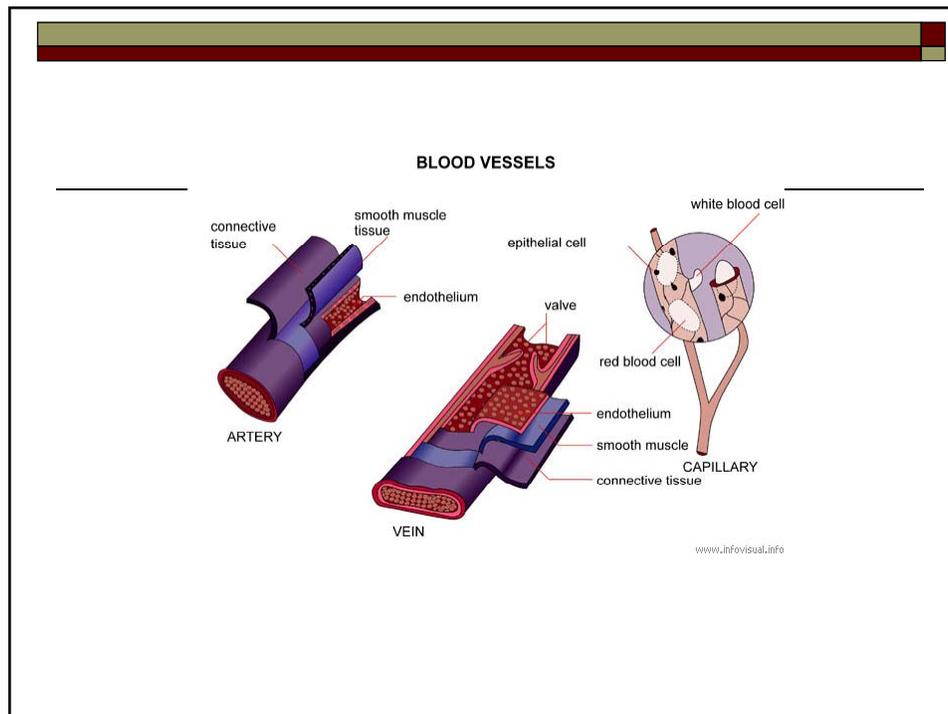
- Blood vessel that carries blood away from the heart**
- Made up of elastic fibres and smooth muscle**
- Thin layer of epithelial cells reduces friction**
- In measuring your pulse you can feel the artery contracting and expanding**

Veins

- Blood vessel that carries blood to the heart**
- Has a thinner wall than arteries, but a larger circumference**
- Is not elastic**
- Gravity aide flow above the heart, one-way valves prevent back flow against gravity below the heart**

Capillary

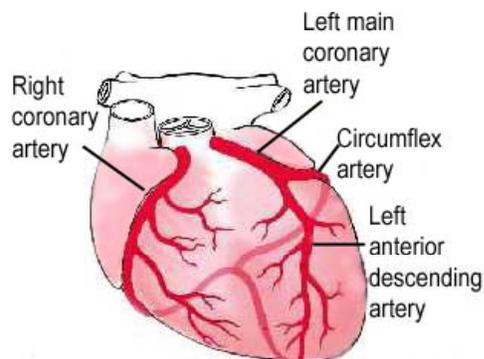
- The smallest blood vessel, only a single cell thick
- Allows for the exchange of oxygen and nutrients in the blood for carbon dioxide and wastes in the body cells.



Three Cycles of Blood Circulation

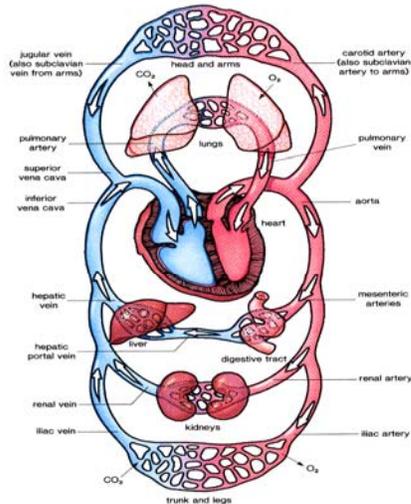
- Cardiac
 - Pathway blood takes in the heart
- Pulmonary
 - Pathway of blood from the heart to the lungs and back
- Systemic
 - Path through the rest of the body

Coronary/Cardiac Circulation

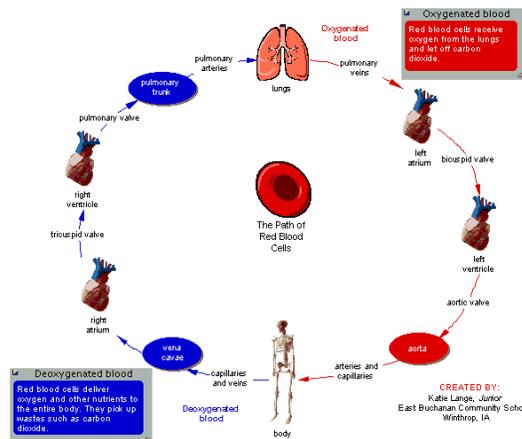


Circulation in and around the heart

Pulmonary and Systemic Circulation



Pathway of a Blood Cell

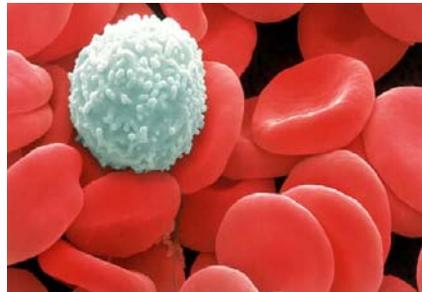


Components of blood

- Plasma - 55% of the blood
 - Water, proteins, dissolved gasses, sugars, vitamins, minerals and waste products
- Red Blood Cells - 44% of the blood
- White Blood Cells - 1% of the blood

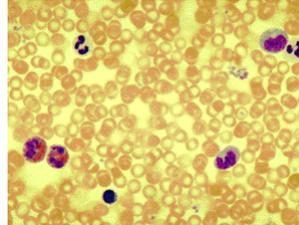
Erythrocytes (Red Blood Cells)

- Cells in the blood of vertebrates
- Transport oxygen and carbon dioxide to and from the tissues.
- In mammals, these cells are disk-shaped and biconcave, contain hemoglobin, and lack a nucleus.



Leukocytes (White Blood Cells)

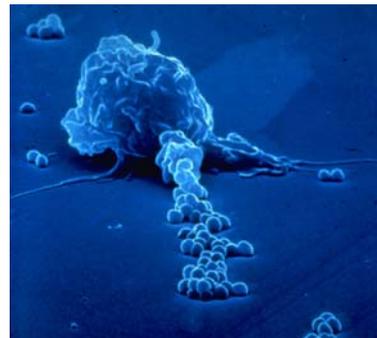
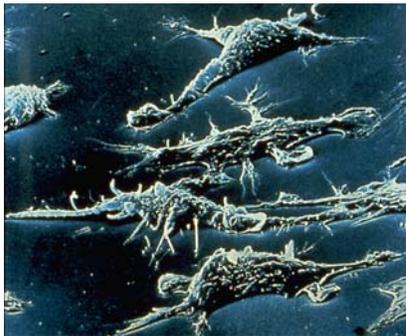
- **Blood cells that have a nucleus and cytoplasm and help protect the body from infection and disease.**



Lymphocytes and macrophages are good examples

Macrophages

Four macrophages or "engulfing" cells. Macrophages are highly deformable cells. They are able to creep actively into the smallest gaps (and so also to penetrate the vascular walls, for example) and work their way into the most diverse tissue types. They form semi-liquid projections which are used for motility and also for trapping pathogens and other foreign bodies.

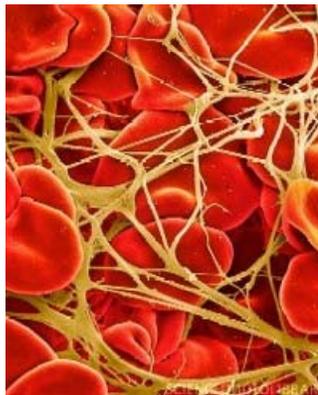


Lymphocytes

- **Non-phagocytic cells that play a role in immunity by recognizing and fighting off specific pathogens.**

Platelets

- **Fragments of cells that play an important role in clotting blood.**

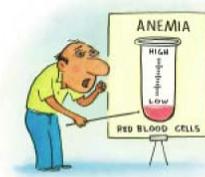


Hemoglobin

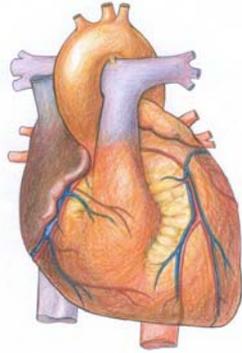
- ❑ **Red Blood Cells are packed with this iron containing molecule that binds with oxygen. It allows oxygen to be transported in the blood.**

Anemia

- ❑ **This deficiency occurs when the number of healthy red blood cells decrease in the body which causes a shortage of hemoglobin (and thus low iron).**



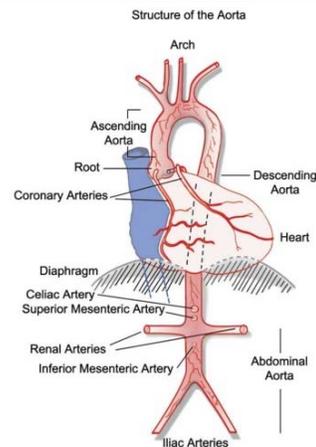
Blood Flow Through the Heart



1. RIGHT ATRIUM
to
2. RIGHT VENTRICLE
to
3. PULMONARY SYSTEM
to
4. LEFT ATRIUM
to
5. LEFT VENTRICLE
to
6. AORTA (Rest of body)

Aorta

- The largest artery
- Carries blood from the left side of the heart into systemic circulation.

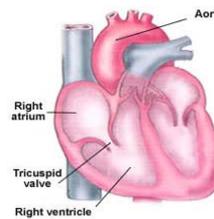


Bicuspid Valve

- **A valve of the heart located between the left atrium and left ventricle that keeps blood in the left ventricle from flowing back into the left atrium.**
 - **Also known as the Mitral valve and is one of the two atrioventricular valves.**

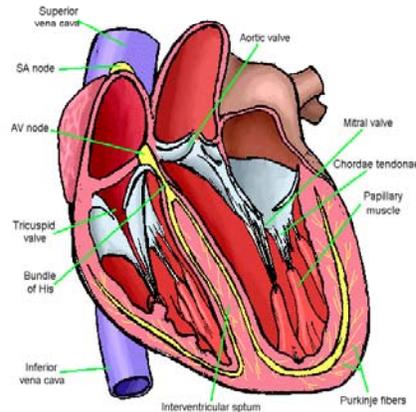
Tricuspid Valve

- **A valve of the heart located between the right atrium and right ventricle that keeps blood in the right ventricle from flowing back into the right atrium.**
 - **It is one of the atrioventricular valves**



Sinoatrial/ SA/ Sinus Node

- A small bundle of specialized cardiac muscle tissue located in the wall of the right atrium of the heart that acts as a pacemaker by generating electrical impulses that keep the heart beating.

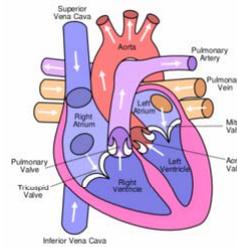


Atrioventricular Valves

- On both sides of the heart the atria and ventricles are separated from one another by this set of valves. (These are also called the bicuspid and tricuspid valves).

Atria

- The upper chambers of the heart that receives blood from the veins and forces it into a ventricle
 - Plural for atrium.



Left Ventricle

- The chamber on the left side of the heart that receives arterial blood from the left atrium and contracts to force it into the aorta.
- Septum → The wall that separates the right and left ventricles.

Right Ventricle

- ❑ **The chamber on the right side of the heart that receives venous blood from the right atrium and forces it into the pulmonary artery.**

Vena Cava

- ❑ **Either of two large veins that drain blood from the upper body (superior vena cava) and from the lower body (inferior vena cava) and empty into the right atrium of the heart.**

Pulmonary Artery

- **A blood vessel that carries deoxygenated blood from the right ventricle of the heart to the lungs.**

Pulmonary Vein

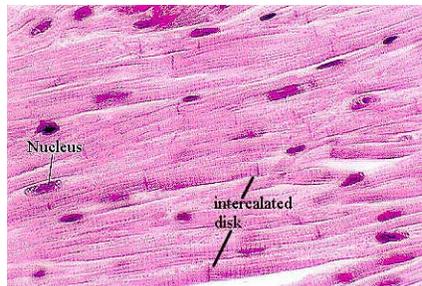
- **A blood vessel that carries oxygenated blood from the lungs to the left atrium of the heart.**

Electrocardiogram

- A device that measures the voltage of the electrical signals produced by the SA and AV nodes.

Cardiac Muscle

- This type of muscle consists of individual cells each with a single nucleus that form a branching interlocking network.



Electrocardiograph

- The tracing produced by an electrocardiogram.



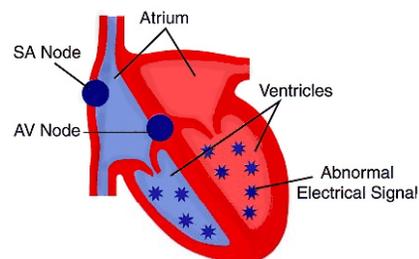
ECG tracing of a normal heart rhythm.



In atrial fibrillation, the tracing shows tiny, irregular "fibrillation" waves between heartbeats. The rhythm is irregular and erratic.

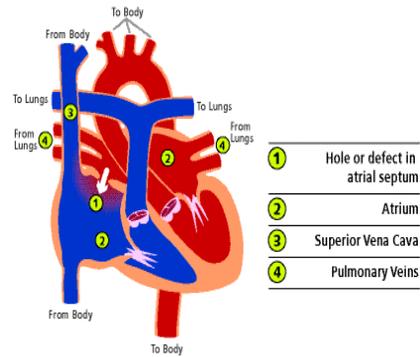
Ventricular Fibrillation

- This is a condition where the ventricles contract randomly causing the heart to quiver or twitch.



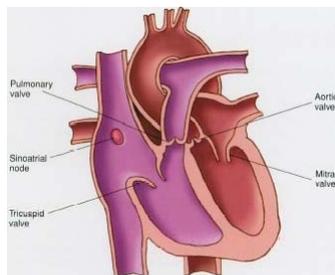
Septal Defect

- A hole in the septum that allows oxygenated and deoxygenated blood to mix.



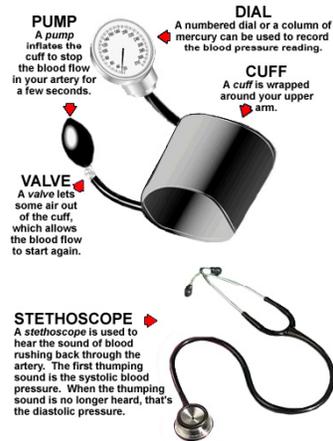
Heart Murmur

- A condition that occurs when one or more of the heart valves does not open or close properly



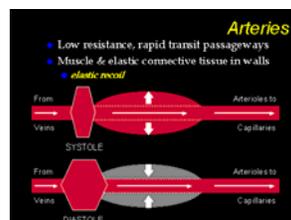
Sphygmomanometer

- An instrument for measuring blood pressure in the arteries.
- Hypertension
 - Condition where blood pressure is abnormally high



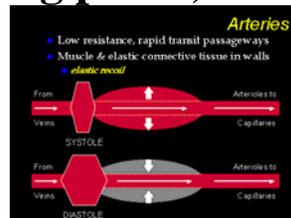
Systolic Pressure

- The blood pressure that is exerted on blood vessels only in short bursts following the ventricular contractions.



Diastolic Pressure

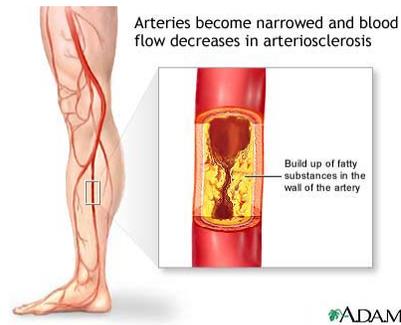
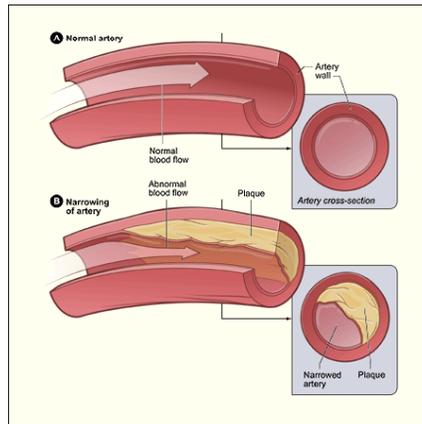
- The blood pressure that blood vessels are exposed to most of the time (pressure of the blood during the hearts resting phase).



Atherosclerosis & Arteriosclerosis

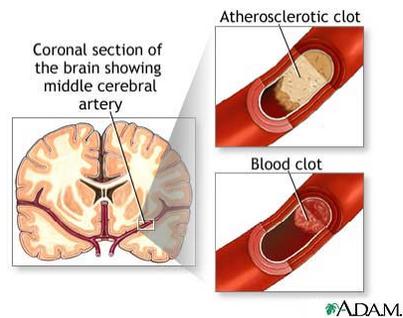
- Atherosclerosis
 - A narrowing of the arteries caused by cholesterol or fatty tissue buildup called plaques, ON the inner lining of the artery wall.
- Arteriosclerosis
 - A condition where plaque material becomes deposited UNDER the inner lining of the arteries

Atherosclerosis & Arteriosclerosis



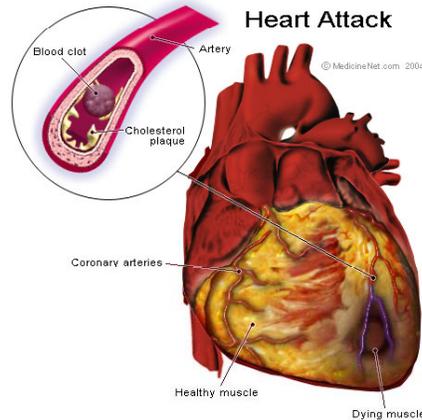
Stroke

- **A condition that occurs when a blood clot blocks an artery going to the brain and causes the brain to be starved of oxygen, killing the brain tissue**



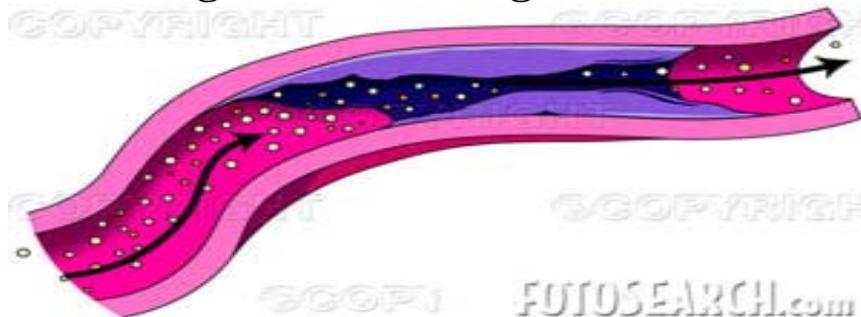
Heart Attack

- A condition that occurs when a blood clot blocks an artery going to the heart muscle and causes the heart to beat irregularly or stop altogether. A part of the heart actually dies when this happens.



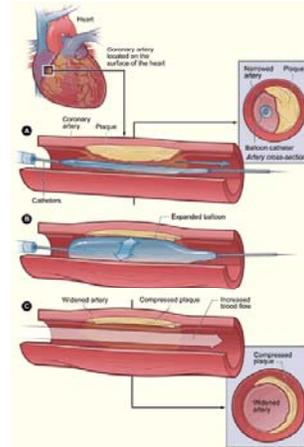
Clot Busting Drugs

- Medicines that help dissolve blood clots in arteries, allowing blood to once again flow through them.



Angioplasty

- A procedure in which a fine plastic tube is inserted into a clogged artery, a tiny balloon is pushed out from the tip of the tube and forces the vessel to open allowing blood to flow through.



Coronary Bypass Surgery

- A common surgical procedure in which a segment of healthy blood vessel from another part of the body is used to create a new pathway around a blocked coronary artery.

