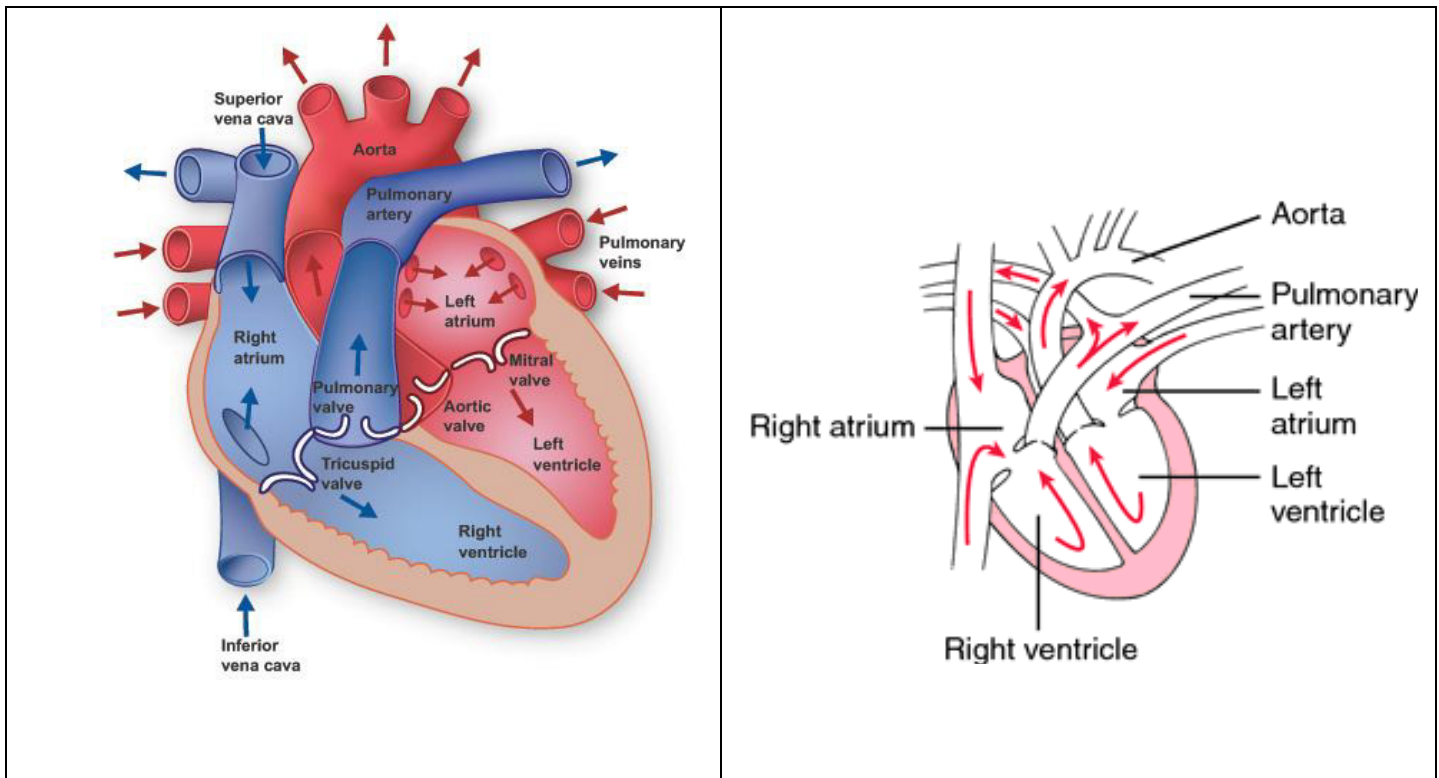


Unit 4 Study Guide

4.1 – Heart Structure

- EQs 1 & 4 & 5 – What are the structures that make up the human heart and how are they organized? What are the functions of valves in the heart? How does the structure of arteries and veins relate to their functions?**

Category	Characteristics	Includes
chambers	open, like rooms—hold blood	right and left atria and right and left ventricles
valves	flaps, like doors—let blood move one way; create a 1-way flow of blood through the heart	tricuspid, bicuspid (mitral), aortic & pulmonary
veins	bring blood to heart—tubes, like halls; thin walls (no muscle layer); very little contraction	superior & inferior vena cavae & pulmonary veins
arteries	carry blood from heart—tubes, like halls ; thick walls (thick muscle layer); capable of contraction – creates pulse	pulmonary arteries, aorta



- EQs 2 & 3 – How do the heart and lungs work together to pick up and deliver oxygen to the cells? What is the pathway blood takes as it passes through the heart?**

- Pulmonary arteries carry deoxygenated blood into the lungs and pulmonary veins carry the oxygenated blood back to the heart to be sent to the body. A capillary network in all of the body's tissues allows for the exchange of gases (O_2 and CO_2).

- right atrium → tricuspid valve → right ventricle → PSV → pulmonary arteries → lungs for oxygen → pulmonary veins → left atrium → bicuspid (mitral) valve → left ventricle → ASV → aorta → arteries all over body → arterioles → capillaries (to drop off oxygen, nutrient & hormones & pick up waste & CO_2) → venules → veins → vena cavae → right atrium

4.2 – The Heart at Work

• EQ 1 – In what ways can technology be used to collect and analyze cardiovascular data?

Thing measured	Tool used	Used how
Blood pressure	Sphygmomanometer "pulse measurer"	Determines systolic and diastolic arterial pressure
Heart rate	Timer	Used to find beats during 10 seconds (then multiply by 6 for bpm)
Electricity within heart	EKG	Electrodes on skin pick up current and show graphically

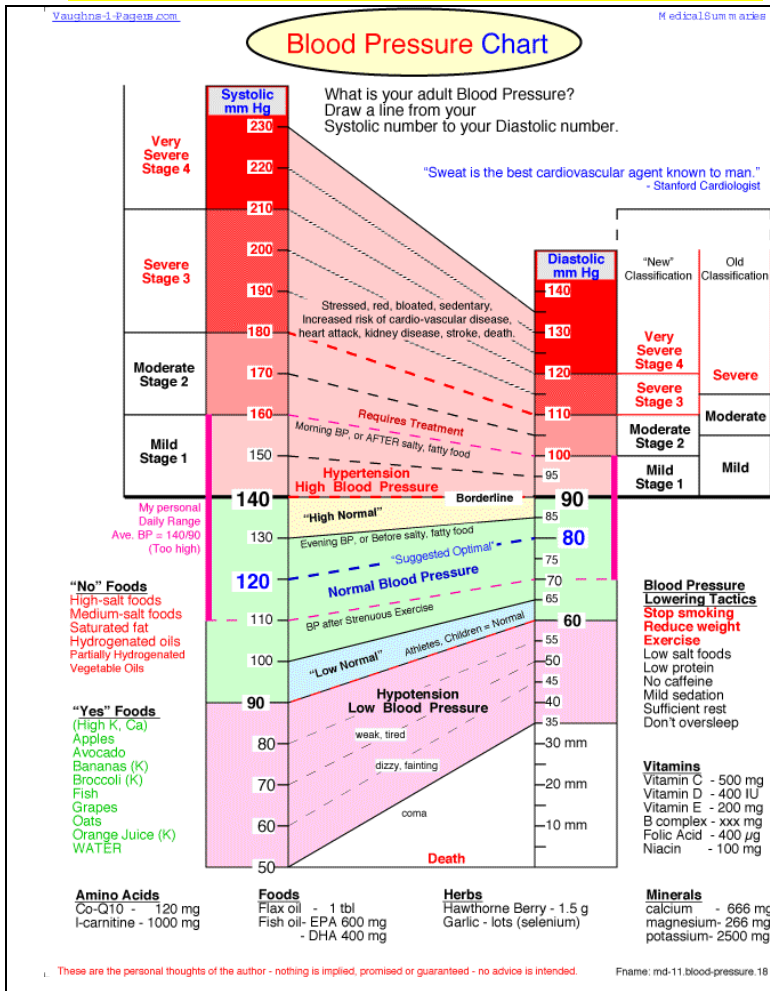
• EQs 2 & 3– Why is it important to monitor the rate at which the heart beats? What factors can influence heart rate?

Lower heart rate	Raise heart rate
<u>Short-term method</u> <ul style="list-style-type: none"> Sleeping or relaxing Hydrating yourself <u>Long term method</u> <ul style="list-style-type: none"> Exercise Reducing stress Eating fruits, vegetables, nuts, beans & fish 	<u>Short-term method</u> <ul style="list-style-type: none"> Exercising or other rapid movements Being scared or very stressed briefly Drinking caffeine or alcohol <u>Long term method</u> <ul style="list-style-type: none"> Being out of shape Increasing stress
Heart rate can indicate problems with heart function: rapid heart rate (tachycardia), irregular heart rate (a-fib or valve issues).	

• EQs 4 & 5 – What is blood pressure? How do systolic and diastolic pressure values relate to the movement of blood in arteries?

<p>A normal blood pressure reading usually indicates a healthy heart, with higher readings indicating that the heart is stressed. It measures the pressure on vessel walls from the movement of blood particles.</p> <ul style="list-style-type: none"> Top number Systolic pressure in arteries as the ventricles contract & the chambers emptying (always higher) Bottom number Diastolic pressure in arteries when ventricles are relaxed & the chambers are filling with blood (always lower) 	Blood Pressure Category	Systolic mm Hg (upper #)	Diastolic mm Hg (lower #)
	Normal	less than 120	and less than 80
	Prehypertension	120 – 139	or 80 – 89
	High Blood Pressure (Hypertension) Stage 1	140 – 159	or 90 – 99
	High Blood Pressure (Hypertension) Stage 2	160 or higher	or 100 or higher
	Hypertensive Crisis (Emergency care needed)	Higher than 180	or Higher than 110

EQ 6 – What factors can influence blood pressure?

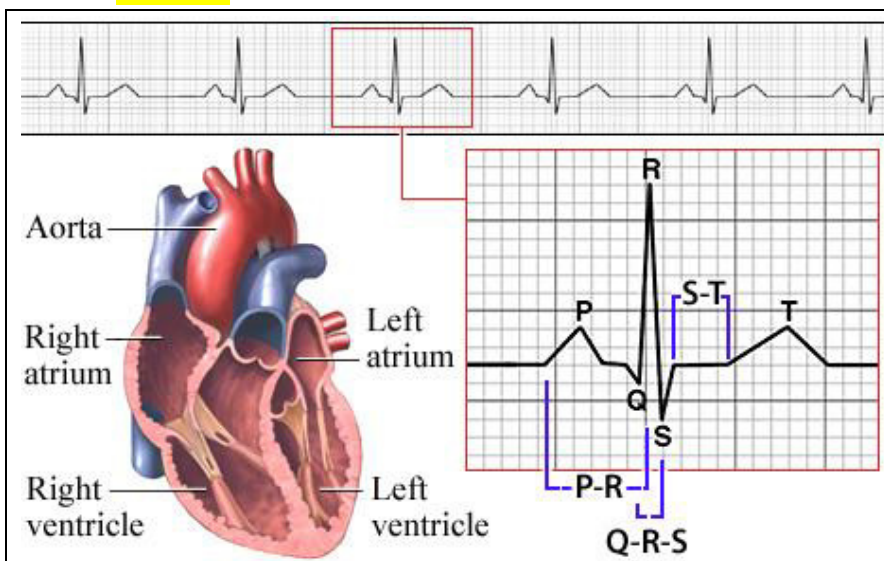


According to the Mayo Clinic, the top 10 ways to reduce your blood pressure or prevent hypertension (“extra tension”) are to:

1. Lose extra pounds and watch your waistline
2. Exercise regularly
3. Eat a healthy diet
4. Reduce sodium in your diet
5. Limit the amount of alcohol you drink
6. Avoid tobacco products and secondhand smoke
7. Cut back on caffeine
8. Reduce your stress
9. Monitor your blood pressure at home and make regular doctor's appointments
10. Get support from family and friends

<http://www.mayoclinic.com/health/high-blood-pressure/HI00027>

EQs 7 & 8 – What is an EKG? How can an EKG be used in the diagnosis and treatment of heart disease?



EKGs, or electrocardiographs (“electricity heart pictures”) measure the heart’s electrical activity and display it in the form of a picture:

- **P wave** - signal passes from **SA node** (sinoatrial node) to AV node (atrioventricular node), moving across atria
- **QRS interval** - signal passes from AV node through Purkinje fibers & the ventricles contract
- **T wave** - the ventricles repolarize & the heart is relaxed

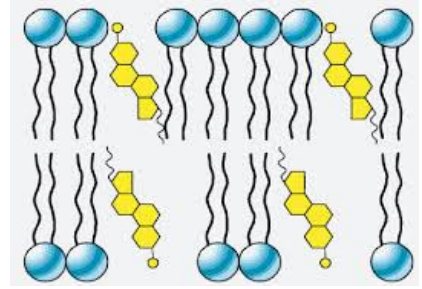
EKGs are examined for missing, extra or malformed waves.

EKGs are taken when heart problems are suspected and can be used in **cardiology** (“the study of the heart”) to diagnose heart attacks, lack of blood flow to the heart, arrhythmia (“no rhythm”), lack of forcefulness of heart muscle, muscle parts that are too thick or heart parts that are too big, birth defects of the heart, heart valve diseases.

4.3 – Heart Dysfunction

EQs 1 & 2 - What is cholesterol? What roles does cholesterol play in our cells and in the body?

Cholesterol is a lipid made in the liver of animals. It helps form cell membranes & is found in all tissues, but especially nervous and fat tissue. It protects the skin and helps nerve cells function. It also helps detoxify the blood. Humans do not need to consume **cholesterol** to be healthy. The human liver makes it. Most humans take in too much **cholesterol** from their food, putting the health of their hearts at risk.



EQ 3 – What are HDL and LDL?

LDL

Low Density Lipoprotein

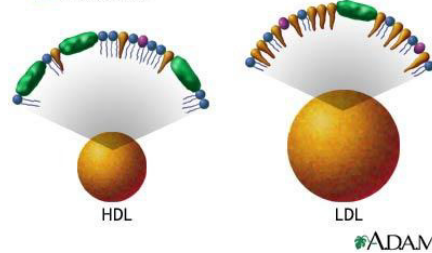
- Carry **cholesterol** through blood to all tissues—if there’s too much it just stays in the blood
- Raises risk of heart disease
- Leads to blood vessel blockages—white blood cells try to digest LDL & convert it to a toxic form. White blood cells create inflammation & that draws more cells & plaque

Both

- Part lipid, part protein
- Carry **cholesterol**

Lipoproteins vary in size and composition

■ Proteins
■ Cholesterol



HDL

High Density Lipoprotein

- Pick up **cholesterol** in the bloodstream and take it to the liver for removal from the body
- Lowers risk of heart disease
- Reduces blood vessel blockages

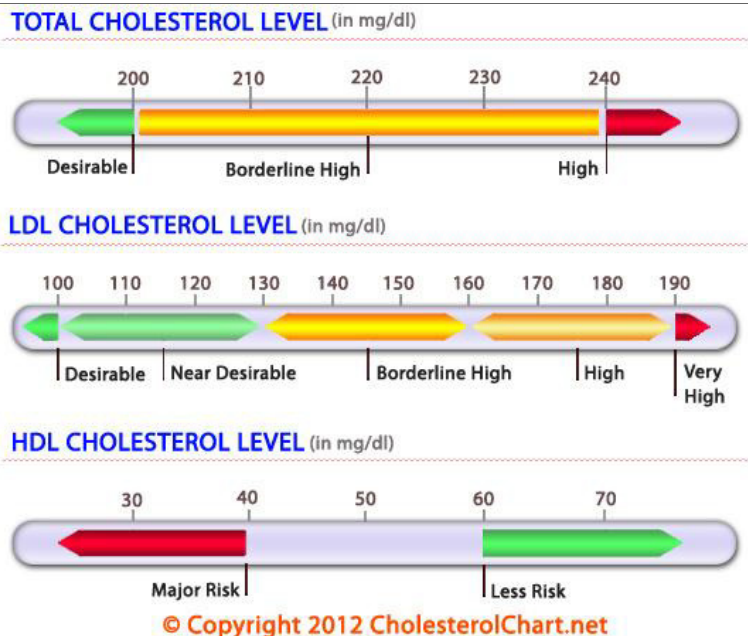
EQs 4 & 5– How are LDL, HDL, and cholesterol related to heart disease? How do doctors interpret the results of a cholesterol test?

- Heart disease is the #1 killer of Americans, killing over ½ million Americans per year.
 - **HDL, LDL & total cholesterol** levels are highly correlated with risk of heart disease and heart attack. Keeping levels healthy is a great way to protect the cardiovascular system.

- Here are facts from the CDC*:

- 71 million American adults (33.5%) have high LDL, or “bad,” cholesterol
- People with high total cholesterol have approximately **twice the risk** of heart disease as people with optimal levels

*<http://www.cdc.gov/cholesterol/facts.htm>



- EQs 6 & 12 – What is familial hypercholesterolemia and how is it inherited? How can cholesterol plaques affect the overall function of the heart?

Unaffected Mother (dd) and Affected Father (Autosomal dominant faulty gene, Dd) have offspring with a 50% chance of being Unaffected (dd) and a 50% chance of being Affected/Predisposed (Dd).

The diagram illustrates how cholesterol plaques narrow the opening in arteries, making blood flow more difficult and leading to higher blood pressure.

Familial Hypercholesterolemia (“high cholesterol in the blood”) is a dominant autosomal genetic disorder, the result of a **mutation** in DNA that is passed from parents to their offspring. The disease typically occurs when a person inherits a dominant **allele** from one parent, giving him a heterozygous (“full of different things joined together”) genotype (Hh). On very RARE occasions, the person has TWO affected parents and inherits the mutation from BOTH of them, giving him a **homozygous** (“full of same things joined together”) dominant genotype (HH). Either will result in **familial hypercholesterolemia**, but a homozygous dominant genotype makes the condition far worse. The **phenotype** (“showing type”) of a person with familial hypercholesterolemia is that LDL cholesterol (generally called —bad cholesterol builds up in the bloodstream, leading to very high cholesterol levels in the blood and putting the person at high risk for a heart attack.

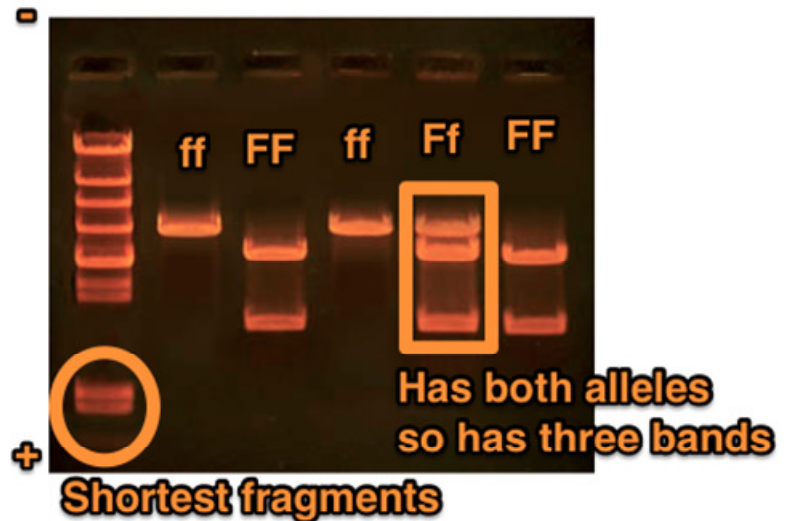
Cholesterol plaques narrow the opening in arteries making blood flow more difficult. The result is a harder working heart and higher blood pressure.

- EQ 7 – How can techniques of molecular biology be used to analyze DNA for the presence of the FH mutation?

DNA can be analyzed through gel **electrophoresis**. **Electrophoresis** allows the comparison of an unknown piece of DNA to a known gene. The more the pieces of DNA match up, the more similar the DNA sequences. DNA from a person with a disease (like **familial hypercholesterolemia**) can be compared to someone who wants to know whether (s)he has that disorder.

Amplify the DNA sample

- Use **restriction endonuclease** to cut the DNA into pieces
- Make an **agarose** gel (source is seaweed) that the DNA can travel across in a **linear** (straight) line
- Load the DNA samples into the wells in the **agarose** gel and put the wells in the negative end of the **electrophoresis** apparatus
- Turn on the **electrophoresis** apparatus and let it run about 30 minutes—DNA will travel toward the + electrode because of its – charge
- Stain the **agarose** gel to get the DNA to appear
- Compare the lanes of DNA



To interpret results, geneticists look at which RFLPs (lines) match between lanes. Where lines match, the DNA strand is the same length and that means the DNA is the same. Where lines DO NOT match up, there’s a difference in the DNA strand.

EQs 8 & 9 - What lifestyle changes may help a patient obtain healthy cholesterol levels? What are the pros and cons of using cholesterol lowering medicines?



- Limit Trans and Saturated Fat as they increase LDL
- Eat unsaturated fats to increase HDL
- Exercise daily
- Maintain healthy weight
- Manage stress and do not smoke
- Take medications, like statins if needed

- Common cholesterol medication, statins, will decrease LDL, triglycerides, and even CRP (involved in strokes), while slightly elevating HDL
- However it can lead to side effects, such as muscle weakness and pain, even in the heart (since it is a muscle)
- They can also cause amnesia for minutes to hours, headaches, dizziness, and liver dysfunction

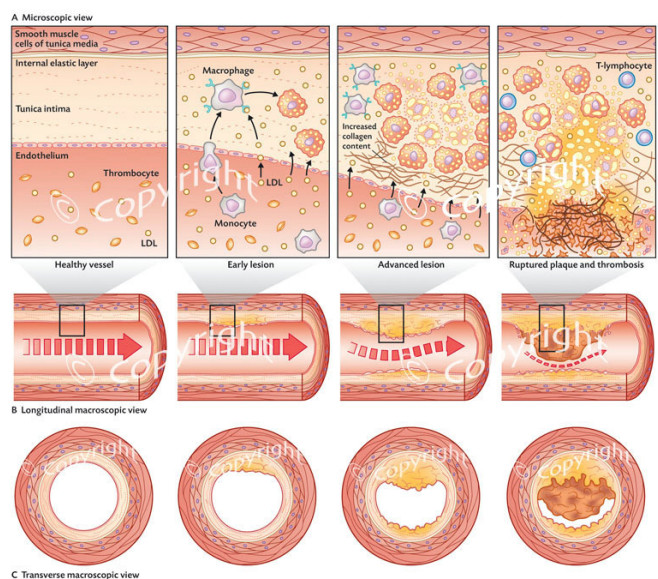
EQ 10 – How does the heart work like a pump?

Pumps move fluids using pressure

The heart is a pump because it moves a fluid (blood) using pressure (contractions of ventricles). The heart powers the whole **cardiovascular system**.

EQ 11 – What is atherosclerosis?

- Atherosclerosis is the build up of plaque, which can be due to excess LDL along the arterial walls, reducing blood flow
- Atherosclerosis of the coronary artery can cause lack of oxygen to fuel the heart, leading to a myocardial infarction (heart attack)
- It can cause lack of blood flow to the extremities, including the brain, causing strokes

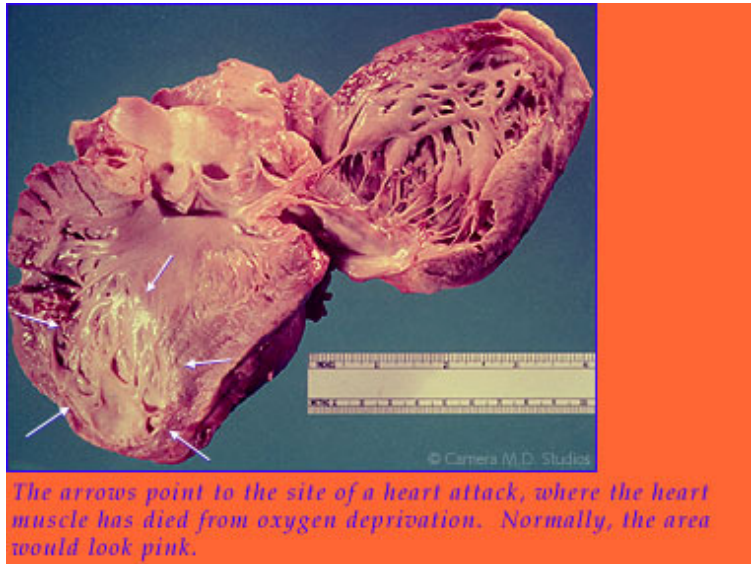


4.4 – Heart Intervention

- EQs 1 & 2 – What is heart disease? What happens inside the heart to cause a heart attack?

Heart disease occurs when damage to the heart has been done. Damage could occur because of: infection, lack of oxygen, occluded arteries. Damage will affect heart function and the efficiency that oxygen is transported to the body's tissues.

Heart attacks (myocardial infarction) occur when the muscle of the heart doesn't receive enough oxygen and the muscle cells die.



- EQs 4-6 – What are risk factors for the development of heart disease? How can a person decrease his/her risk of heart disease? What is metabolic syndrome?

The risk factors for heart disease are:

- Smoking
- Family History
- Diabetes
- High blood sugar
- High cholesterol (High LDL, low HDL)
- Obesity
- High triglycerides
- High Blood Pressure
- The last 5 make up **metabolic syndrome**.
If you have 3 or more, you increase your risk of heart disease.

A person can reduce his/her risk of heart disease if:

- Increase exercise
- Maintain a diet low in fat and excessive carbohydrates
- Take prescribed medication
- Quit smoking
- Maintain a healthy weight

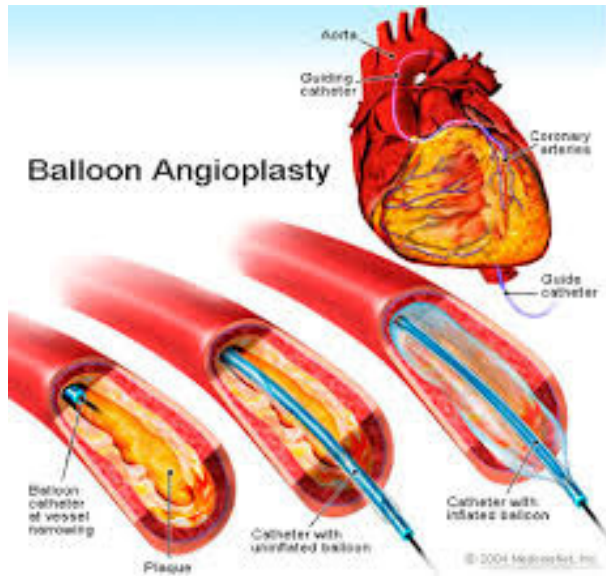
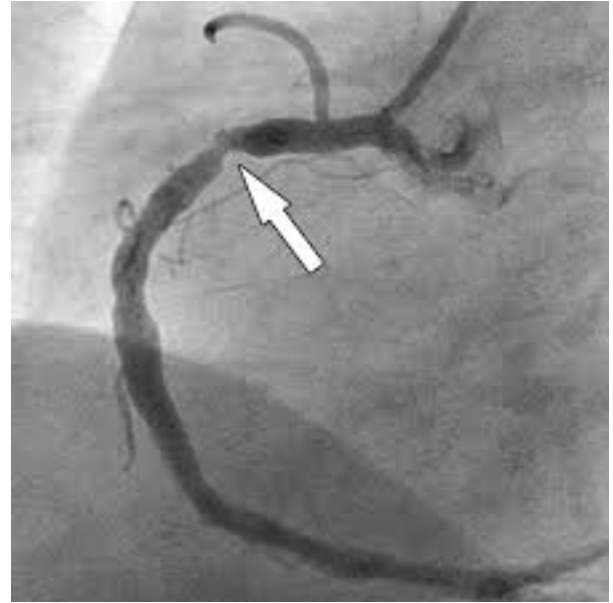


• EQ 3 – How do doctors treat a blocked blood vessel?

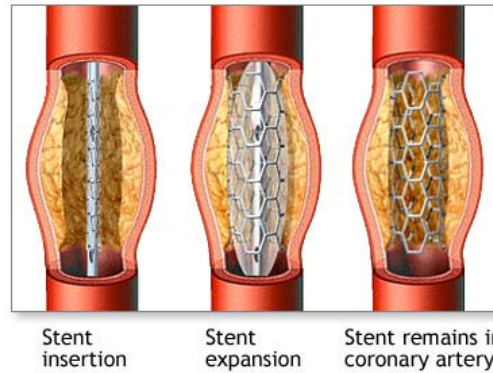
Diagnosis – Use an **angiogram** to detect a blocked blood vessel. A radioactive dye is injected into the blood and X-rays are used to view the passage of the blood through the blood vessels

Treatments

1. **Angioplasty** – A balloon is inserted via a catheter and is blown up to expand the artery to push the plaque against the walls and restore blood flow



2. **Stent** – Wire mesh is inserted into the artery and compresses the plaque. It then stays that way allowing for proper blood flow.



3. **Coronary Artery Bypass Graft (CABG)** – A vessel, usually from the leg, is taken and inserted on the heart to bypass the clogged area of the coronary artery to restore blood flow.

Coronary Artery Bypass Surgery

