Year 12 - AS

SGS -PE

Section A : Anatomy And Physiology

Name .....

Form.....

Staff.....

Anatomy and Physiology

This section focuses on the impact of physical activity on the systems of the body and on young people's participation and performance in physical activity as part of a balanced, active and healthy lifestyle.

Candidates will develop their knowledge and understanding of anatomical and physiological factors affecting body and mind readiness. This will lead to an improvement in the effectiveness and efficiency of their performance in roles such as performer, leader/coach and official.

The application of the knowledge gained will enable candidates to evaluate lifestyle choices critically in relation to their impact on body systems and lifelong participation in physical activity.

The skeletal and muscular systems

A general overview of the skeletal system is required and should include reference to the functions of the skeleton, the axial and appendicular skeleton and types of bone and cartilage.

Name the functions of the skeletal system

Functions

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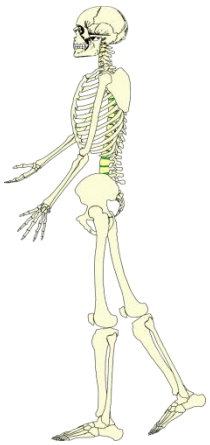
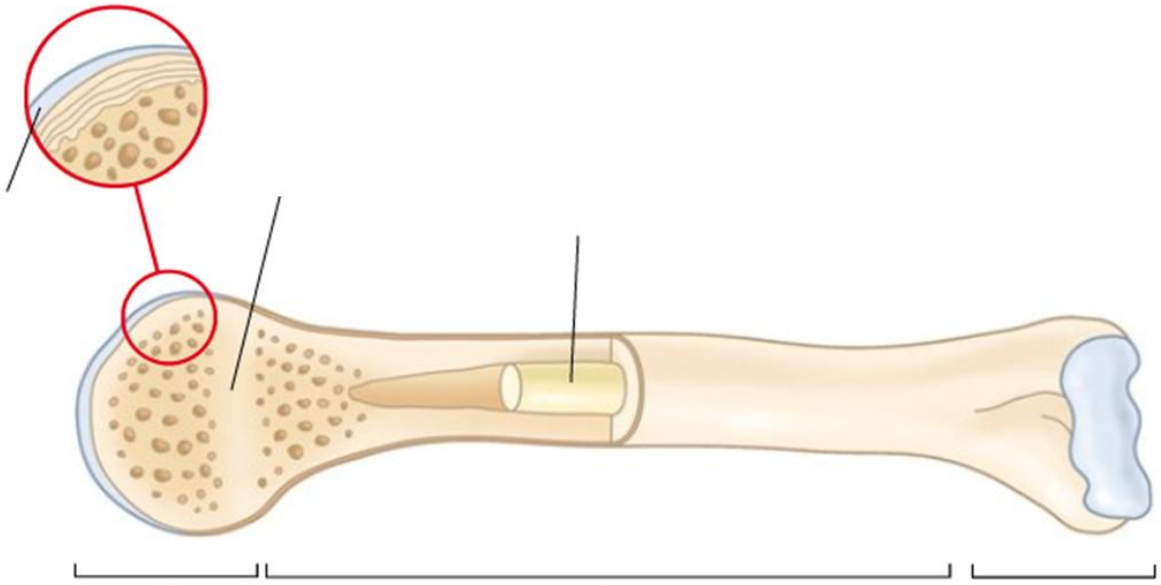
- .....



Label the structure of the long bone below



Long bone is one of five types of bone found in the skeleton. Identify and give examples of the other four types of bone

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Articular cartilage is one of the three types of cartilage found in the human body. Identify, outline the function and give examples of the other two types of cartilage.

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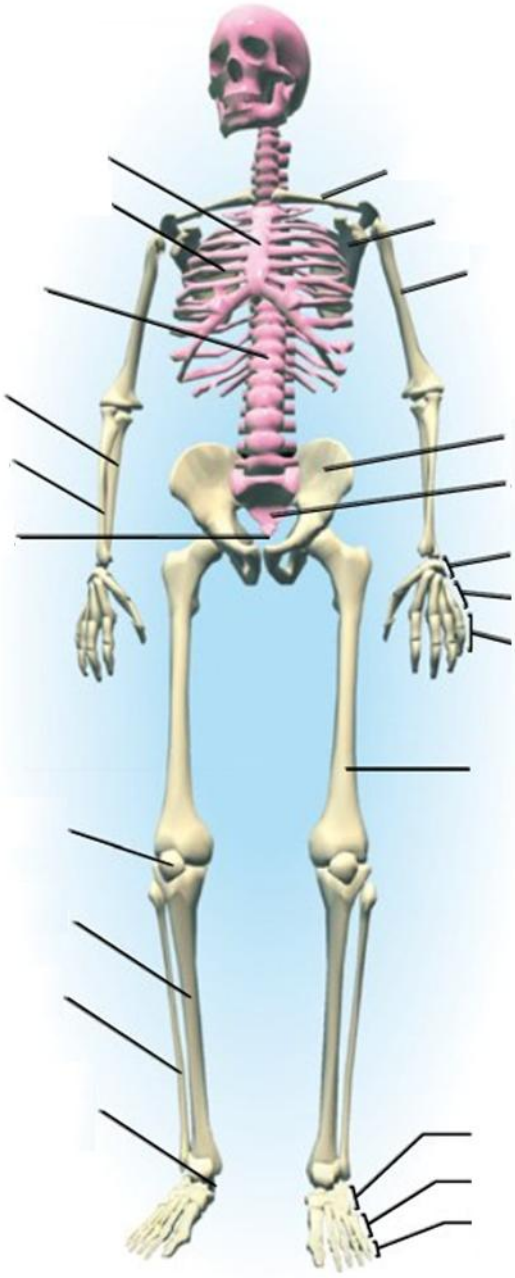
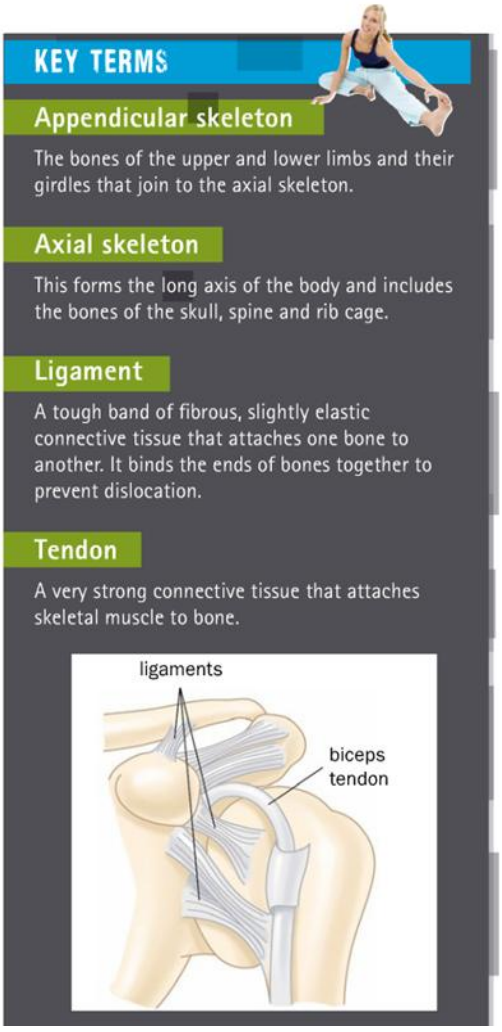
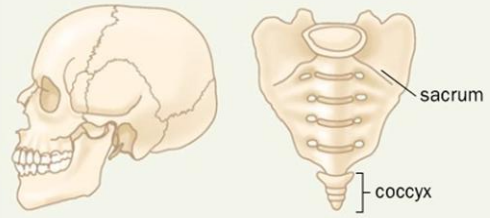
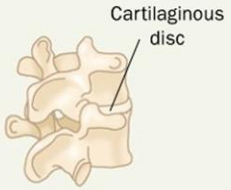
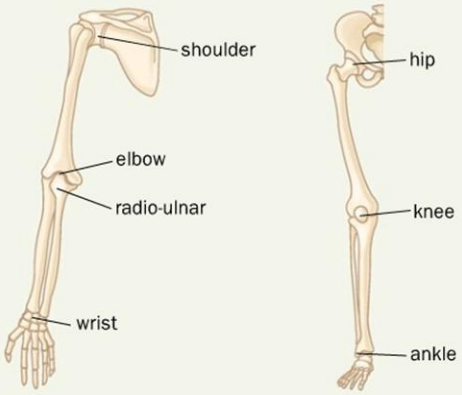
Label the skeleton below and fill in the key to indicate the Axial and Appendicular skeleton



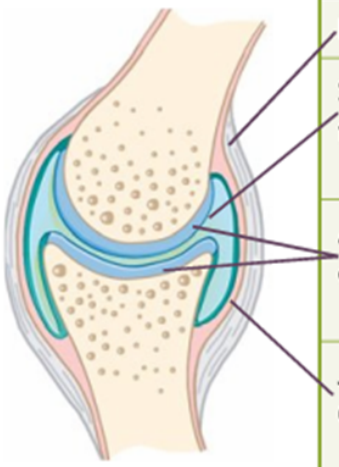


Key

Using the table and pictures below name the 3 classes of joint found in the body and state the differences between them

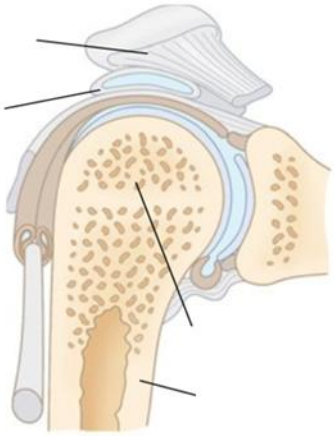
Class of joint	Mobility	Stability	Examples from the skeleton	Diagram
Fibrous				
Cartilaginous				
Synovial				

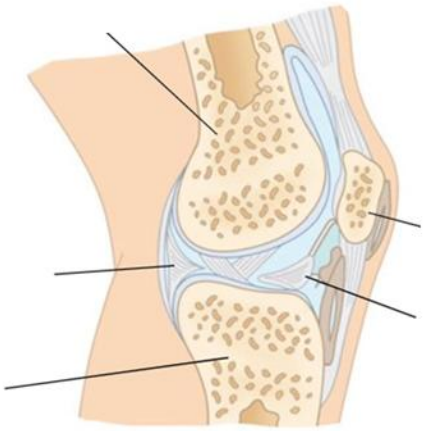
Fill in the table below showing the four main distinguishing features of a synovial Joint

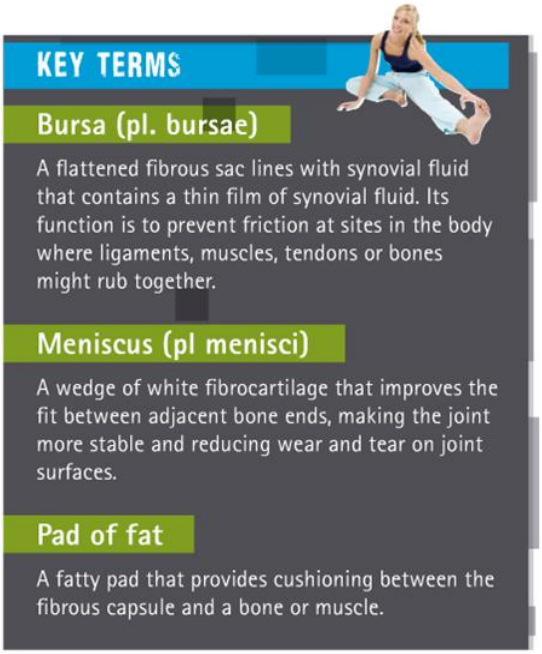


Feature	Structure	Function
Ligament		
Synovial fluid		
Articular cartilage		
Joint Capsule		

Label three of the most commonly identifiable synovial joints







Synovial joints require a fine balance between stability and mobility. From your knowledge of the general structure of synovial joints:

1. List two features that increase joint stability, giving a specific function for each.

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2. List two features that increase joint mobility, giving a specific function for each.

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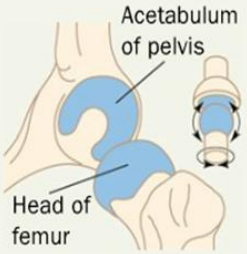
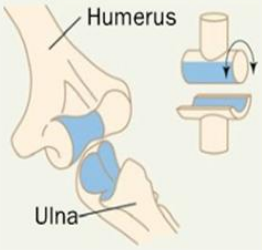
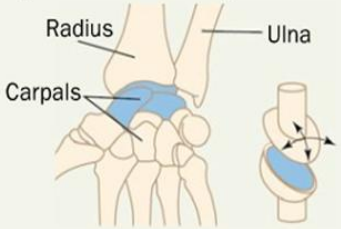
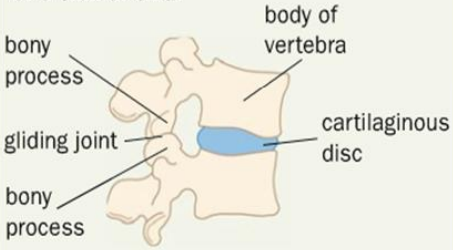
The table below shows the mobility at the 5 different types of synovial joint. Fill in the two blank columns

Type of Synovial Joint	Examples from the skeleton	Description	Mobility
		A ball shaped head of one bone articulates with a cup like socket of an adjacent bone. 	Movement can occur in three planes. This joint allows the greatest range of movement.
		A cylindrical protusion of one bone articulates with a trough-shaped depression of an adjacent bone. 	Movement is restricted to one plane. This joint allows bending and straightening only.
		A rounded or pointed structure of one bone articulates with a ring-shaped structure of an adjacent bone. 	Movement is restricted to one plane. This joint allows rotation about its longitudinal axis only.
		Similar to a ball and socket joint but with much flatter articulating surfaces forming a much shallower joint. 	Movement can occur in two planes. This joint allows the second greatest range of movement.
		Articulating surfaces are almost flat and of a similar size. 	Gliding allows movement in three planes, but it is severely limited.

Joints, Muscles and Movements

Candidates should be able to demonstrate knowledge and understanding of the

- wrist: flexion and extension; wrist flexors and extensors;
- radio-ulnar: pronation and supination; pronator teres and supinator muscle;
- elbow: flexion and extension; biceps brachii and triceps brachii;
- shoulder: abduction, adduction, flexion, extension, rotation, horizontal flexion, horizontal extension, circumduction; deltoid, latissimus dorsi, pectoralis major, subscapularis, infraspinatus, teres major and teres minor; trapezius; the role of the rotator cuff muscles, supraspinatus infraspinatus, teres minor and subscapularis;
- spine (cartilaginous, gliding and pivot): flexion, extension, lateral flexion; rectus abdominus, external and internal oblique and the erector spinal group; sacrospinalis (the role of the transverse abdominus and multifidus in relation to core stability);
- hip: abduction, adduction, flexion, extension, rotation illiopsoas, gluteus maximus, medius and minimus, adductor longus, brevis and magnus;
- knee: flexion and extension; biceps femoris, semi-membranosus , semi-tendinosus, rectus femoris, vastus lateralis, vastus intermedius and vastus medialis;
- ankle: dorsi flexion, plantar flexion; tibialis anterior, soleus and gastrocnemius.

For each of the following movement identify a sporting example. Some of them have been done for you

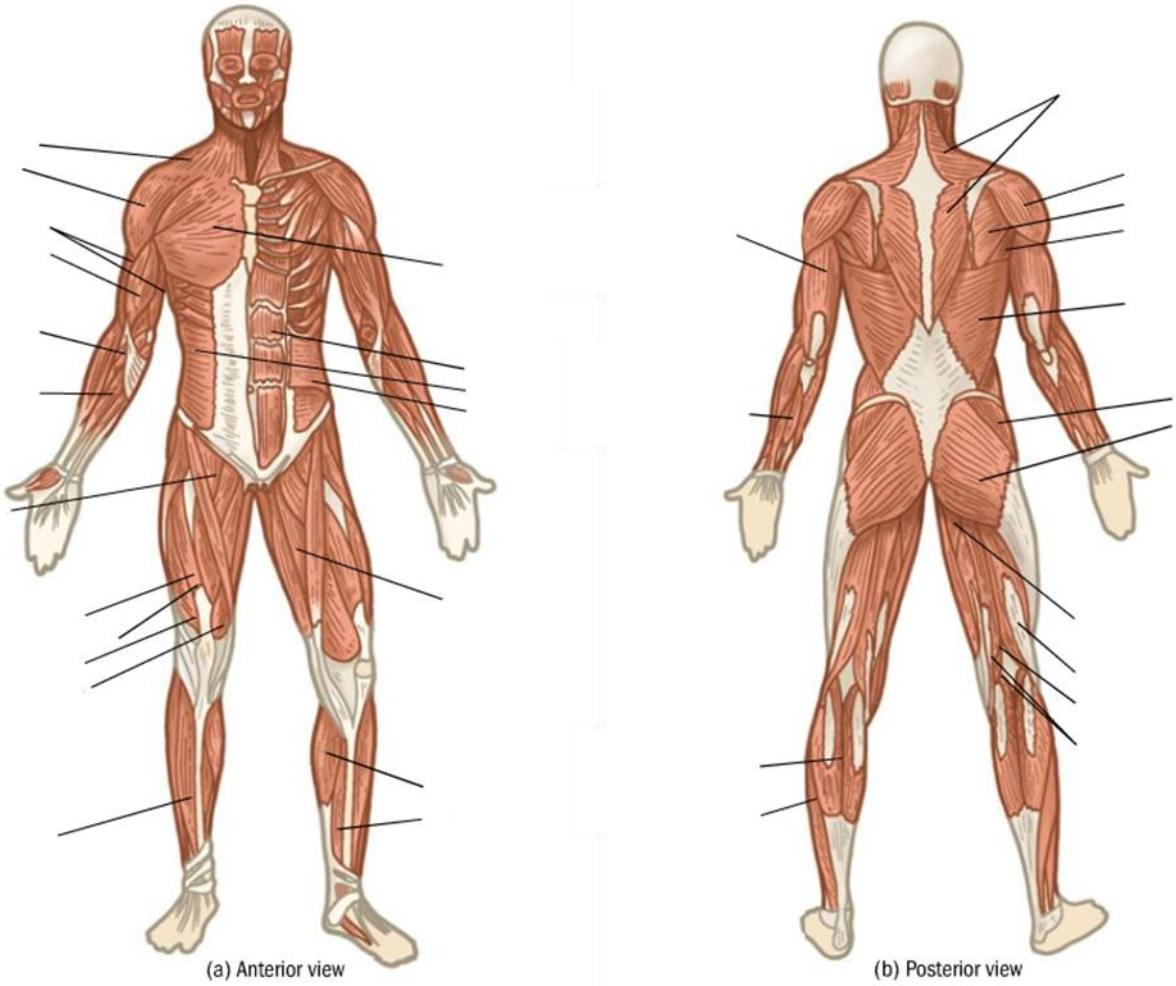
- Flexion at the Wrist – *During the follow-through a set shot in basketball*
- Extension at the Wrist.....
- Flexion at the Elbow.....
- Extension at the Elbow.....
- Flexion at the Shoulder.....
- Extension at the Shoulder.....
- Flexion at the Spine.....
- Extension at the Spine.....
- Flexion at the Hip.....
- Extension at the Hip.....
- Flexion at the Knee.....
- Extension at the Knee.....
- Horizontal flexion at the Shoulder – *The throwing arm during the execution phase of a disc throw*
- Horizontal extension at the Shoulder.....
- Abduction of the Shoulder.....
- Adduction of the Shoulder.....
- Abduction of the Hip – *The upward phase of a straddle jump*
- Adduction of the Hip.....
- Rotation of the Shoulder.....
- Rotation of the Hip.....
- Circumduction of the Shoulder.....
- Pronation of the Forearm.....

- Supernation of the Forearm.....
- Lateral flexion of the Spine.....
- Dorsiflexion of the Ankle.....
- Plantar flexion of the Ankle.....

There are over 600 skeletal muscle in the body but, don't worry, you do not need to know them all! Most of the muscles you will need to know are shown in the diagram below.

Most of the Muscles we will look at extend from one bone to another, are attached in at least two places and cross at least one joint.

Label the skeletal muscles in the diagram below



What is a muscle origin.....
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What is a muscle insertion.....
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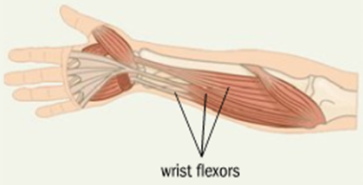
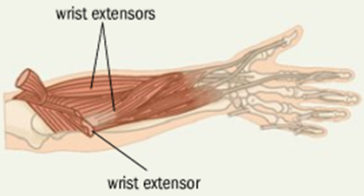
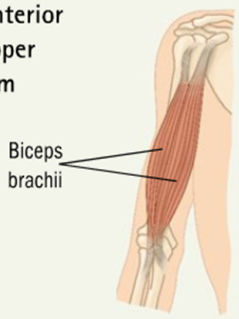
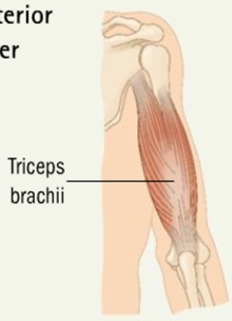
Location and Actions of Specific Muscles

Fill in the tables below to show the locations and actions of the specific muscles involved in the joint movements

Joint	Joint movement	Muscle responsible	Location
			Anterior forearm 
			Posterior forearm 

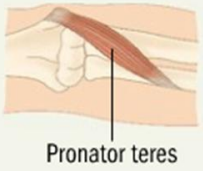
REMEMBER

The wrist joint is a condyloid joint with its articulating bones being the radius, ulna and carpals.

Joint	Joint movement	Muscle responsible	Location
			Anterior upper arm 
			Posterior upper arm 

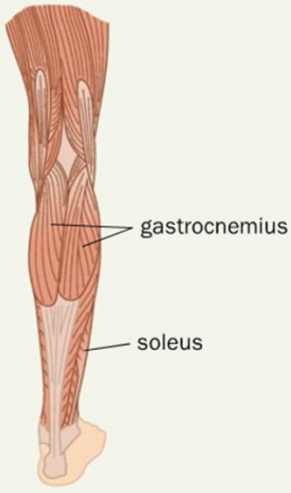
REMEMBER

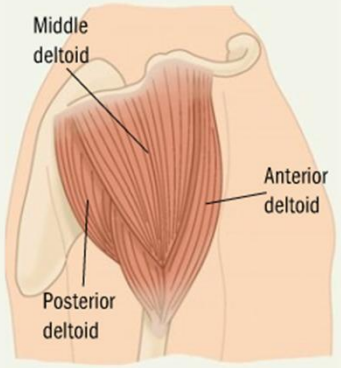
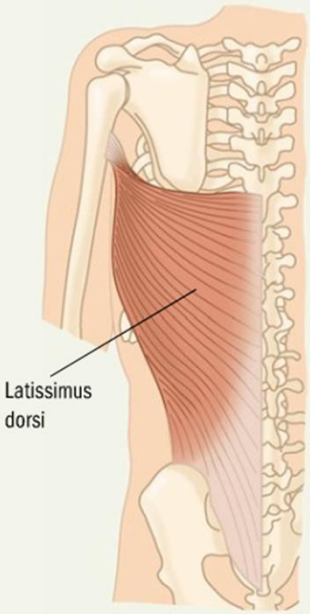
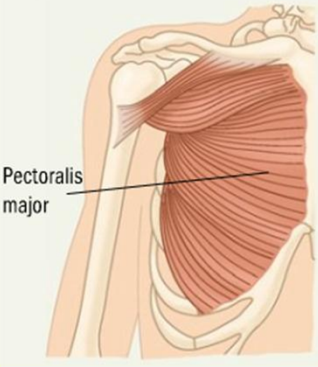
The elbow joint is a hinge joint with its articulating bones being the humerus, radius and ulna.

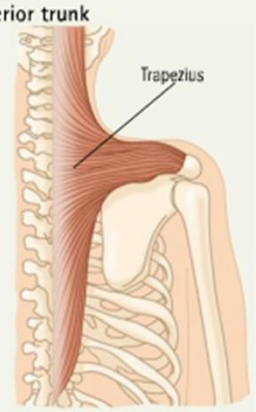
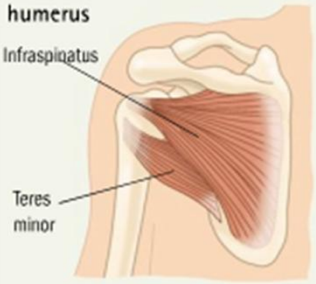
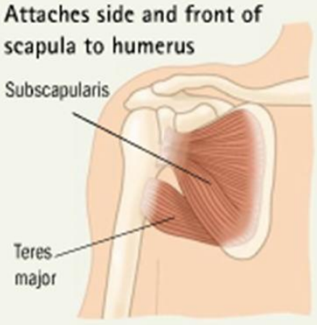
Joint	Joint movement	Muscle responsible	Location
			Superior anterior forearm 
			Lateral anterior forearm 

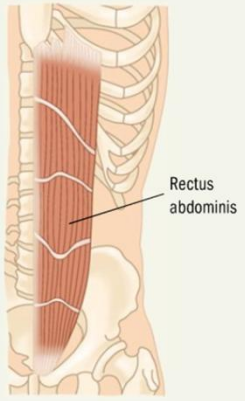
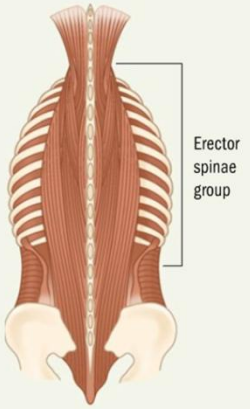
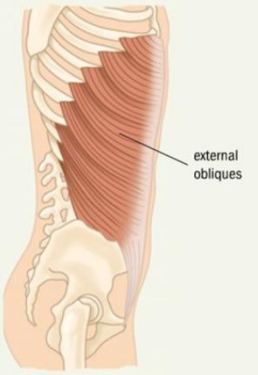
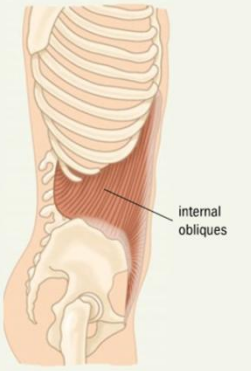
REMEMBER

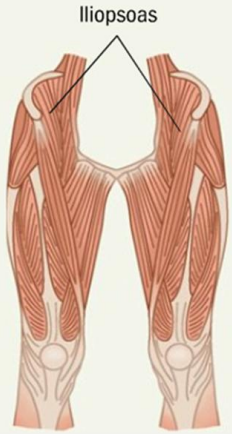
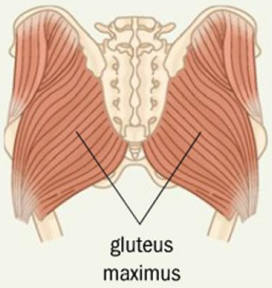
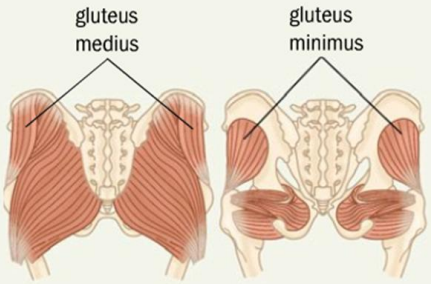
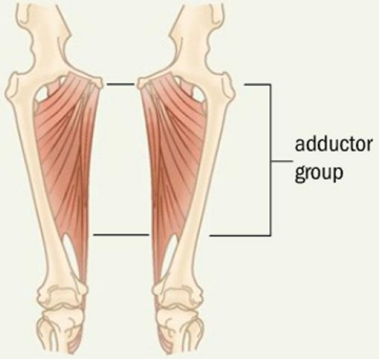
The radio-ulnar joint is a pivot joint with its articulating bones being the radius and ulna.

Joint	Joint movement	Muscle responsible	Location of muscle
			Cover anterior tibia 
			Calf muscles 

Joint	Joint movement	Muscle responsible	Location of muscle
			Covers shoulder joint 
			Posterior trunk 
			Top of chest 

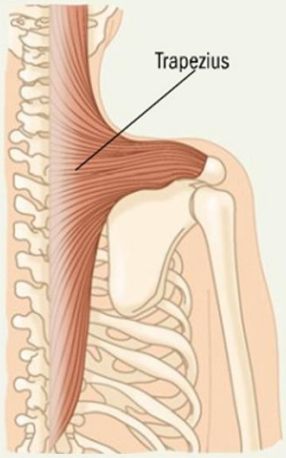
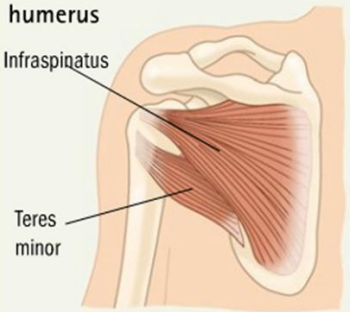
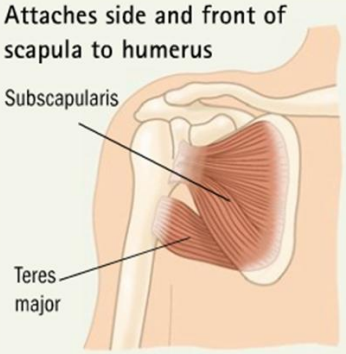
Joint	Joint movement	Muscle responsible	Location of muscle
			Posterior trunk 
			Attaches back of scapula to humerus 
			Attaches side and front of scapula to humerus 

Joint	Joint movement	Muscle responsible	Location of muscle
			Middle of abdomen 
			Covers length of spine 
			Lateral abdomen 
			Lateral abdomen beneath external obliques 

Joint	Joint movement	Muscle responsible	Location of muscle
			Anterior pelvis 
			Posterior pelvis 
			Lateral hip (minimus is underneath medius) 
			Medial thigh 

REMEMBER

The gluteus maximus also produces lateral rotation of the hip, while the gluteus minimus produces medial rotation.

Joint	Joint movement	Muscle responsible	Location of muscle
			Posterior trunk 
			Attaches back of scapula to humerus 
			Attaches side and front of scapula to humerus 

What is the *rotator cuff* and how does it affect the stability of the shoulder?

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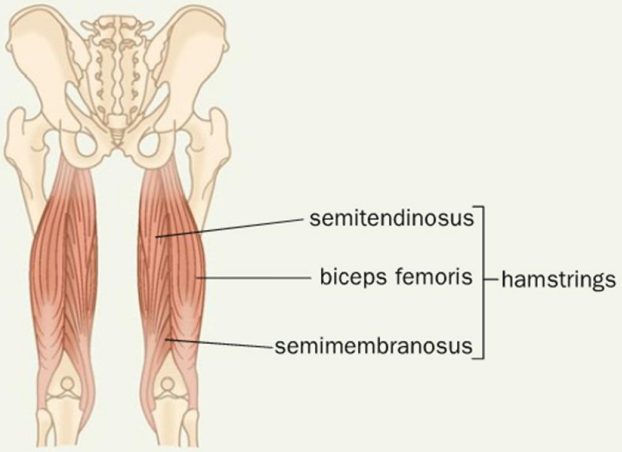
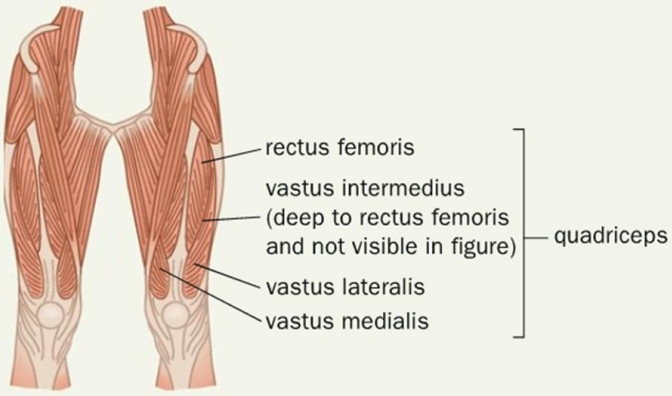
Joint	Joint movement	Muscle responsible	Location of muscle
			Posterior thigh 
			Anterior thigh 

The role of muscular contraction

Candidates should be able to:

- explain concentric eccentric and isometric contraction

State the three types of muscular contractions and give a sporting example for each one

1.....

Example.....

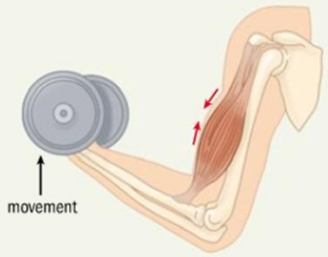
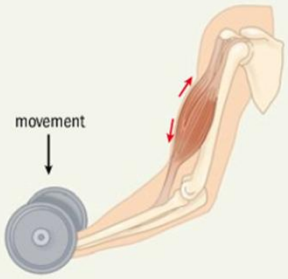
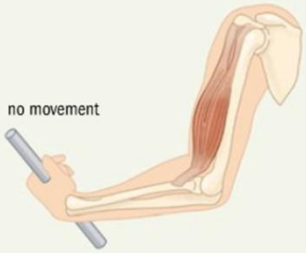
2.....

Example.....

3.....

Example.....

Fill in the titles for the correct muscular contractions

		
• ??????? contraction in the biceps brachii during upward phase of exercise. • the biceps brachii produces tension and *shortens*. • it pulls the forearm upwards to *cause* flexion of the elbow.	• ??????? contraction occurs in the biceps brachii during the downward phase of the exercise. • the biceps brachii produces tension and *lengthens*. • it slows the lowering of the forearm and *controls* extension of the elbow.	• ??????? contraction occurs in the biceps brachii when the muscle is holding the weight still. • the biceps brachii develops tension and *stays the same length*. • it *stops* flexion and extension of the elbow.

What is the difference between an Agonist, Antagonist and a fixator muscle?

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Movement analysis of physical activity

Candidates should be able to:

- Carry out movement analysis making reference to joint type, the type of movement produced, the agonist and antagonist muscle (or muscles) in action and the type of muscle contraction taking place.

Look at the picture of the British gymnast.

Try to complete the grid with the joint type, joint movement, agonist, contraction type and antagonist.

Remember that when the grid asks for the right or left side, it means the performers right or left side.

Joint	Joint Type	Joint Movement	Agonist	Contraction Type	Antagonist
Right Hand					
Right Elbow					
Right Shoulder					
Spine					
Right Hip					
Right Knee					
Right Ankle					

Joint	Joint Type	Joint Movement	Agonist	Contraction Type	Antagonist
Right Shoulder					
Left Elbow					
Left Shoulder					
Right Hand					
Spine					

Fill in the table above using the photo of tiger Woods

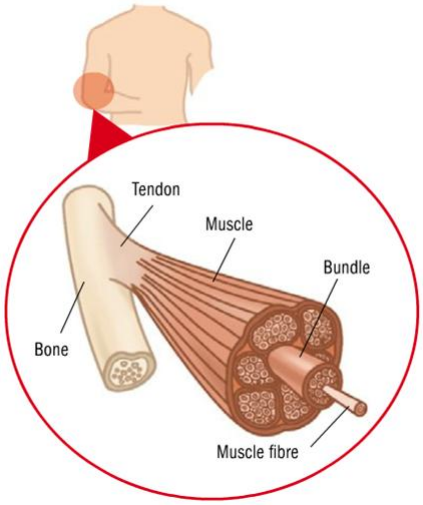
Muscle fibre types in relation to choice of physical activity

Candidates should be able to:

- describe the structure and function of the different muscle fibre types (slow oxidative, fast oxidative glycolytic and fast glycolytic) in relation to different types of physical activity;
- explain how an individual's mix of muscle fibre type might influence their reasons for choosing to take part in a particular type of physical activity.

Key terms

Fill in the information for the titles of the key terms below.
Try to include as much information as possible.



Aerobic Exercise

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Anaerobic Exercise

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Slow Twitch Muscle Fibre

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Fast Twitch Muscle Fibre

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Structural Differences			
Characteristics	Slow Twitch (Type 1)	Fast Oxidative Glycolytic (Type 2a / FOG)	Fast Glycolytic (Type 2b / FG)
Fibre Size			
Number of Mitochondria			
Number of Capillaries			
Myoglobin Content			
PC Stores			
Glycogen Stores			
Triglyceride Stores			
Functional Differences			
Speed of Contraction			
Force of Contraction			
Resistance to Fatigue			
Aerobic Capacity			
Anaerobic Capacity			
Activity Suited			
Athletic Activity			

Using the completed table above compare the fibre type make up of a 100 metre sprinter in comparison to a marathon runner.

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What percentage of fibre types do you believe the two have in their Gastrocnemius?

100m Sprinter = ... % Fast Twitch and .....% Slow Twitch

Marathon Runner = ... % Fast Twitch and .....% Slow Twitch

Look at the pictures below and try to identify what you think their muscle type make up is. Try to give reason for your answers

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Explain how an individual's mix of muscle fibre types might influence their reasons for choosing to take part in a particular type of physical activity.

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Warm up / cool-down

Candidates should be able to:

- analyse the effect of a warm up and cool-down on the skeletal muscle tissue in relation to the quality of performance of physical activity.

Fill in the table below with the effects on muscular system with regards to warming up and cooling down

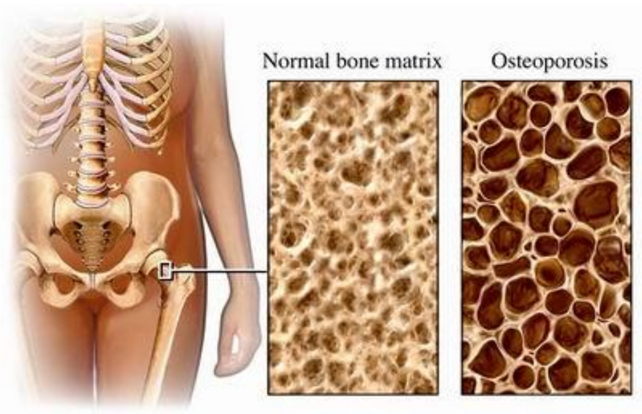
Effect of a warm up on skeletal muscle tissue	Effect of a cool down on skeletal muscle tissue
.... • .... • .... •	• .... • ....

Impact of different types of physical activity on the skeletal and muscular systems

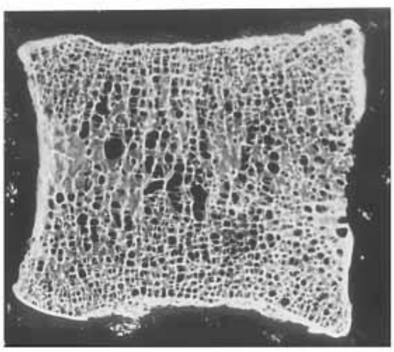
Candidates should be able to:

- evaluate critically the impact of different types of physical activity (contact sports, high impact sports and activities involving repetitive actions) on the skeletal and muscular systems (osteoporosis, osteoarthritis, growth plate, joint stability, posture and alignment) with reference to lifelong involvement in an active lifestyle.

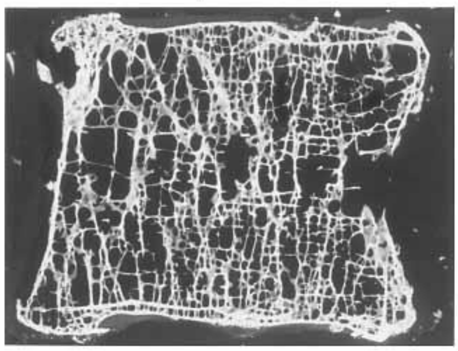
Use the pictures below to describe what osteoporosis is and how it affects your bones density.



L2, 37y.o. male



L2, 75y.o. female



How does physical activity affect Osteoporosis?

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What is a Growth Plate?

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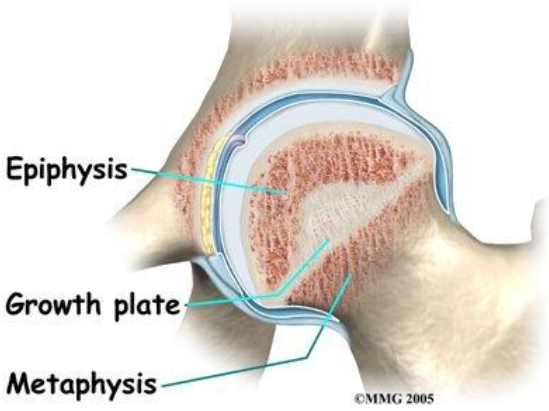

What can happen to the Growth plate during physical activity? Give examples of types of sports, actions and the people that growth plate injuries may affect.

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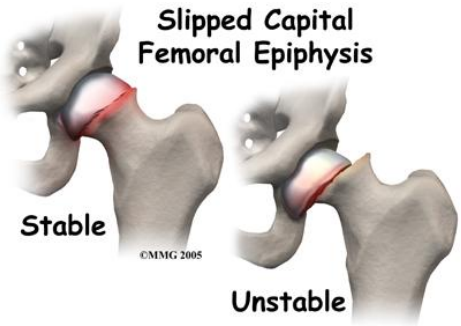

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It appears that there may be a slight disagreement to the value of high impact activities to young people. On one hand health professionals promote this type of activity to increase bone density, but on the other hand, the risk of damage to the growth plate is high.

Could you suggest some guidelines for a young performer taking part in high impact sports.

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Use the pictures below to describe what Osteoarthritis is and how it affects movement

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How does physical activity affect osteoarthritis?

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Weightlifter are prone to early development of osteoarthritis of the knee due to their high body weight. Early development of osteoartritis in the knees of some football players has been attributed to repeated trauma to ligament, bones and cartilage. Interestingly, however, recent studies have not found an increased risk of osteoartritis in long-distance runners. Can you suggest reasons for this?

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There are three main factors that affect joint stability. Names and describe all three in relation to the knee joint.

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2. .....
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3. .....
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Motion and Movement

Basic concepts of Biomechanics

Candidates should be able to:

- define Newton's Laws of Motion;
- describe the types of motion produced (linear, angular or general);
- describe the effect of size of force, direction of the force and the position of application of the force on a body;
- define centre of mass;
- explain the effect of changes in the position of the centre of mass and the area of support when applied to practical techniques;
- carry out a practical analysis of typical physical actions.

State Newton's laws and give a practical example for each

Newton's first law of motion – Law of 'INERTIA'

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Example.....
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Newton's second law of motion – Law of 'ACCELERATION'

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Example.....
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Newton's third law of motion – Law of 'REACTION'

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Example.....
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What is meant by the term 'body'?

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What is motion?

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What is linear motion?

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Give an example

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What is angular motion?

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Give an example

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What is general motion?

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Give an example

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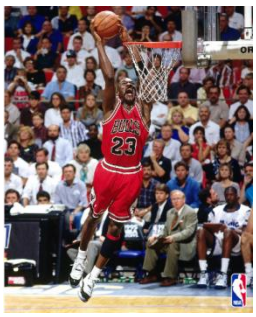



What are the motions above? Label each of the pictures

What is your centre of mass?

.....
.....

Does your centre of mass have to be inside your body?.....

What is the area of support for an athlete?

.....
.....

What is the line of gravity?

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.....

On the pictures below draw on the centre of mass, area of support and line of gravity

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Using the centre of mass, area of support, and line of gravity describe how an athlete or performer maintains and manages their stability

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Explain how a sprinter uses their stability to initiate movement in a sprint start?

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Fill in the table below to explain the effect of force will have on a body during your chosen sporting action (e.g. a tennis ball).

Action	.....
Size of force	.....
Direction of force	.....
Position of application of force	.....

The cardiovascular and respiratory systems in relation to the performance of physical activity and sustained involvement in an active and healthy lifestyle.

Content assumes prior knowledge of the structure and function of the cardiovascular and respiratory systems.

Response of the cardiovascular system to physical activity

Candidates should be able to:

- describe the link between the cardiac cycle (diastole and systole) and the conduction system of the heart;
- describe the relationship between stroke volume, heart rate and cardiac output and resting values for each;
- explain the changes that take place to stroke volume, heart rate and cardiac output during different intensities of physical activity;
- describe the distribution of cardiac output at rest and during exercise (the vascular shunt mechanism);
- explain the role of the vasomotor centre and the involvement of arterioles and pre-capillary sphincters;
- explain how carbon dioxide and oxygen are carried within the vascular system; how effective transportation of carbon dioxide and oxygen within the vascular system aids participation in physical activity; how smoking affects transportation of oxygen;
- define blood pressure and identify resting values;
- explain the changes that occur during physical activity and hypertension;
- explain how venous return is maintained; the effects that a warm-up and cool-down period has on the cardiovascular system; how venous return affects the quality of performance;
- evaluate critically the impact of the different types of physical activity on the cardiovascular system (coronary heart disease (CHD); arteriosclerosis, atherosclerosis, angina, heart attack) with reference to lifelong involvement in an active lifestyle.

On the diagram opposite place the following things

1. Directional arrows to show blood flow around the body
2. Oxygenated and deoxygenated blood

Why is the heart a double pump?

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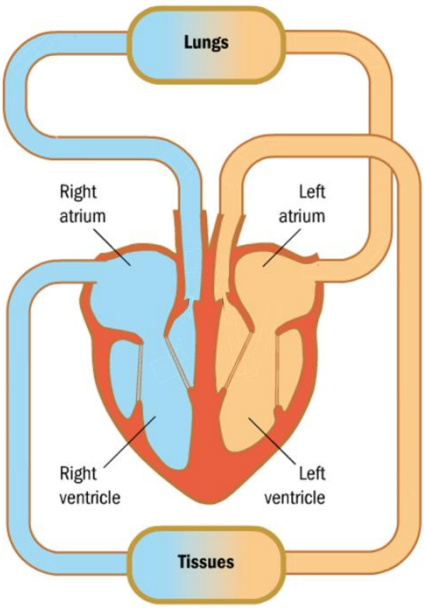

What is the main function of the heart?

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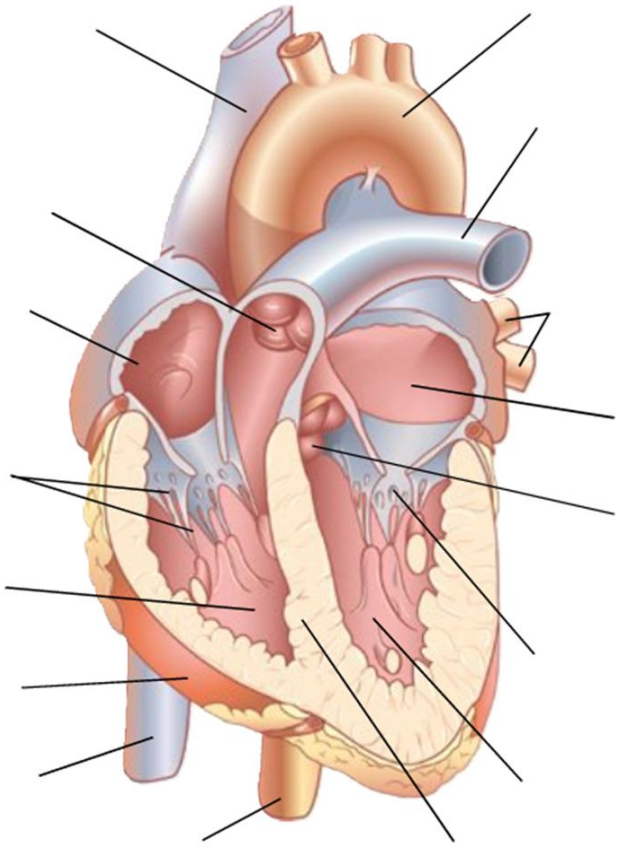

Imagine you are a red blood cell travelling through the body. Describe, step by step, the route taken and whether you are oxygenated or deoxygenated at each stage starting from the right atrium.

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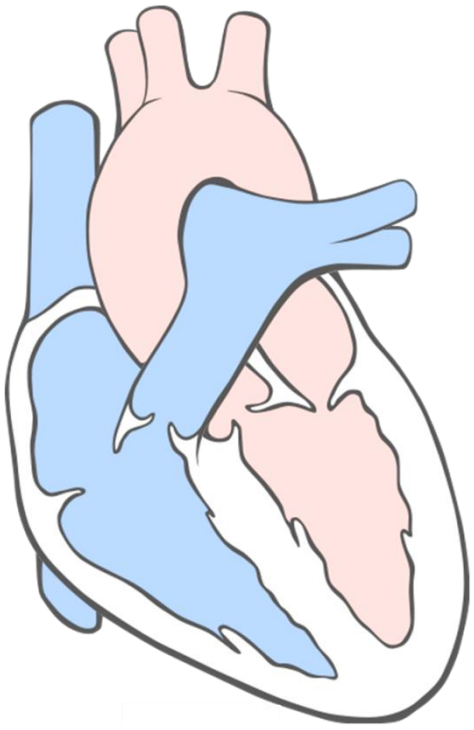
Draw and add the following labels to the diagram

1. SA node
2. Right and Left atria
3. AV node
4. Bundle of His
5. Bundle branches
6. Purkinje Fibres



Use the numbered labels to describe the action of the conduction system in controlling a heartbeat

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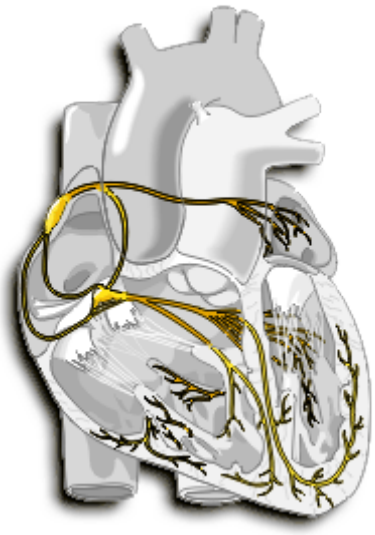

What is Bradycardia?

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What is Hypertrophy?

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What is a cardiac cycle?

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The Cardiac cycle can be broken down into two stages. What are they?

1..... 2.....

Briefly describe what each stage is and how long it lasts for?

1.....
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2.....
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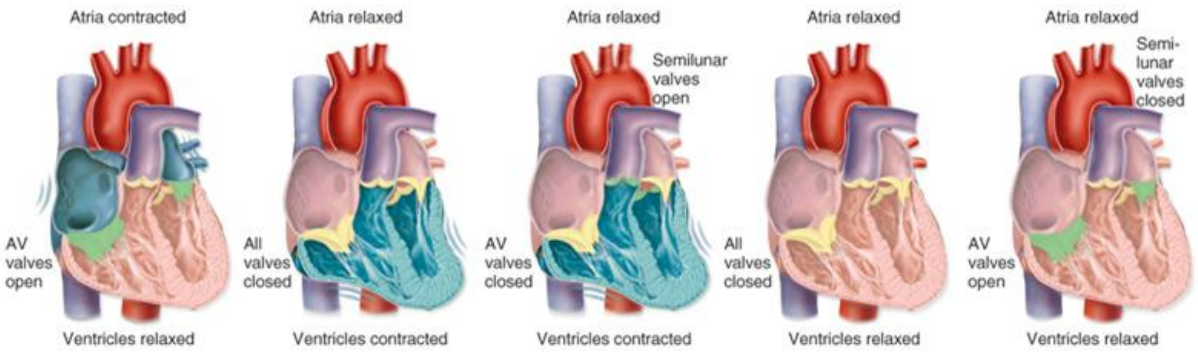

Use the pictures above and your text book to describe in depth the cardiac cycle

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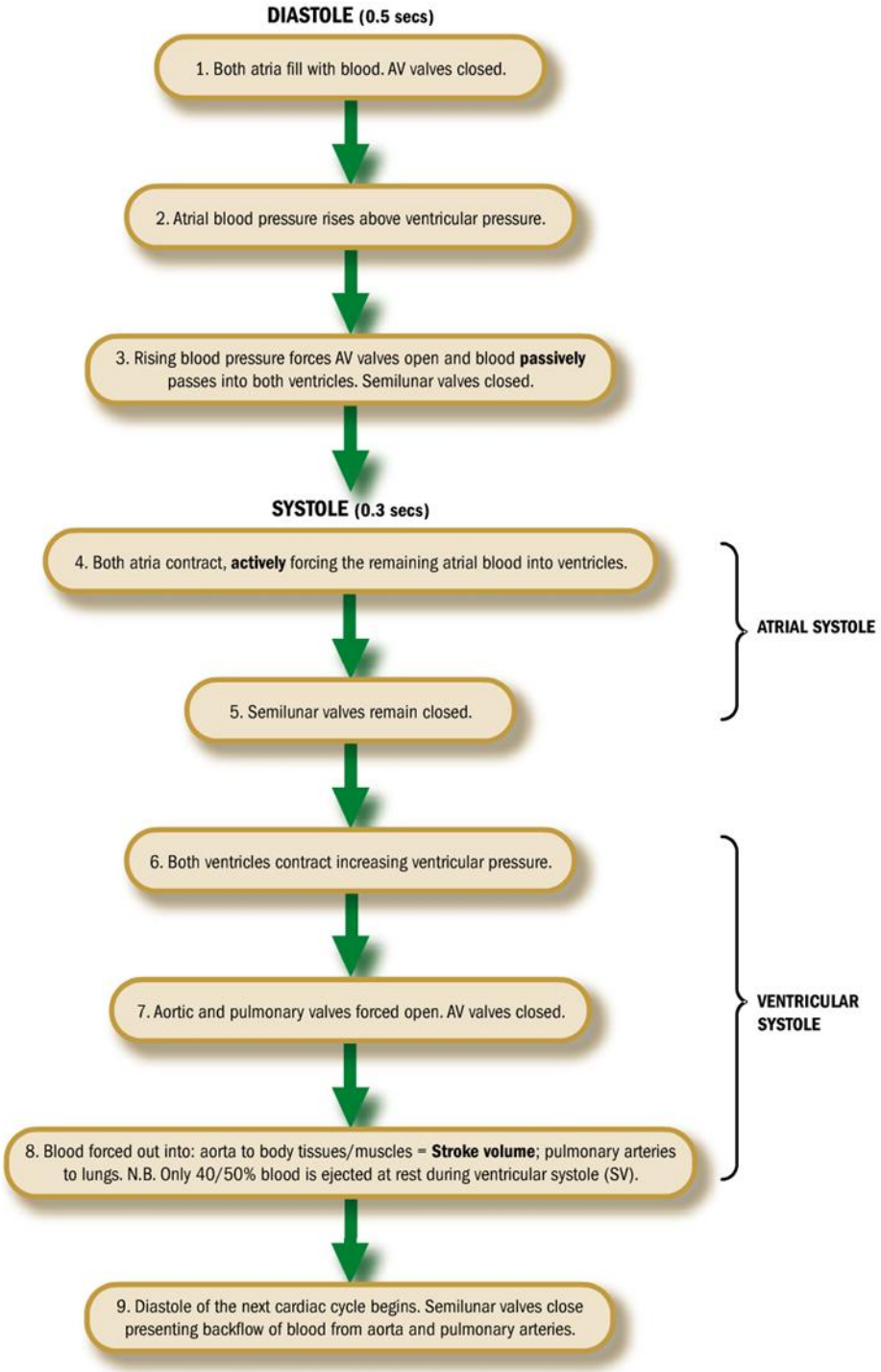
Annotate the flow diagram to include the stages of the conduction system of the heart.



Define heart rate (HR)

.....

What is the equation for working out maximum heart rate?

..... - AGE = MAX HEART RATE (HR)

What is an average resting heart rate?.....

Define strove volume (SV)

.....

What is an average resting stroke volume?.....

Define Cardiac output (Q) in terms of heart rate and stroke volume

.....

..... = ... x .....

If an athlete has a resting Q of 5L/min and a resting heart rate of 60, what is their resting SV?.....

Definition	Heart rate	Stroke Volume	Cardiac Output
Untrained	70bpm	70/72ml	5000ml (5L)
Trained	50bpm	100ml	5000ml (5L)

Look at the table above and give possible reasons as to how and why HR and SV at rest increases in a trained athlete compared to an untrained athlete.

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What is sub maximal exercise?

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As an athlete begins to exercise the heart must increase its output. Why does the heart need to do this?.....
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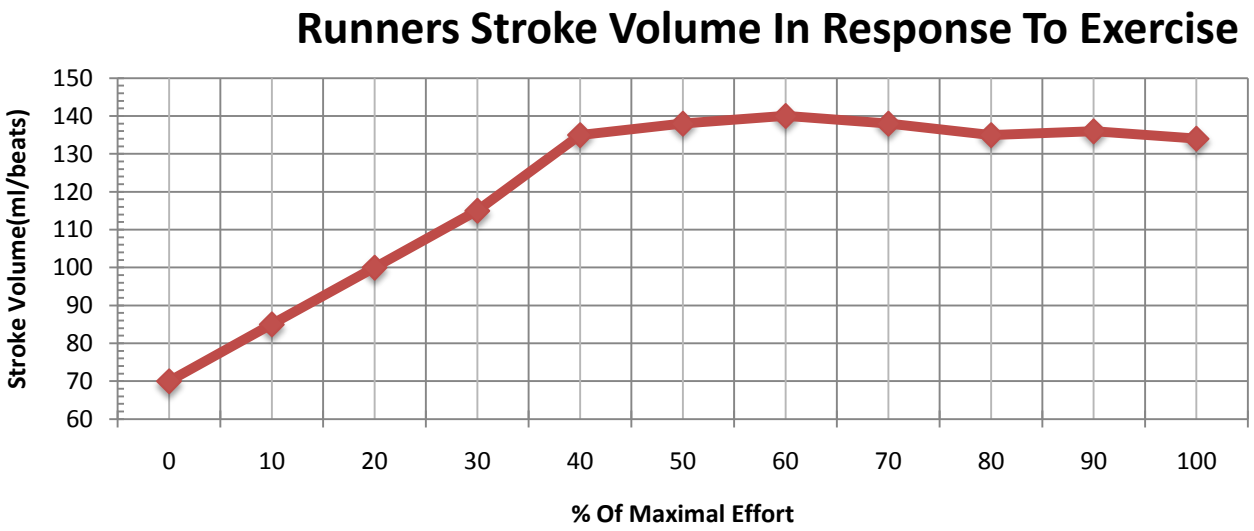

Look at the graph above and comment on the relationship between stroke volume and sub-maximal exercise (60%)

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To understand why stroke volume increase, we need to identify the factors that determine it. Put simple, stroke volume is determined by the heart's ability to fill and empty at each beat

1. The heart's ability to fill is dependent on:
   - .....
     .....
   - .....
     .....
2. The heart's capacity to empty is dependent upon:
   - .....
     .....
   - .....
     .....

As the runner continues towards there maximal exercise intensity level, they will need to increase their cardiac output (Q) further. However, their stroke volume has already reached its plateau (maximal value) during sub-maximal work, what else can happen to increase the Q further?

.....
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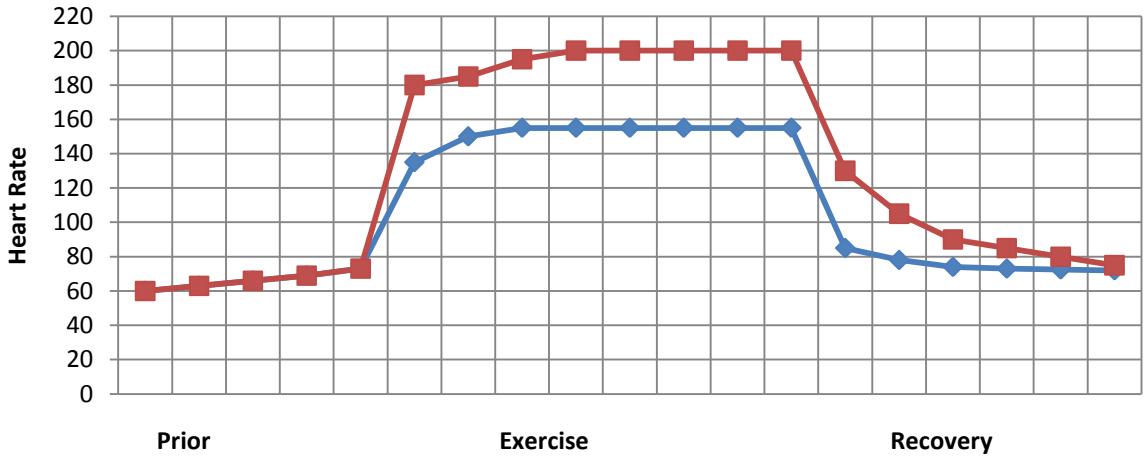
Heart Rate Response To Submaximal and Maximal Exercise



Look at the graph above and analyse the difference and similarities between the heart rates of maximal and sub maximal exercise

Anticipatory rise

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Sharp rise at onset of exercise

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Plateau during exercise

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Recovery

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Why does cardiac output increase during exercise?

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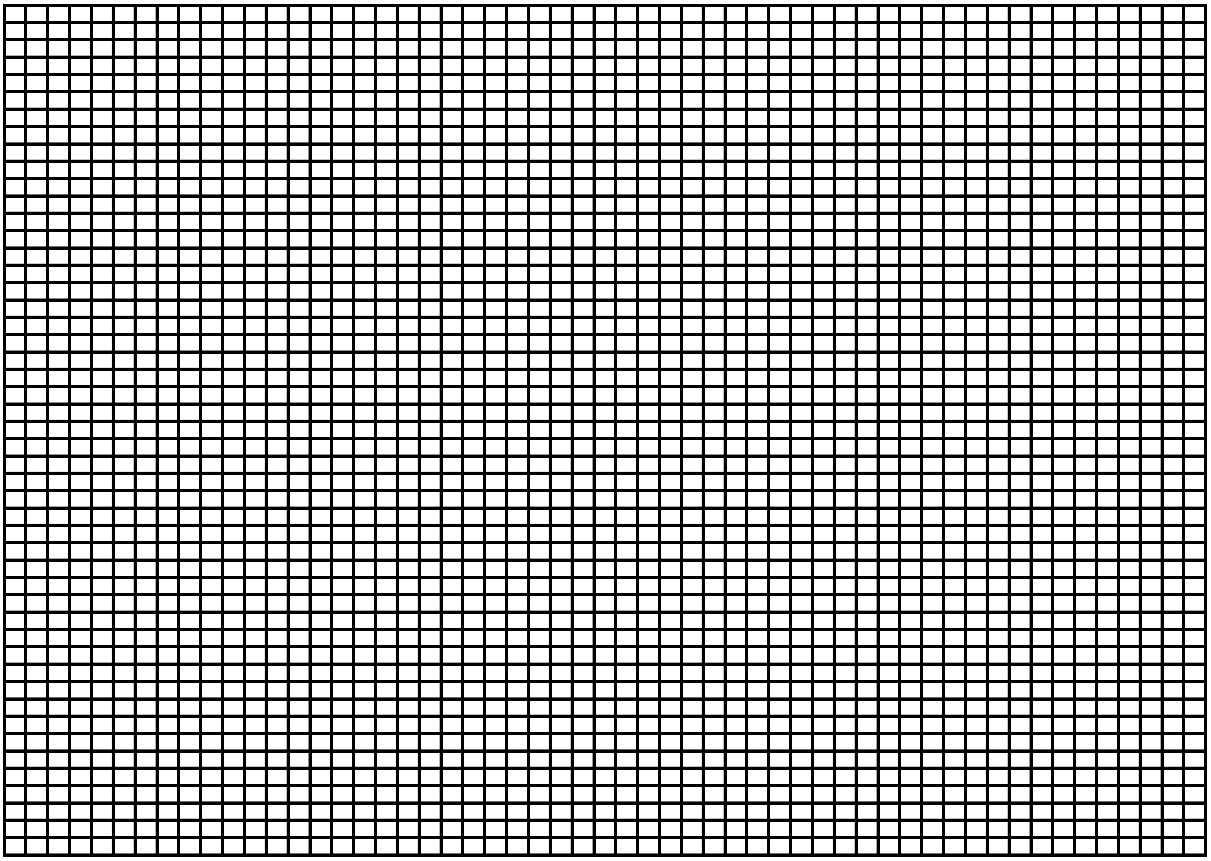
Fill in the chart below with figures for sub-maximal and maximal exercise

Exercise Intensity			
	Resting	Sub-maximal	Maximal
SV	60/80ml		
HRT	70/72bpm		
Q	5L/min		

Measure your heart rate and that of four others in the following positions. Make sure you leave a gap of 2-3mins between each measurement and plot a graph below to show the changes.

Supine (lying flat) - Sitting - Standing - Light Exercise



What is the cardiac control centre?

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Where is the cardiac control centre found in the body?

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The cardiac control centre is controlled by the autonomic nervous system. What does this mean?

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What do sympathetic nerves do?

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What do Parasympathetic nerves do?

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How does the CCC regulate heart rate?

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What are the three main factors that affect the CCC?

1. ……
2. ……
3. ……

During exercise the CCC is stimulated by sensory receptors. What are the three neural control sense receptors and what do they detect?

1. …….
   - ……
     ……
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2. …….
   - ……
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3. …….

- ……
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Which hormone is released into the blood stream before and during exercise, and what area of the heart does it affect?

……
……

What does the word intrinsic mean?

……

What are the factors that effect intrinsic control of heart rate?

1. During Exercise

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- ……
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2. After Exercise

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- ……
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What does the term venous return mean?

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What is Starling's Law of the heart?

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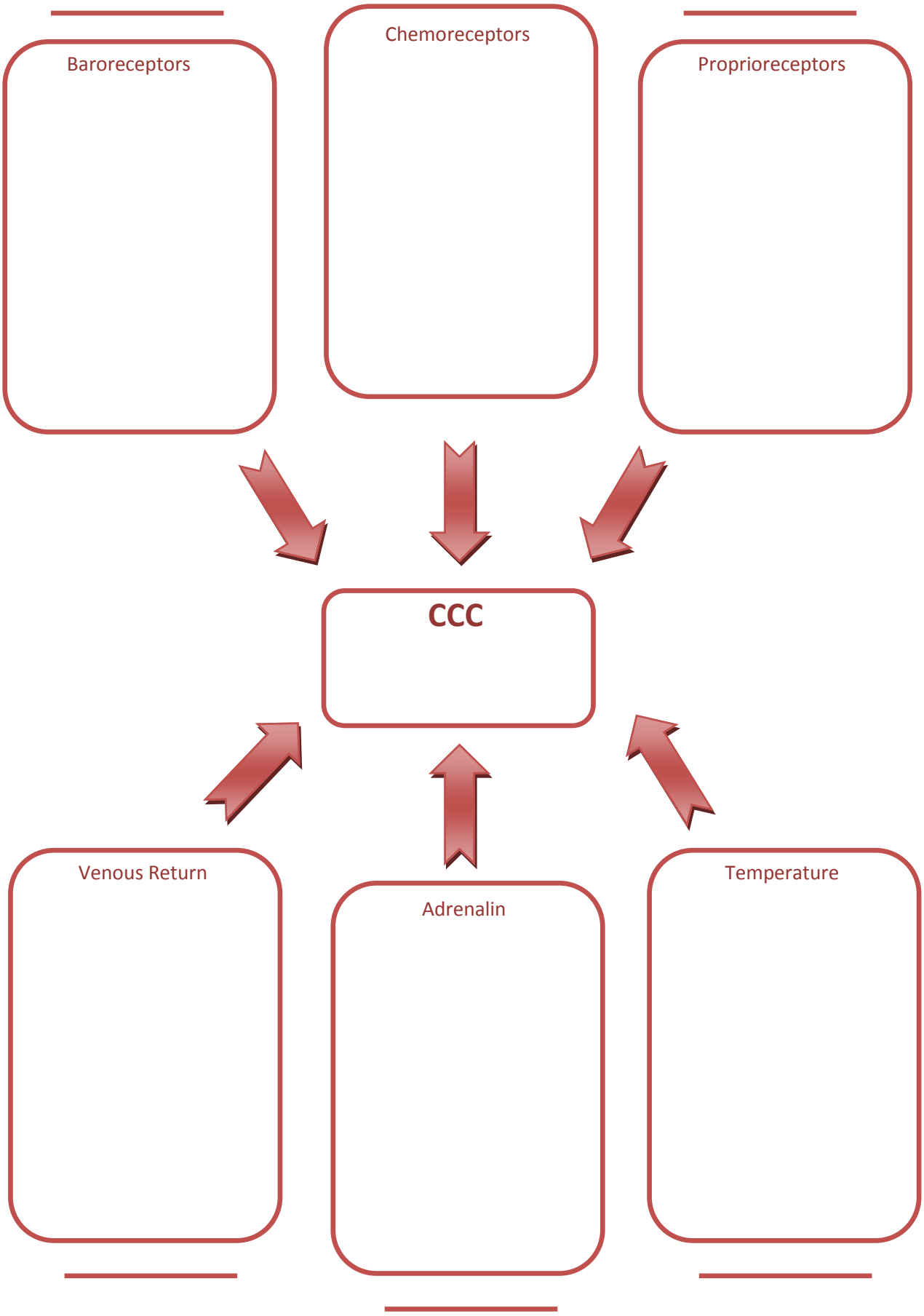
Baroreceptors
Chemoreceptors
Proprioreceptors
CCC
Venous Return
Adrenalin
Temperature

What is the Pulmonary circulation system?

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What is the Systemic circulation system?

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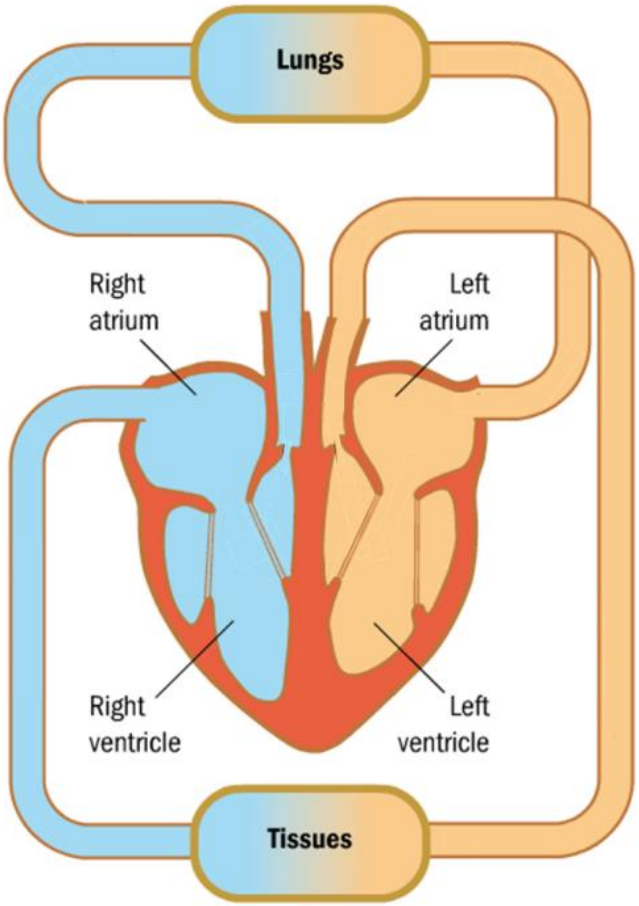
On the diagram below label the Pulmonary and Systemic circulation systems along with the blood vessel and direction of blood



What type of muscle is found in blood vessel walls?.....

What does vasodilation mean?

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What does vasoconstriction mean?

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What is venodilation?

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What is venoconstriction?

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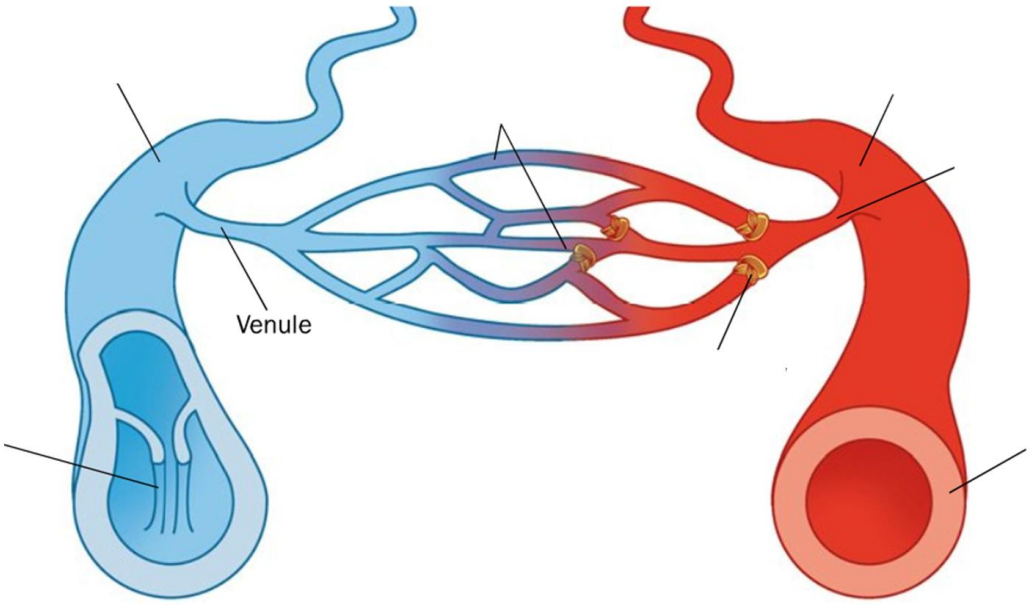
……

What are the three main types of blood vessel?

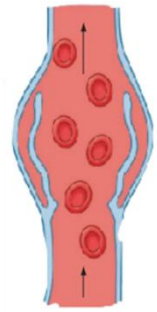
1. ……
2. ……
3. ……

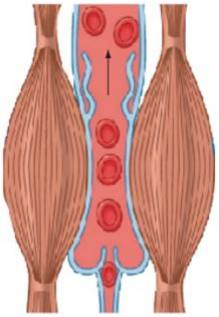
Label the diagram below and annotate the differences between the three types of blood vessel

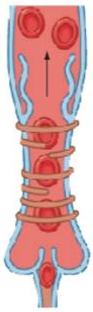


What are the five mechanism that help maintain Venous Return (VR)

1. ……
2. ……
3. ……
4. ……
5. ……







If you increase the stoke volume of the heart what else will be affected?.

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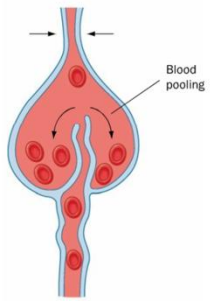
What is blood pooling? Use the diagram to explain what happens when blood pooling takes place.



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Consider the following scenario which is a problem faced by all athletes.

A cyclist completes an exhausting high intensity training programme and immediately stops, climbs off the bike and stands against a wall whilst recovering. Feeling light headed or dizzy they faint, falling to the floor.

Use your knowledge of venous return to explain this sequence of events and give your recommendations to avoid a recurrence.

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What effects would an increased venous return have on the performance of a centre in Netball, or a midfielder in Football?

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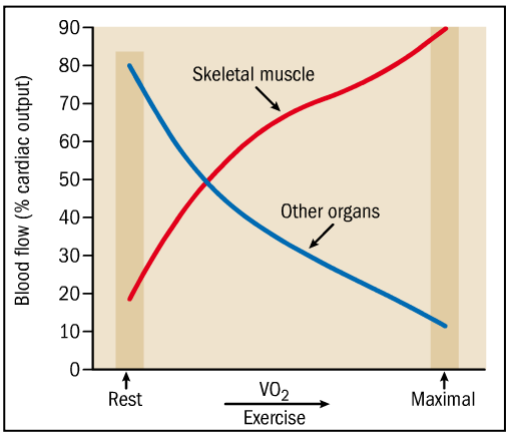
Use the graph to fill in the table below with figures for cardiac output %

	Skeletal Muscle	Other organs
Rest		
Maximal Exercise		



What is the process of redistributing cardiac output around the body called?

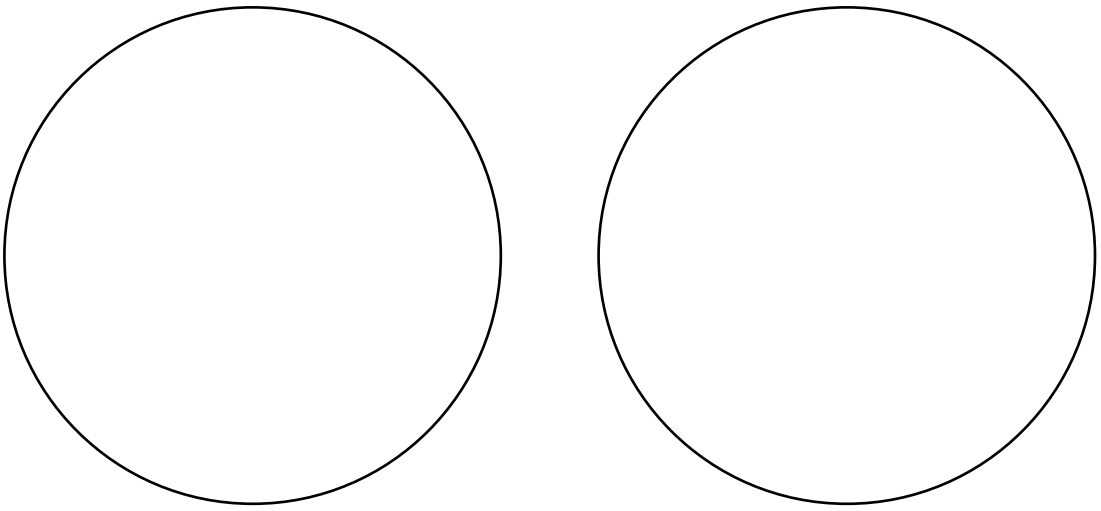
.....

Fill in the table below with the % of redistributed blood for the different intensities of exercise

Tissue	Rest		Light Exercise		Moderate Exercise		Maximal Exercise	
	%	ml	%	ml	%	ml	%	Ml
Liver		1350		1100		600		300
Kidneys		1100		900		600		250
Brain		700		750		750		750
Heart		200		350		750		1000
Muscle		1000		4500		12500		22000
Skin		300		1500		1900		600
Other		350		400		500		100
Total	100	5000	100	9500	100	17600	100	25000

To help with the %'s use the formula (Tissue ml / Total ml) x 100 = % of Distributed blood

Once you have completed the table fill and label to two pie charts below for the distribution of blood at rest and maximal exercise



Why does an athlete move blood to the skin during exercise?

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Can you explain why there is a drop in distributed blood to the skin when an athlete is working at maximal intensities

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Let us use the example of the cyclist to explain the distribution of blood and why they fainted after a bout of exercise

At rest and prior to training, the cyclist's cardiac output (Q) was spread around the _____ organs and _____ related to resting needs for _____. When exercise began, _____ muscle in the legs increase its demand for _____ and blood flow was increased. In contrast, the tissue and organs not directly required during exercise (l_____, k_____, intestines etc.) had their blood flow _____.

Initially blood flow to the skin surface _____ to help decrease rising _____, but as the intensity of exercise increased, the ever-increasing demand for _____ by the muscles overrode the need to _____ temperature, and blood flow to the skin _____. Once exercising stopped, Q was gradually redistributed back towards resting levels as the body recovered.

Fainting

In immediately stopping and standing still, blood _____ occurred in the pocket valves of the veins in the cyclist's legs due to insufficient p_____ to maintain venous return against g_____. By immediately stopping the cyclist switched off the m_____ and r_____ pump mechanisms of _____ _____. As venous return decreases, _____ _____(SV), and therefore Q, decreased (_____ Law of the heart) and reduced blood pressure thus threatening the blood supply to the brain which simply responded by making the cyclist dizzy and faint.

The cyclist fell which lowered the head, which aided _____ _____ and therefore blood pressure, SV and Q, restoring blood flow to the brain. Recall that an active _____-_____ is essential to maintain venous return and prevent blood pooling.

Which control centre is responsible for the redistribution of blood during rest and exercise and where is it found in the body?

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Which part of the nervous system is used to send messages to control the redistribution of blood?

.....

Which of the blood vessels is primarily responsible for the vascular shunt mechanism?

.....

The vasomotor control centre receives information from two main receptors. What are they, where are they found and what do they detect?

1.....

2.....

What is the term vasomotor tone referring to with regards to the pre-capillary sphincters?

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During Exercise how does the vasomotor control centre (VCC) control the flow of blood to the organs and muscles?

Organs

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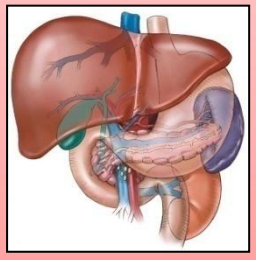

Muscles

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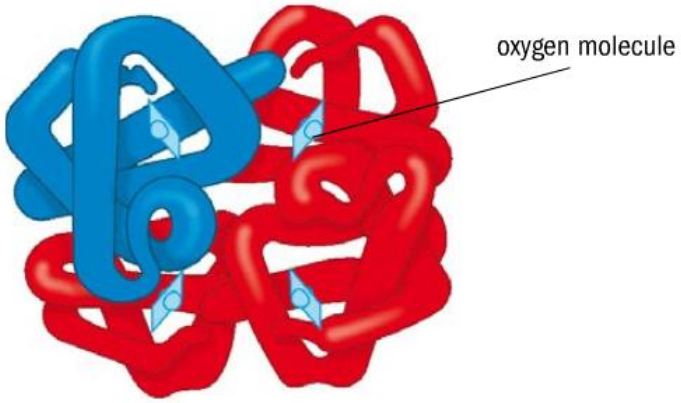
Below sketch a flow diagram to describe and explain the control of the vascular shunt mechanism. Starting from rest, include the factor affecting the VCC and how it controls the redistribution of blood flow during exercise

What is the main purpose of a red blood cell?

.....

What percentage of blood is plasma and what percentage are blood cells?

Plasma..... Blood Cells.....



The diagram opposite represents a haemoglobin molecule combined with 4 oxygen molecules

Where are haemoglobin molecules found in the blood?

.....

What is the term used when oxygen is combined with haemoglobin (HbO_2)?

.....

What percentage of oxygen is carried in the blood by the haemoglobin molecule?.....

Where is the rest of the oxygen carried?.....

Carbon dioxide is carried in 3 ways. What are they?

70%.....
.....
.....
23%($HbCO_2$).....
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7%.....
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Having an efficient O_2 and CO_2 transport system aids participation and performance by

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In what why does smoking effect the transportation of oxygen in the blood?

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Effect of a Warm Up on the Vascular System

1	2	3	4	5
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What does the term OBLA mean?

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What is blood viscosity?

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What is an enzyme?

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Effect of a Cool Down on the Vascular System			
1	2	3	4
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What produces the pressure to force blood through the arteries?

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The average resting blood pressure is normally seen as the value below

120mmHg

80mmHg

What do the units and numbers represent?

120.....
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80.....
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mmHg.....

What is resistance in terms of blood flow?

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How does the body help to regulate blood pressure?

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What is blood pressure measured with?.....

Describe how it is measured?

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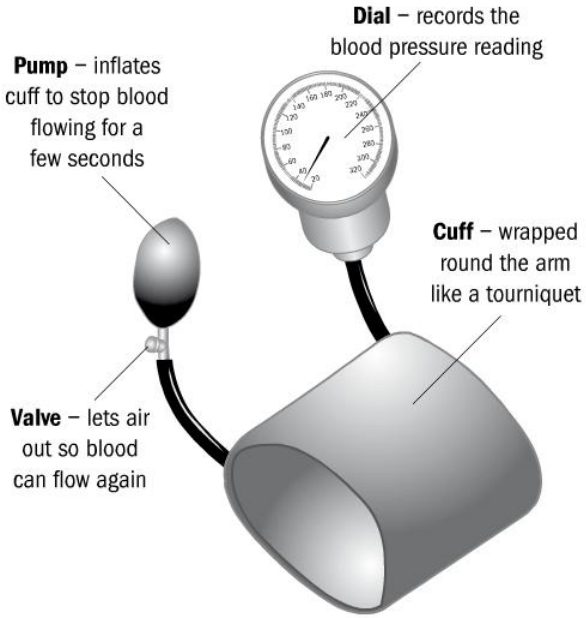

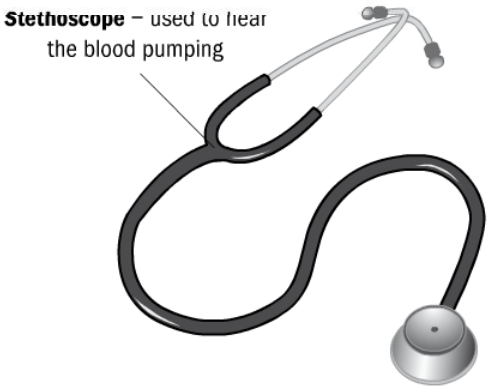

What is your blood pressure?

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Explain why the average blood pressure in the left ventricle is 120mmHg, and diastole in the aorta is 80mmHg, while it is only 25mmHg in the right ventricle and 10mmHg in the pulmonary artery?

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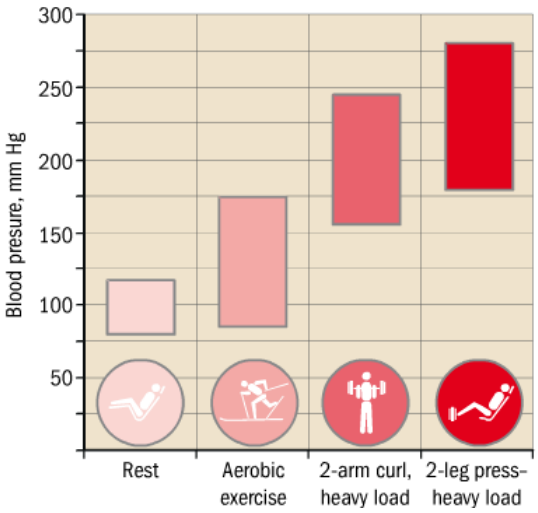
How does blood pressure change during different types of physical activity?

Endurance Training



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Isometric / Resistance Training

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Post Exercise Recovery

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What are the long term changes in blood pressure with regards to physical activity?

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What is hypertension? And what blood pressure value is normally associated with hypertension?

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Colour the categories below that are related to hypertensive (remember the values relate to long term blood pressure levels and not as a result of physical activity)

HIGH blood pressure symptoms: Stressed, sedentary, bloated, weak, fainting	
Systolic – Diastolic	Category
210 – 120	Stage 4 (very severe) High Blood Pressure
180 – 110	Stage 3 (severe) High Blood Pressure
160 – 100	Stage 2 (moderate) High Blood Pressure
140 – 90	Stage 1 (mild) High Blood Pressure
130/139 – 85/89	High normal
<130 - <85	NORMAL Blood Pressure
110 – 75	Low normal
90 – 60	BORDERLINE LOW
60 – 40	TOO LOW Blood Pressure
50 – 33	DANGER Blood Pressure
LOW blood pressure symptoms: Weak, tired, dizzy, fainting, coma	

At what high level blood pressure would treatment normally begin?.....

What changes occur to the body during hypertension?

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How can an active lifestyle help prevent high blood pressure?

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Why do you think a well trained athlete involved in an active lifestyle will have a lower exercising blood pressure compared with a more sedentary individual?

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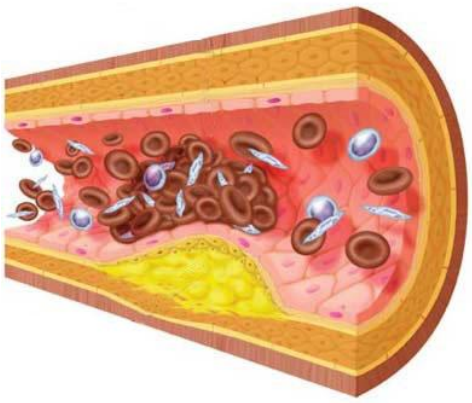
Cardiovascular diseases (CHDs) are the single largest cause of death in the western world and are more likely to occur when a more sedentary lifestyle is followed.

The four cardiovascular heart diseases that you are required to know show a cause and effect relationship where the two blood vessel diseases can lead to the two heart-related diseases.

Blood Vessels:

What is Arteriosclerosis?



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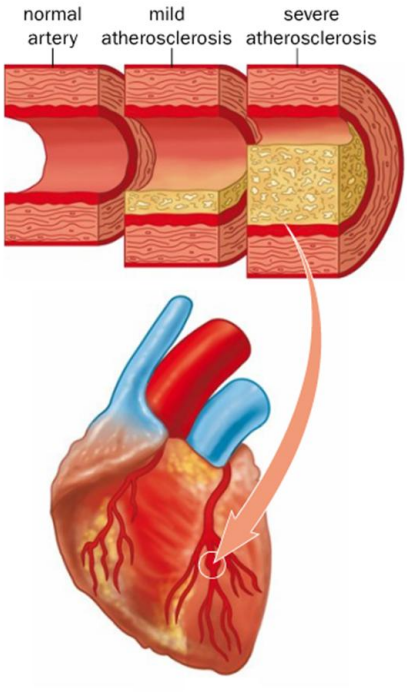
What is Atherosclerosis?



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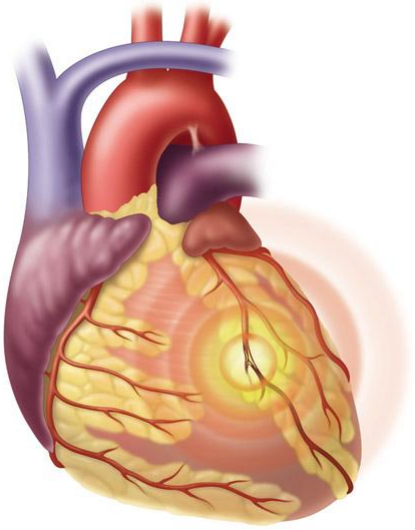
Heart:

What is Angina?



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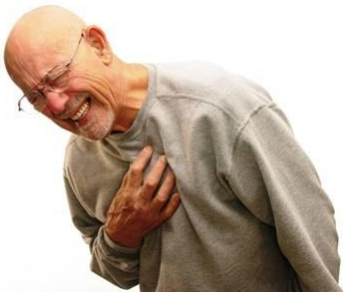
What is a Heart Attack?



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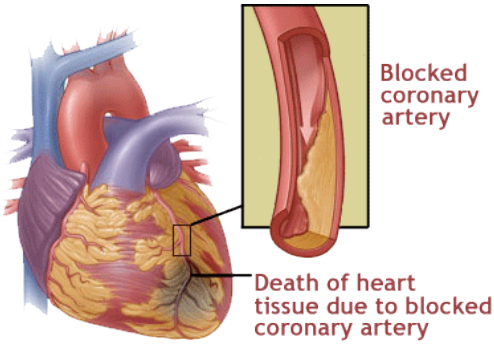

What can physical activity do to protect us from cardiovascular disease?

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What other factors can help reduce the risk of cardiovascular disease?

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WHO = World Health Organisation ACSM = American College of Sports Medicine

WHO Children & Young People	WHO Under 65 (Adults)	ACSM healthy adults under 65
All young people should participate in physical activity of at least moderate intensity for 60 minutes per day.	Every adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of week.	Do moderately intense cardio activity 30 minutes a day, five days a week
At least twice a week some of these activities should help to enhance and maintain muscular strength, flexibility, and bone health.	Those not engaging in regular physical activity to begin by incorporating a few minutes of increased activity a day, and build up gradually to 30 minutes per day.	Or, Do vigorously intense cardio 20 minutes a day, 3 days a week...
		And, Do 8 to 10 strength-training exercises, 8 to 12 repetitions of each exercise twice a week
Activity may be divided into shorter periods throughout the day, and should be as versatile and inspiring as possible.	The 30 minutes can be split up into shorter periods, ideally no less than 10 minutes, but even shorter bouts contribute to substantial health benefits.	The 30-minute goal can be split into short bouts of physical activity each with a minimum length of 10 mins.
Recent studies suggested physical activity levels in children should be about 30 minutes higher than the current guidelines of at least 60 minutes per day to prevent clustering of cardiovascular disease risk factors.	However, it is likely that for many people, 45–60 minutes of moderate-intensity physical activity per day is necessary to prevent weight gain or reduce overweight.	To lose weight or maintain weight loss, 60 to 90 minutes of physical activity may be necessary. The 30-minute recommendation is for the average healthy adult to maintain health and reduce the risk for chronic disease.
Moderate-intensity physical activity relates to quick or brisk walking. Cycling, swimming and gardening with moderate effort are other modes of moderate-intensity physical activity.	Moderate-intensity physical activity relates to quick or brisk walking. Cycling, swimming and gardening with moderate effort are other modes of moderate-intensity physical activity.	Moderate-intensity physical activity means working hard enough to raise your heart rate and break a sweat, yet still being able to carry on a conversation.

Do you meet the recommended minimum guidelines for any of the three columns? If no what were you missing?

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What generic exercise recommendations would you give to reduce the risk of cardiovascular disease?

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Response of the respiratory system to physical activity

Candidates should be able to:

- describe the mechanics of breathing at rest and the respiratory muscles involved (including the diaphragm and external intercostals muscles);
- explain the changes in the mechanics of breathing during physical activity including reference to additional muscles involved (sternocleidomastoid and pectoralis minor) and the active nature of expiration (internal intercostals and abdominal muscles);
- explain how changes in the mechanics of breathing during physical activity are regulated by the respiratory centre (both neural and chemical control) to take into account the demands of different intensities of physical activity;
- describe the process of gaseous exchange that takes place between the alveoli and the blood and between the blood and the tissue cells. (An awareness of partial pressure is required but candidates will not be expected to provide specific respiratory pressures.);
- explain the changes in gaseous exchange that take place between the alveoli and the blood and between the blood and the tissue cells (increased diffusion gradient and accelerated dissociation of oxy-haemoglobin) as a direct result of participation in physical activity;
- explain the effect of altitude on the respiratory system and how it influences the performance of different intensities and activity;
- evaluate critically the impact of different types of physical activity on the respiratory system with reference to lifelong involvement in an active lifestyle (to include an awareness of asthma and smoking).

What is the primary aim of the respiratory system?

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The respiratory system performs three main processes which are linked via the heart and vascular systems. What do the three processes mean?

1. Pulmonary ventilation
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   .....
   .....
   .....
2. External respiration
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   .....
   .....
3. Internal respiration
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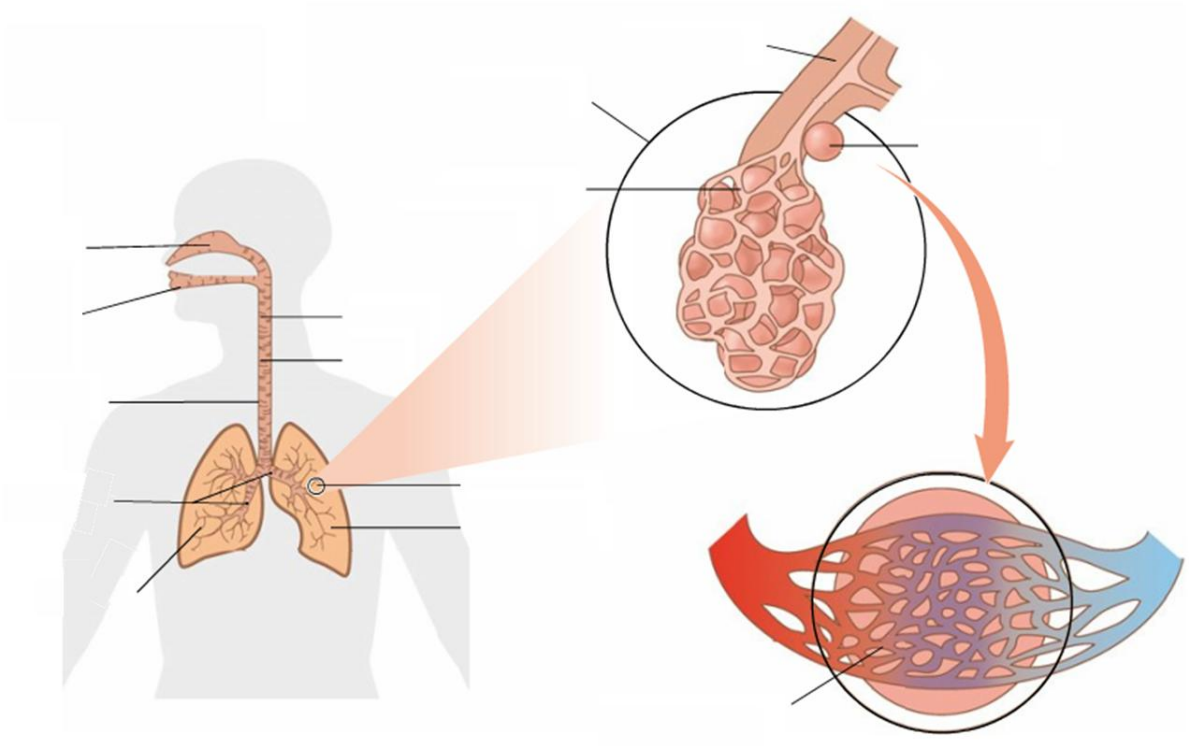
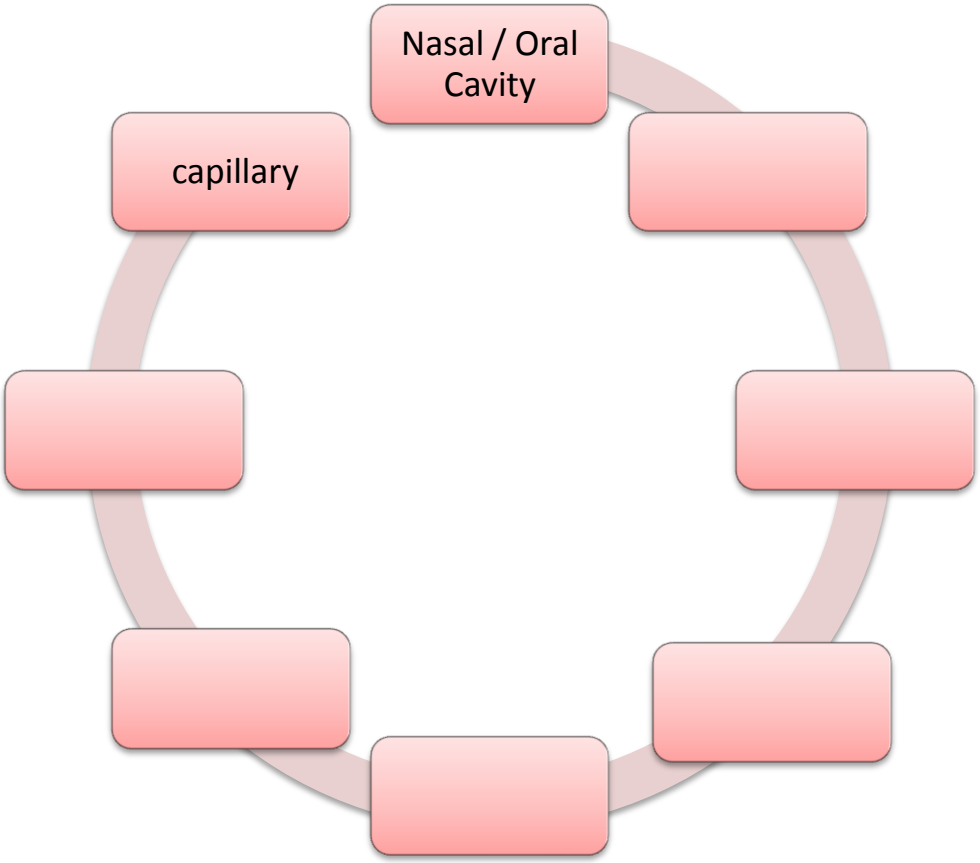
   .....
   .....

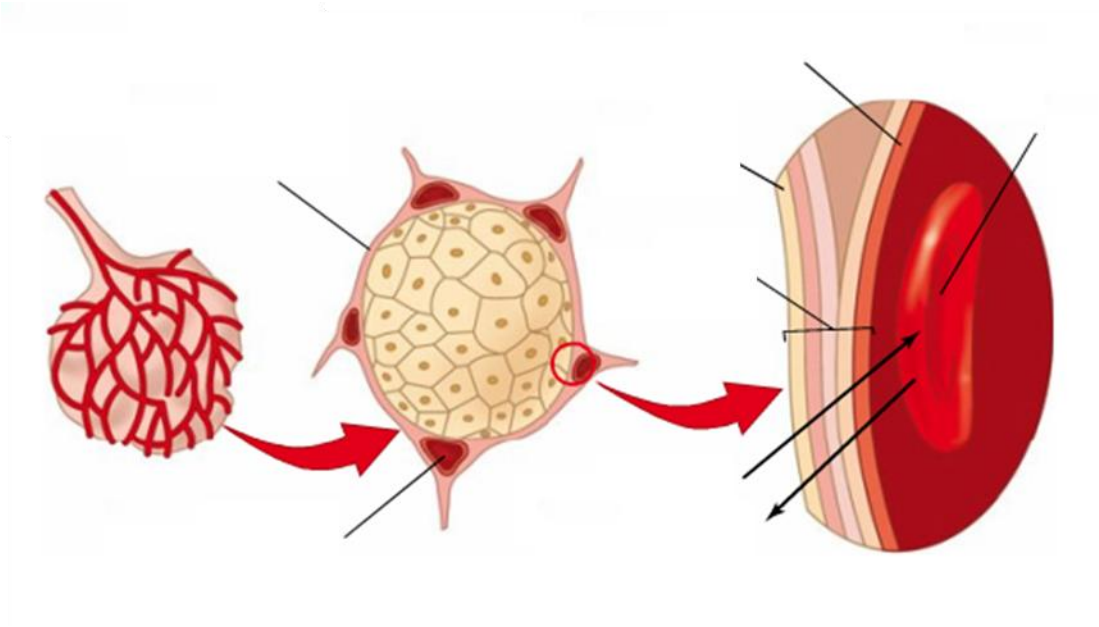
Label the diagram below with the structures of the respiratory system



Put the structures from the diagram in order to show the path of atmospheric air to the site where gaseous exchange takes place



Label the structure of an alveolus



The alveoli are the sites at which gaseous exchange takes place. But how does an alveoli increase the efficiency of gaseous exchange?

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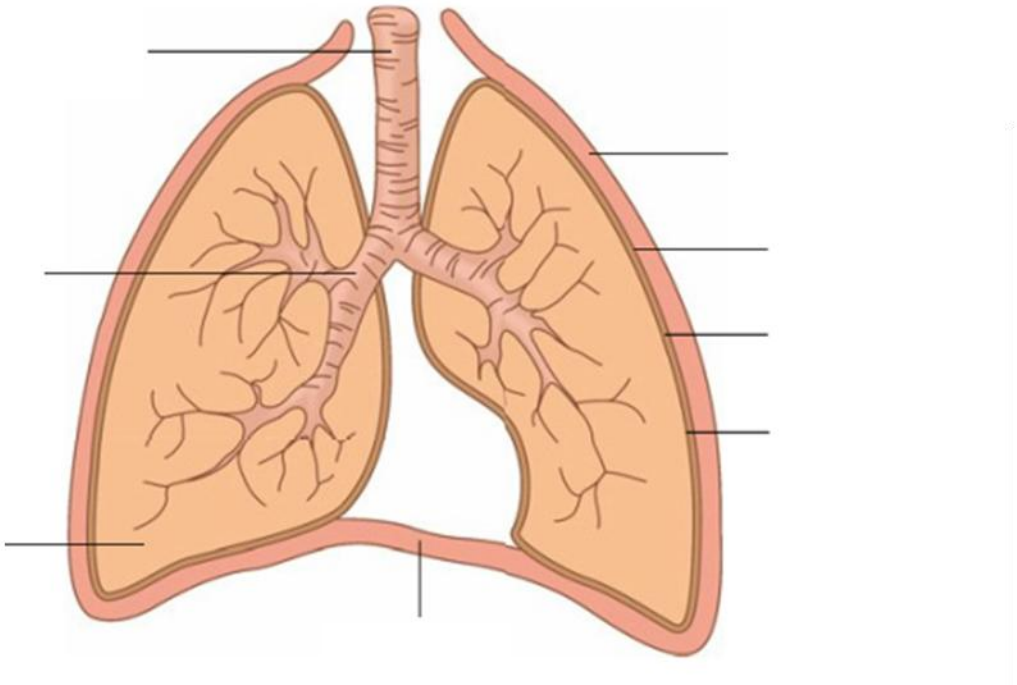
Label the diagram of the lungs below



Why is there is there a double membrane filled with pleural fluid surrounding the lungs?

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What is meant by the terms inspiration and expiration?

.....

The mechanics of breathing are easier to learn by linking five steps

1. Muscles -
   .....
   .....
2. Movement -
   .....
   .....
3. Thoracic cavity volume -
   .....
   .....
4. Lung air pressure -
   .....
   .....
5. Inspiration or expiration -
   .....
   .....

When respiration takes place at rest there is an active inspiration and passive expiration. Briefly describe what is meant by active and passive?

.....
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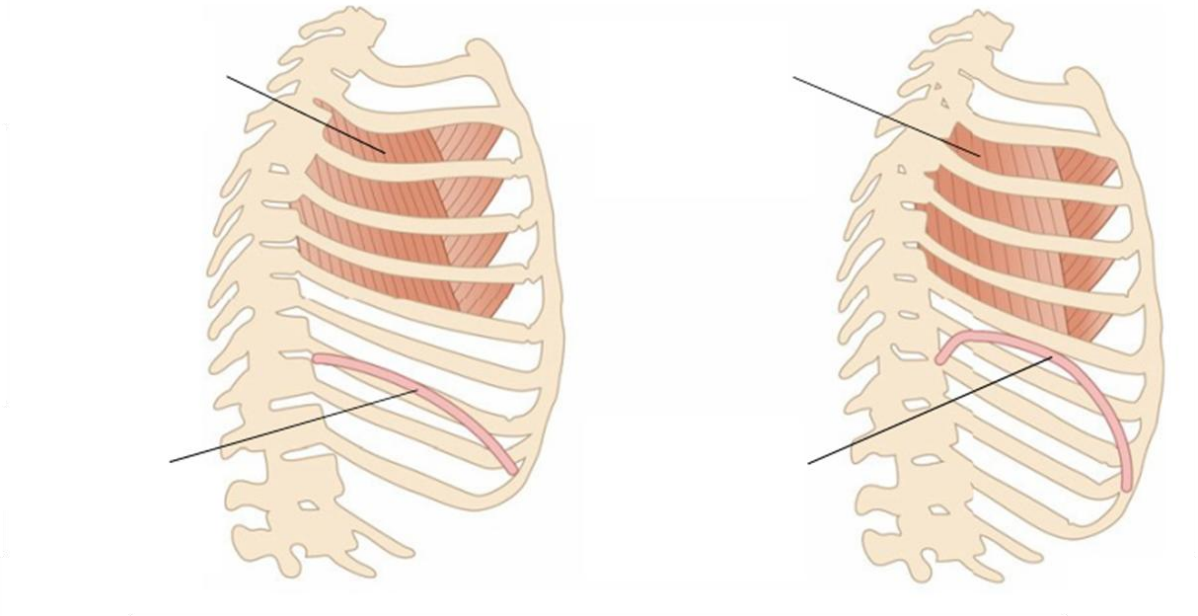
.....

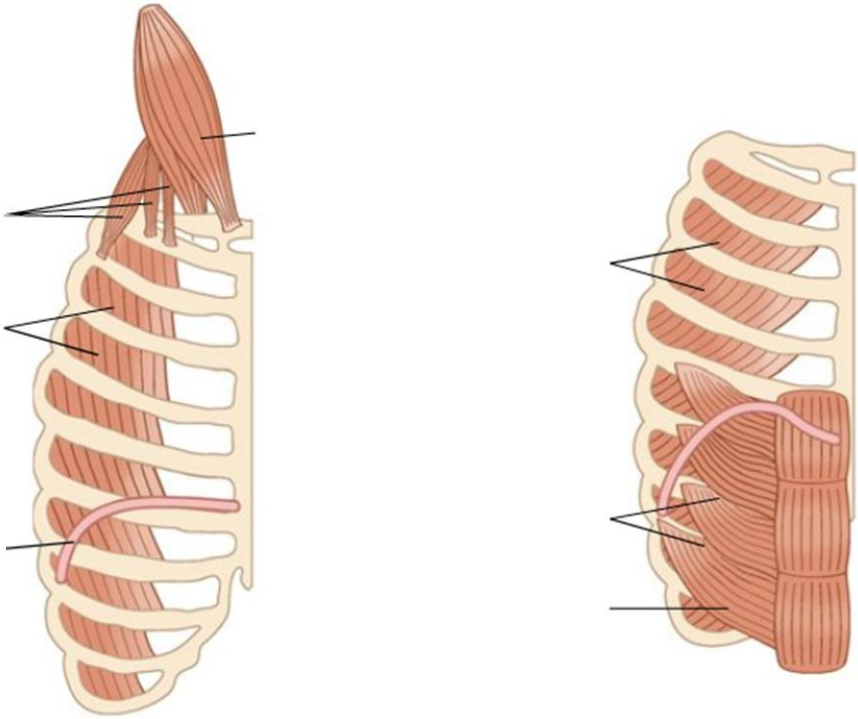
Label the muscles and their contractile state during active inspiration and passive expiration at rest



Respiration at REST

Inspiration (**active**)	Expiration (**passive**)
1.....	1.....
2.....	2.....
3.....	3.....
4.....	4.....
5.....	5.....

Label the muscles and their contractile state during active inspiration and active expiration at rest



As we begin to exercise the demand for oxygen increases. We therefore begin to use additional muscles (as shown above) to affect our breathing in two ways. What are they?

1. .....
2. .....

In pairs, one partners completes three minutes of aerobic exercise (light run?) and the other partner completes three minutes of anaerobic work (shuttle runs at speed?) Record the following breathing frequencies (one minute values) – Breathing at rest, one minute after completion, and how long it takes to return to normal

Name	Rest	One minute after	Time to return to normal
..... (aerobic)			
..... (anaerobic)			

Discuss why the rests differ

.....
.....
.....
.....
.....

Respiration during EXERCISE

Inspiration (**active**)	Expiration (**active**)
1.....	1.....
2.....	2.....
3.....	3.....
4.....	4.....
5.....	5.....

What are the definitions of the following lung volumes?

Tidal Volume (TV)

.....

.....

Frequency (f)

.....

.....

Minute ventilation (VE)

.....

.....

Use the following normal values to calculate the minute ventilation of a normal performer

TV = 500ml Frequency = 15 breaths

.....

What equation did you use to calculate the minute ventilation of an athlete?

.....

A Tidal volume (TV) of 500ml and a frequency (f) of 12 produces a Minute Ventilation (VE) of 6L/min. Explain why increasing the frequency to 24 and a Tidal Volume of 4000ml per breath during exercise would be beneficial to an aerobic athlete

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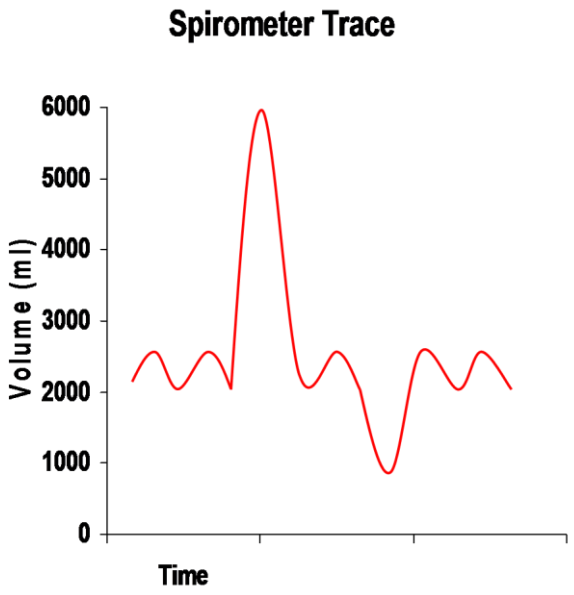

On the graph can you work out the tidal volume value of the performer at rest?

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What is the tidal volume of the performer during exercise?

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Why does the graph not go down to 0?

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The exchange of oxygen and carbon dioxide takes place in the lungs and tissue and are called external and internal respiration respectively.

What is the process of Diffusion and how does the diffusion gradient affect the movement of oxygen and carbon dioxide?

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What does the term Partial Pressure refer to when describing the movement of gases within the body?

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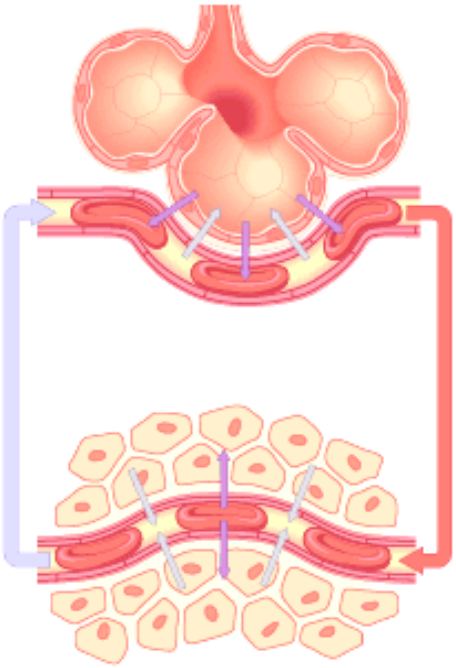

Label the diagram with a high and low partial pressure for oxygen and carbon dioxide

What is gaseous exchange? And where does it take place?

……
……
……
……

Fill in the table below

	External respiration	Internal respiration
Where?		
Movement		
Why? –O_2		
Why? –CO_2		

Describe the process of External (Alveoli) Respiration

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Describe the process of Internal (Tissue) Respiration

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What is does an Oxygen-Haemoglobin Dissociation curve show us?

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What does the word saturation mean?

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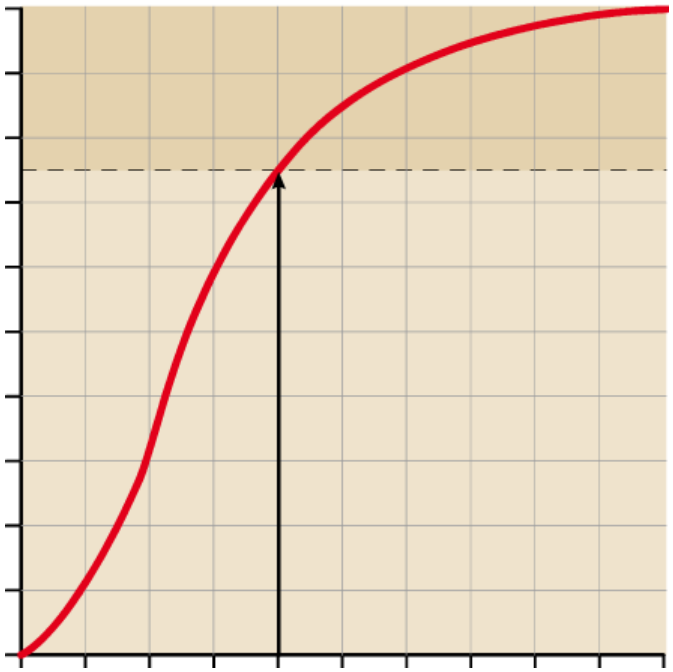
Can you label the Oxygen-Haemoglobin Dissociation curve for a performer at rest.



At rest, the PP of oxygen in the lungs is 100mmHg. Follow this line up from the 100mmHg and see where it intersects the curve. Draw a line across to the 'y' axis and record the value

……

If you have followed the steps correctly you should have a figure of around 98%. This represents the percentage of saturation/association of oxygen with haemoglobin in the alveoli capillary blood.

At rest the PP of oxygen in the tissue/muscle is around 40mmHg. Repeat the steps above to calculate the percentage saturation/association of oxygen and haemoglobin in the tissue/muscles' capillary blood.

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What has happened to the 25% of the oxygen that was associated with haemoglobin?

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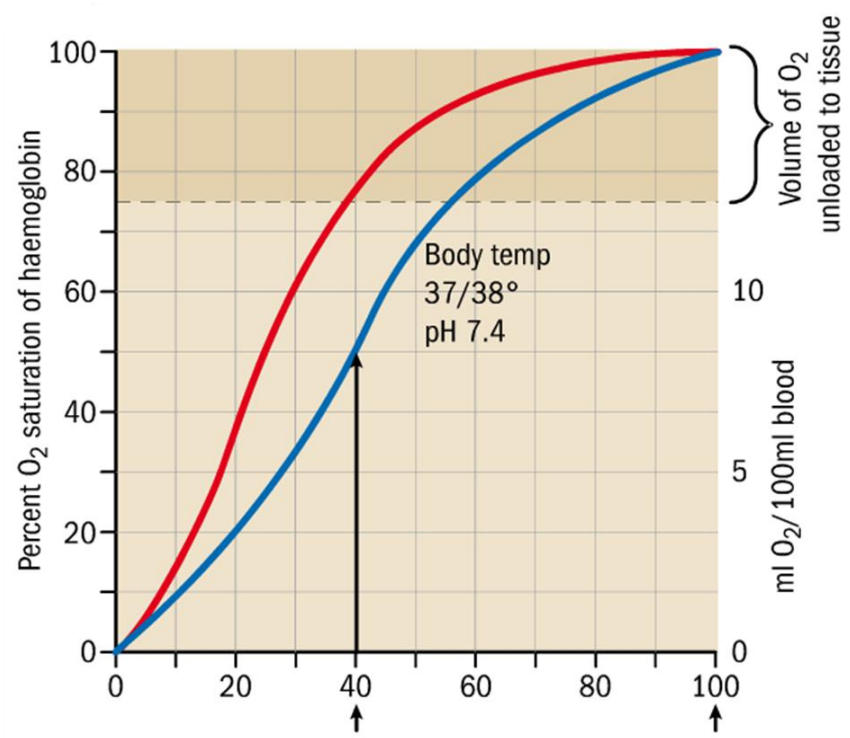
Where does the association and dissociation of oxygen take place in order to maintain an efficient supply of oxygen to the working muscles during exercise?

Association

……

Dissociation

……



The red curve on the left of the diagram represents the normal curve we have already looked at. Read off the values for the percentage saturation/association of oxygen and haemoglobin in the tissue/muscles using the blue curve on the right.

……

What effect does moving the curve to the right have on the saturation of haemoglobin if we assume the PP of oxygen remains the same in the tissue?

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What are the benefits for an athlete of the curve shifting to the right?

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Place an arrow to show the direction of diffusion during external respiration

Partial pressure	Alveolar air	Direction of diffusion (High to low PP)	Alveoli capillary blood	Diffusion gradient
O_2	100 (high)		40 (low)	60
CO_2	40 (low)		46 (high)	6

Use the table above to describe what is happening during external respiration during exercise.

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Place an arrow to show the direction of diffusion during internal respiration

Partial pressure	Capillary blood	Direction of diffusion (High to low PP)	Muscle tissue	Diffusion gradient
O_2 resting	100		40	60
O_2 during exercise	100		<5	95
CO_2 resting	40		45	6
CO_2 during exercise	40		80	40

Use the table above to describe what is happening during external respiration during exercise.

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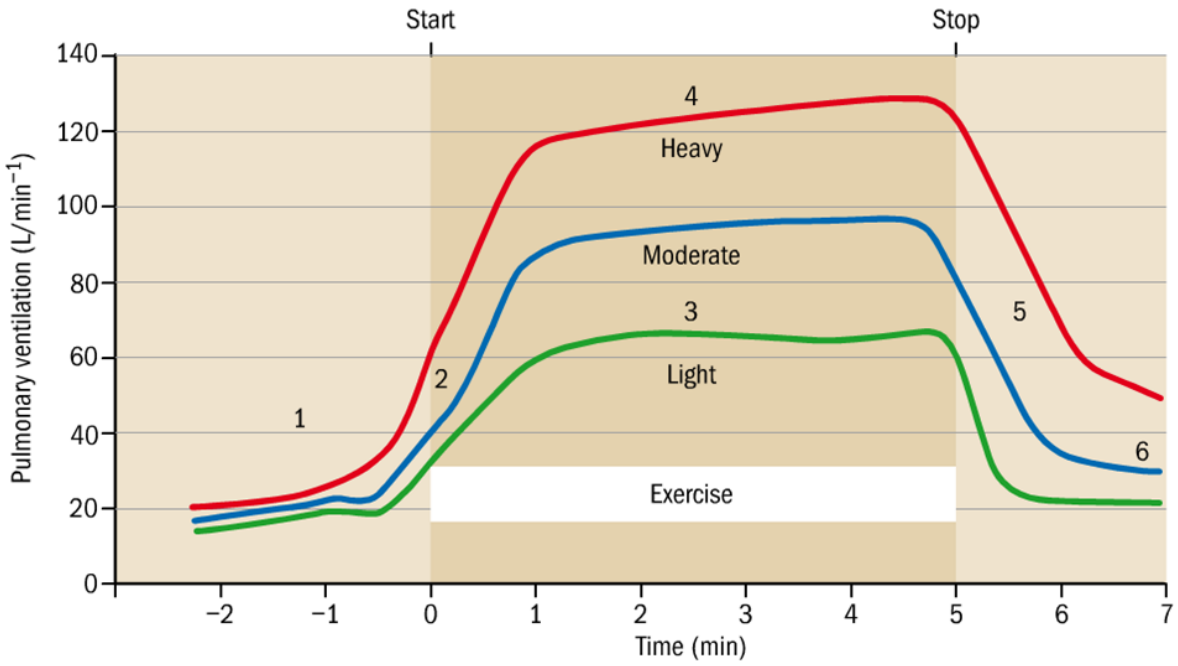

Ventilatory responses to exercise mirror that of the heart except that it is the Respiratory Control Centre (RCC), controlling the respiratory muscles, which increase or decrease breathing.

Use the number on the diagram to describe the VE responses at varying intensities

1. Anticipatory rise -

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2. Rapid rise in VE -

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3. Slower increase/plateau -

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4. Continued but slower increase -

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5. Rapid decrease in VE -

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6. Slower decrease -

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Where is the Respiratory Control Centre (RCC) found?

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Explain how nervous/neural control effects breathing?

Overview……
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At rest……
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During exercise ……
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What factors influence the neural control of breathing?

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Which of the above factors influence the inspiratory centre?

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Which factor influences the expiratory centre?

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Which area of the RCC is responsible for increasing the depth of breathing?

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Which area of the RCC is responsible for increasing the rate of breathing?

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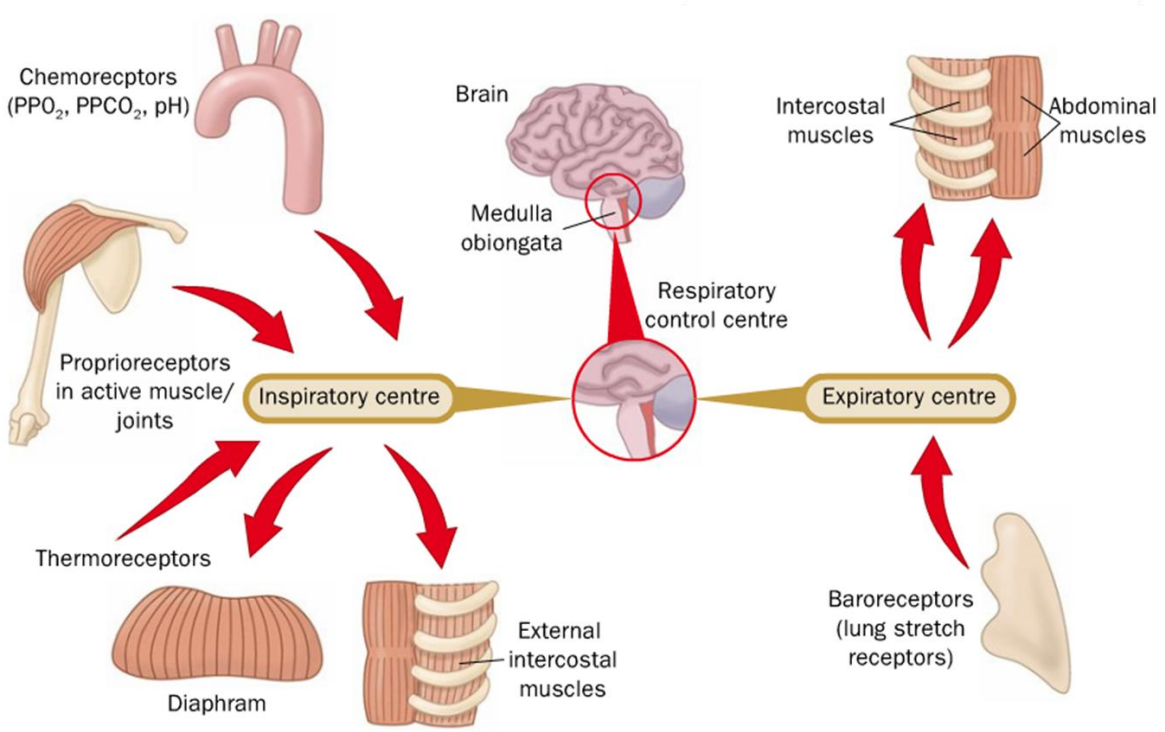
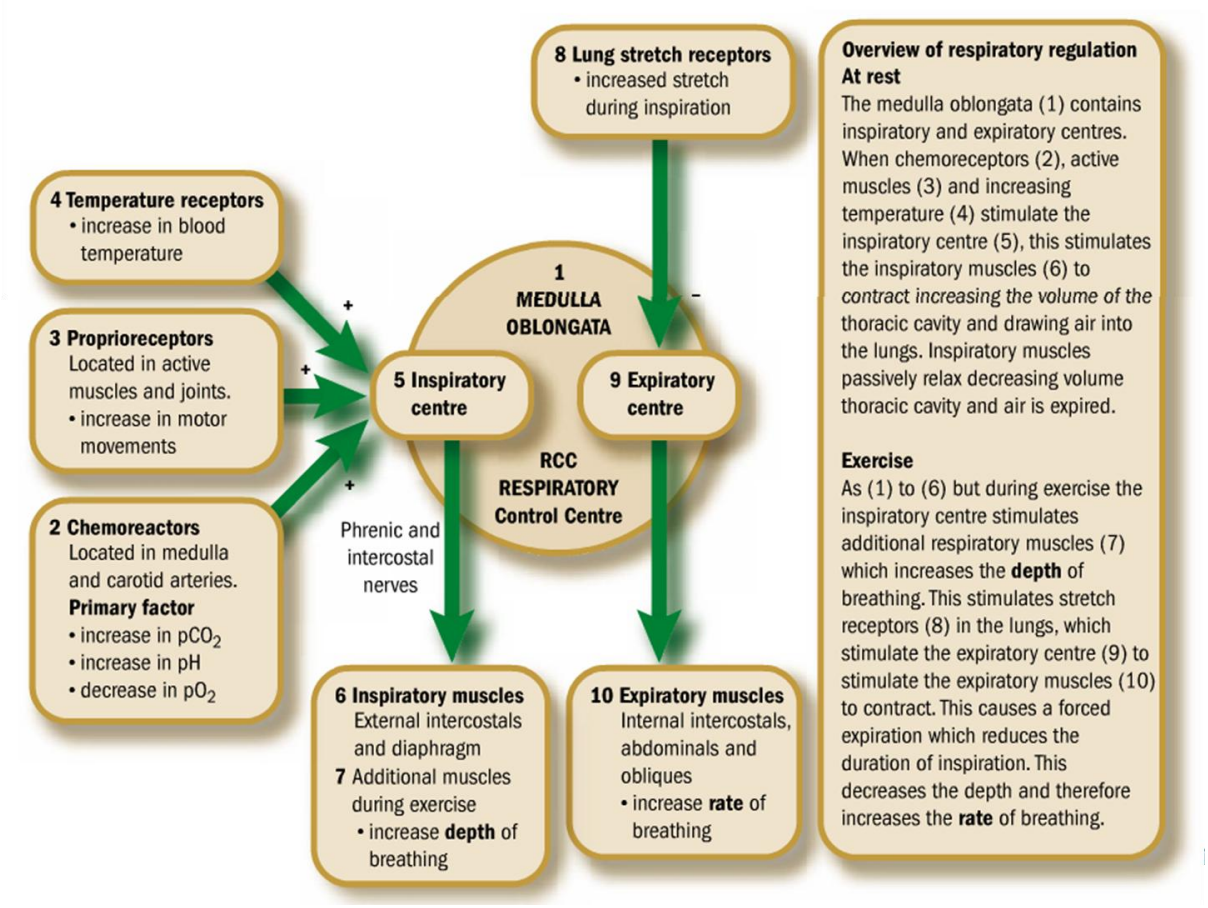
RCC Overview





What is the difference in air pressure at higher altitude?

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What is EPO? And what does it do?

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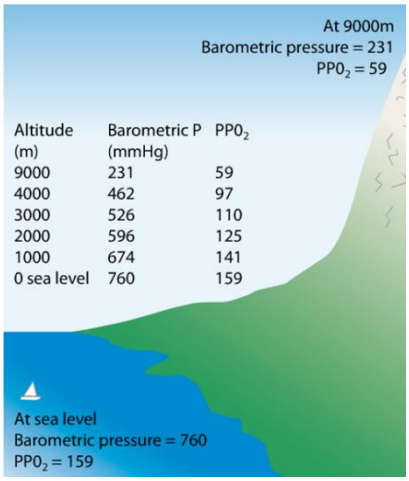

What is hypoxia?

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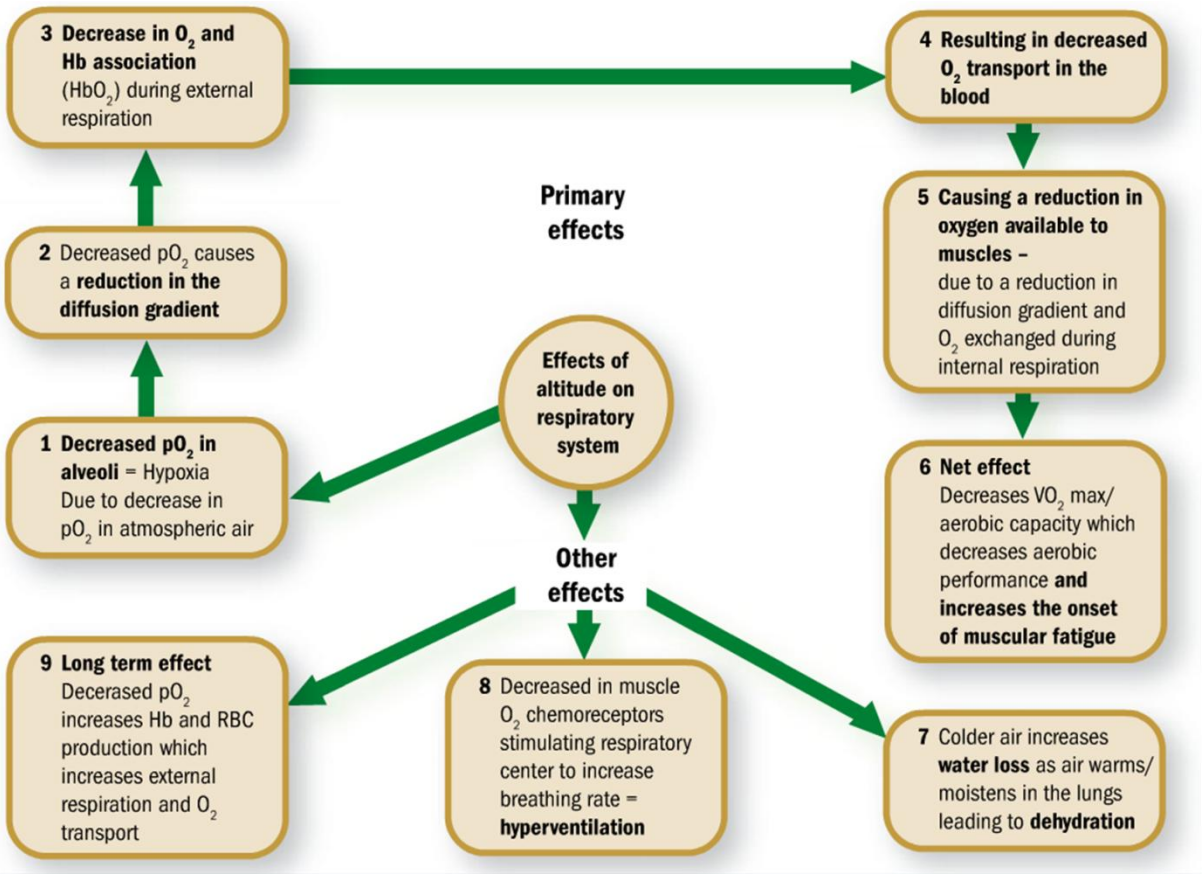

Use the diagram below to describe the effects of attitude training

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There are three main methods of altitude training which have mixed and conflicting research. Research and discuss the three methods of altitude training below in relation to their benefits to improving performance.

1. Live High Train High – LHTH
2. Live Low Train High – LLTH
3. Live High Train Low – LHTL

The net effect on the respiratory system of training is an increase in its efficiency to supply O_2 to the working muscles during higher intensities of physical activity. What are the specific respiratory adaptations that help improve this efficiency?

1. Respiratory structures

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2. Breathing Mechanics

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3. Respiratory Volumes

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4. Diffusion

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What is VO_2 Max?

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Asthma

What are the symptoms of Asthma?

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How is Asthma measured?

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What are the triggers of Asthma?

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What are the medical treatments for Asthma?

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What are the non-medical treatments for Asthma?

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What is Inspiratory Muscle Training (IMT) and what possible effects could it have on Asthma?

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Use the pictures below and your own knowledge to describe the health effects of Smoking?

What effects does smoking have on performance?

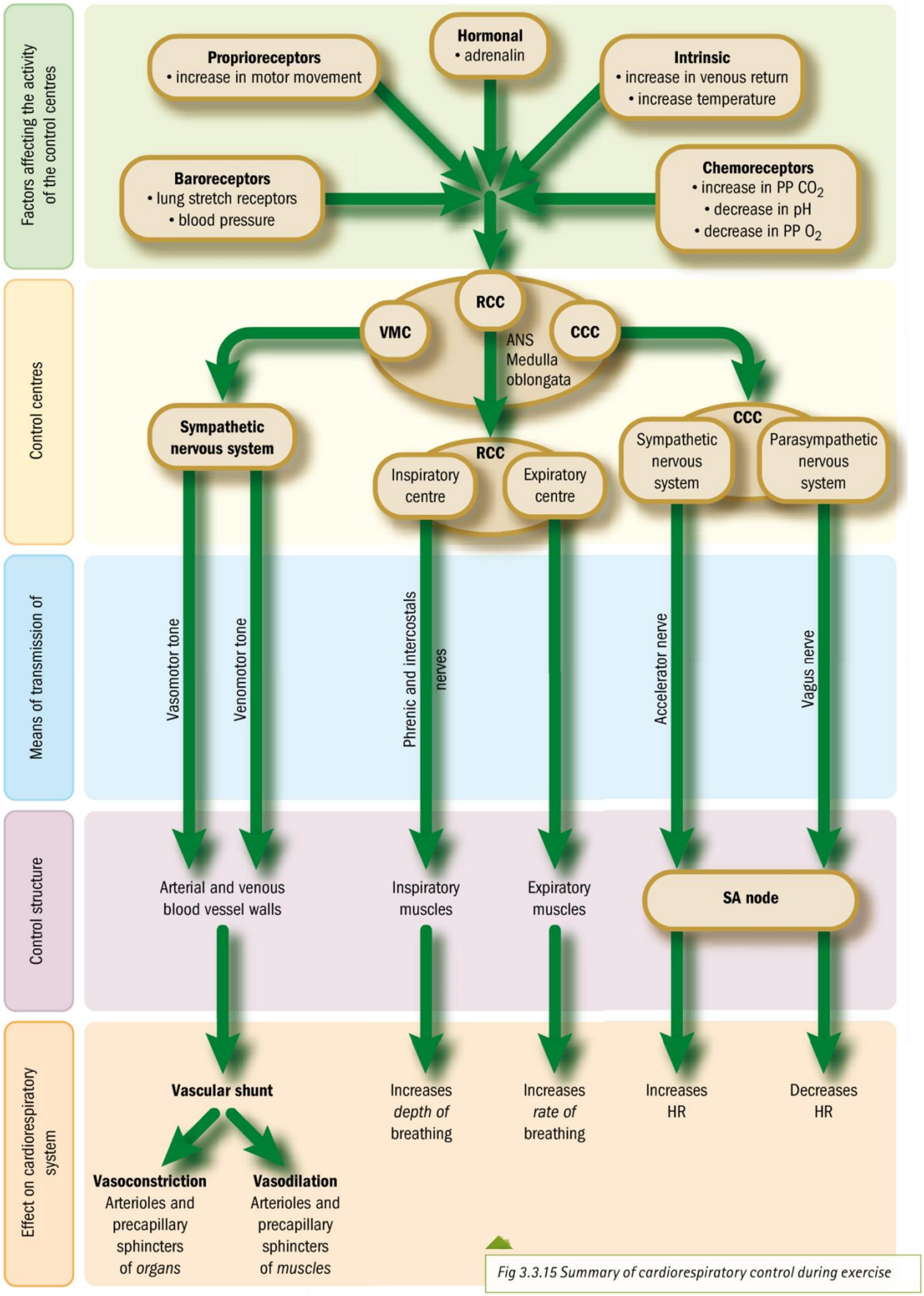

Fig 3.3.15 Summary of cardiorespiratory control during exercise