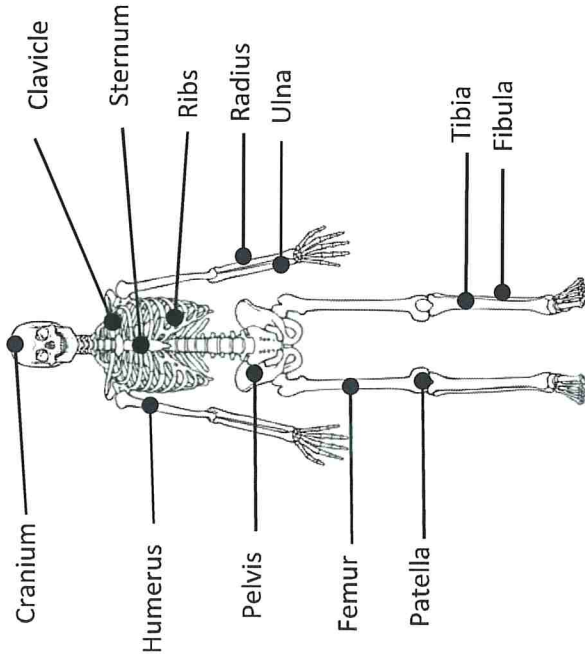
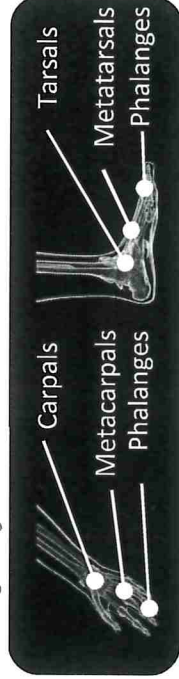
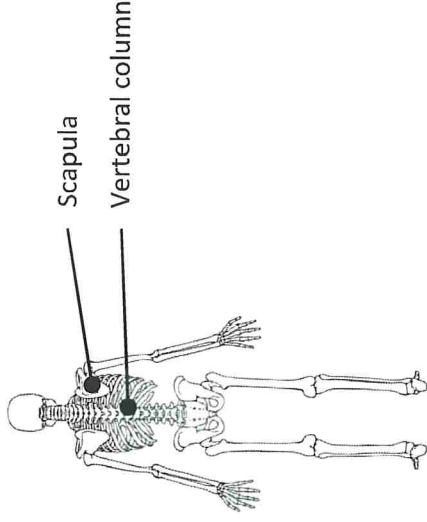


GCSE Physical Education – The structure and functions of the skeletal system

Structure of the skeletal system

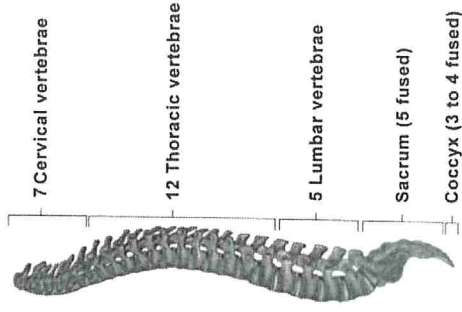


Structure of the skeletal system



Vertebral Column

The vertebral column is divided into 5 sections. It is made up of irregularly shaped bones called vertebrae.



Each vertebra is protected with cartilage to prevent friction.

The vertebrae protects the spinal cord.

Function of the skeleton

- Protection of vital organs
- Muscle attachment
- Joints for movement
- Blood cell production (platelets, red and white)
- Storage of calcium and phosphorus

Classification of joint

- Pivot (neck – atlas and axis)
- Hinge (elbow and knee)
- Ball and socket (hip and shoulder)
- Condyloid (wrist)

Connective tissue

Ligaments – attaches bone to bone to add joint stability.

Tendons – attaches muscles to bone and contributes to joint movement as a result of muscle contraction.

Classification of bones

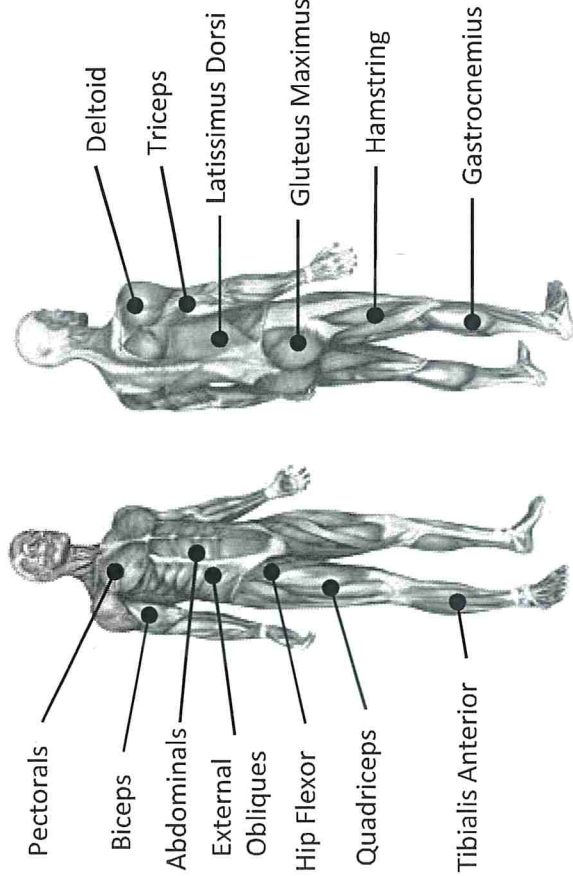
Long (leverage)	Short (weight bearing)	Flat (protection + muscle attachment)	Irregular (protection and muscle attachment)
<p>Clear shaft region to the bone. <i>i.e. femur, humerus & phalanges</i></p>	<p>Light, small and very strong. <i>i.e. carpals tarsals</i></p>	<p>Broad surface area for muscle attachment. <i>i.e. cranium</i></p>	<p>Assist the functioning of certain joints. <i>i.e. Patella/vertebrae</i></p>

Joint movements

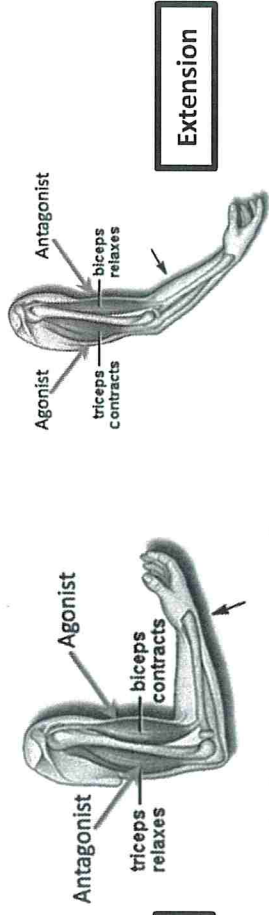
Flexion	Adduction	Rotation	Dorsi-Flexion (ankle joint)
<p>Decreasing the angle at a joint (bending)</p>	<p>Limbs moving towards the midline of the body.</p>	<p>A twisting/turning action around a joint.</p>	<p>When the toes are turned up to the body.</p>
Extension	Abduction	Circumduction	Planter-Flexion (ankle joint)
<p>Increasing the angle at a joint (straightening)</p>	<p>Limbs moving away from the midline of the body.</p>	<p>A combination of flexion, extension, adduction & abduction.</p>	<p>When the toes are pointed away from the body.</p>

GCSE Physical Education – The structure and functions of the muscular system

Structure of the muscular system



Antagonistic pairs - Muscles are arranged in antagonistic pairs. As one muscle contracts (shortens) its partner relaxes (lengthens) i.e. *Biceps and Triceps*.



Agonist = the muscle that contracts to produce movement.
Antagonist = the muscle that relaxes to allow the movement to occur.

Examples in the body:

- Biceps & Triceps
- Quadriceps & Hamstring
- Hip Flexor & Gluteus Maximus
- Tibialis Anterior & Gastrocnemius

Types of muscle

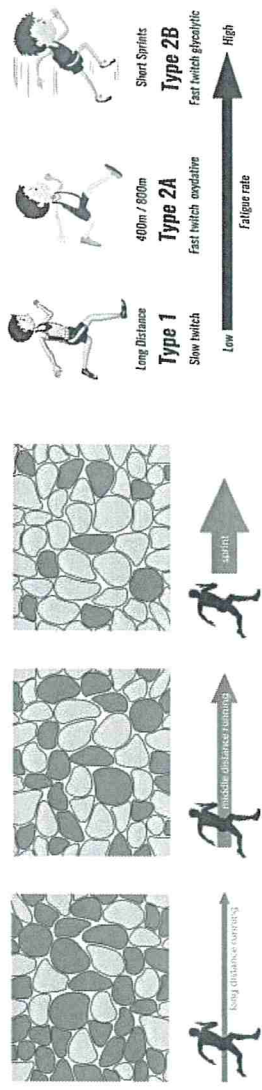
Voluntary muscles enable movement throughout the body.

Involuntary muscles are essential in maintaining healthy body systems.

Cardiac muscle is vital in sport because it makes the heart pump. Fitness training will strengthen cardiac muscle making the heart more efficient at pumping blood around the body.

Muscle fibre types

Slow twitch muscle fibres (Type I)	Fast twitch muscle fibres (Type IIa)	Fast twitch muscle fibres (Type IIx/b)
<ol style="list-style-type: none"> 1. Smaller in size. 2. Work aerobically with high fatigue resistance. 3. Have a good oxygen supply = deep red in colour. 4. They contract slowly, but can work for long periods. <p>Marathon runner</p>	<ol style="list-style-type: none"> 1. Larger in size 2. Work anaerobically & linked to high intensity activities. 3. Are paler in colour and have limited oxygen supply. 4. They contract quickly and powerfully, but tire easily. <p>400/800m runner</p>	<ol style="list-style-type: none"> 1. Large in size 2. Work anaerobically & linked to extreme high intensity activities. 3. Very high speed of contraction but low fatigue resistance. <p>100m Sprinter</p>



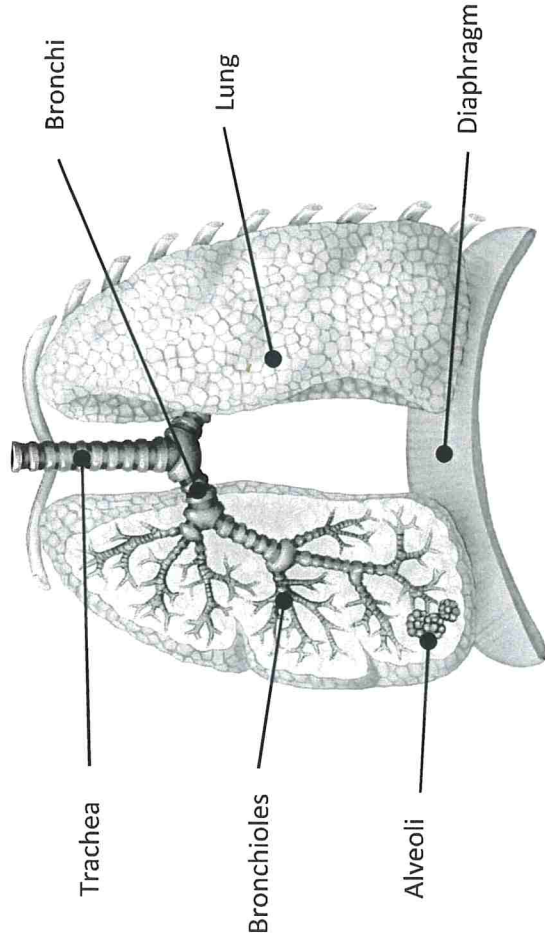
The short term effects of exercise on the muscles:

1. Working muscles produce heat
2. Increased muscle fatigue due to lactate accumulation
3. Blood is re-distributed to working muscles (Shunting)

Link of the muscular and skeletal system – both systems work together to produce movement. i.e. a contracting muscle pulls on a bone which changes the angle at a joint.

GCSE Physical Education – The structure and functions of the respiratory system

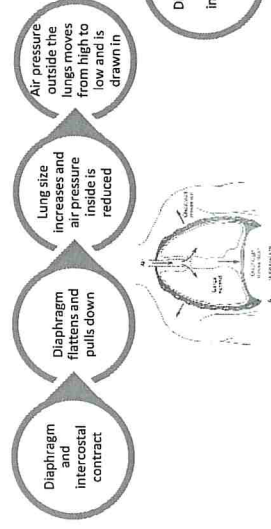
Structure of the respiratory system



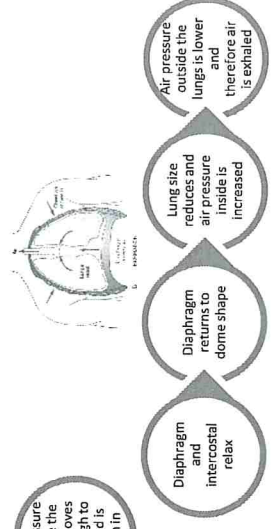
Composition of inhaled and exhaled air

Gas	Inhaled air	Exhaled air
Oxygen	21%	16%
Carbon dioxide	0.04%	4%
Nitrogen	78%	78%

Inhalation/Inspiration



Exhalation/Expiration



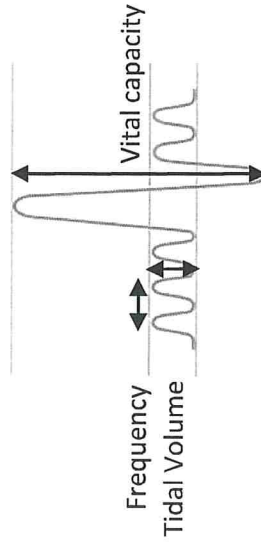
Respiratory values

Tidal Volume – the amount of air inhaled and exhaled per breath. Resting value = 500ml

Vital Capacity – The maximum amount of air exhaled following a maximal breath in.

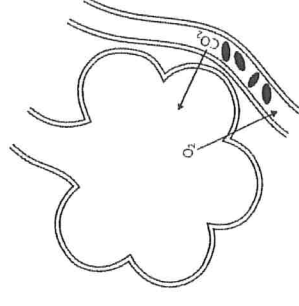
Frequency – The number of breaths taken per minute. Resting value – 12-20 breaths.

Minute Ventilation – The amount of air inhaled and exhaled per minute. Measured in litres.



Gaseous exchange at the alveoli

- Diffusion is the movement of molecules from an area of high concentration to a low one.
 - The alveoli have thin moist walls to allow diffusion to occur.
 - Capillaries are closely wrapped around the alveoli to reduce the distance of diffusion and increase efficiency.
- During inhalation:
- The concentration of **oxygen** is air is higher than the alveoli.
 - The concentration of **carbon dioxide** in the blood is higher than that in the air.



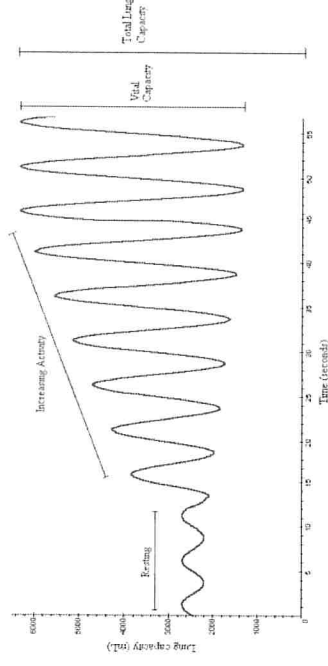
During exercise

Gaseous exchange increases as the intensity of the activity increases to cope with:

- An increase demand for oxygen at working muscles
- An increase in carbon dioxide production and the need to rid this waste product.

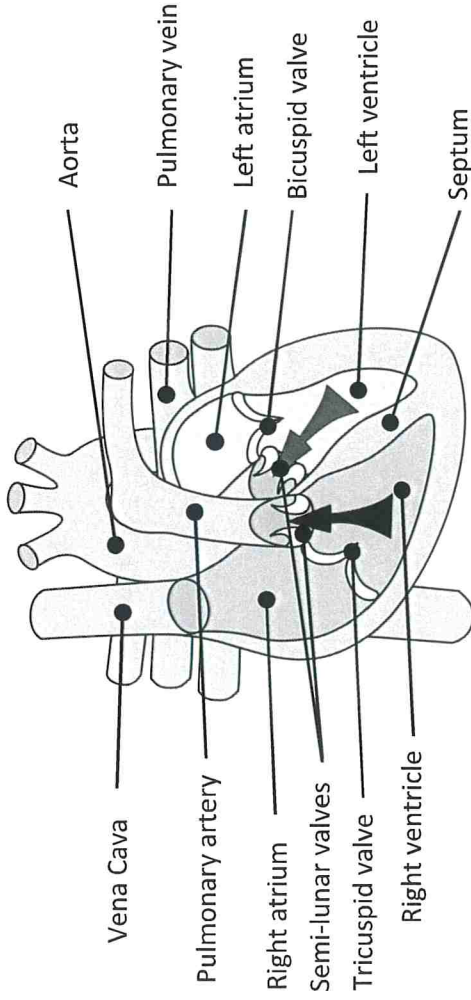
Frequency \uparrow + Tidal Volume \uparrow

Training increases total lung capacity and vital capacity readings.



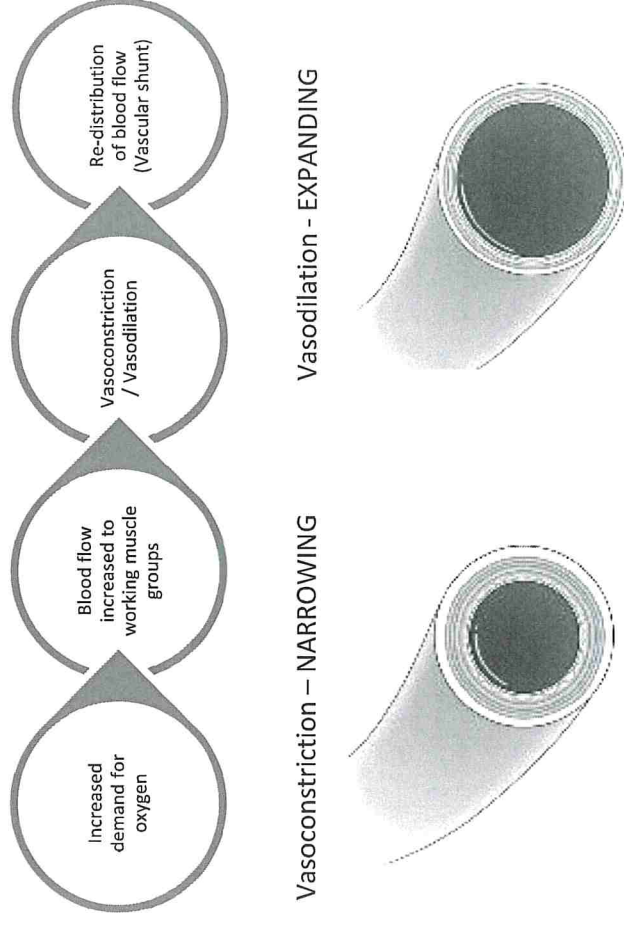
GCSE Physical Education – The structure and functions of the cardiovascular system

Structure of the cardiovascular system



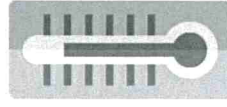
Deoxygenated blood = BLUE (Right side)
 Oxygenated = RED (Left side)

Vascular Shunting



Function of the cardiovascular system

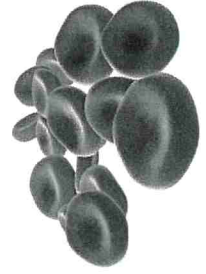
- Transport of oxygen, carbon dioxide and nutrients
- Clotting of open wounds
- Regulation of body temperature






Components of blood - Red blood cells

Carry oxygen from the lungs to the working muscles + Removes CO₂.

Haemoglobin binds the oxygen

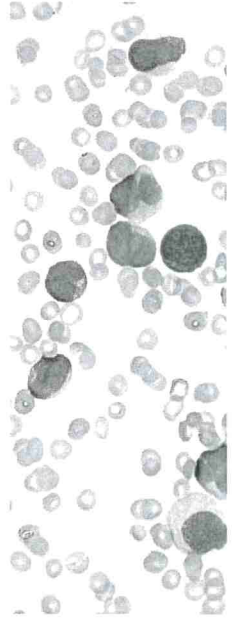


Blood vessels

Arteries	Veins	Capillaries
<ol style="list-style-type: none"> 1. Away from the heart 2. Oxygenated blood (except pulmonary artery) 3. Thick/elastic walls 4. High pressure 5. Small lumen 	<ol style="list-style-type: none"> 1. Back to the heart 2. Deoxygenated blood (except pulmonary vein) 3. Thin walls + larger lumen 4. Lower pressure 5. Valves 	<ol style="list-style-type: none"> 1. In the tissue 2. Site of gaseous exchange 3. Very thin walls 

White blood cells

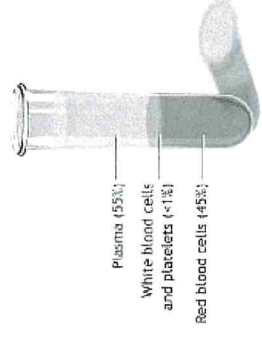
Are part of the immune system and **fight disease** and infection.



Platelets & Plasma

Platelets **clot blood** and form a scab around the site of injury.

Plasma is the **liquid/fluid** part of blood that allows it to flow.



GCSE Physical Education – Aerobic/Anaerobic and long term effects of exercise

Aerobic and Anaerobic exercise – two methods of energy production by the body (Energy: the capacity to do work)
Two factors determine which method is used: **Intensity & duration**

Aerobic energy production – takes place in the presence of oxygen



Exercise intensity is moderate/low for a sustained period of time. *i.e. marathon runner/endurance cycling*



By products are released as sweat and CO2 exhaled.

Cardiovascular system

Cardiac equation – Cardiac output (Q) = Stroke Volume (SV) x Heart Rate (HR)

Long term effects of exercise

1. Cardiac hypertrophy – this is the increased size of the heart due to training. This impacts on the cardiac equation above.

Lower resting HR - **Increased maximum Q** - **Increased SV**

2. Increased elasticity in the walls of arteries and veins – more efficient constriction and dilation.
3. Increased number of red blood cells – has capacity to carry more oxygen to working muscles.



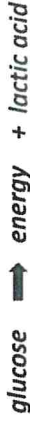
Skeletal system

Long term effects of exercise

1. Increased bone density – strong bones reduce the risk of injuries.
2. Increased strength of ligaments and tendons – allows the body to change direction quickly without injury occurring.



Anaerobic energy production – takes place in the absence of oxygen



Intensity of anaerobic activity is high as muscle contraction are powerful & quick *i.e. 100m sprinter/long jump*

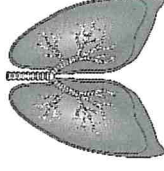


By product (lactic acid) builds up and causes fatigue.

Respiratory system

Long term effects of exercise

1. Increased capillarisation – better blood supply around the alveoli.
2. Increased number of alveoli – results in better gaseous exchange (oxygen delivery and waste product removal)
3. Increased strength of diaphragm and intercostal muscles – this increased tidal volume and vital capacity.



Muscular system

Long term effects of exercise

1. Muscular hypertrophy – increase in muscle size and strength/endurance.
2. Increase size and number of mitochondria – produces more energy aerobically.
3. Increased tolerance to lactic acid – reduces muscle fatigue.



GCSE Physical Education – Components of Fitness

Health – A state of complete mental, physical and social well-being, fitness.
Fitness - The ability to meet the demands of the environment.

Exercise - A form of physical activity done primarily to improve health and/or fitness. Not competitive sport.

Performance – The action of performing a task/action.

Relationship between these:

- Regular **exercise** increases general **health & fitness**.
- High levels of **fitness** can in turn have a positive impact on **performance**.

How to remember this?

B - Bob
 M - Munches
 M - More
 F - Fried
 C - Chicken




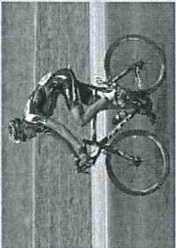
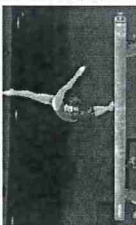



How to remember this?








C
R
A
B
S
P



Health Related Components of Fitness

Component	Definition	Sporting Example
Body Composition	The percentage of a body that is fat, muscle, bone and water.	 
Muscular Strength	The amount of the force muscles can generate against a resistance.	
Muscular Endurance	The ability to use voluntary muscles, over long periods of time without getting tired.	
Flexibility	The range of movement at a joint.	
Cardiovascular Fitness (Aerobic Endurance)	The ability of the heart and circulatory system to meet the demands of the body for a long period of time.	

Skill Related Components of Fitness

Component	Definition	Sporting Example
Coordination	The ability to move two or more body parts at the same time.	
Reaction Time	The time taken for a response to occur after a stimulus.	
Agility	The ability to change direction at speed.	
Balance	The ability to keep the body steady when in a static position or when moving.	
Speed	The time taken to cover a set distance/complete a movement.	
Power	The ability to combine speed and strength.	 

GCSE Physical Education – Principles of Training

Principles of training - **Guidelines** that ensure **training is effective** and results in **positive adaptations**. These principles are used in **Personal Exercise Programmes (PEP)**

FITT Principle

Frequency	How often training takes place.	Increase training from once a week to two
Intensity	How hard the exercise is.	Increase resistance from 10kg to 15kg or increase incline on the treadmill.
Time	The length of the session.	Increase training session from 45 minutes to 55 minutes.
Type	The method of training used.	Change to from interval training to Fartlek training.

Specificity

Training showed be **matched** to the requirements of the sport or position the performer is involved in.

Training must be specifically designed to develop the right:

- Muscles
- Type of fitness
- Skills



PAR-Q – Physical Activity Readiness Questionnaire

Conducted before fitness testing or an activity programme to examine the performer's readiness for training or any health conditions/lifestyle choices that may affect the successful completion.

Progressive Overload

Working the body harder than normal/gradually increasing the amount of exercise you do. *i.e. bench press 50kg x 10 repetitions and increase to 55kg x 5 repetitions.*



Reversibility

If training is not regular, adaptations will be reversed. This can happen when:

- Suffering from illness and cannot train
- Injury
- After an off-season.



Individual needs

All PEP's would differ depending on:

- Performer's goals/targets
- Strength and weaknesses
- Age/gender
- Current health/fitness levels



Overtraining

Occurs when you **train too hard** and do not allow the body enough **rest/recovery time**. Signs/symptoms include: extended muscle soreness, frequent illness & increase injuries.

Calculating Training Zones/Thresholds of Training

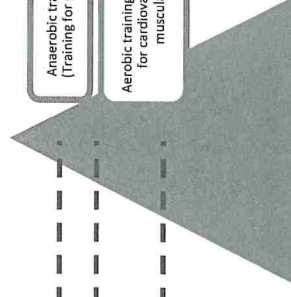
Karvonen formula used to calculate aerobic and anaerobic target training zones.

Maximum Heart Rate (MHR) = 220 – age	Aerobic target zone: 60–80% of MHR (60% = x 0.6 / 80% = x 0.8)	Anaerobic target zone: 80%–90% of MHR (80% = x 0.8 / 90% = x 0.9)
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90%
80%
60%

Anaerobic training target zone
(Training for power and speed)

Aerobic training target zone (Training for cardiovascular fitness and muscular endurance)



GCSE Physical Education – Fitness Testing

Muscular Strength

Test: Hand Grip Dynamometer Test

Protocol: Grip the dynamometer in one hand. Start with your hand up and bring down to side while pulling in handle. No swinging your hand.



Advantages

- Simple and easy to complete

Disadvantages

- Only one size of dynamometer which may affect reading.
- Focuses solely on forearm strength.

Muscular Endurance

Test: 1 minute sit up test

Protocol: Complete as many full sit ups/press ups as possible in 1 minute.



Advantages

- Simple test to complete
- Minimal equipment needed.

Disadvantages

- Difficult to assess whether each repetition is performed correctly. Difficult to accurately measure large groups.

Flexibility

Test: Sit and Reach Test

Protocol: Sit with legs straight out in front and soles of feet against box/table. Reach forward without bending knees. No jerking movements.



Advantages

- Quick and easy to perform.
- Data table readily available for comparison

Disadvantages

- Can cause injury if not fully warmed up appropriately.
- Only measures flexibility of lower back and hamstrings.

Cardiovascular Fitness (Aerobic Endurance)

Test: 12 min Cooper Run

Protocol: Continuously run/swim for 12 minutes.



Advantages

- Minimal equipment needed
- Test can be self administered.

Disadvantages

- Inaccuracy of heart rate measurements
- Motivation dependant

Test: Harvard Step Test

Protocol: Step continuously for 5 minutes.

Measure heart rate at 1, 2 and 3 minutes after exercise.



Advantages

- Simple test to complete

Disadvantages

- Motivation dependant

Agility

Test: Illinois Agility Test

Protocol: Start lying down at the start line. Complete course as quick as possible (10m x 5m – 4 central cones)



Advantages

- Simple and easy to complete

Disadvantages

- Motivation dependant / Timing errors.

Speed

Test: 30m Sprint Test

Protocol: Start from stationary position. Complete distance in the quickest possible time. Time is stopped when chest crosses the line.



Advantages

- Quick test to complete.
- Minimal equipment needed and can be performed anywhere with a flat 50m run.

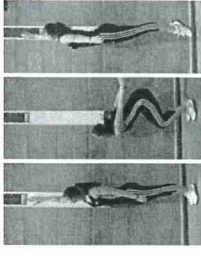
Disadvantages

- Running surfaces/weather conditions can affect the results.
- Inaccuracies with stopwatch usage.

Power

Test: Vertical jump Test

Protocol: Stand next to wall and mark an initial reach while feet are flat on the ground. Standing jump to reach as high as possible. Measure distance from first mark to second.



Advantages

- Quick and easy to perform.
- Easy to complete with large groups.

Disadvantages

- Technique plays a large role in successful completion.

Reliability / Validity

Validity relates to whether the test actually measures what it sets out to measure.

Reliability is a question of whether the test is accurate. It is important to ensure that the procedure is correctly maintained for ALL individuals.



Results can be improved:

- By using experienced testers & calibrating equipment
- Ensuring performers have the same level of motivation to complete each test
- Repeatedly test to avoid human error (x3)

GCSE Physical Education – Methods of Training

Continuous training - Involves a steady but regular pace at a moderate intensity (aerobic) which should last for at least 20 minutes. i.e. running, walking, swimming, rowing or cycling. Used by a **marathon runner**.

Interval training - Involves periods of work followed by periods of rest. i.e. *Sprint for 20 metre + walk back to start*. Used by a **200m sprinter**

Advantages	Disadvantages
<ul style="list-style-type: none"> • Ideal for beginners • Highly effective for long distance athletes 	<ul style="list-style-type: none"> • Can be extremely boring as repetitive



Advantages

- Quick and easy to set up.
- Can mix aerobic and anaerobic exercise which replicates team games.

Disadvantages

- It can be hard to keep going when you start to fatigue (high motivation and self discipline needed)
- Over training can occur if sufficient rest is not allowed between sessions (48 hours)

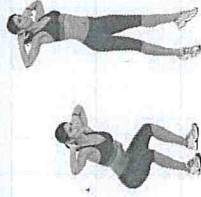
Fartlek training – Referred to as ‘**speed play**’ This is a form interval training but without rest. Involves a variety of changing intensities over different distances and terrains. i.e. *1 lap at 50% max, 1 lap walking, 1 lap at 80% (aerobic and anaerobic used)* Used by **games players – Hockey players**



Plyometrics training

Involves high-impact exercises that develop power. i.e. *bounding/hopping, squat jumps*. Used by **long jumpers, 100 m sprinters or basketball players**.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Easy to set up requiring little or no equipment • Hugely effective in developing power 	<ul style="list-style-type: none"> • Can result in injury if not fully warmed up. • Can place a great stress on joints and muscles.



Advantages

- Easy to set up requiring little or no equipment
- Hugely effective in developing power

Disadvantages

- Can result in injury if not fully warmed up.
- Can place a great stress on joints and muscles.

Weight/Resistance training – A form of training that uses progressive resistance against a muscle group. Used by **cyclists**.

Muscular strength: High weight x low repetitions
 Muscular endurance: Low weight x high repetitions

Circuit training - A series of exercises completed one after another. Each exercise is called a station. Each station should work a different area of the body to avoid fatigue. i.e. *press ups, sit ups, squats, shuttle runs*.



Advantages	Disadvantages
<ul style="list-style-type: none"> • Variety of equipment to prevent boredom • Strengthens the whole body or the muscle groups targeted. • Can be adapted easily to suit different sports 	<ul style="list-style-type: none"> • Requires expensive equipment • If exercises are not completed with the correct technique it can cause injury to the performer

Advantages	Disadvantages
<ul style="list-style-type: none"> • Quick and easy to set up • Easy to complete with large groups • Can be adjusted to be made specific for certain sports. i.e. <i>netball specific circuit</i> 	<ul style="list-style-type: none"> • Technique can be affected by fatigue and can increase risk of injury • Must have motivation and drive to complete the set amount of repetitions and sets.

Advantages

- Quick and easy to set up
- Easy to complete with large groups
- Can be adjusted to be made specific for certain sports. i.e. *netball specific circuit*

Disadvantages

- Technique can be affected by fatigue and can increase risk of injury
- Must have motivation and drive to complete the set amount of repetitions and sets.

Fitness classes
 Body pump – Weight based exercise class
 Aerobics – Rhythmical dance movements set to music
 Pilates/Yoga – Series of movements completed to core muscle strength & posture
 Spinning – A high intensity workout on a stationary bike.



Advantages

- Variety avoids boredom
- Instructor will challenge & motivate
- Great way to meet new people

Disadvantages

- Gym membership can be expensive.
- Group classes are not tailored to individual needs.

GCSE Physical Education – Health, Fitness and Well-Being

Lifestyle choices – the decisions we make about how we live and behave that impact on health.

Diet

Activity levels

Work/rest/sleep balance

Eating healthy	Eating unhealthy
<ol style="list-style-type: none"> Boosts energy levels Reduces the risk of developing serious health conditions Help lose weight 	<ol style="list-style-type: none"> Leads to deficiencies Increases weight and % body fat Causes depression with poor body shape

Active lifestyle	Inactive lifestyle
<ol style="list-style-type: none"> Boosts self esteem Reduces stress and anxiety Improves fitness levels 	<ol style="list-style-type: none"> Increases risk of disease Decreases muscle mass, strength and energy levels

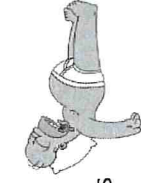
Good balance	Poor balance
<ol style="list-style-type: none"> Improves mood Increases productivity at work Contributes to quality of sleep 	<ol style="list-style-type: none"> Increases the risk of depression Leads to weight gain Increased blood pressure

Well being – a combination of physical, emotional and social health.

Positives effects of training/exercise on:

Physical health

- Stronger bones (increased bone density)
- Lower cholesterol / reduced obesity
- Increase/development of components of fitness
- Increase life expectancy



Emotional health

- To increase self esteem/confidence – increased endorphins released
- Reduced risk of age-related diseases - dementia
- Relieve stress and tension
- Fun/enjoyment / reduced boredom



Social health

- To develop teamwork skill
- To meet new people/friends
- Develop communication skills
- Develop leadership skills



Social benefits may vary depending on age group:

- Elderly
- Children

Negative effects of training on:

- Physical health – overexertion leading to heart failure / overuse injuries
- Emotional health – training can lead to injury and cause depression
- Social health – training long hours means less time spent with family.

Impact of a sedentary lifestyle on weight

Overweight – weighing more than the expected weight for height and gender / **Overfat** – high percentage of body fat

Obese – weighing significantly more than expected.

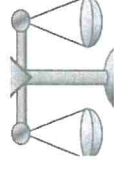
Recreational drugs – these are taken for pleasure and are legal to those over a certain age.

Smoking

Causes breathlessness and reduces the oxygen-carrying capacity. This affect aerobic ability for endurance events. Smoking (nicotine) increases the risk of lung cancer, bronchitis, pneumonia & emphysema.



Alcohol - contains chemicals which act on the brain affect judgement.



Balance, co-ordination and reactions are affected



Diuretic – increased water levels in urine and cause dehydration



Reduction of glycogen levels and slower lactic acid removal

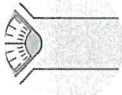


Liver problems

Sedentary lifestyle – a lifestyle with no or irregular physical activity. This includes sitting, reading, watching television & playing video games.

Health risks associated are:

- Heart disease
- Type 2 diabetes
- Obesity
- Osteoporosis
- Depression



GCSE Physical Education – Diet, Weight, Nutrition & Hydration

A **balance diet** – eating the right foods in the correct proportions. Insufficient macro and micronutrients can cause health issues *i.e. anaemia, rickets and scurvy*.

7 components of a balanced diet:

Macronutrients

- Carbohydrates – Main energy source. *i.e.* pasta & potatoes
- Fats – Secondary energy source & provides insulation. *i.e.* butter
- Proteins – Help growth and repair of muscles. *i.e.* eggs, meat & fish

Micronutrients

- Minerals – Maintains a healthy bodily functioning. *i.e.* iron and calcium
- Vitamins - Maintains a healthy immune system. *i.e.* vitamin C/D

Other components

- Fibre – Aids digestion of food in the gut. *i.e. cereals & nuts*
- Water – Maintains hydration of an athlete.



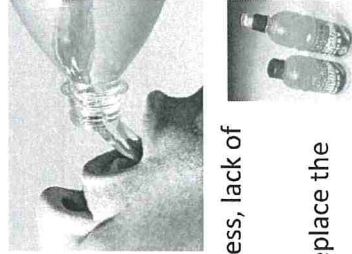
Hydration and physical activity

Water is necessary for:

- Transportation of nutrients
- Removes waste products through urine
- Regulates body temperature

A lack of water can cause **dehydration**. Symptoms are tiredness, lack of concentration and headaches.

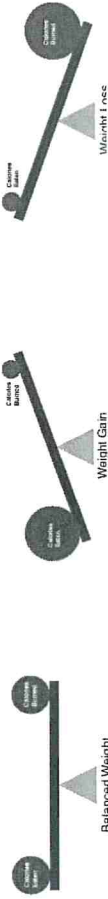
After the event - An athlete will continue to drink fluids to replace the water and carbohydrate levels that are depleted.



Organising meals around exercise – it is recommended to eat 2-3 hours before exercise. This is due to redistribution of blood during exercise (Blood Shunting)

When exercising, the distribution of blood around the body changes according to the demands. *i.e. away from digestive system and to working muscles.*

Energy Balance – this relates to intake and energy expenditure.



Dietary manipulation to optimise performance

Carbohydrate Loading – a strategy used by endurance athletes to increase carbohydrate stores



1 week before competition – train and eat normally

3-4 days before competition – reduce the amount of exercise. Increase carbohydrate intake

24 hours before competition – no exercise and large carbohydrate intake

Protein intake – the intake and timing of this consumption is vital to maximise the repair of muscle tissues after training. Protein should be taken straight away to increase muscle repair. Used by **sprinters, shot putters & power events**.



Optimum Weight – this is the ideal weight someone should be. This will depend on:

- Height
- Gender
- Bone structure
- Muscle girth (size)



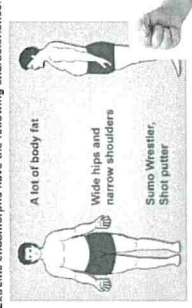
Optimum weight varies depending on the requirements of different sports/positions. *i.e. rugby forwards & backs*



Somatotypes (AQA only)

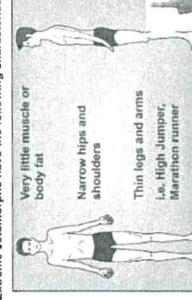
1. Endomorph Remember the 'D' stands for DUMPHY

Extreme endomorphs have the following characteristics:



2. ECTOMORPH Remember the 'T' stands for THIN.

Extreme ectomorphs have the following characteristics:



3. Mesomorph Remember the 'M' stands for MUSCULAR.

Extreme mesomorphs have the following characteristics:

