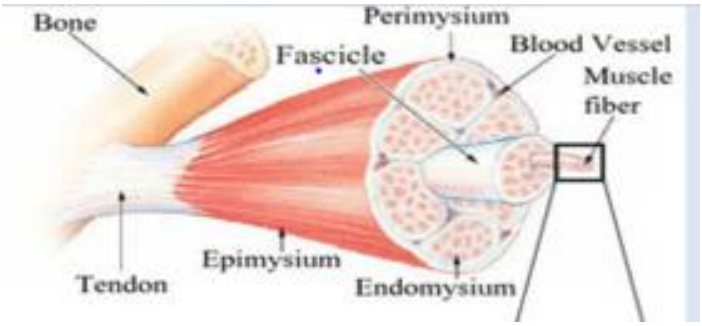
PHYSED NOTES:

Functional anatomy

SKELETAL MUSCLES:

STRUCTURE OF SKELETAL MUSCLE:

- Skeletal muscle tissue is named for it's location- attached to bones (skeleton) by bundles of collagen fibres known as tendons
- Skeletal muscle links 2 bones across its connecting joint- as a result it is responsible for moving the skeleton via the contraction or shortening of muscles. This process occurs via voluntary control
- It is striated in appearance which means the fibres contain alternating light and dark bands that are perpendicular to the fibres
- There are 2 distinct types of skeletal muscle which are determined by their colour
  1. Fast twitch- white
  2. Slow twitch-red



DEFINITIONS OF SKELTAL STRUCTURES:

- Epimysium- connective tissue sheath surrounding each muscle
- Perimysium- connective tissue which surround each bundle of muscle fibres
- Endomysium- connective tissue which surrounds each individual muscle fibre
- Fassicle- a bundle of skeletal muscle fibres surrounded by the perimysium
- Myofibril- small, thread like strands that run through each muscle fibre

SLIDING FILAMENT THEORY:

HOW DO WE PRODUCE MOVEMENT:

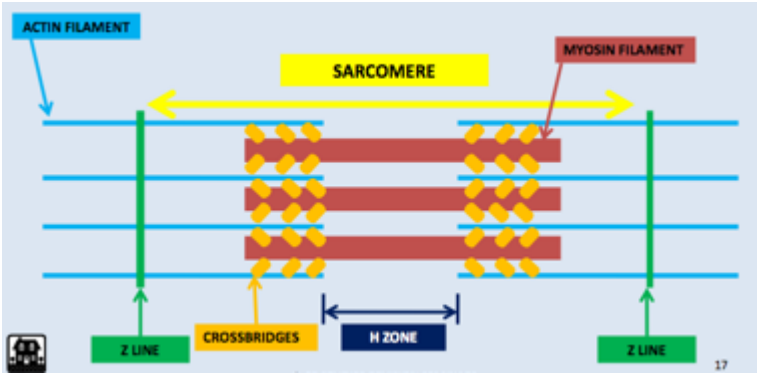
- The human body is made up of over 600 muscles, working together to provide both conscious and subconscious movements for the human body
- One of the major functions of the muscular system is to produce movement; Produce movement:
- Skeletal muscles which are consciously controlled (voluntary) are attached to bones
- When we want to produce movement e.g walking, swimming, the CNS sends a message from the brain to the relevant muscle to contract , resulting in 'pulling the bone' causing movement to occur
- This enables the human body to respond quickly to changes in the external environment e.g changing direction in a game of sport.

- Muscles have two attachment points onto the skeleton. Each attachment is on a different bone across a joint
  Origin:
- The origin of a muscle is the attachment onto the bone that does not move when the muscle contracts
- The origin of a muscle is the point which is usually at the proximal end
  Insertion:
- The insertion is attached to the bone which moves more when the muscle contracts
- The insertion of a muscle is the point which is usually at the distal end

HOW DO MUSCLES HELP US MOVE?

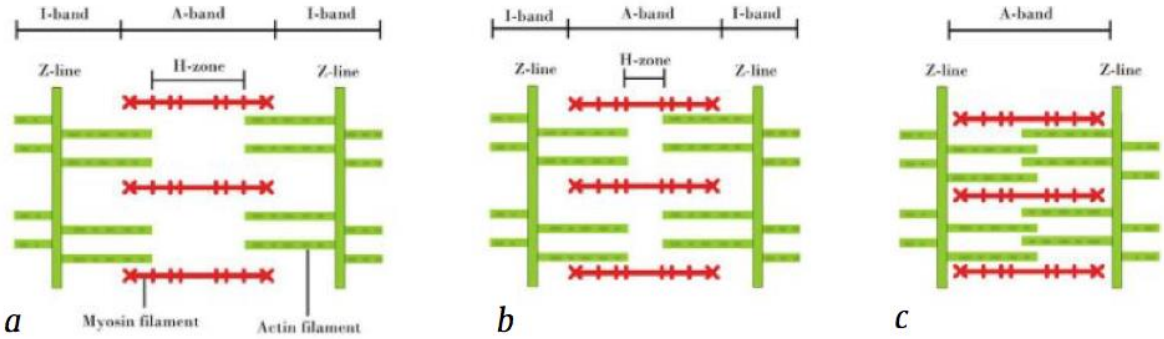
- When a muscle contracts, it pulls on 1 of the 2 bones to which it is attached, creating movement
- The origin and insertion points of a muscle are it's two attachment points on the skeleton
- All muscles bridge a joint and when contraction occurs, movement takes place altering the joint angle
- Once a muscle contracts to move a bone, another muscle must contract to return the bone to its original position- hence muscles work in pairs
- When muscles produce movement, they work in pairs- this is because muscle can only pull, not push
- The prime mover involved in any movement is referred to as the agonist
- The muscle which relaxes to allow the movement to occur passively is referred to as the antagonist
- The term reciprocal inhibition is used to describe the coordinated relaxing of muscles on one side of a joint to accommodate contraction on the other side of that joint

STRUCTURE OF A SARCOMERE:



- Sarcomere- Comprises of the unit between the 2 Zlines and makes up the functional unit of a muscle fibre
- Z lines- fund at either end of the sarcomere
- Actin- the thin protein filament attached to the z line
- Myosin- the thick protein filament attached to the crossbridges
- Crossbridges- tiny projections on myosin filaments that attach on the actin filaments, pulling the actin filaments upon contraction

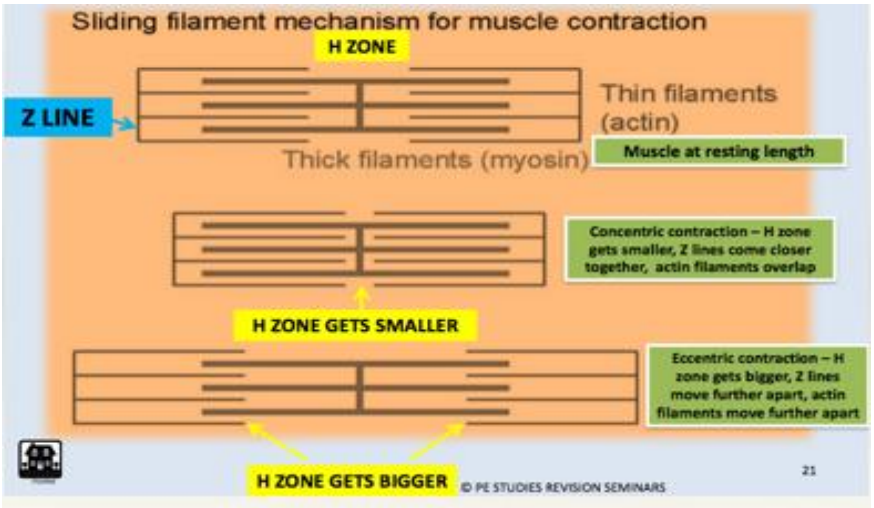
- H zone- space between the actin filaments



- I band- gap between the end of the myosin and the z line
- A band- the gap between each z line

SLIDING FILAMENT THEORY:

- Biomechanists use sliding filament theory to explain the shortening of the sarcomere (concentric contraction) and the resulting contraction of the muscle
- Where there is a neuromechanical stimulation, calcium is released into the muscle prompting a reaction in each muscle fibre between the myosin ad the actin filaments
- Myosin filaments contain crossbridges at regular intervals. These crossbrodges attach and reattach at different times along the actin pulling on them to create movement and maintain tension
- This causes the actin to move into the centre of the sarcomere, shortening the myofibril and causing the actin and myosin filaments to be almost fully overlapped when in fully contracted position
- As each sarcomere shortens, so does the total length of each muscle fibre
- When the contraction finishes, the myosin and actin filaments return to a relaxed position



DEVELOPING MUSCLE FORCE:

FORCE WITH MOTION- ISOTONIC FORCE:

- An isotonic force is one which results in a change in the length of a muscle performed against a constant load- e.g performing a triceps extension
- Isotonic forces can be further broken down into 2 types of muscular contractions, both involving a change in length of the muscle
  1. Eccentric muscular contraction
  2. Concentric muscular contraction

CONCENTRIC MUSCULAR CONTRACTION:

- A muscular contraction that results in the shortening of a muscles length. It occurs when you apply a force against the direction of gravity
- E.g the quadriceps shorten during kicking of a ball and the biceps shorten during the raising phase of a bicep curl

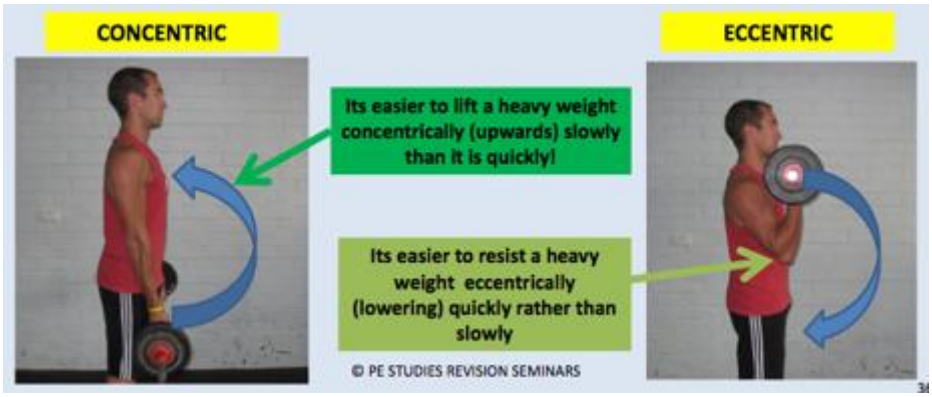
ECCENTRIC MUSCULAR CONTRACTION:

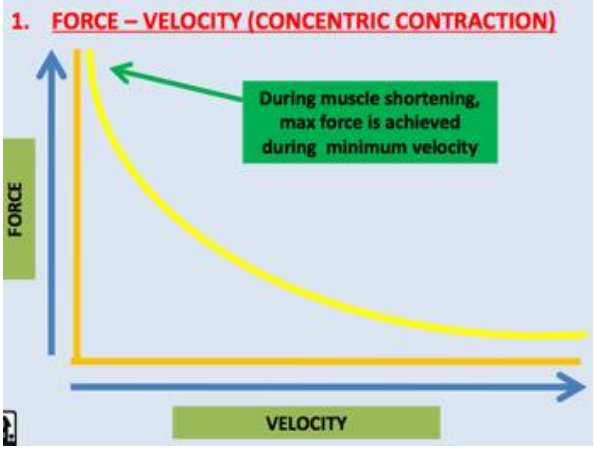
- A muscular contraction that results in an increased length of the muscle. A muscle lengthens when resisting the force of gravity
- E.g quadriceps when walking down a hill or the biceps when lowering a weight

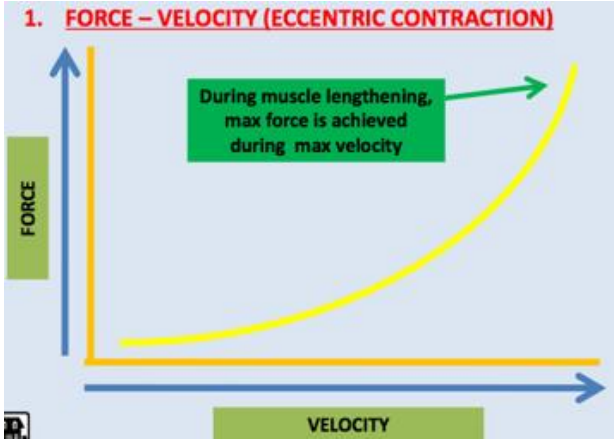
MECHANICAL CHARACTERISTICS OF A MUSCLE:

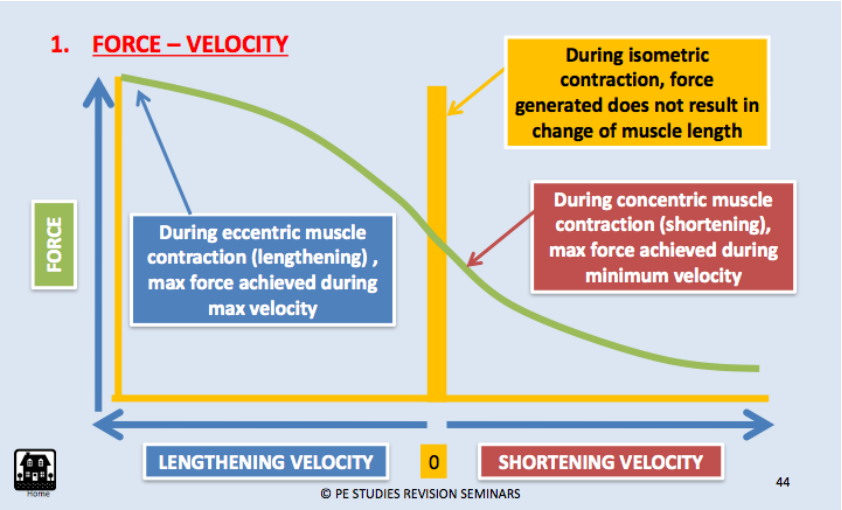
1. Force- velocity:

- Muscle can create increase force with a decrease velocity of concentric contraction
- Muscle can resist increase force with an increase velocity of eccentric contraction









FORCE-VELOCITY RELATIONSHIP:

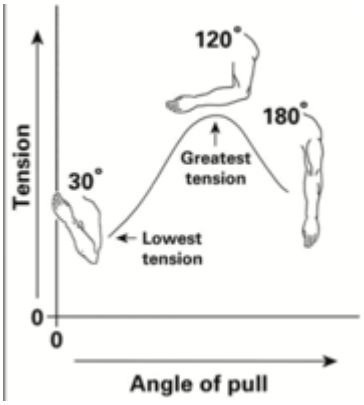
- Maximum force is generated from an isometric contraction
- Power is a combination of strength and speed
- To achieve maximum power, the velocity and resistance should a approx one third of the maximum values

2. Force-length:

- The length of a muscle affects how well it creates tension
- Max tension is created in a muscle fibre occurs at length slightly greater than the resting length (approx 130%)
- Within the human body, force generation will increase when the muscle is slightly pre stretched- this is one of the major reasons why we have a wind up or preparation phase as it allows us to place our muscles on 'pre stretch'

FORCE-LENGTH RELATIONSHIP:

- The length of a muscle and the angle at the joint has an impact on the force that can be generated
- The optimum muscle length and joint angle is different for each part of the body
- However the optimal position is somewhere near the middle of a joints range, allowing maximum attachment of the myosin cross bridges with the actin
- The longer muscles can create a greater range of motion at a joint.
- A shorter wider muscle produces greater amounts of force



NERVOUS CONTROL OF MUSCULAR CONTRACTION:

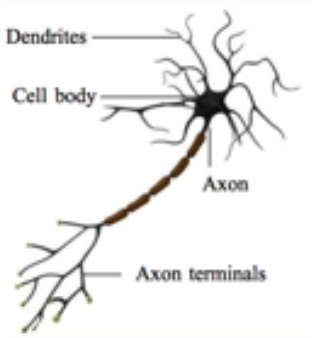
NERVOUS SYSTEM:

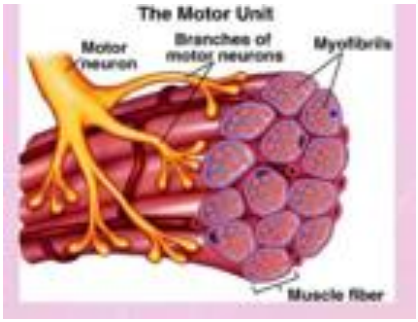
- The nervous system comprises of 2 main parts, the CNS and the PNS
- The CNS is comprised of the brain and spinal cord
- The PNS includes all the nerve branches that are outside the spinal cord
- Information must be sent from the brain down the spinal cord then to the target muscle for muscle contraction, and thus movement occurs
- The information is sent via an electrical impulse with nerves acting as a conductor. These nerves act in the same manner as an electrical cord such as a power cord for a toaster

- When neural messages travel to the target muscle from the CNS, they do so along the motor neurons and when they send impulses back from receptors to the brain, they do so along sensory neurons

COMPONENTS OF A MOTOR NEURON:

- A motor neuron is a nerve whose end point is a muscle
- A motor neuron or nerve is made up of 3 main parts; the dendrite, the cell body, and axon
- The dendrite is like a TV antennae, it receives the signal or information from the CNS. It feeds this information to the cell body
- A cell body directs the activities of the neuron, so when it receives the signal it then transmits the information along the length of the axon
- The axon is responsible for transmitting messages away from the cell body
- The motor neuron and the muscle fibres that it innervates are collectively called a motor unit
- The axons of motor units are myelinated (insulated by a myelin sheath)
- This myelination increases the speed of the information transfer to 100ms-1





MUSCLES AND MOVEMENT- NERVOUS CONTROL OF MUSCULAR CONTRACTION:

- In order to contract or shorten, muscle fibres must be stimulated by nerve or electrical impulses sent via motor neurons or nerves
- For this to take place, a message is sent from the brain, in the form of an action potential, down a spinal cord through to the motor neuron, which innervates the required muscle fibres

MOTOR UNIT:

- Refers to a single motor neuron and all of the corresponding muscle fibres it innervates
- When a motor unit is activated, all of its fibres contract
- This is known as the 'all or none principle' which states that all muscle fibres in a motor unit will either contract with 100% force or not at all
- This is determined by whether or not the signal transmitted from the brain is above or below the threshold required for contraction
- To increase the strength of contraction, the brain simply send more signals resulting in the recruitment of more motor units
- The number of muscles fibres within each unit can vary;

- The smaller the motor unit, e.g innervates a small number of muscle fibres,the more precise the action of the muscle e.g the eye
- The larger the motor unit e.g innervates large number of muscle fibres, usually results in the recreation of gross motor skills e.g the muscles of the quadriceps when kicking a ball
- A single motor neuron joins with muscle fibres which respond (contract) when the motor neuron is activated. The motor neuron and it's fibres it activates/ innervates is called a motor unit

NEUROMUSCULAR RESPONSE TO STRENGTH TRAINING:

- Improvements in muscular training can occur in the first 2-8 weeks of training without any changes to the muscle size
- Improvements occur at the neuromuscular level- the skill level improves
- Four main responses to strength training without changes to muscle bulk:
  1. Improved technique
  2. Increased firing rate of motor units
  3. More motor units are recruited
  4. Firing pattern is better coordinated

MUSCLE FIBRES AND MOVEMENT- NERVOUS CONTROL OF MUSCULAR CONTRACTION:

- In order to contract, muscle fibre must be stimulated by nerve or electrical impulses sent via motor neurons or nerves
- For this to take place;
  1. A message is sent from the brain, in the form of an action potential (electrical impulse), down the spinal cord
  2. The action potential is detected by the dendrites of a motor neuron which send the information to the cell body
  3. The cell body directs the information down the axon to the motor end plate (attached to targeted muscle)
  4. The action potential is delivered to the muscle which is innervated as long as the signal/stimulus/ impulse is strong enough

THE ROLE OF THE NERVOUS SYSTEM WHEN BATTING IN CRICKET:

- The eyes (sensory neurons) detect the stimulus- the ball- and sends a message to the brain via the optic nerve.
- The brain analyses the message;
  1. How fast is the ball is coming?
  2. What line is the ball?
  3. What length is the ball?
- The brain then selects the most appropriate shot to play and sends a message/ action potential to the spinal cord which delivers the message to the dendrites of the motor neurons which connect the peripheral nervous system

- The dendrites of motor neurons detect the message from the spinal cord, send it to the cell body and from there the message is sent down the axon to the motor end plate which attaches the motor neuron to the muscle
- A motor unit is a motor neuron and all the fibres it innervates. If the stimulus threshold of the motor unit is reached by the intensity of the stimulus, it will contract all its fibres at 100% intensity- contraction is initiated when calcium is released into the muscle fibres
- Sensory neurons in the body relay information back to the spinal cord which delivers the message to the brain which analyses the information to determine how the movement felt
- Sensory neurons in the eye send a stimulus to the brain to analyse where the ball has been hit to

MOTOR UNIT RECRUITMENT- ATHETICS EXAMPLE:

- 15km run Low, sustained force required –low intensity stimulus sent from brain to muscles will innervate motor units containing Type I (slow twitch) fibres as these fibres can meet the demands of the task. Signal is not of high enough intensity to innervate motor units with Type IIa or IIb muscle fibres. Motor units containing Type I muscle fibres recruited.
- 800m run A sustained high intensity event where Type I fibres are not capable of providing the force required to meet the demands of the task.
- Brain sends a higher intensity signal to the muscles which will innervate motor units containing Type IIa fibres -motor units containing Type I fibres which are also innervated. Signal is not of high enough intensity to innervate Type IIb fibres. Motor units containing Type I and IIa muscle fibres recruited.
- 100m sprint Maximum force required over a short period of time Brain sends an even larger stimulus which innervates motor units containing Type IIb fibres to generate maximum force - motor units with Type I and Type IIa muscle fibres are also innervated due to the stimulus size. Motor units containing Type I, IIa and IIb muscle fibres recruited

INCREASING FORCE GENERATED BY A MUSCLE:

- The force produced by a muscle can be increased in 2 ways:
  1. Increasing the number of motor units recruited by increasing the size of stimulus. Increasing the number of motor units used in generating force will increase the size of the force generated
  2. Increasing the rate at which impulses are sent to the motor unit resulting in the motor unit firing repeatedly to increase the force generated
- The increase in signal size or frequency of signal is controlled by the brain which recognised the need for greater force- it's a neural process

TYPES OF MUSCLE FIBRES:

Type I:

- Referred to as red twitch or slow twitch fibres
- Endurance- based activities
- Aerobic ATP production

Type II:

- Referred to white fibres or fast twitch fibres
- Speed and power events

2 subcategories:

Type II a:

- Intermediate speed of contraction (faster than type I, slower than type IIb)
- Can develop aerobic characteristics with training

Type II b:

- Fastest speed contraction (x10 speed of contraction compared to type I)
- Explosive movements
- Purely anaerobic activities

SLOW TWITCH (TYPE I-RED):

- Slow contraction speed- used for endurance/ submaximal activities
- Uses aerobic energy system
- Low force of contraction for extended periods
- High capacity for ATP production- generates ATP using the aerobic system
- Fatigue resistant and can contract repeatedly for continuous activity
- Low glycolytic capacity
- Glycogen and fats are the major fuel source
- Possess aerobic characteristics;
- High levels of myoglobin transport more oxygen from the haemoglobin to the mitochondria
- Increased number of mitochondria increases ATP production o Increased number of blood capillaries delivers more blood and therefore oxygen to the working muscle.
- High level of oxidative enzymes
- Stimulated by relatively small motor neurons (diameter of slow twitch fibres is smaller than Type IIA and IIB fibres) and are stimulated at a lower frequency
- E.g. Endurance cyclist (up to 80% slow twitch)

FAST TWITCH TYPE II A:

- Fast contraction speed –used for speed endurance-based activities
- Moderate force of contraction (larger than Type I, smaller than Type IIB)
- Fatigue resistance but not as much as slow twitch fibres
- Generate greater force and more powerful contractions as they are larger in diameter than red fibres

- Possess some aerobic characteristics such as moderate levels of myoglobin, mitochondria and blood capillaries –can with training, assist Type I fibres in aerobic events.
- Creatine phosphate and glycogen are main fuel source
- Medium level of oxidative enzymes
- Medium glycolytic capacity
- Stimulated by relatively large motor neurons and are stimulated at a moderate frequency. (diameter of a Type IIA fibre is smaller than IIB fibres but bigger than Type I fibres)
- E.g. 800m runner (up to 70% fast twitch)

FAST TWITCH TYPE II B:

- Low levels of oxidative enzymes
- They have very high anaerobic characteristics such as high levels of;
- Glycogen
- PCR
- Glycolytic enzymes
- Stimulated by very large motor neurons and are stimulated at a very high frequency
- E.g. Sprinter (up to 80% fast twitch)

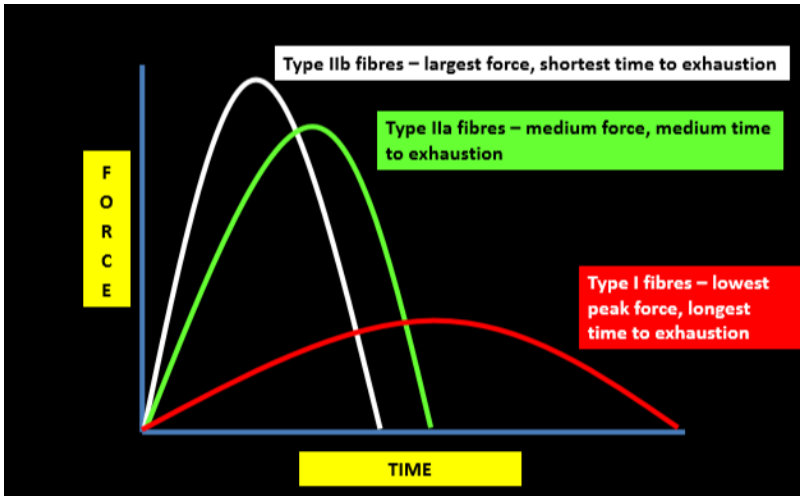
NEURON SIZE AND FIBRE TYPES:

- The size of the neuron required to activate Type I and Type IIa and IIb fibres is determined by the diameter of the fibres which need to be stimulated.
- The greater the diameter of the fibres, the larger the neuron needs to be to activate the muscle fibres
- Type I muscle fibres have small diameters and can be stimulated by a small neuron.
- Type IIa muscle fibres have intermediate size diameters and can be stimulated by an intermediate size neuron.
- Type IIb fibres have a large diameter and need a large neuron to stimulate them.

RECRUITMENT OF MUSCLE FIBRES:

- Type I fibres have a lower activation level than type II fibres and are more easily recruited
- During low intensity exercise, type 1 fibres are predominantly recruited –fibres small in diameter, low stimulus threshold means the stimulus intensity required for the motor unit to fire is low.
- At higher level intensity, type IIa fibres are predominantly recruited –fibres larger in diameter, higher stimulus threshold means the stimulus intensity required for the motor unit to fire is higher than type I but lower than type IIb.
- At very high intensity exercise, type IIb fibres are predominantly recruited -fibres very large in diameter, higher stimulus threshold means the stimulus intensity required for the motor unit to fire is very high.

COMPARISON OF FORCE DEVELOPMENT OVER TIME:



MUSCLE FIBRE CHARACTERISTICS TABLE:

Fibre Type	Slow Twitch (Type 1)	Fast Twitch (Type 2A)	Fast Twitch (Type 2B)
Contraction Time	Slow	Fast	Very Fast
Size of Motor Neuron	Small	Large	Very Large
Resistance to Fatigue	High	Medium	Low
Activity used for	Aerobic	Long term Anaerobic	Short term Anaerobic
Force Production	Low	High	Very High
Capillary Density	High	Intermediate	Low
Oxidative Density	High	Moderate	Low
Glycolitic Capacity	Low	High	High
Major Fuel Source	Triglycerides and glycogen	Creatine phosphate and glycogen	Creatine phosphate and glycogen

ENERGY DEMANDS AND NUTRITIONAL REQUIREMNETS:

BALANCED DIET:

In addition;

- Drink plenty of water
- Limit intake of foods high in saturated fat (e.g. cakes, biscuits, fried foods)
- Limit intake of food and drinks containing added sugars (e.g. soft drinks & lollies)
- Limit alcohol intake
- Milks, yogurts, cheeses and/or alternatives (reduced fat where possible)

The Australian Guide to Healthy Eating:

- Wide variety of foods everyday
- Vegetables, Legumes and fruits
- Cereals (breads, rice, pasta & noodles), preferably wholegrain
- Lean meat, fish, poultry and/or alternatives
- Milks, yogurts, cheeses and/or alternatives (reduced fat where possible)

DAILY ENERGY REQUIREMENTS- A BALANCED DIET:

- The amount of energy we consume each day is dependant on a number of factors. These include;
  1. Age
  2. Sex/gender
  3. Level of physical activity
  4. Periods of growth
- To meet the bodys energy demands, it is important that we adjust our diet accordingly
- For a normal male, approx. 50-60% carbohydrates, 25-30% fats and 10-15% proteins
- For athletes involved in heavy endurance training, approximately; 70% carbohydrates, 15% fats and 15% protein- may increase up to 30% for body builders

PROTEIN:

- Functions of protein;
  1. Growth of muscle tissue
  2. Repair of muscle tissue
  3. Production of red blood cells, hormones and antibodies
  4. Contribution to ATP production when carbohydrate and fats stores are depleted. This may occur in extreme circumstances such as starvation or during ultra-endurance events such as Hawaiian ironman
- E.g poultry, meat, eggs, fish
- For athletes In heavy training a protein intake between 1.5-2.0kg of body mass on a daily basis is sufficient and won't require a supplement.

FATS / LIPIDS:

- Represents body's most plentiful source of potential energy
- Fats (stored as triglycerides in muscle cells and broken down into free fatty acids) are the major energy source during rest (60%) and light to moderate exercise
- Your body takes a long time to break fats down so tends not to use them when demands for energy are high
- Trained athletes are better able to break down fats and hence use them as fuel source at higher intensities leading to glycogen sparing
- Nutritionists recommend fats account approximately 20-30% of a normal diet

CARBOHYDRATES(CHO):

- What happens when you ingest CHO?
  1. First converted to blood glucose leading to raise insulin levels

2. Excess blood glucose converted to glycogen

- Glycogen is stored for future use in the muscle and the liver
- 80 kg person stores approx. 400g in muscle and 100g in liver

CARBOHYDRATES-GLYCAEMIC INDEX (GI):

- Glycaemic index- ranking of carbohydrates based on their immediate effect of blood glucose (blood sugar) levels
- Measured on a scale of 1(low)-100(very high)

LOW GI FOODS	MODERATE GI FOODS	HIGH GI FOODS
Apples	Corn	Pure glucose which has a GI of 100
Lentils	Peas	Honey
Kidney beans	White pasta	White bread
Peanuts	Sweet potatoes	White rice
Navy beans	Oranges	Gel shot
Sausages	Oatmeal	

HIGH GI FOODS:

- Break down quickly during digestion- therefore immediate effect on increasing blood sugar levels
- Best consumed during and immediately after the event

1. During exercise:

- Rapid absorption and release of energy into bloodstream provides opportunity to top up glycogen stores, helping with glycogen sparing

2. Immediately after (first 30 minutes):

- Immediately after exercise muscles are most responsive to topping up fuel supplies, therefore high GI foods best served here

LOW GI FOODS:

- Break down slowly during digestion- releasing glucose gradually into the bloodstream
- Best consumed as part of the pre-event meal and after the event to replenish supplies

1. Pre event meal (1-4hrs prior):

- Slower release of glucose into bloodstream helps keep blood glucose levels topped up prior to the race

2. After exercise (1-2 hours post exercise):

- Assists with repletion of muscle and liver glycogen stores in the 24hours post exercise

CARBOHYDRATE LOADING:

- Carbohydrate loading- is a nutritional intervention aimed at delaying the depletion of glycogen stores. It occurs when the athlete increases the amount of CHO consumed prior to competition with the aim being to store extra glycogen in the liver and muscles. There are 2 main methods to load.

1. 3 day method:

- Consume approximately 7-8/kg bodyweight of carbohydrates for 3 days leading up to competition (approx. 700g stored in the muscle and liver)
- Players can still exercise, however there is significant tapering occurring leading up to competition as to no to deplete glycogen stores
- 3 day method is not suitable for sports which require athletes to perform every week- a 3 day taper leading to a match on Saturday would require a taper staring on Wednesday which is not ideal

2. 1 day method:

- Consume approximately 8-10kg/body weight of carbohydrates the day before competition (appro 700kg stored in muscle and liver)- this is equivalent to eating almost 3 loaves of bread in one day- you may need to use supplements
- Tapering or reducing training load is required to spare muscle glycogen stores
- As exercise intensity increases, CHO usage increases
- 85% VO2 max= 90% of energy from CHO

ADVANTAGES AND DISADVANTAGES TO CARBOHYDRATE LOADING:

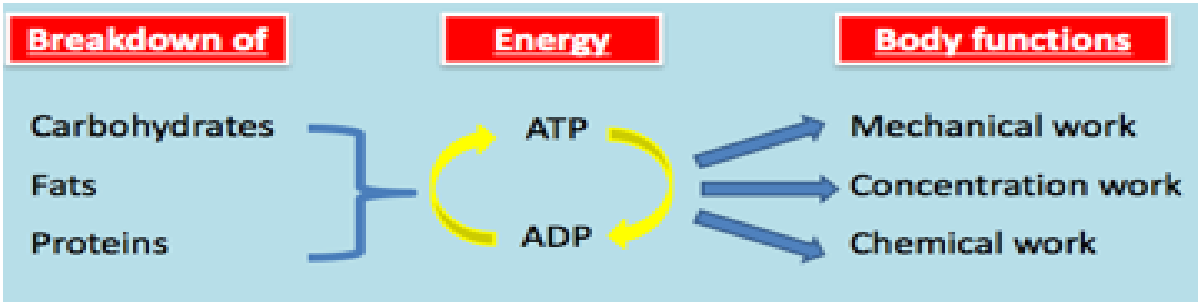
Advantages:

- CHO loading avoids the depletion of glycogen stores by increasing muscle and liver glycogen levels
- By sparing glycogen, it allows aerobic athletes to maintain a higher intensity for a longer period of time

Disadvantages:

- Binding of H2O to CHO molecules increases water absorption, causing an increase in weight

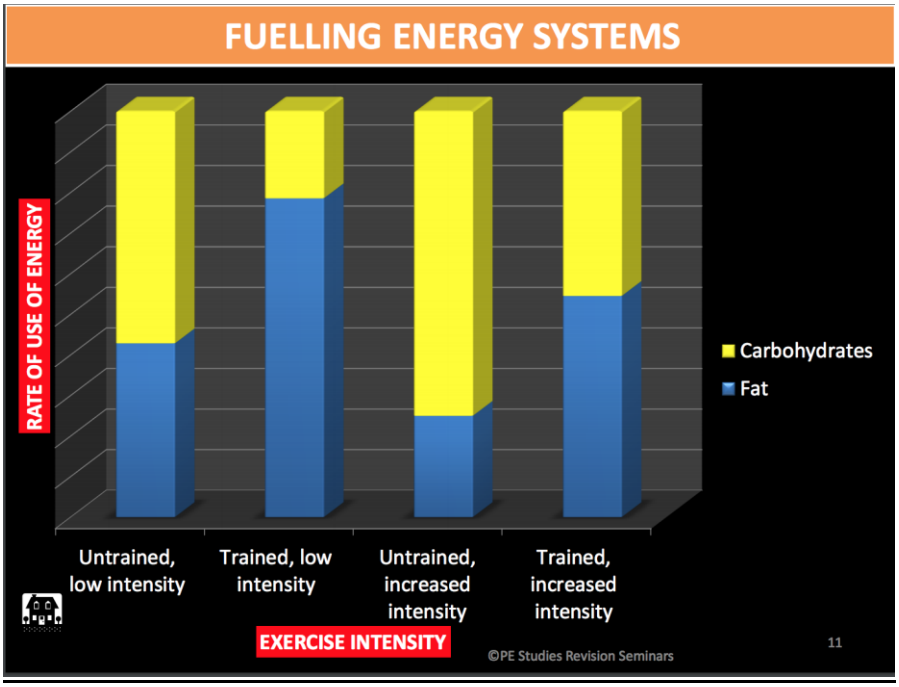
FUELING ENERGY SYSTEMS:



- The fuel source used for ATP production is based on the duration and intensity of exercise

1. Low intensity/ rest- stored fats are the main fuel source
2. As intensity of exercise increase, the contribution of muscle glycogen increases to meet the more immediate demands for fuel
3. There is enough glycogen stored in muscles to fuel up to 90 mins depending on intensity. Athletes 'hit the wall' when the muscle glycogen runs out
4. When muscle glycogen stores run out, the stored liver glycogen becomes the primary fuel source allowing exercise to continue but performance starts to diminish

5. Depletion of liver glycogen is referred to as 'bonking' and it affects the brain- decision making ability affected
6. fats now become primary fuel source and intensity of exercise is reduced as fats are more difficult to breakdown
7. depletion of fats results in protein being used as fuel source- this only occurs in ultra endurance events- this is only likely to occur in ultra endurance events

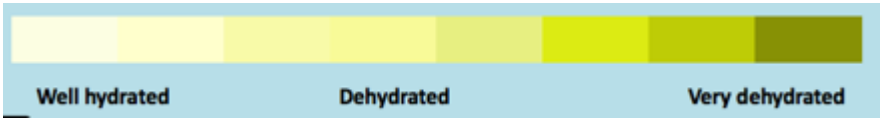


GLYCOGEN SPARING:

- glycogen sparing- is the ability of an athlete to spare glycogen supplies by using an alternative fuel of source during physical activity
- this can be achieved by:
  1. training effect;
- through aerobic training program, athletes are better able to break down fats for a given intensity, sparing glycogen for later in the event
  2. caffeine consumption;
- by consuming caffeine before the event, it better enables the athlete to break down fats at the start of the event, sparing glycogen for later in the event
  3. pre event meal;
- by consuming a low GI meal 1-4hours prior to the event, it increases blood glucose levels allowing for the sparing of glycogen for later in the event
- CHO loading before the event does not achieve this as it is used to increase initial stores of muscle and liver glycogen
  4. During the event;
- By consuming high GI foods during the event, it allows blood glucose levels to be constantly topped up, sparing the use of glycogen as a fuel source

HYDRATION CONSIDERATIONS:

- as humans, we lose water from the body via a number of different processes. These include;
- breathing
- sweating
- urinating
- to ensure the body does not become depleted (a state in which fluid loss exceeds fluid intake), it is recommended we consume approximately 2L of fluids/day
- a simple method of determining hydration levels is to look at the colour of the urine
- the urine of a well hydrated person is almost clear in colour and gets progressively darker as the level of dehydration increases
- the darker the urine, the more fluid is required by the performer to return to the desired hydration levels



HYDRATION WITH EXERCISE:

HYPERHYDRATION PRE EXERECISE:

- involves increasing the body's fluids stores by consuming extra fluid prior to an event
- 1L prior to exercise recommended
- 600ml 3-4 hours before the game
- 400ml just prior to the game to prime the stomach
- Avoid drinks with caffeine as they act as a diuretic and will cause increase fluid loss
- Allow athlete to sweat more before performance is inhibited

DURING EXERCISE:

- Drink approx. 200ml of water every 15minutes during activity. Influenced by environmental conditions and exercise intensity
- Don't just drink when you are thirsty- you are usually dehydrated already at this stage
- Avoid drinking just water as salt lost in sweat needs to be replaced (sports drinks effective)

POST EXERCISE:

- Want to replenish back to pre exercise weight
- For every 1L of sweat loss, consume 1.5L as you will urinate some of this out
- Consume slightly salty fluid to keep osmolality higher so you don't urinate as much

MEALS WITH EXERCISE: (NUTRITION)

PRE-EVENT MEAL:

- Main aim of the pre competition meal is to provide adequate carbohydrates and to ensure optimal hydration leading into the event
- Considerations;
- Food preference- liquid meals, nutrition bars may be consumed
- Digestibility of foods- consume foods low in fat and fibre
- Advantages;
- Increase glycogen levels leading up to glycogen sparing
- Ensure optimal hydration
- Ensure gastro- intestinal tract feels comfortable during performance
- Make sure;
- Meal is Consumed 1-4 hours prior to competition
- You Consume low GI foods for slow release of glucose into bloodstream
- The body tends to use the foods most recently digested as energy source- this assists with glycogen sparing
- E.g pasta, all bran cereal, apples, lentils
- Consume approx. 600-800ml of fluid 1hour prior to the event to assist with hydration

DURING THE EVENT:

- CHO and fat are the most common fuels used by athletes, sports lasting up to 60 mins can be fuelled from stored CHO and fat
- For those events lasting longer than 60mins, CHO consumption is important to avoid depletion of stored glycogen- consumption of high GI foods can assist glycogen sparing
- Ingestion of CHO during the event also prevents low blood sugar levels. The brain relies on a constant supply of glucose to avoid the CNS inhibition and the feeling fatigue- this particularly important for team sports relying on decision making and concentration
- Make sure you;
- Consume 30-60grams of high GI CHO per hour, or 1kg of body mass every hour e.g sports bar, jelly beans
- Consume approx. 150-200ml of fluid every 15 minutes to prevent dehydration- sports drinks with 5-8% CHO concentration are consumed to spare glycogen stores for later in exercise and also to prevent dehydration

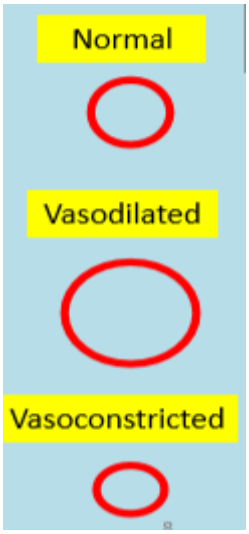
POST EXERCISE (FIRST 30 MINUTES AFTER):

- Immediately following exercise, muscles are most responsive to topping up glycogen stores
- As a result an increase muscle glycogen storage occurs due to the consumption of high GI foods

- The more depleted the stores of CHO, the faster the rate of recovery

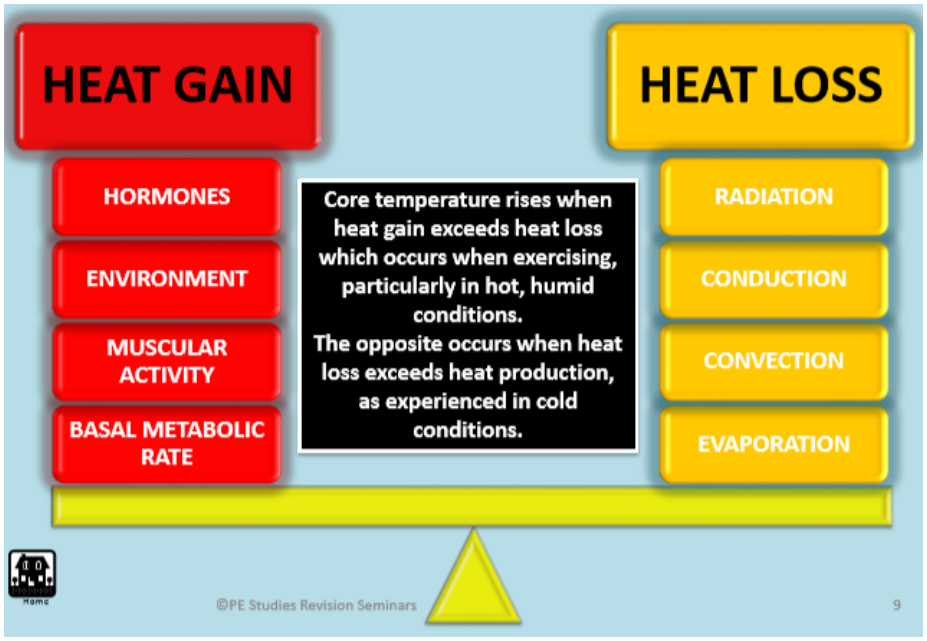
ENVIRONMENTAL CONDITIONS AND PERFROMANCE:

IMPORTANT TERMS/CONCEPTS:



- Ambient temperature –the temperature of the environment the athlete is performing in
- Core temperature –the temperature inside the athlete's body
- The body uses blood as a thermo regulator of body temperature;
- If the body needs to lose heat, vasodilation (blood vessels to the skin surface increase their diameter) takes place, increasing blood flow to the skin so heat loss can occur via sweating
- If the body is trying to retain heat, vasoconstriction(blood vessels to the skin decrease their diameter) occurs and less blood is sent to the skin surface so heat loss is minimized. Vasoconstriction can result in a loss of fine motor skills.

TEMPERATURE REGULATION:



PARTICIPATION IN THE HEAT:

- When the body exercises in the heat, it is faced with the difficult task of maintaining its core temperature within very small limits around 37°C. +/-3 degrees is life threatening.
- The body must cope with the heat continually produced by the active muscles and also environmental conditions, which can reach as high as 50°C –this is known as a double heat load.
- Heat loss from the body occurs via 4 different ways;
  1. . Conduction
  2. . Convection

3. Radiation
4. Evaporation

METHODS OF HEAT TRANSFER:

CONDUCTION:

- Conduction- heat exchanged by 2 objects in contact.
- Factors that determine rate at which conduction occurs
- Difference in temp between 2 surfaces (heat flows from hot to cold)
- Surface area (↑SA→ ↑ heat loss)
- Thermal conductivity of material (metal –good conductor of heat)
- Athletes competing in hot environments can use ice vests to cool down before or during a game or immerse themselves in an ice bath at half time or at the end of the game.

CONVECTION:

- Convection- heat exchange by contact with a fluid that is flowing
- This will occur when heat is carried away from body by air or water currents.
- Magnitude of heat loss is dependent on – Speed and temperature of the air / water e.g. as the breeze gets stronger, heat loss occurs faster.
- The layer of warm air which continually surrounds our body is continually displaced by cold air when air temperature is lower than skin temperature – By wearing appropriate clothing, athletes can promote heat loss by exposing more of their body surface area to the cooler surrounds.

RADIATION:

- Radiation- occurs when heat is transferred from a warmer body to the cooler surroundings without physical contact
- When exposed to sunshine, people absorb radiant heat energy when surroundings are hotter than their core temperature.
- Radiation accounts for 60% of heat loss from body at rest on a cool day

Heat loss via radiation occurs as their core temperature is higher than ambient temperature

Heat gain via radiation occurs as ambient temperature is higher than core temperature

EVAPORATION:

- Evaporation- is the cooling of the body as a result of the vaporisation of sweat
- When the body exercises, muscles create heat:
- To avoid overheating the body uses blood to help regulate temperature
- Heat is transferred to the skin's surface via the blood where it is released as sweat- Increased blood flow to the skin occurs as a result of vasodilation of blood vessels
- Evaporation of sweat on skin creates cooling effect - As a result, the cooled skin cools the blood travelling to the skin's surface, maintaining the body's core temperature
- At rest accounts for approx. 25% heat loss
- In hot conditions can account for up to 80%
- Evaporation is dependent on activity levels and environmental conditions;
- Evaporation is most effective in dry conditions
- As humidity increases, evaporation becomes less effective
- 100% humidity results in no heat loss via evaporation as sweat cannot be evaporated off the skin if the surrounding air is already saturated.
- Body will continue to sweat but no heat loss occurs and core temperature will rise. Dehydration becomes a problem due to large volume of fluid being lost from the body.
- Rate of sweating dependent on;
- Gender (male more than female)
- Number of sweat glands
- Body surface area (↑SA = ↑ sweat)
- How fit you are (↑fitness = ↑ sweat if all other factors are equal e.g. body SA)
- Excessive sweating leads to a loss of body fluids and when level of fluid drops, body's core temp↑.
- It is this gradual dehydration which leads to heat exhaustion and heatstroke ¾ Sweat loss can reach 6-10% of body mass
- >2% generally means performance and thermoregulation are compromised!

THE BODY'S PREFERRED MECHANISM OFHEAT LOSS:

- The body's preferred mechanism of heat loss is dependent upon the following 3 factors;

ENVIRONMENT:

- Ambient temperature –if above the body's core temperature, then evaporation is the only method of heat loss. Other methods will result in heat gain.
- Forced convection –heat loss via convection will occur if it is windy.
- Barriers to convection –clothing will minimise the effect of convection as it will insulate the boundary layer of air.
- Temperature radiating surfaces –light clothing will not absorb as much heat as dark clothing
- Relative humidity –if 100%, no heat loss via evaporation.

AGE:

- Children don't sweat as much as their sweat glands are not as developed as adults.

PHYSIOLOGICAL STATE:

- Rate of heat production (how much work the athlete is performing)
- Hydration state –will determine rate of evaporation as a reduction in plasma volume leads to a decrease in sweat rate

EXERCISE IN HEAT KEY TERMS:

- Heart rate (HR) –the number of times the heart beats per minute
- Stroke Volume (SV) –the amount of blood ejected from the heart each beat
- Cardiac Output (Q) –the amount of blood circulating around the body every minute = HR x SV
- Double heat load –situation where the body is forced to deal with 2 forms of heat (metabolic heat and environmental heat)
- Cardiovascular drift (cardiac drift) – when heart rate increases in an attempt to maintain cardiac output caused by a decrease in stroke volume
- Dehydration-occurs when the amount of water leaving the body is greater than the amount being taken in

EXERCISING IN HEAT-DEHYDRATION:

- dehydration occurs when the amount of water leaving the body is greater than the amount being taken in
- We lose water by;

1. Breathing, as humidified air leaves the body
2. Sweating, which is used as a cooling mechanism
3. Urination or bowel movements in the removal of waste products.

REST AND EXERCISE IN THE HEAT:

- At rest in the heat, heart rate and cardiac output increase. – This is to allow more blood to be sent to the peripheries resulting in increased radiative heat loss to the environment, particularly from the hands, feet and forehead.
- When exercising in the heat, the body is forced to deal with 2 forms of heat, known as a double heat load
    1. Metabolic heat created by working muscles
    2. Environmental heat in hot conditions
- As a result this double heat load creates competition for blood flow
- Muscles and vital organs require blood flow to sustain energy metabolism
- Skin blood flow required to transport heat out to environment to keep core temperature cool. This blood flow cannot deliver its oxygen to the working muscles, impacting on performance.

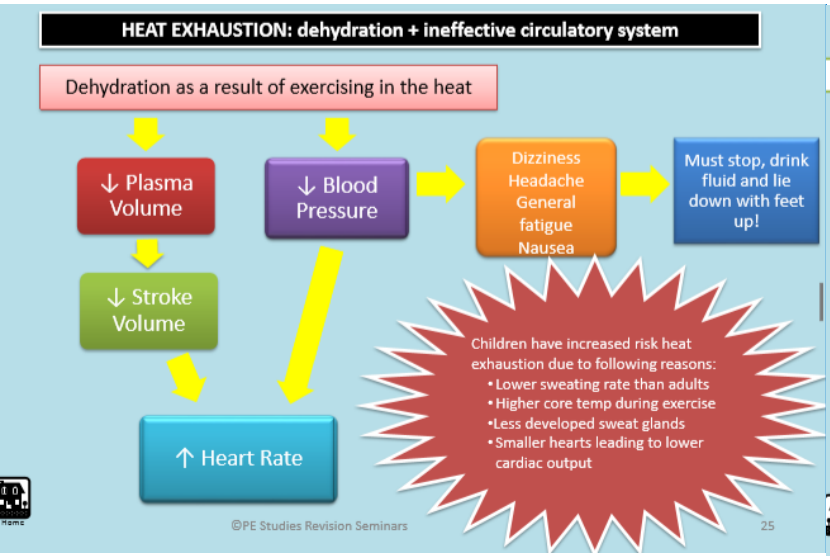
EXERCISING IN THE HEAT-CARDIOVASCULAR:

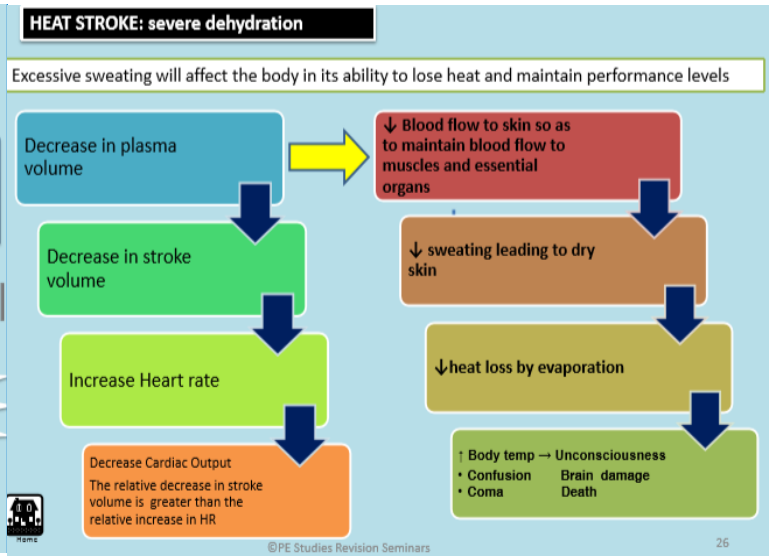
- When exercising in the heat, the body directs blood flow to the skin and away from the working muscles to increase heat loss via evaporation
- An ↑ in sweat rate → ↓ blood plasma volume.
- As a result cardiovascular drift occurs;
- In an attempt to maintain cardiac output, HR increases.
- This increase in HR is relatively smaller than the decrease in SV, therefore cardiac output is reduced.
- As a result, skin blood flow ↓ (cooling mechanism) and oxygen sent to working muscles is also reduced, placing extra strain on the body to maintain exercise levels.
- A reduction in blood flow to the working muscles increases production of lactic acid
- A reduction in blood flow to the skin reduces the rate of sweating, inhibiting the body's ability to lose heat via evaporation. These changes lead to a rise in core temperature and negatively affect performance

The impact of cardiac drift, as a result of dehydration, on cardiac output

Performance state	Heart rate (bpm)	Stroke Volume (ml)	Cardiac Output (L)
Rest	60bpm	100ml	6L
Sub maximal exercise, optimal hydration	150bpm	140ml	21L
Sub maximal exercise, dehydration	165bpm	115ml	≈19L

EFFECTS OF DEHYDRATION:





EXERCISING IN THE HEAT- FLUID REPLACEMENT TO MINIMISE DEHYDRATION:

HYPONATREMIA:

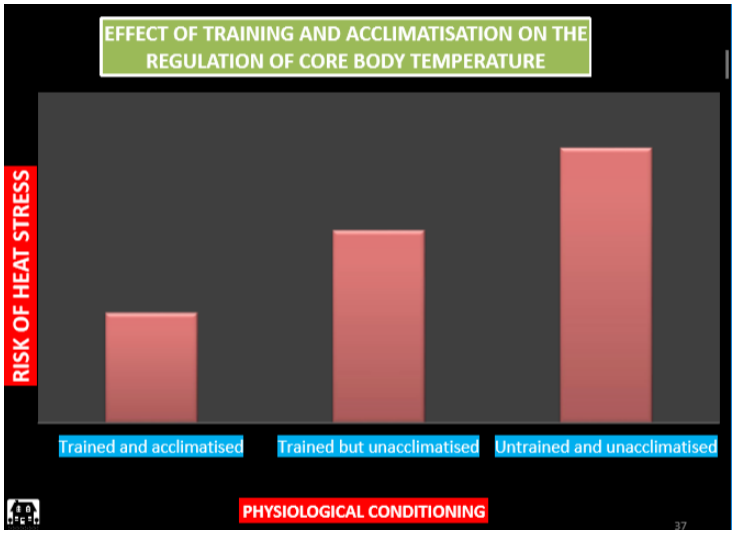
- An abnormally low concentration of sodium (salt / electrolytes) in the blood.
- When a person sweats profusely for an extended period of time, drinking too much water can cause problems because the body is losing salt and water in the sweat, but only the water is being replaced
- Imbalance, or lack of salt can interfere with brain, heart and muscle function

SPORTS DRINKS:

- Contain carbohydrates, sodium and potassium
- Effective due to the fact they;
- Taste good meaning athlete wants to drink more
- Provide athlete with rapid supply of energy (high GI) and assist in glycogen sparing
- Replace lost electrolytes (particularly effective in ultra endurance activities where massive amounts of sweat loss and electrolyte loss occurs)
- Rehydrate the performer
- For events of less than 1 hour, water is sufficient to replace fluid loss but events longer than 1 hour, drinks containing high GI carbohydrates should be used.

ACCLIMATISING TO THE HEAT:

HEAT ACCLIMITISATION:



- Heat acclimatisation- is when the heat tolerance is improved by repeated exposure to hot environments
- Adequate hydration is required for optimal heat acclimatisation.
- Exposure to thermal stress is a major concern for athletes who compete in hot climates.
- This is particularly a concern for athletes who have little or no previous exposure to heat. -
  Athletes who train in hot climates have a thermoregulatory advantage over athletes who train in cool climates when it comes to competing in hot weather

HOW TO ACCLIMATISE:

- How long?
- The first sessions of heat acclimatisation should last for 15-20 minutes and be combined with light to moderate activity.
- It should increase to 45-60min daily for approx 8-9 days with an increase in exercise intensity & duration.

- 5-10 days living and training in heat is recommended
- Where?
- Athletes who are unable to use natural acclimatisation should use;
- Artificial heat sources
- Climate chambers
- Saunas
- Sweat clothing
- When?
- Should be completed 4-6weeks prior to competition and then 2* per week leading up to competition to maintain benefits
- Never restrict fluids and avoid extending acclimatisation training beyond 14 days as it may lead to tiredness and overtraining

MAJOR ADAPTATIONS TO HEAT ACCLIMATISATION:

SWEATING:

- ↑ blood plasma volume -More fluid stored in blood. Increases length of time to dehydration
- ↑ Sweat rate (sweat glands ↑ size) -Sweat rate can nearly double after 10 days of acclimatisation
- Start sweating at lower core temperature -Leads to lower core temperature, skin temperature and heart rate at any given exercise intensity. -A lower core temperature allows more blood to be sent to the working muscles
- Sweat becomes more dilute & is distributed over the body more effectively – keeps salt in the body -The body uses a greater surface area for evaporative cooling leading to better maintenance of core temperature.

CARDIOVASCULAR:

- Heat acclimatised athletes exercise with lower core and skin temperatures due to sweating adaptations
- As a result the acclimatised athlete's HR is lower than an unacclimatised athlete as they have a more efficient cooling mechanism.
- A lower core temperature also reduces the body's need to send blood to the skin for cooling, resulting in a greater % of cardiac output going to the active muscles.
- Increased blood volume to allow for increased sweating

SUMMARY OF PHYSIOLOGICAL RESPONSESTO EXERCISING IN HOT ENVIRONMENTS:

- Increased heart rate, decreased stroke volume, decreased cardiac output (cardiac drift)
- Rapid dehydration due to increase sweating
- Increase blood viscosity caused by decreased plasma volume
- Increased blood pressure as a result of increased viscosity
- Increased peripheral blood flow
- Increased core temperature and peripheral temperature

- Increased ventilation
- Increase blood lactate levels

METHODS TO HELP COPE WITH EXERCISING IN THE HEAT:

1. Hydration

- Hyperhydrate by consuming 300-400ml just prior (prime stomach) on top of 600ml 3-4hr before (attempt in training first)
- Consume approximately 150-200ml every 15min during exercise (this may vary according to conditions).
- Consume approximately 1.5* weight loss following exercise

2. Clothing

- Wear loose fitting, light coloured clothing to permit free circulation of air between the skin and the environment, promoting convection and evaporation from the skin.

3. Pre cool body

- Pre cool core body temperature via a range of methods including;
- Ice towels/ice vests
- Immersion in cool water
- Drinking a slushie

4. Acclimatise

HUMIDITY:

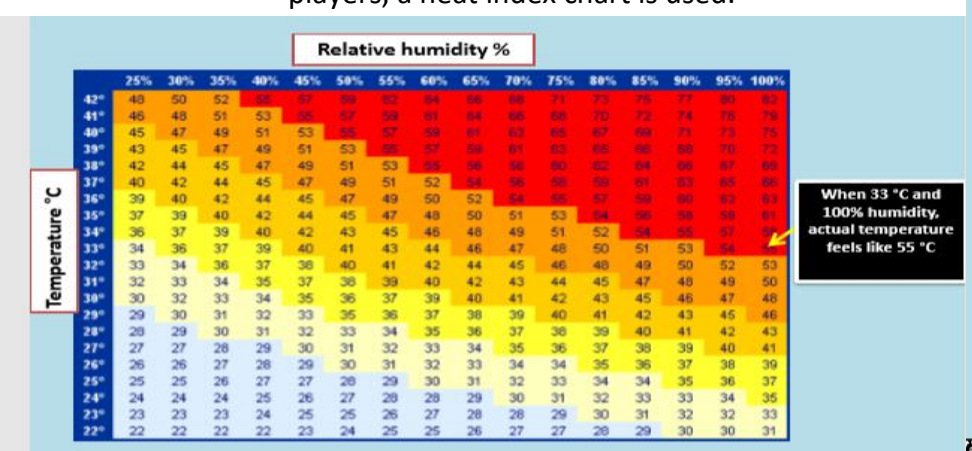
- Humidity- defined as the amount of water vapour that exists in the air
- The higher the humidity, the greater the amount of water there is in the surrounding air.
- Humidity will;

1. Increase sweat rate
2. Increase fluid loss
3. Decrease the effectiveness of cooling via evaporation
4. Decrease performance, particularly aerobic performance

- Maintaining a high level of fluid intake is essential when performing in hot humid environments

HUMIDITY- HEAT INDEX:

- Heat index- used to determine how hot it feels by taking into account the air temperature and the relative humidity
- Heat and humidity combine to make the environment feel hotter than it actually is. To determine how hot, it actually feels for the players, a heat index chart is used.



EFFECT OF HUMIDITY ON BODY DURING EXERCISE

	PERTH	SINGAPORE
Ambient Temperature	32°C	32°C
Relative humidity	43%	75%
Heat index	37.5	46
Performance time	0:35:00 min	0:41.35 min
Pre - run core temperature	36.9°C	36.9°C
Post - run core temperature	39.3°C	40.5°C
Pre - run skin temperature	32.0°C	33.6°C
Post - run skin temperature	33.9°C	35.7°C
Exercise heart rate	180bpm	190bpm
Pre - run body mass	75.4kg	75.4kg
Post - run body mass	74.9kg	73.8kg
Esimtated fluid loss	0.5L	1.6L
Estimate fluid loss (% body mass)	0.60%	2.30%

Sweating is the body's most efficient physiological mechanism for reducing core temperature, so when competing in high humidity and extreme heat, the risk of experiencing heat stress is elevated.

EXERCISING IN THE COLD WEATHER:

- Cold environments can cause dehydration as the body moistens the air as we inhale resulting in fluid being lost from the body;
- Maintain fluid intake at all times
- Cold weather increases chances of injury particularly early in the event if not properly warmed up;
- Warm up in sheltered area to avoid wind chill contributing to heat loss
- Do a longer warm up than normal
- Have suitable warm clothing for players on the bench

BODYS PHYSIOLOGICAL RESPONSES TO COLD WEATHER:

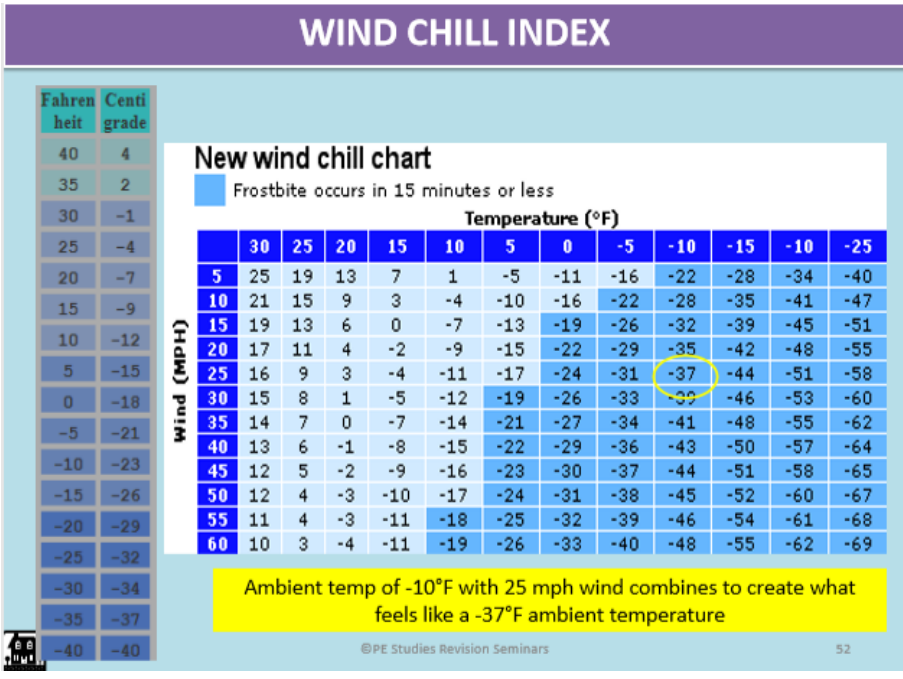
- When exposed to cold conditions, the body is forced to try and conserve heat. This is achieved by a number of mechanisms including;
  1. Peripheral vasoconstriction
- Involves the redirection of blood flow, away from the skins surface and towards the body's core, to help minimise heat transfer from the blood to the cold external environment
  2. Shivering
- Involuntary muscular contractions designed to help increase heat production
  3. Piloerection
- When the hairs on the body stand on end and trap a warm layer of air close to the skin to help keep the skin surface warm

PERFORMANCE IN COLD WEATHER:

- ↑ submaximal VO2 at given exercise intensity- For endurance exercise, shivering may lead to early glycogen depletion
- Fine motor skills deteriorate- caused by reduced sensation in hands and feet due to vasoconstriction

WIND CHILL:

- Wind chill- is the apparent temperature felt on the skin due to the combination of wind and ambient temperature
- Wind increases the loss of heat via convection as it constantly removes the layer of warm air around the body and the body cools rapidly.



- Rain, strong winds and a cold ambient temperature increase heat loss even further

RISK OF DEHYDRATION:

- Inhaled air is very cold and dry
- It needs to be warmed and humidified, meaning a lot of fluid is lost via respiration
- With a reduced sensation to thirst and thus reduced voluntary intake of fluids, risk of mild dehydration exists!
- Playing sport during the cold winter months can pose significant problems to athletes. A reduced thirst mechanism combined with fluid loss via respiration can cause athletes to become dehydrated, affecting performance

HYPOTHERMIA:

- Hypothermia- occurs when the body's temperature falls below 35 degrees
- The human body has constant core temperature of around 37°C.
- Situations that can cause the body to lose more heat than it can generate include;
- Prolonged exposure to cold, wintry conditions
- Being in cold water for a length of time
- Being out in windy weather in wet clothes
- Symptoms of hypothermia include;
- Feeling cold
- Shivering
- Loss of concentration loss of fine motor skills
- Facial skin turns grey or blue
- Lethargy
- Confusion
- Loss of physical coordination
- Lack of shivering
- Slowed breathing
- Speaking difficulties
- Coma
- Death

HYPOTHERMIA - TREATMENT

DO	DONT
Remove all wet clothing	Put them in a hot bath – the shock of the hot bath may cause further problems
Keep the patient awake	Apply direct heat like a hot water bottle
Wrap them in blankets	Provide alcohol
Share body heat through direct skin contact between individual not suffering hypothermia and victim.	Force them to move around in an attempt to get warm. Their body isn't capable of warming itself anymore.
Cover all extremities - use socks, gloves and a beanie to prevent further heat loss	
Dress them in dry clothes once warmth returns	

ACCLIMATISING TO THE COLD:

COLD ACCLIMATISATION:

- Less important than for exercise in the heat
- 7-10 days prior to competition
- Allows chance for experimentation clothing/warm up

- Psychological adaptation
- Athletes train their body systems to generate more heat and better prevent heat loss (no evidence to suggest physiological acclimatisation actually takes place –more of a psychological advantage)

METHODS TO HELP COPE WITH EXERCISING IN THE COLD:

1. Experiment with length of warm up
2. Experiment with layered clothing
3. Psychological acclimatisation
4. Ensure adequate fluid replacement as water loss will be increased via the need to humidify dry, cold air before it enters the lungs

EXERCISING AT ALTITUDE:

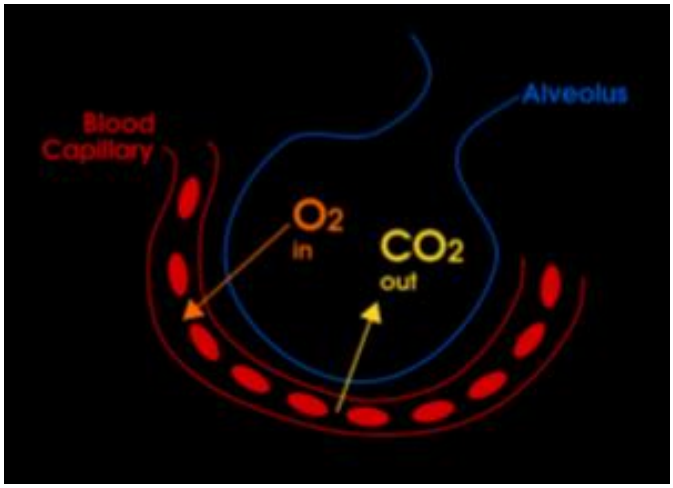
- Mexico City only Olympics held at altitude –7500 feet
- World records smashed in throwing, sprint and jump events as a result of reduced air density, resulting in less friction. Also reduced gravitational pull on objects meant objects travelled further for a given force.
- Endurance performance was significantly hampered as a result of lower O2 partial pressures reducing O2 uptake and hence O2 delivery to the working muscles (see next slide). Low humidity also increased the risk of dehydration.
- Never to be held at altitude again!
- Athletics comps now held below 1500m (5000 feet)- For every 300m above 1500m, aerobic capacity is reduced by approx 3%
- During the Mexico Olympics, events such as the 10 000m recorded times 1min slower with the Kenyans, who trained at altitude, dominating endurance events!

HOW ALTITUDE AFFECTS PERFORMANCE:

HIGH ALTITUDE ENVIRONMENT;

- Air at any level contains;
- 20.93% Oxygen
- 79.04% Nitrogen
- 0.03% Carbon Dioxide
- At any point on earth, the more air above that point, the greater the barometric pressure will be.
- At sea level, air has a barometric pressure of 760mmHg
- At Mexico City, 2240m above sea level, air has a barometric pressure of 585mmHg.
- At Mount Everest, 8848m above sea level, air has a barometric pressure of 231mmHg
- When we inhale, O2 moves through the lungs and into the alveoli where it diffuses to the blood to be transported to the tissues.

- Gas exchange takes place due to a pressure difference called a pressure gradient. The alveoli is high in O2 and therefore is high in pressure. The blood capillary is low in O2 and therefore low in pressure.
- This pressure differential causes O2 to move from the lungs into the blood capillary



At sea level;

Alveoli

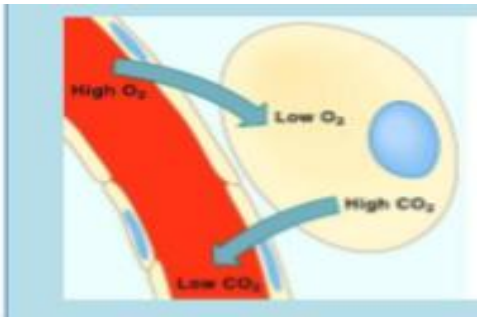
- High in oxygen and low in carbon dioxide

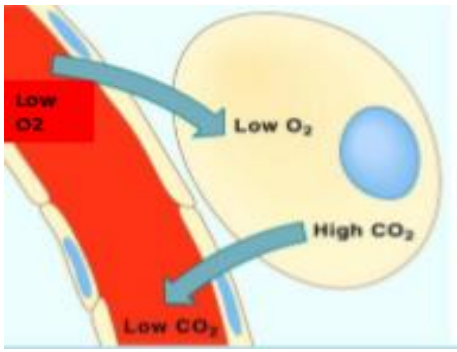
Venous Blood

- Low in oxygen and high in carbon dioxide

Large pressure differential allows for;

- diffusion of oxygen from the alveoli into the capillary





At altitude;

Alveoli

- Low in oxygen and low in carbon dioxide

Venous Blood

- Low in oxygen and high in carbon dioxide

Small pressure differential makes it difficult for;

- diffusion of oxygen from the alveoli into the capillary

- At altitude, there is a reduction in the pressure of oxygen entering the lungs. This reduces the pressure differential between the alveoli and the capillaries with the result being less oxygen diffusing from the alveoli into the blood.
- At sea level, oxygen has a partial pressure of 159mmHg
- At Mt Everest, oxygen has a partial pressure of 48mmHg
- In surrounding venous blood, oxygen has a partial pressure of 47mmHg at any altitude
- Therefore at sea level pressure difference is 159mmHg –47mmHg = 112mmHg - diffusion is easy
- On Mt Everest, pressure difference is 48mmHg –47mmHg = 1mmHg–diffusion nearly impossible

Less air pressure (less air above athlete)

Low pressure differential between alveoli and capillaries

Harder to breath as the pressure difference between the alveoli and capillaries is low

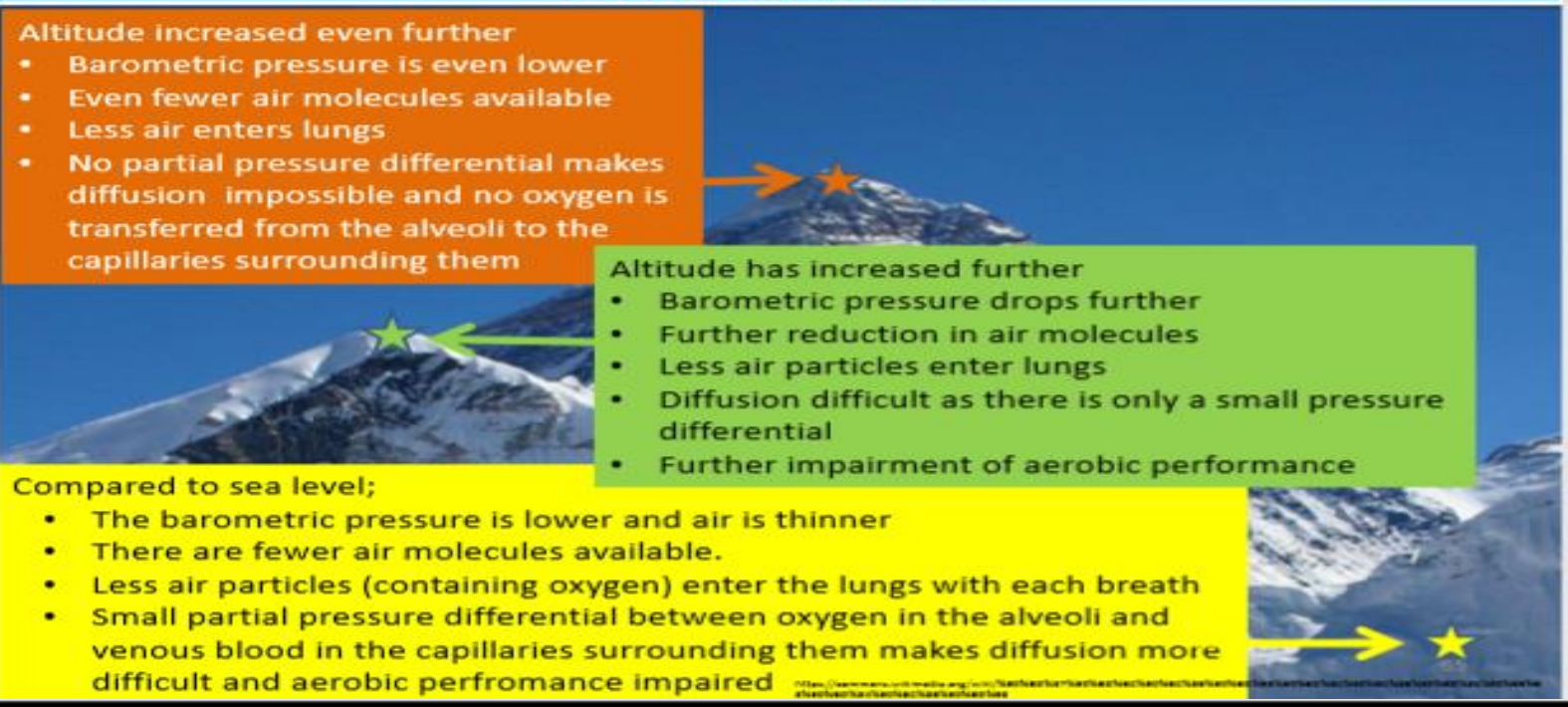
High air pressure (more air above athlete)

High pressure differential between alveoli and capillaries

Easier to breathe as air moves from high pressure in the environment to low pressure in the lungs.

ALTITUDE – UNDERSTANDING HOW IT AFFECTS PERFORMANCE

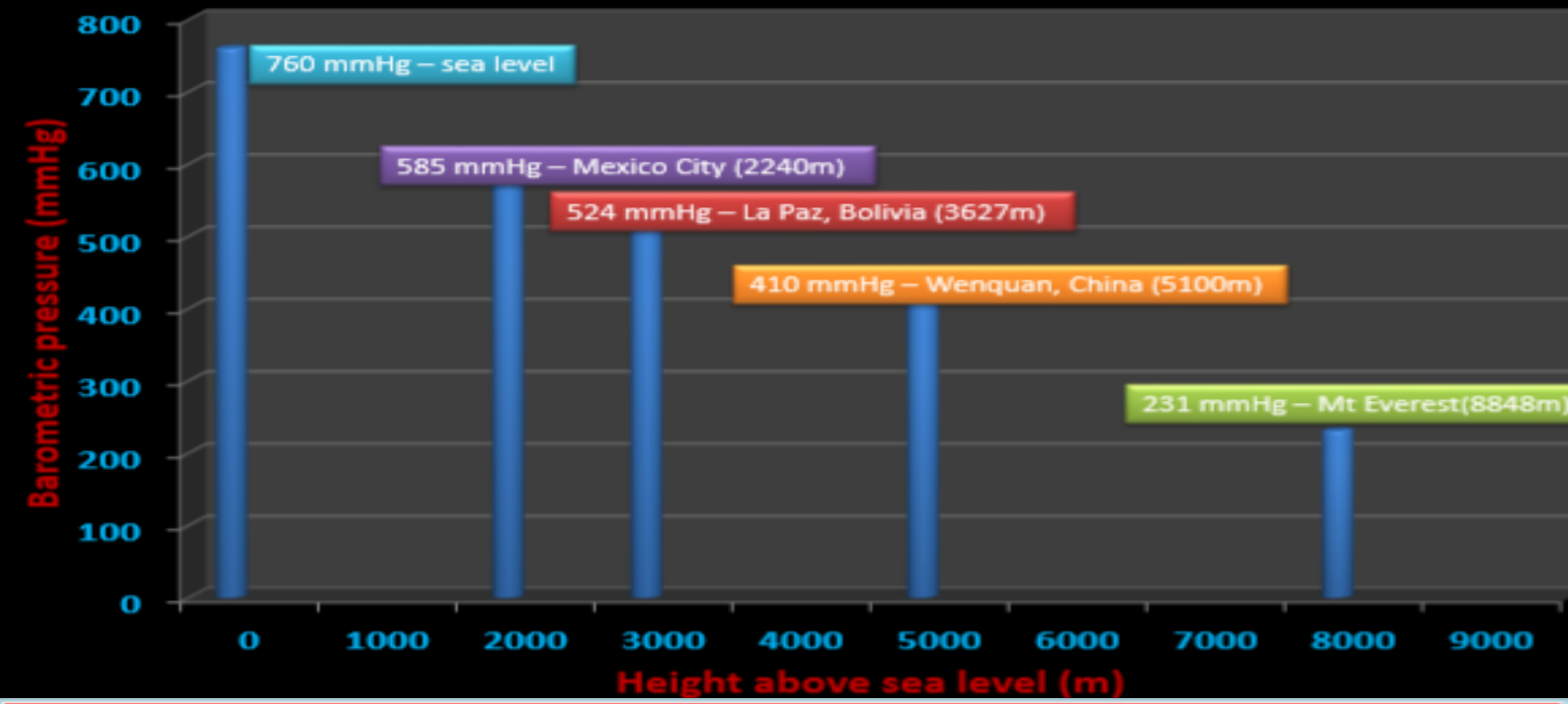
Altitude increased even further
- Barometric pressure is even lower
- Even fewer air molecules available
- Less air enters lungs
- No partial pressure differential makes diffusion impossible and no oxygen is transferred from the alveoli to the capillaries surrounding them



Altitude has increased further
- Barometric pressure drops further
- Further reduction in air molecules
- Less air particles enter lungs
- Diffusion difficult as there is only a small pressure differential
- Further impairment of aerobic performance

Compared to sea level;
- The barometric pressure is lower and air is thinner
- There are fewer air molecules available.
- Less air particles (containing oxygen) enter the lungs with each breath
- Small partial pressure differential between oxygen in the alveoli and venous blood in the capillaries surrounding them makes diffusion more difficult and aerobic perfromance impaired

Relationship between Altitude and Barometric Pressure

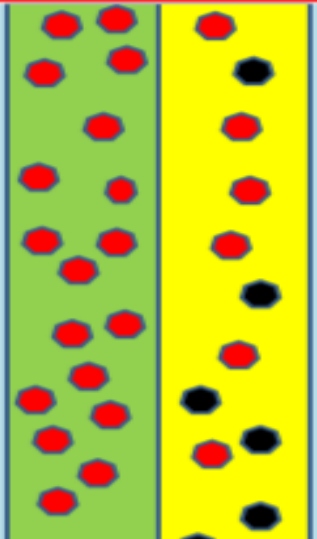


Diffusion is the movement of a liquid or gas across a semi permeable membrane from an area of high concentration to an area of low concentration

Sea level

In the lungs;

Large difference in partial pressure of oxygen in alveoli and the returned venous blood



The oxygen moves from the high pressure area in the alveoli to the low pressure of the blood vessel and is delivered to the body.

Carbon dioxide moves from the blood vessel to the alveoli and expelled from the body

Oxygen Molecule

Carbon Dioxide

Alveoli

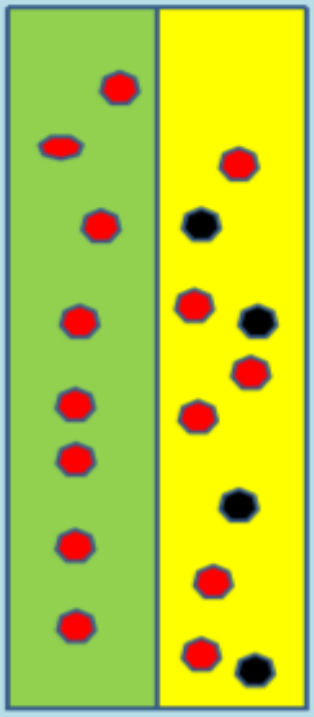
Capillary

At Altitude

In the lungs;

Small difference in partial pressure of oxygen in alveoli and the returned venous Blood

Little oxygen diffused to blood vessel



Only a small difference in the partial pressure of oxygen between the alveoli and the blood vessel results in limited diffusion and limited oxygen being transferred from the alveoli to the blood vessel for use by the body.

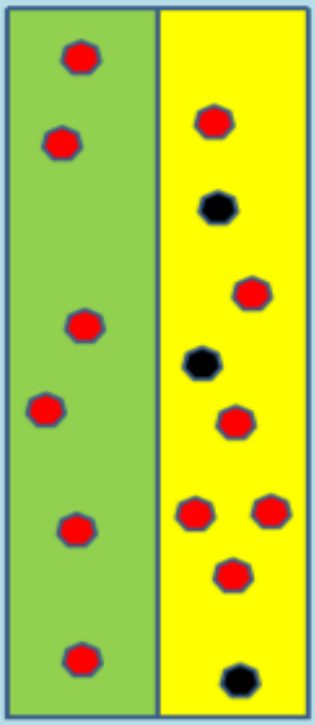
The higher the altitude, the lower the diffusion rate as the partial pressures become closer together

Oxygen Molecule

Carbon Dioxide

Alveoli

Capillary



When partial pressure is the same, no diffusion will take place and you will die unless you use oxygen tanks which deliver oxygen to the alveoli and increase the partial pressure thereby allowing diffusion to take place again

Oxygen Molecule

Carbon Dioxide

Alveoli

Capillary

ALTITUDE ACCLMATISATION:

ACCLIMATISING TO ALTITUDE:

- Altitude acclimatisation describes the improved physiological response to hypoxia
- There are several methods used by athletes to try and gain the chronic adaptations of acclimatisation to altitude. These include the following;
  1. Live high, Train low
  2. Live high, Train high
  3. Live low, Train high

3 METHODS OF ACCLIMATISATION:

1. Live high, train low:

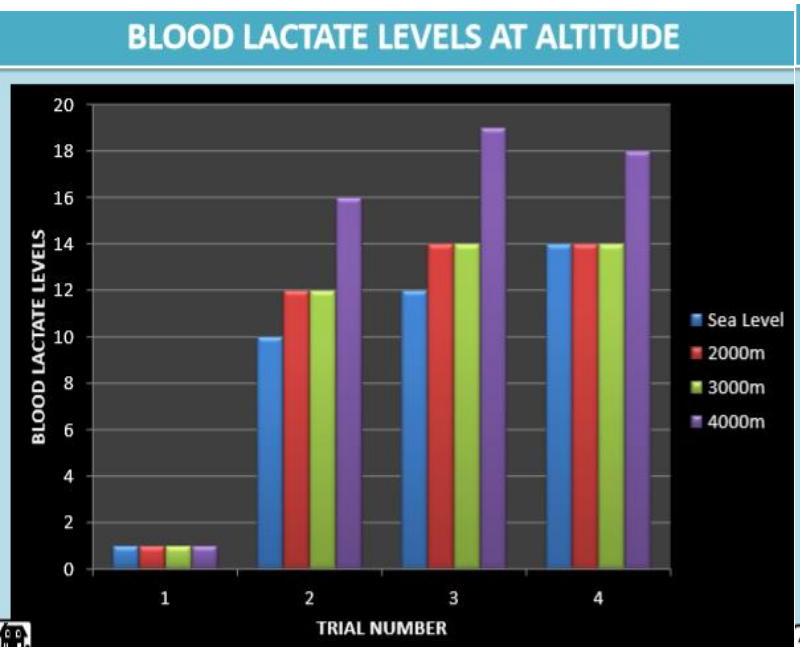
- This involves daily intermittent exposure to artificial altitude environments whilst maintaining normal training intensities
- Hypoxic apartments, altitude houses and tents (eg. at the AIS) are used where the pressure of O2 in the air is manipulated to simulate conditions at altitude.
- artificial chambers allow athletes to sleep in altitude induced environments whilst still training under normal conditions at sea level
- This method is seen to be more beneficial as it allows players to maintain their training intensity whilst still getting the added benefit of altitude exposure and its associated physiological adaptations.

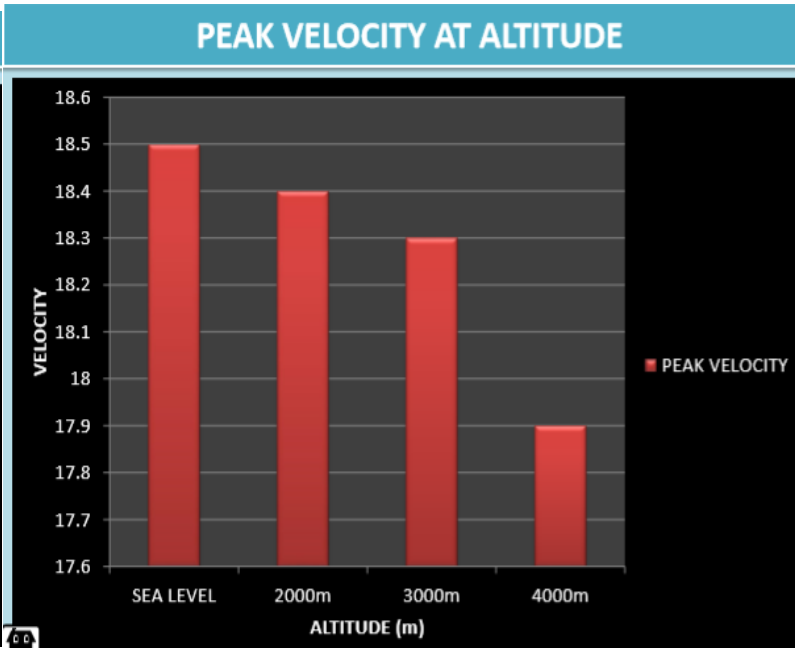
2. Live high, train high:

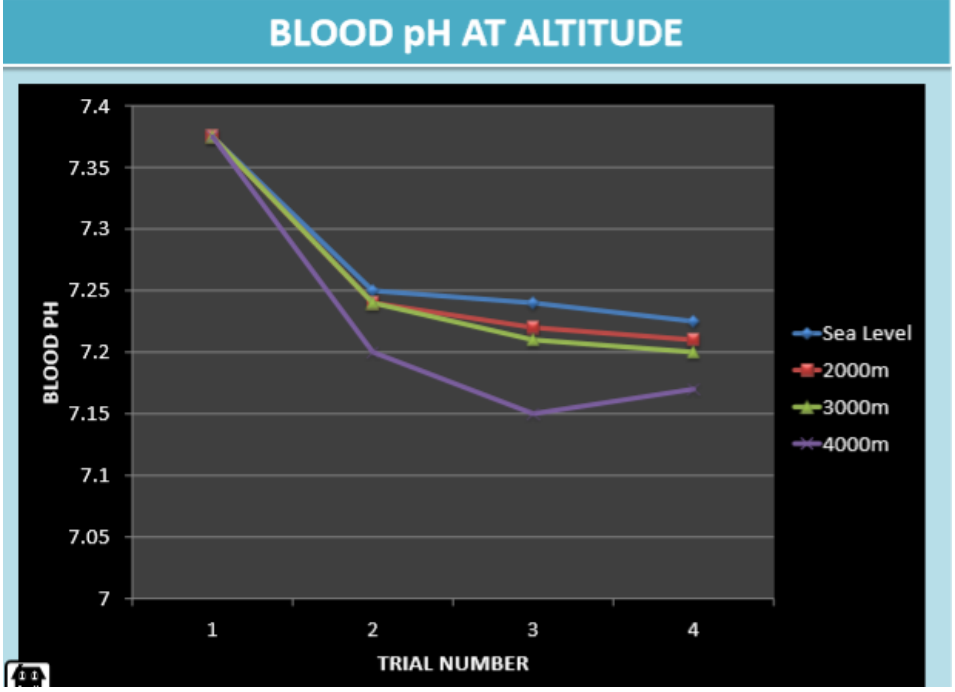
- Athletes lives at altitude to achieve physiological benefits of decrease in 02 concentration and trains at altitude to obtain adaptations
- Usually require going to altitude at least 2000-3000m above sea level to live and train for a period of 3-4weeks
- Acute mountain sickness often occurs as body comes to terms with hypoxic stress placed on the body
- As a result athletes required to stay longer, sometimes placing logistical and financial strain on the performer
- As a result, reduced benefits in performance due to reduced training intensity over a prolonged period of time –detraining
- Best suited to preparing teams to compete at altitude, not to compete at sea level.

3. Live low, train high:

- Athletes live at sea level but train in hypobaric chambers or altitude tents to simulate a hypoxic environment.
- No evidence that this method is effective in gaining the chronic adaptations achieved by using the “live high, train low” method.







ACUTE ADAPTATIONS TO ALTITUDE TRAINING (FIRST 24 HOURS):

1. ↑ Respiratory rate
- Because the "absolute" amount of 02 available in the air is reduced, the body will hyperventilate (↑ rate of breathing) in an attempt to ↑ the amount of 02 getting into the lungs
2. ↑ Tidal Volume
3. ↑ Nausea/headaches/giddiness
- Brought on as a result of lowered oxygen levels created through hypoxic stress
4. ↑ HR and Q during rest and submaximal exercise
- Because the "absolute" amount of 02 available in the air is reduced, the body will ↑ HR in an attempt to ↑ the amount of 02 getting to the working muscles
5. ↓ plasma volume to ↑ concentration of haemoglobin in the blood

CHRONIC ADAPTATIONS TO ALTITUDE TRAINING:

1. ↑Haematocrit (represents the %RBC in the blood –the average person has a reading of approximately 45%. Tour De France riders from the US Postal Team (aka team Lance) all recorded levels over 50% but claimed they hadn't doped!!!!)
- Is caused by an increase level of EPO which is secreted by the kidney to act on red bone marrow to ↑RBC production –occurs within 2-3hrs arriving at altitude
- This will cause ↑ haemoglobin concentration as RBC contains haemoglobin
2. ↑ mitochondria –powerhouse of the cell and the site for ATP production. Increases the rate of ATP production
3. ↑ aerobic enzymes –increases the rate at which ATP is produced
- Assists O2 unloading at tissue level
- Reduces affinity of haemoglobin for O2
- Improves ability of cell to grab hold of O2 (Better at taking it in)
4. ↑ capillaries –allows for greater surface area for diffusion of O2 at the site of the muscle and the lungs
5. ↑ myoglobin –responsible for transporting O2 molecules from the haemoglobin to the mitochondria therefore improving the rate of ATP production

RETURNING TO SEA LEVEL AFTER ALTITUDE TRAINING:

- Within 7 days;
- Hyperventilation not required at sea level as there is more oxygen available in the atmosphere at sea level.
- After 2-4 weeks;
- Haemoglobin and haematocrit levels back to normal
- ↑Mitochondria, capillary and enzyme levels thought to last longer provided training is maintained

ENDURANCE ATHLETES	POWER ATHLETES
Negatively affected due to; • Less 0_2 uptake (hypoxia) and lower pulmonary diffusion means a reduced ability of the body to provide 0_2 to the muscles via the aerobic pathway. Aerobic metabolism is adversely affected • Low humidity at altitude – greater risk of dehydration	Positively affected due to; • Less drag (friction) due to thinner air causing less resistance • Decreased gravity effect on objects – objects travel further for any applied force

HOW ELITE ATHLETES PREPARE FOR MAJOR EVENTS:

- Elite level athletes prepare for major events by simulating as much as possible the conditions they expect to face;
  - Practice at same time of day as they expect to compete at
  - Practice in similar environmental conditions –acclimatise
  - Practice against similar standard opponents as you expect to play

PERFORMANCE ENHANCER STRATEGIES:

PHYSIOLOGICAL CHANGES BROUGHT ON BY THE USE OF PERFROMANCE ENHANCERS:

- Physiological changes brought on by the use of performance enhancers.
  - Anabolic steroids
  - Protein powders
  - Stimulant
- An athlete can seek to gain advantage over opponents by manipulating or supplementing their diet to;
  - Enhance training adaptations
  - Improve performance
  - Improve recovery
- Athletes need to be aware of the specific requirements of their sport and the methods available to enhance their performance.

- For all performance enhancement strategies, you must be able to answer the following; 1. What are the advantages? 2. What are the disadvantages? 3. Which athletes benefit from its use?

ILLEGAL PERFROMANCE ENHANCER- ANABOLIC STEROIDS:

- Major benefit in sports requiring strength and power as athletes are able to train harder and more frequently.

ADVANTAGES

- Increase the performer's size,strength and power.
- Decreases recovery time
- Stimulates protein synthesis
- Improved rate of tissue repair.

DISADVANTAGES/SIDE EFFECTS

- Acne
- Liver damage
- Depression
- Aggression
- Hypertension
- Infertility
- Testicular atrophy
- Increased masculinity
- Male breast enlargement.

ILLEGAL PERFROMANCE ENHANCER- STIMULANTS:

- Stimulants (amphetamines, cocaine, pseudoephedrine)
- Major benefit in sports requiring increased alertness and maximal efforts

ADVANTAGES

- Increases awareness
- Increases aggression
- Masks fatigue, improving anaerobic performance

DISADVANTAGES/SIDE EFFECTS

- Anxiety
- Restlessness
- Insomnia
- Dependence
- Ineffective heat regulation and dehydration
- Increase chance of heart disease

LEGAL PERFROMANCE ENHANCERS- STIMULANTS:

- For maximum benefits, 3-6 mg/kg of body mass is consumed approx. 60min prior to competition- This equates to 210mg –420mg for a 70kg athlete.

ADVANTAGES

- Acts as an analgesic reducing the perception of effort and therefore increasing the time to exhaustion in short distance events
- Stimulates the CNS, increasing alertness, arousal levels and decreasing reaction times
- Thought to also create a glycogen sparing effect through the oxidation of free fatty acids
- Through the mobilisation of fat as a fuel source during moderate to high intensity exercise, the athletes spares glycogen supplies improving performance in long duration events

DISADVANTAGES/SIDE EFFECTS

- Potent diuretic
- This may cause an unnecessary loss of fluid pre exercise, having a negative effect on the athletes ability to regulate temperature, particularly during hot conditions
    - Irritability
    - Muscle twitching
    - Insomnia
    - Withdrawal effects
    - Headaches
    - Excessive intake may lead to over arousal

PROTEIN POWDERS:

ADVANTAGES OF PROTEIN

- Increased protein consumption may assist in increasing muscle bulk (hypertrophy) and repair damage tissue.
- Protein powders decrease muscle catabolism using protein as a fuel source
- Protein powders improve the rate of recovery from training sessions

- Increase muscle mass only occurs if the athlete is doing a resistance training program.
- Best consumed along with high GI snack immediately after exercise.

DISADVANTAGES/SIDE EFFECTS

- Increased risk of osteoporosis
- Colon cancer
- Kidney damage
- Increase water retention

TRAINING PROGRAMS:

SPECIFIC ENERGY SYSTEMS:

- The specific energy system requirements of any training session will be dependent upon the type of activity being conducted.
- An analysis of a game of soccer would demonstrate the need for speed, agility and aerobic endurance.
- An analysis of a sprinter would demonstrate the need for speed and power.
- Consequently, training sessions would be tailored towards developing these physical attributes and the energy systems which fuel them
- By specifically developing the energy systems which fuel the components of fitness for a given sport, athletes are better able to improve performance. This concept relates to the training principle of specificity.

PLANNING THE TRAINING PROGRAM:

- The training program generally consists of;
- ANNUAL PLAN –the year as a whole with the big goal pictured
- TRAINING PHASES –large training phases
- MACROCYCLES –large blocks of training which lasts minimum of 3 months
- MESOCYCLES –medium block of training within a macrocycle
- MICROCYCLES –smaller blocks of training (week, day, session)

Macrocycle – **Ma**jor

Mesocycle - **Me**dium

Microcycle – **Mi**nor

PERIODISATION OF PHYSICAL SKILLS TRAINING:

- Periodisation- is the planning, well advance, of training variables to achieve optimal performance at the most crucial times.
- It involves varying the volume and intensity of training and if done properly, it will;
- Help to avoid staleness, overtraining and burnout
- Promote higher levels of enthusiasm in the player group.
- Ensures proper application of the principal of progressive overload in the physical conditioning of the players.
- Minimises likelihood of injuries
- Improves the psychological, physiological, technical and tactical levels of the players.
- Plans for the athlete to ‘peak’ at the right time

- Plans for rest / recovery periods

THE ANNUAL PLAN

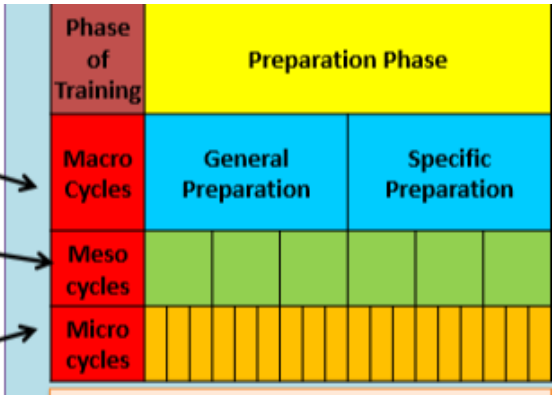
- Training program spread across the whole year
- The purpose of the annual plan is to ensure optimal performance occurs at the right time by;
  - Applying training principles over the year
  - Applying a taper prior to competition
  - Monitoring of fatigue and recovery to prevent overtraining
- Some annual training programmes follow the same principles of dividing the programme into smaller units, however the annual programme is one macrocycle and with mesocycles and micro cycles being smaller blocks of time making up the single macrocycle .

- Another interpretation of the annual training programme is;
- Macrocycle –represents the whole year
- A number of mesocycles form the macrocycle
- A number of micro cycles form the mesocycle

4 PHASES OF PERIODISATION BROKEN DOWN:

- These 4 phases are then broken down into **macrocycles. – 3 months**
- **Mesocycles** are smaller blocks of time which together form a macrocycle. Each mesocycle has a specific goal or objective. Mesocycles are between **4** – 12 weeks long.
- A **microcycle** is a smaller unit of time normally between 3 – 10 days long but can be as short as one day. Several microcycles form a mesocycle.

A microcycle is often one training week.



The Preparation Phase broken down to show the relationship between macrocycles, mesocycles and microcycles

- All micro cycles have set goals which contribute towards the goal of each mesocycle
- All mesocycles have set goals which contribute towards the goal of each macrocycle
- Each macrocycle has set goals which contributes towards the long-term goal

PREPARATION PHASE (PRE-SEASON):

- Divided into general preparation and specific preparation
- Usually lasts 6-12 weeks

1. GENERAL PREPARATION

- Objective: Training is designed to build a suitable aerobic base and skill level leading into the competition.

- High volume training with low / medium levels of intensity
- Continuous, interval& fartlek training
- Flexibility training
- Basic skill work
- Fitness testing used to gather baseline data and comparison to other players, teams, previous seasons etc.

2. SPECIFIC PREPARATION

- Objective: Develop game specific fitness, skills and strategies
- Training may need to be personalised depending on players / positional needs
- Reduced training volume with increased intensity occurs during this macrocycle

- High intensity interval training.
- Weight training
- Plyometrics training (up to 2 x per week)
- Flexibility / agility training.
- Appropriate mental skills developed

COMPETITION PHASE:

- Divided into pre competition and competition

1. PRE-COMPETITION

- Objective is to reach peak match condition

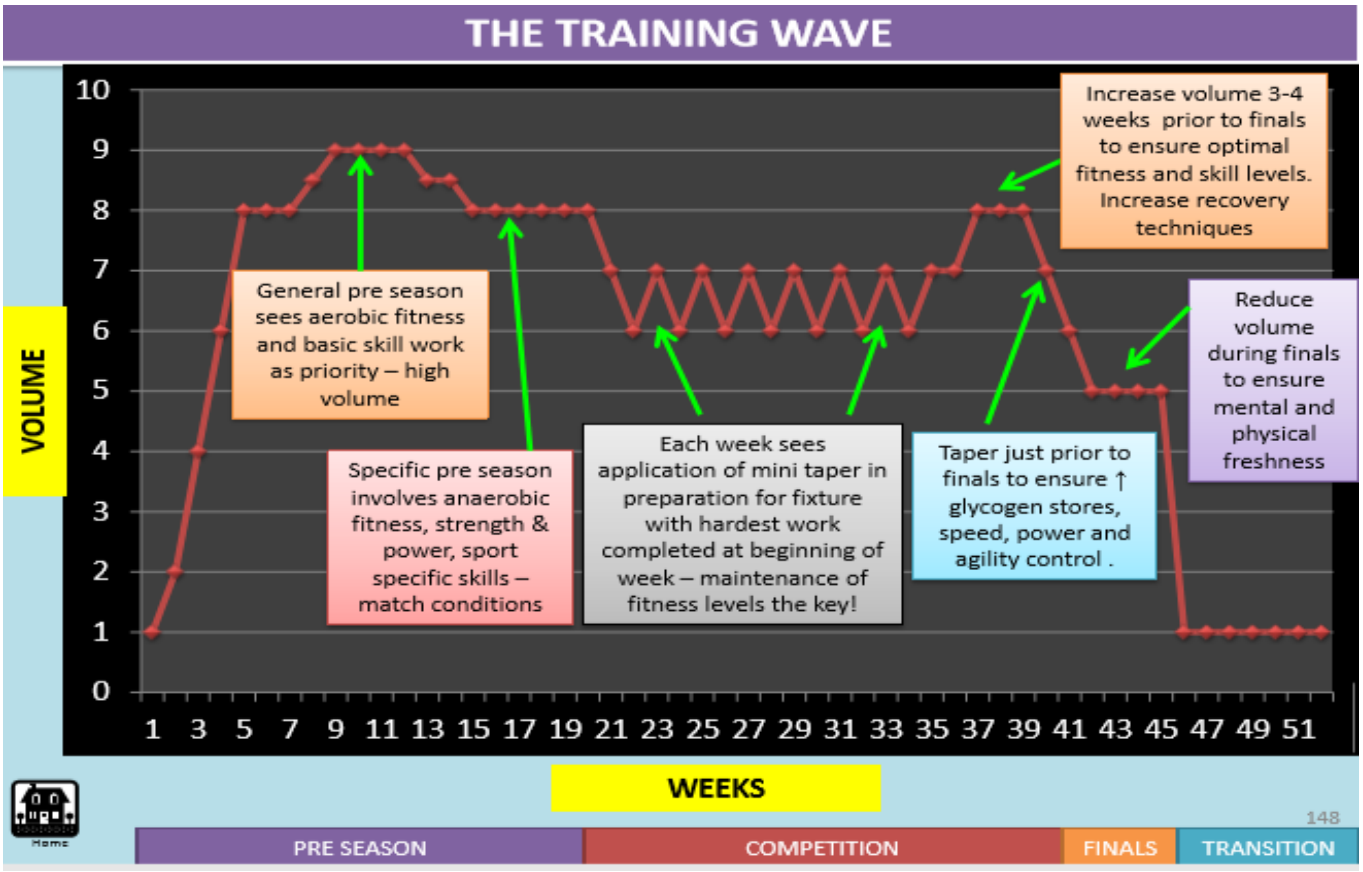
- Focus at training moves to match specific intensities, durations & tactics
- Application of the principle of specificity is crucial
- Continue to develop appropriate mental skills
- Intensity of training increases
- Volume of training decreases
- Recovery between sessions essential
- Play trial games

2. COMPETITION

- Objective -Fitness is maintained -dependent on individual situations (injury and illness, position, number games played, game time played).
  - Players at optimal level of skills and fitness
  - Focus on psychological and tactical preparation
  - Recovery sessions critical, particularly after games when players are often sore

• Constant peaking & tapering are critical in allowing players sufficient recovery during the season

• Variation in the hard / easy cycles forms a "training wave" and is of particular significance where fixtures are played weekly to ensure players are optimally prepared for competition.



EVALUATION PAHSE: (MANLY FOR COACHES)

- Done as soon as the season ends
- Involves the analysis of the strengths and weaknesses of the programme, to determine what worked and what did not. - Questionnaires, checklists and quantitative data can be used to gather information.
- Coaches need to determine whether the physical and mental skills introduced, practiced and used during the annual programme were beneficial to the performer.
- Changes are made to the program based on feedback received
- What do we need to improve –recruit specific players, certain positions, who to target in the draft etc

TRANSITION PHASE: (OFF SEASON)

- Training volume and intensity significantly reduced to allow for full physical and psychological recovery.
    - Older players in particular find this time crucial in allowing the body to recover Aerobic fitness should be maintained to avoid detraining through involvement in enjoyable activities

- Surfing
- Different sports

- Monitor nutrition to ensure a return to active participation close to playing weight
- Opportunity for corrective surgery and rehabilitation
- Specialised programs to correct structural or skill deficiencies

Biomechanics

WHAT IS BIOMECHANICS:

- The study of motion and the effects of forces relative to the body.
- Applies the laws of mechanics and physics to human performance – Contributes to the improvement in mechanical aspects of sports performance in the following areas
  • Description
  • Explanation
  • Prediction
  • Improvement

FORCE:

- Force is the product of mass times acceleration, represented mathematically as; F = MA
- The concept of force is common to all Newton's Laws.
- Force is the pulling or pushing effect of a body on another body that can;
  1. Get objects moving
  2. Stop objects moving
  3. Change the direction of a moving object
  4. Change the speed of a moving object
  5. Balance another force to keep an object still
- Forces can be external;
- Gravity
- Friction
- Air resistance
- Water resistance
- Forces can also be internal;
- Actions of muscles and tendons on the skeletal system

FRICTIONAL FORCE:

- Friction is a force that arises when one object or body moves across another – friction always opposes motion. Frictional forces play a large part in changing the state of motion of an object or body.
- There are four types of friction;
  1. Static friction- Friction between two objects that are not moving
  2. Sliding friction -This occurs when two objects slide over each other eg sand boarding
  3. Rolling Friction- When one object rolls across another object E.g lawn bowls.

4. Fluid Friction- Friction caused by water / air.

- Excepting static friction, these frictional forces all act on an object and change its state of motion –slow them down.
- Some sports benefit from increasing frictional forces while other sports try and minimise frictional forces.

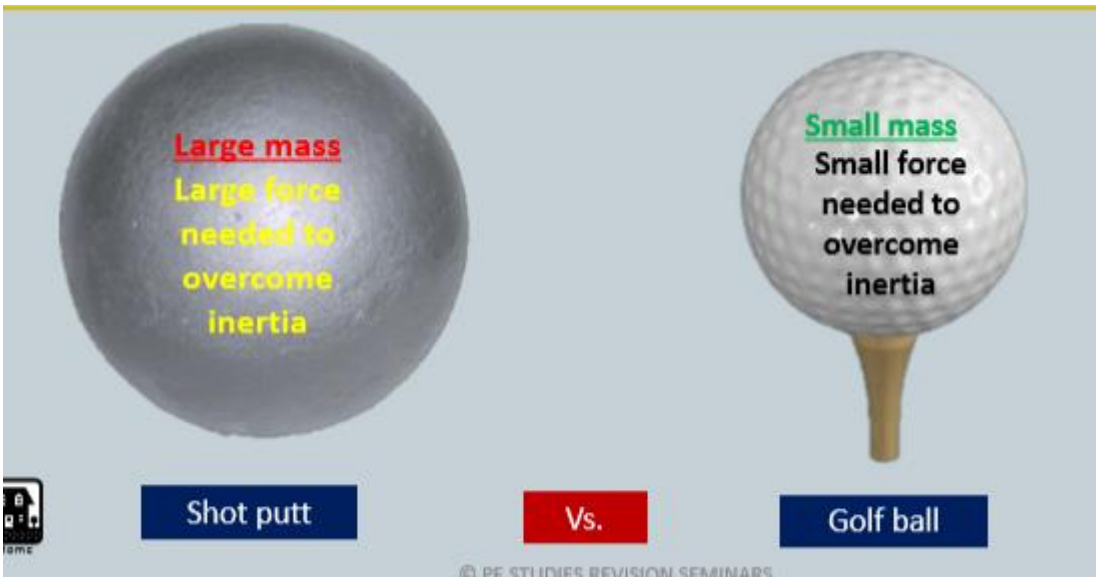
NEWTONS 1ST LAW OF MOTION:

- "A body continues in its state of rest or state of motion unless acted upon by a force". This law is also referred to as the Law of Inertia.

- Newton's 1st Law can be applied to;
  • Creating movement –golf ball remains on the tee unless force is exerted on it.
  • Changing movement –once hit, the ball would travel forever if no forces were acting on it to slow it down and bring it back to earth and stop it moving.
  o Air resistance is a force that slows the ball down
  o Gravity is a force that pulls the ball back to the ground
  o Friction is a force that stops the ball rolling

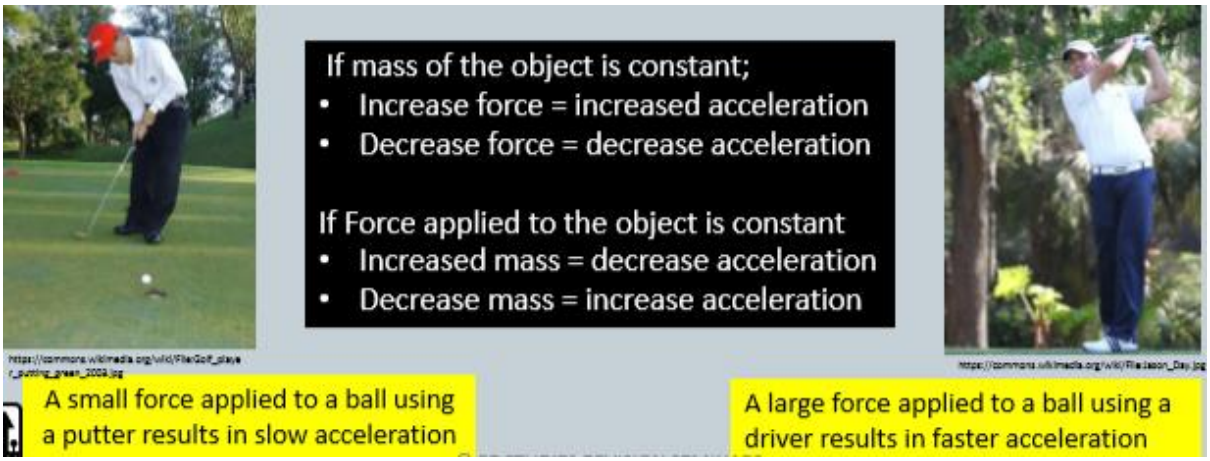
INERTIA:

- Inertia- Is the term used to describe the amount of resistance to a change in an object's state of motion
- The greater an object's inertia, the greater the force required to initiate its movement or change its state of motion.
- Is directly proportional to an object's mass

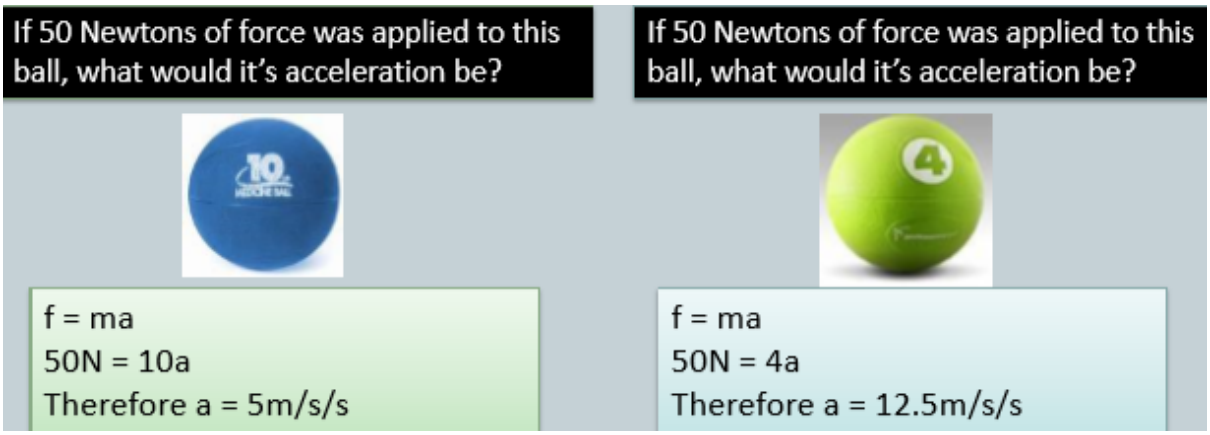


NEWTONS 2ND LAW OF MOTION:

- "The rate of change of acceleration to a body is proportional to the force applied to it and inversely proportional to the mass of the object". This law is also referred to as The Law Of Acceleration
- The greater the force applied to an object, the faster the acceleration will be.
- If the same force is applied to objects of differing mass, the object with less mass will accelerate faster



- Newton's 2nd law can be expressed mathematically as Force = mass x acceleration (m/s/s)



- If the same force is applied to two object's of different masses, the object with the lower mass accelerates faster
- For an object of a greater mass to accelerate at the same speed as an object of a lighter mass, the force applied to it must be greater than the force applied to the lighter object

MOMENTUM:

- Momentum- Momentum is a measure of the amount of motion possessed by a moving body and can be expressed mathematically as p=mv
- An object can only have momentum if it is moving.
- The greater its momentum, the more force that needs to be applied to either stop or slow the object down.
- As a result, when two bodies collide, the one with the most momentum will be least affected

CONSERVATION OF LINEAR MOMENTUM:

- Conservation of linear momentum- Principle states the total momentum of two objects before and after impact are equal
- This occurs in situations where a perfectly elastic collision takes place i.e. one where no energy is lost to sound and heat – The momentum of one object is transferred on contact to the other object, resulting in no change in total momentum, rather a transfer of momentum

E.g. When playing snooker, once struck, the white "cue ball" will contain a certain amount of momentum. This is determined by its mass and how fast its travelling. When this ball makes contact with the black ball (pictured right) the total momentum of the two balls before and after collision will remain the same. Some of the momentum would have simply transferred from the white ball to the black ball.

A hackey sack colliding with the ground represents almost a perfectly inelastic collision.

In this situation almost all momentum has been lost and therefore the concept does not apply.

- E.g of conservation of linear momentum;

For the last over of a one day cricket innings, with the scores close and the match in the balance, the fielding captain decides to ask a slow bowler, rather than a fast bowler, to bowl. Use biomechanical principles related to 'conservation of linear momentum' to justify this decision.

Shane Warne – slow bowler

Mitchell Johnson – fast bowler

When two moving objects collide (cricket bat and ball) the linear momentum is conserved.

By using a relatively slow delivery, when compared with a fast bowler, the momentum of the ball before impact is reduced. Therefore, the bat must be swung with greater velocity if the batsman is to generate the same momentum after impact.

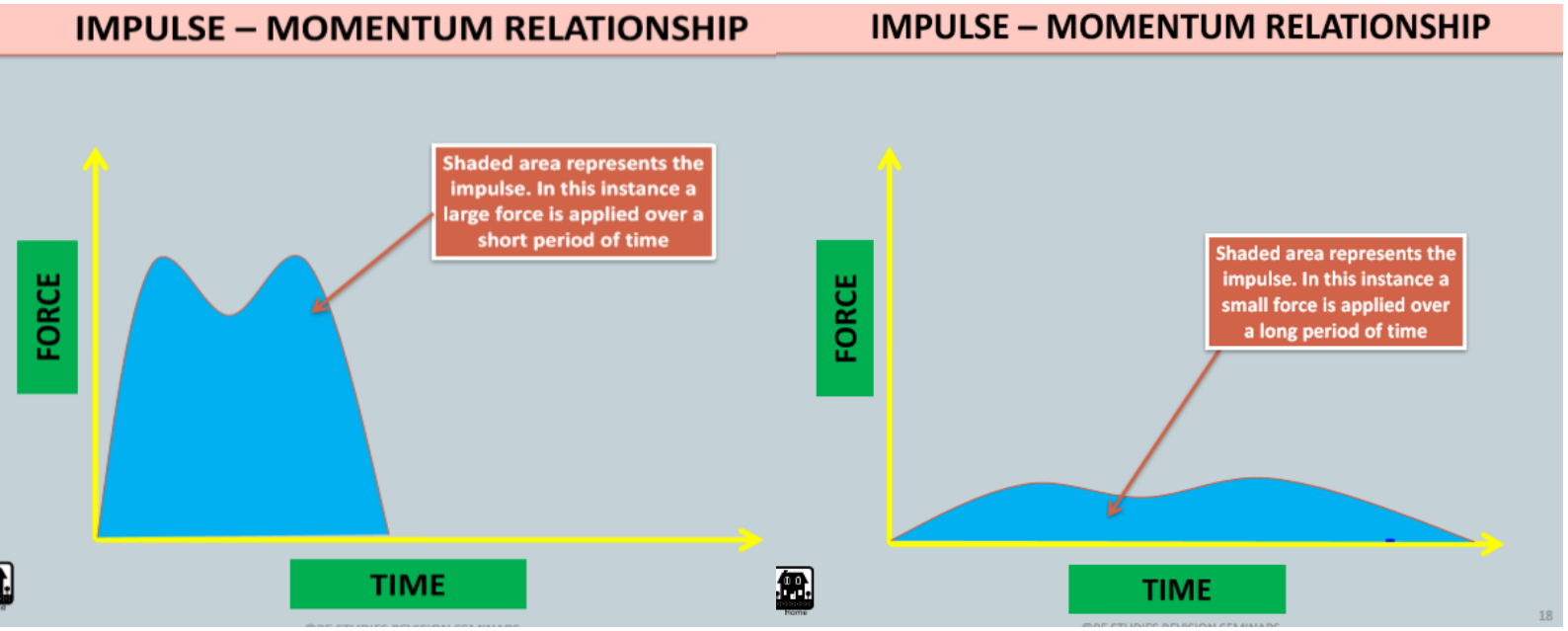
IMPULSE- MOMENTUM RELATIONSHIP:

IMPULSE-FORCE-TIME:

- Impulse- impulse is the application of force over a period of time to change the momentum of an object.

- Impulse is referred to as a biomechanical principle called force-time
- The formula of impulse- momentum relationship is impulse = force x time
- Where force equals the objects mass multiplied by the acceleration, and time equals the length of time for which the force is applied to the object
    1. Impulse creates momentum e.g increase the momentum of an object from zero
    2. Changing momentum e.g increasing/decreasing momentum of a moving object
    3. Stopping momentum e.g taking momentum back to zero

IMPULSE MOMENTUM RELATIONSHIP:



IMPULSE AND SPORT:

- Impulse is important in an impact/collision situation
- We often manipulate the momentum of one of the colliding objects to produce a desired outcome – e.g speed up or slow down an object
- Tennis racquets have different tension strings depending in the users individual requirements
- Looser strings;
- Ball on racquet for longer
- More power, less control
- Tighter strings;
- Ball on racquet for less time
- More control, less power
- Because impulse is force x time, we can change either one to suit the demands of the situation
    1. Increasing momentum
- In hockey, a hit will place a large force, but over a small period of time. A drag flick would use smaller force over a longer period of time. Either way the ball will increase its momentum

- Ideally we look to maximise both force and time, however the human body rarely allows for this to happen

2. Decreasing momentum

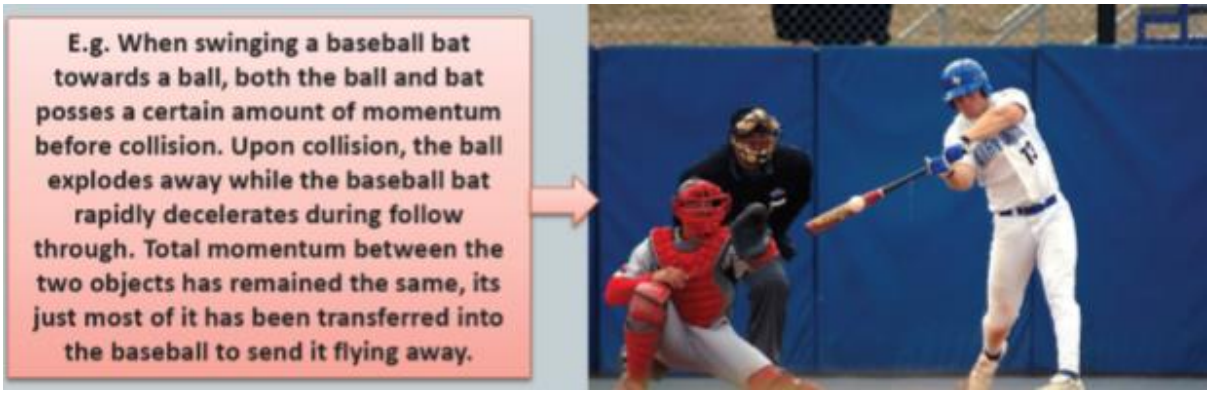
- A cricket ball is hit towards a fielder. The fielder wishes to stop the ball (take the momentum back to zero)

- Would he apply a large force over a short period of time?
- Would he apply a small force over a longer period of time?

- Therefore in stopping a force we usually increase the time component so we can reduce the peak force

NEWTONS 3RD LAW OF MOTION:

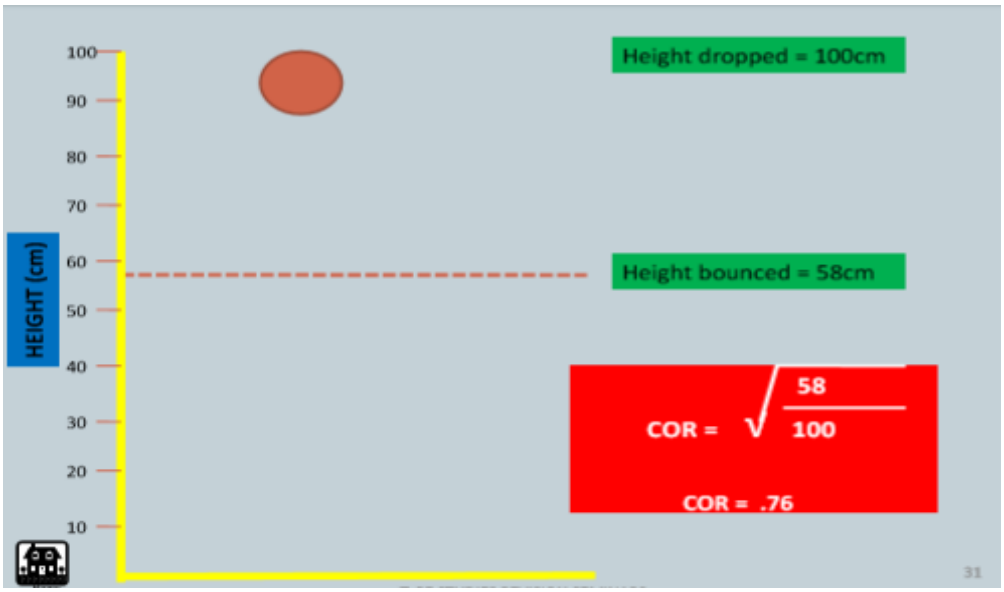
- for every action, there is an equal and opposite reaction
- When two objects exert a force upon each other the forces are opposite in direction and equal in magnitude.
- The law directly applies to the concept of conservation of momentum
- Newtons 3rd law explains that when collisions occur, and equal and opposite reaction occurs resulting in a transfer of momentum from one object to the other



COEFFICIENT OF RESTITUTION:

- COR measures the elasticity of the collision between an object and a given surface. It measures how much energy remains in the object after a collision takes place
- Elasticity is a measure of how much rebound exists following a collision
- An objects COR is measured on a scale of 0-1
- A COR of 1 represents a perfectly elastic collision. (when a ball is dropped from a given height the ball will rebound at the same height after colliding with the ground)
- A COR of 0 represents a perfectly inelastic collision, effectively stopping at the surface with which it collides. (when the ball is dropped, it doesn't bounce at all)
- In golf, the term COR refers to the clubs faces ability to rebound the ball
- To calculate an objects COR in the case of a falling object bouncing off of the floor, or off a racquet on the floor, use the following formula

$$COR = \sqrt{\frac{\text{Height bounced}}{\text{Height dropped}}}$$



FACTORS AFFECTING THE COEFFICIENT OF RESTITUTION:

1. Equipment and materials

- Condition of the balls- think about when a player calls for new balls in tennis how much faster they are able to serve
- Type of equipment being used- in American baseball, wooden bats are compulsory as aluminium bats have a higher COR- this places the pitcher at increased risk of injury due to the ball leaving the bat face faster thus reducing reaction time.
- Type and condition of playing surface – clay court (high COR) vs grass court (low COR)

2. Temperature of the balls

- An increase in the temperature of the balls results in an increase in the COR- in sports such as squash we see a dramatic increase in the bounciness of warm squash ball compared with a cold one

3. Velocity of the collision

- Velocity between the oncoming ball and swinging implement will alter the COR- increase velocity increases the likelihood of the ball losing energy due to greater compression of the ball- therefore increase velocity = decrease COR

ANGULA KINETICS:

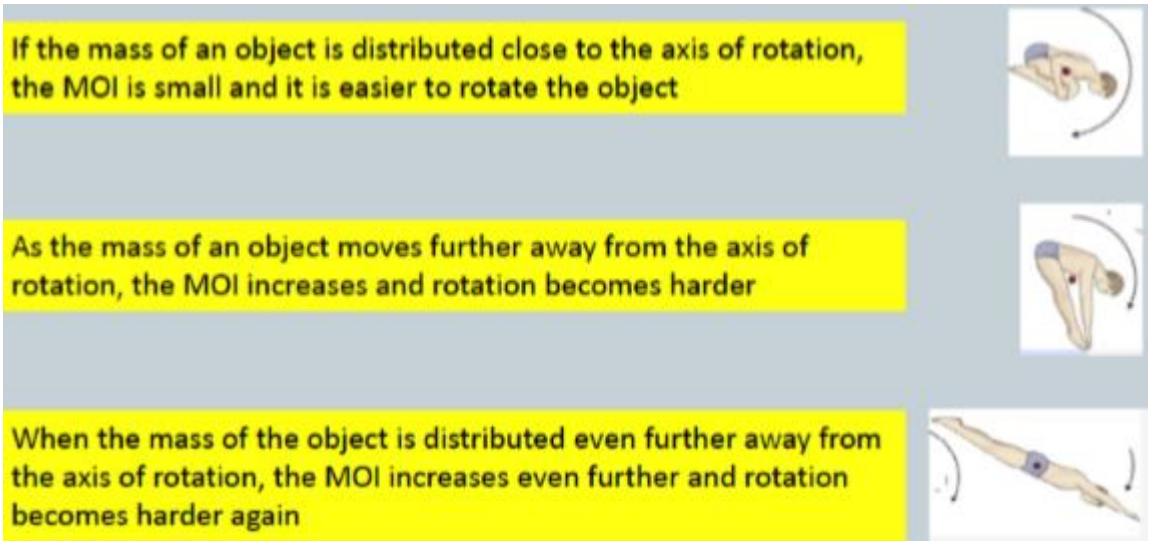
ANGULAR MOMENTUM:

- Angular momentum- The quantity of angular momentum possessed by a rotating body
- Angular momentum = angular velocity x moment of inertia
- Remember when we talking in a linear sense momentum= velocity x mass
- Angular momentum is the same, just in an angular sense
- Angular velocity refers to the velocity or speed of a rotating object
- Moment of inertia refers to the resistance o a rotating object to change its state of motion

LINEAR	ANGULAR
Mass	Moment of inertia
Velocity	Angular velocity
Linear momentum	Angular momentum

ANGULAR MOMENTUM- MOMENT OF INERTIA:

- Moment of inertia- refers to the resistance of a rotating object to change its state of motion



- Moment of inertia = mass of the object x radius of rotation
- By moving the mass of the object further from the axis of rotation, you are increasing its radius of rotation and therefore increasing its moment of inertia making the object harder to control and harder to generate angular velocity
- Moment of inertia body example;
- If the body's mass is close to the axis of rotation, rotation is easier to manipulate. This makes the moment of inertia smaller and results in an increase in angular velocity.
- Moving mass away from the axis of rotation slows down the angular velocity.

TORQUE: (MOVEMENT OF FORCE)

TYPES OF FORCES:

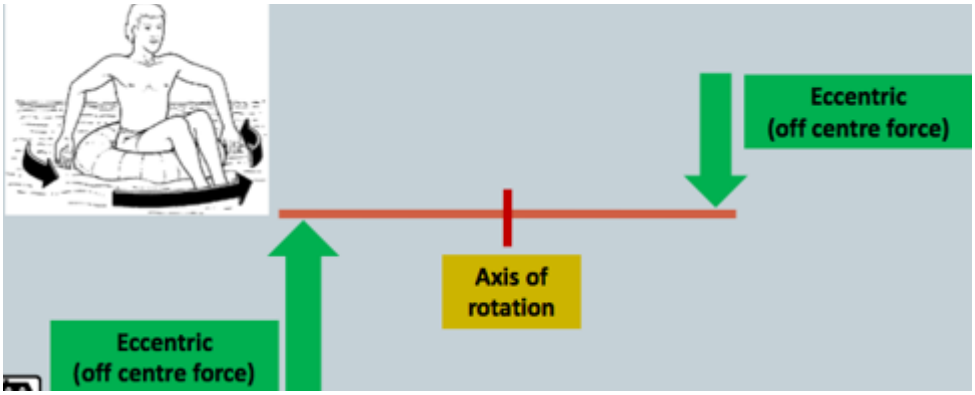
- Concentric force- force applied to produce linear motion e.g hitting a flat serve in volleyball
- Eccentric force- off centre force applied to produce angular motion e.g hitting a top spin serve in volleyball

FORCES THAT CREATE ANGULAR MOTION:

- Forces that create angular motion (known as torque)
- Application of an eccentric force;
- Angular rotation is caused y the application of an eccentric (off-centre) force
- When only 1 eccentric force is applied to the object, both linear and angular motion occur (volleyball top spin serve)- if one end of the object is fixed and an eccentric force is applied, then only angular rotation occurs (e.g a gymnast rotating on a high bar)
- To increase an objects angular motion, you can;
  1. Increase the amount of force applied
  2. Increase the distance from the axis of rotation to where the force is applied (moment arm)

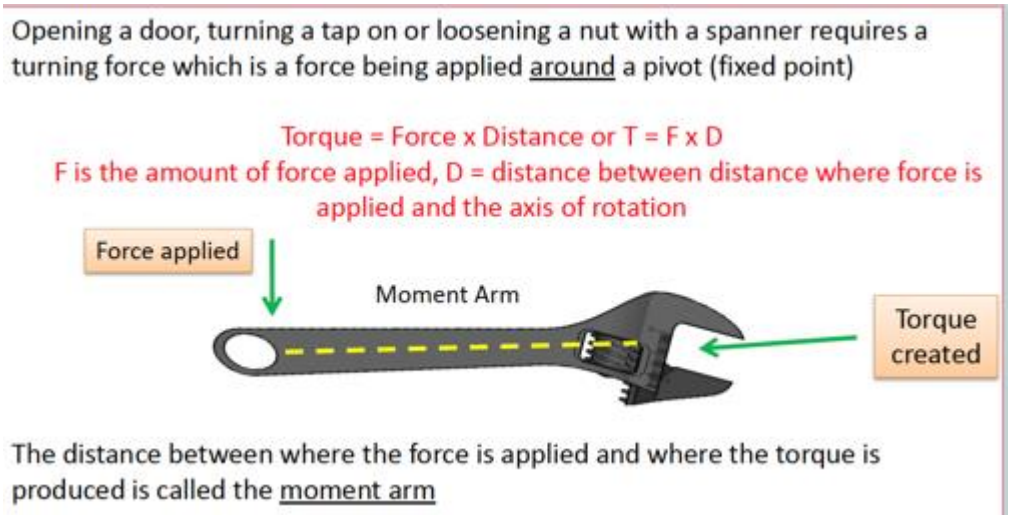
FORCE COUPLES:

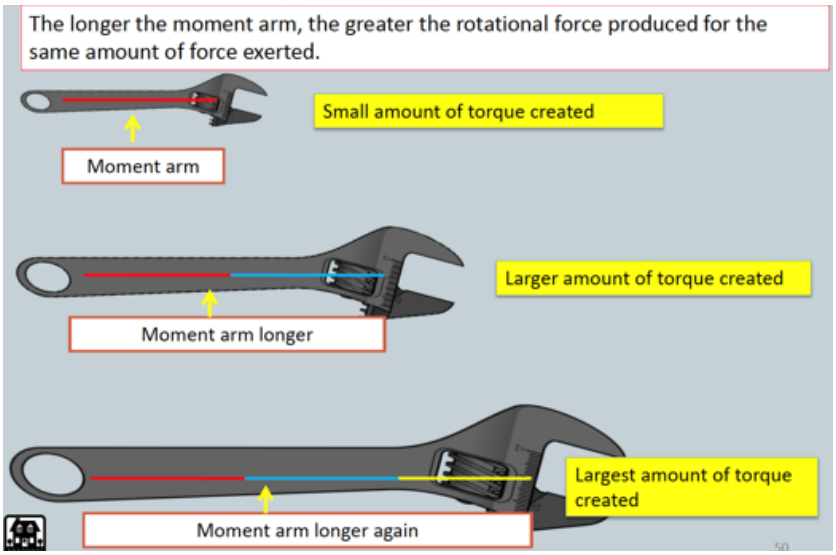
- When two, equal but oppositely directed forces act on opposite sides of an axis of rotation
- This causes the forces that produce linear motion to cancel each other out, causing the object to rotate in a fixed position



TORQUE:

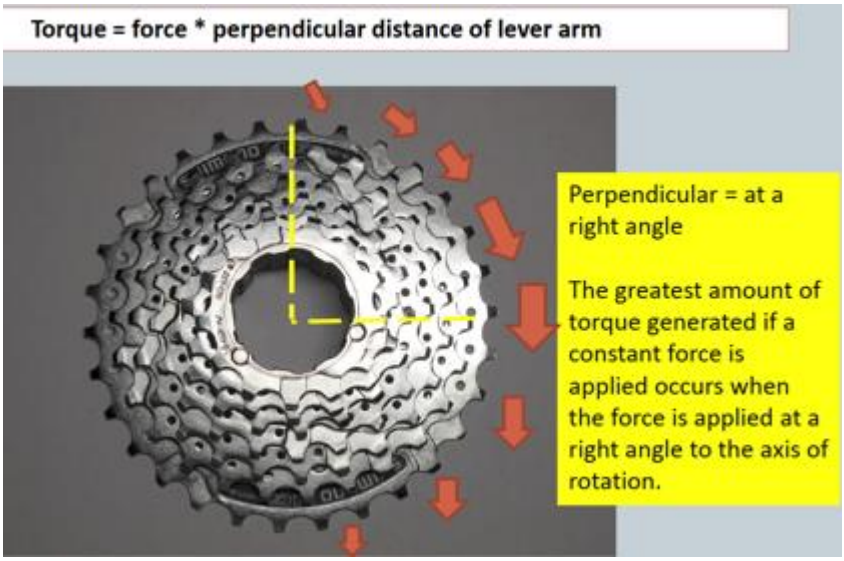
- Torque- torque is the turning effect created as a result of an eccentric force being applied around a pivot or axis





INCREASE AND DECREASE TORQUE:

- Torque can be increased by;
  1. Applying a greater force
  2. Increasing the length of the moment arm
- Torque can be decreased by;
  1. Applying less force
  2. Decreasing the length of the moment arm



LEVERS:

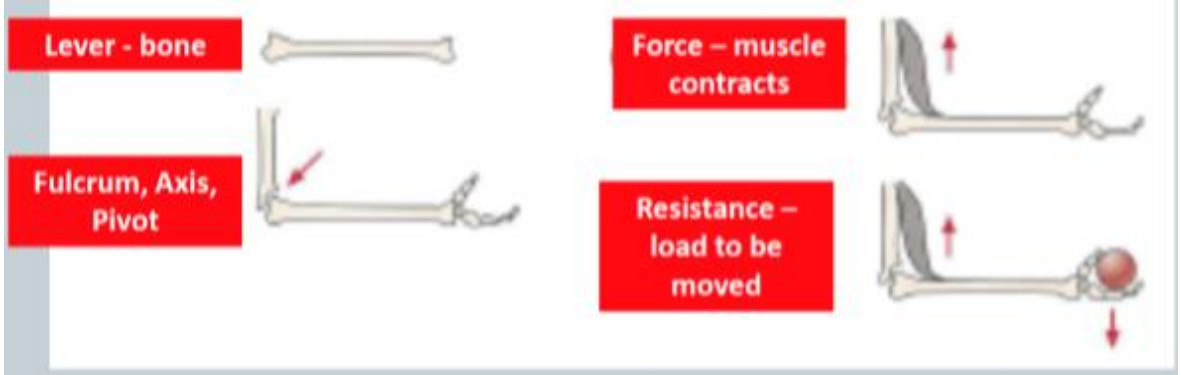
COMPONENTS OF A LEVER:

- A pivot point, or axis (FULCRUM)
- A load / weight / resistance
- The applied force required to move weight / load/ resistance (effort)
- The distance between the force and the pivot point is termed the effort arm; this is the pivot point where the force is applied to move the load
- The distance between the load and the axis of rotation is termed the resistance arm

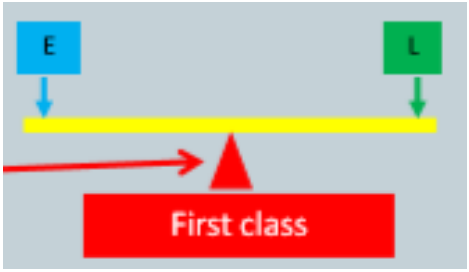
LEVERS-ANATOMY:

- Levers have 3 main parts;
  1. Weight or resistance to be moved
  2. Axis/ pivot point
  3. Application of force
- Fulcrum- point around which levers rotate
- Effort/force arm- the distance between the fulcrum and the point at which force is applied
- Resistance arm- the distance between the fulcrum and the centre of the resistance

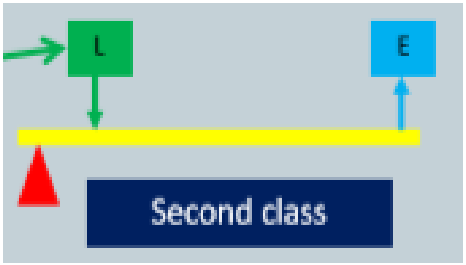
LEVERS:



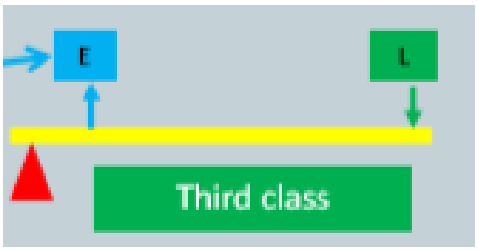
- The acronym FLE to remember the classification of levers
- First class = FULCRUM in the middle



- Second class = LOAD (resistance) in the middle



- Third class = EFFORT (force) in the middle



- The acronym ARF to remember the classification of the levers
- First class = AXIS in the middle
- Second class = RESISTANCE in the middle
- Third class = FORCE in the middle

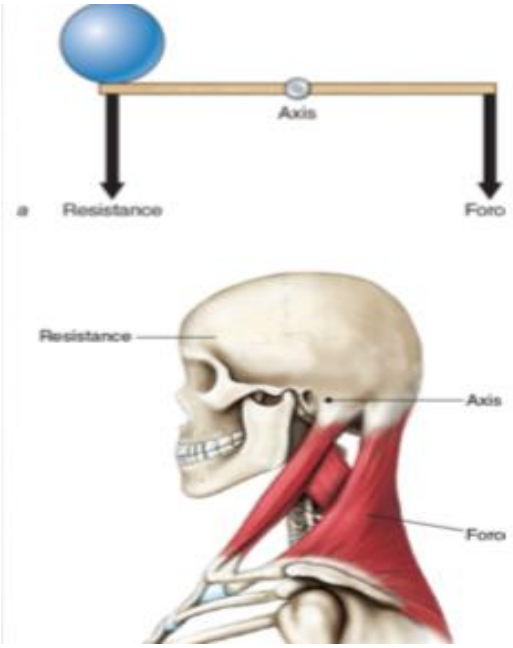
FIRST CLASS LEVER:

- In first class levers, the axis/fulcrum is located in the middle with the force and resistance either side
- There are very few examples of first-class levers in the human body
- An example of a first-class lever is a see saw – where the effort comes from the person pushing down whilst the resistance comes from the person on the other end
- The point of application of force in relation to the axis/fulcrum will determine the mechanical advantage provided by a first class lever
- The further one applies force from the fulcrum, the easier it is to move objects. This allows for individuals to move heavy objects as is seen when using a crow bar
- The closer the applied force is to the fulcrum, the greater the effort is needed to move the object

FIRST CLASS EVERS IN THE BODY:

- Holding your head erect is an example of a first class lever in the human body
- The fulcrum (axis): The joint between the skull and the spine
- The load (resistance) is the weight of the head acting through its centre of gravity

- The force is the muscular force exerted by the neck muscles pulling on the back of the skull

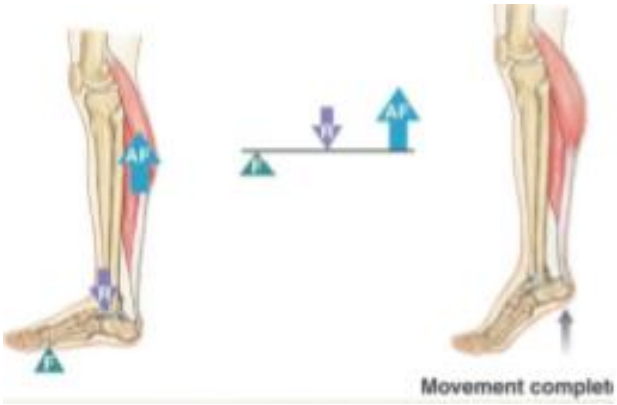


SECOND CLASS LEVER:

- In second class levers the axis /fulcrum is located at the end of the resistance in the middle and the force is applied at the opposite end
- Like 1st class levers, 2nd class levers are very rare in the human body
- An example of a second class lever is a wheelbarrow, where a large force arm ensure the strength to an object can be applied
- An example in the human body can be seen whilst performing a push up.

SECOND CLASS LEVERS IN THE BODY:

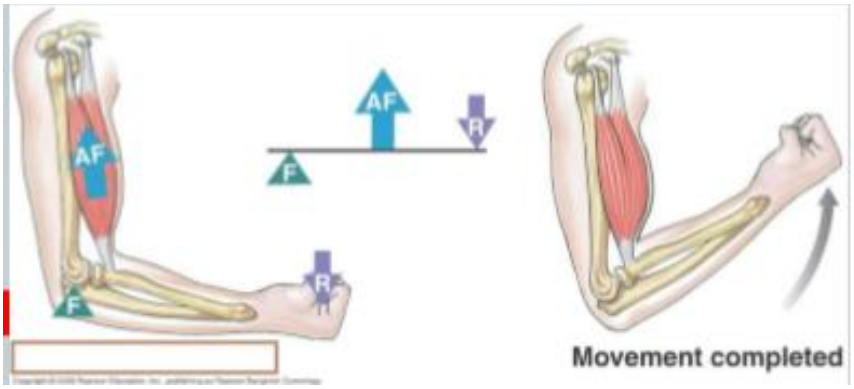
- Performing a calf raise
- The fulcrum (axis): Your toes
- The load (resistance): Your body weight
- The force is the muscular force exerted by the gastrocnemius muscle as is contracts and pulls upwards



THIRD CLASS LEVERS:

- In third class levers the axis/fulcrum is located at one end with application of the force in the middle and resistance applied at the opposite end.

- This is the most common lever in the human body as mechanically we are built for speed- a large resistance arm ensures an increase speed can be obtained
- When looking at the human body, the muscle attachment represents application of force, the joint usually represents the fulcrum/axis and the weight/load represents the resistance



- Third class levers are very effective when using striking implements (golf club, baseball bat, tennis racquet)- by increasing the length of the resistance arm, it is possible to generate greater velocity of the striking surface, resulting in greater force being transferred onto the ball, however in striking sports, an increase in the length of the lever may result in an increased weight affecting control
- In teaching an athlete how to kick, throw, or strike a ball for distance, the same concept should be applied- maximise lever length at the point of impact by extending at the joint to maximise the speed of the impact or release point.

<u>MODIFYINGLEVER LENGTHS:</u>

- The human body comprises primarily 3rd class levers
- This means we are typically not mechanically efficient - The force arm is always going to be shorter than the resistance arm
- When performing force-related activities, such as weight lifting and swimming, we overcome this by reducing the length of the resistance arm as much as possible.
- When performing velocity-related activities, such as a tennis serve or fast bowling action in cricket, we increase the length of the resistance arm by extending the upper limb, to increase the speed of release.
- In throwing;
- We decrease the length of the lever system early in the throw (flex the elbow) to decrease the moment of inertia of the upper limb, thus making it easier to rotate
- We then increase the lever arm closer to the release, which increases the velocity of the endpoint (the hand) and therefore the velocity of the throw

FACTORS AFFECTING THE USE OF LEVERS:

1. Length of the lever

- Velocity is greatest at the distal end of the lever
- Longer the lever, greater the velocity at impact
- E.g increase the club length creates an increase in velocity and momentum at impact provided the athlete can control the longer the lever- longer generally means an increase in mass
- Children often have difficulty with this and subsequently use shorter levers to gain better control- shorter cricket bat, tennis racquet

2. The inertia of the lever

- The longer the lever, the heavier it usually is and therefore the more difficult it is to rotate
- By choking down the club in striking sports, athletes can reduce the rotational inertia of the implement therefore making it easier to swing

3. The amount of force

- The amount of force an athlete is able to generate via their muscles determines the length o the lever the athlete should use
- Longer levers are usually heavier and therefore more force is required to move them
- As a result, its crucial athletes do not try to use longer, heavier equipment if they are not physical strong enough, as this will sacrifice control

FLUID MECHANICS:

STUDY OF FLOW:

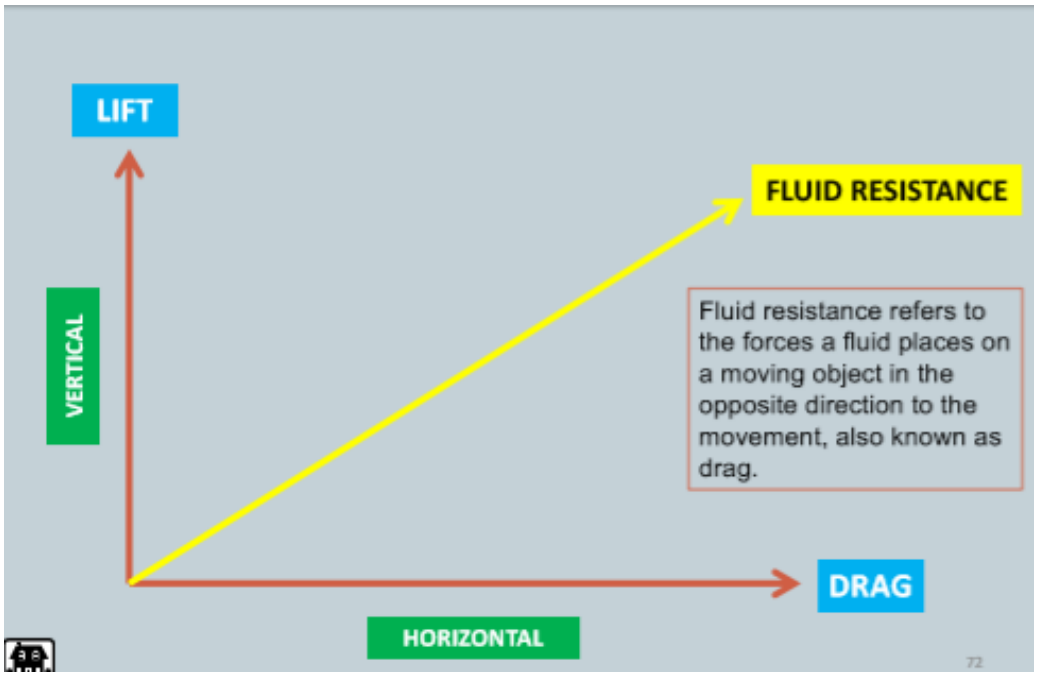
- The study of forces that develop when an object moves though a fluid medium
- Fluids of interest;

- Water
- Air

FLUID FLOW:

- Fluid flow- the natural science of fluids (liquids and gases) in motion
- In some cases fluid forces have little effect on an objects motion (e.g shotput)
- In other cases, fluid forces are significant – badminton, baseball, swimming, cycling
- Major fluid forces of interest:
    1. Drag (works horizontally)
    2. Lift (works vertically)
    3. Buoyancy (works vertically)

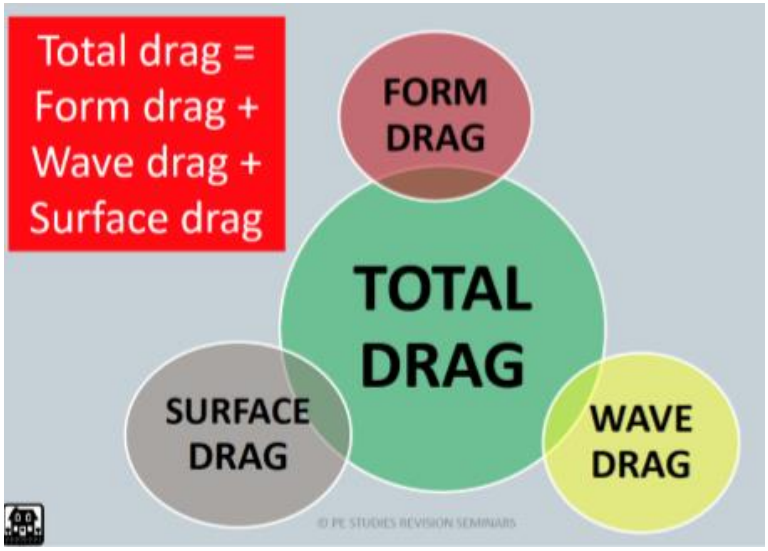
FLUID RESISTANCE- DRAG AND LIFT:



FLUID RESISTANCE:

- As an object moves through a fluid (air or water), it disturbs it
- The greater the disturbance to the fluid, the greater the transfer of energy from object to fluid
- 2 factors affecting fluid resistance
  1. Density
- The more dense the fluid, the more disturbed the fluid becomes and hence the greater the resistance – humid conditions present more dense conditions and therefore a ball will encounter greater levels of air resistance
  2. Viscosity
- The more viscous the fluid (internal resistance of a fluid to flow), the more disturbed the fluid becomes and hence the greater the greater the resistance
- E.g honey is more viscous than water, water is more viscous than air- a swimmer will obviously experience more resistance than a runner

FLUID RESISTANCE- TYPES OF DRAG:



SURFACE DRAG: (AKA SKIN FRICTION)

- Surface drag- friction produced between fluid and surface of a moving object
- Factors affecting surface drag;
  1. Relative velocity of moving object
  2. Relative roughness of surface object
- Golf ball design- dimples allow later boundary separation and therefore reduced surface drag
- Swimmers wear tight fitting swim suits, shave their bodies down and wear lotions to reduce surface friction
  3. Viscosity of the fluid
  4. Surface area of the object
- In rowing and cycling, equipment has been designed to try and reduce the size of the surface area in contact with the surface

FORM DRAG: (AKA PROFILE DRAG, PRESSURE DRAG)

- Form drag- resistance created by a pressure differential between front and back of an object moving through a fluid
- Factors affecting form drag;
  1. Cross sectional are of the object presented to the fluid
- E.g cyclist in upright vs crouched position
  2. Velocity of the object
- At higher speeds, the athletes experience greater levels of form drag
  3. Surface roughness
- Rougher surfaces cause the air to cling to the surface for a longer period, causing a later separation point and hence less drag
  4. Shape of the object
- Round all vs oval ball

DRAG FORCES IN CYLING:

- Main drag forces affecting a cyclist are surface drag and form drag
- To reduce surface drag, the cyclist will;
- Wear smooth, tight fitting clothes
- Shave their legs
- To reduce from drag, the cyclist will;
- Assume streamlined position to reduce cross sectional area
- Aerodynamic rims
- Aerodynamic helmets
- Aerodynamic bike components

WAVE DRAG:

- Wave drag- resistance formed by creation of waves at the point where air and water interact
- Seen as the major form of drag acting on a swimmer
- Factors affecting wave drag;
  1. Relative velocity of the wave
- Greater the velocity, greater the wave drag

2. Technique

- By being more streamlined in the water, swimmers can reduce the effects of wave drag
- Swimming underwater further reduces the wave drag- this is why the rules of underwater swimming in breaststroke had to be changed] over reaching in backstroke will cause the body to move through its own waves causing resistance

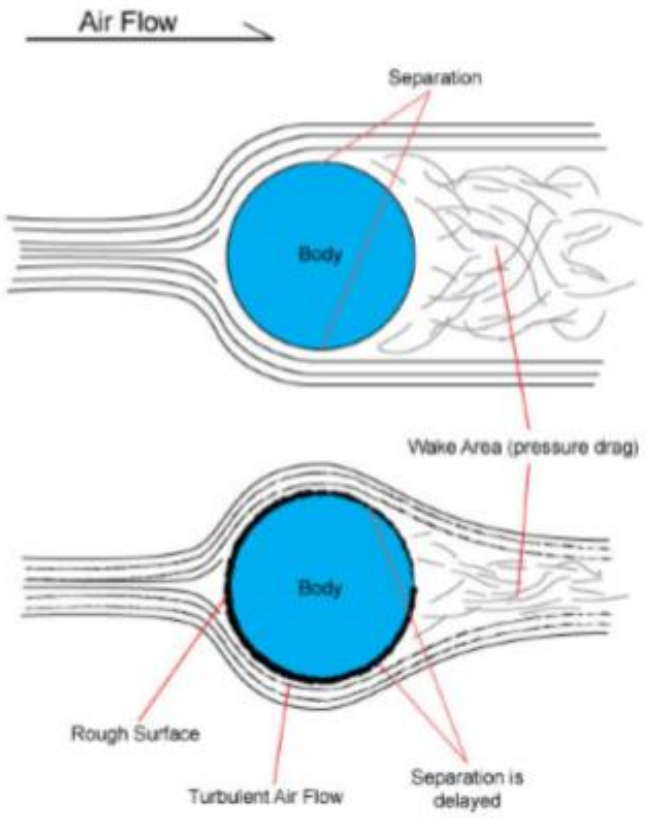
3. Open water (ocean) vs closed conditions (pool)

- Lane ropes used to reduce the wave drag by helping to dissipate moving surface water

BOUNDARY LAYER:

BOUNDARY LAYER:

- Thin layer of air surrounding or attached to the ball
- Laminar- smooth flow, large turbulent pocket at the back of the ball
- Turbulent- rough flow, small turbulent pocket at the back of the ball



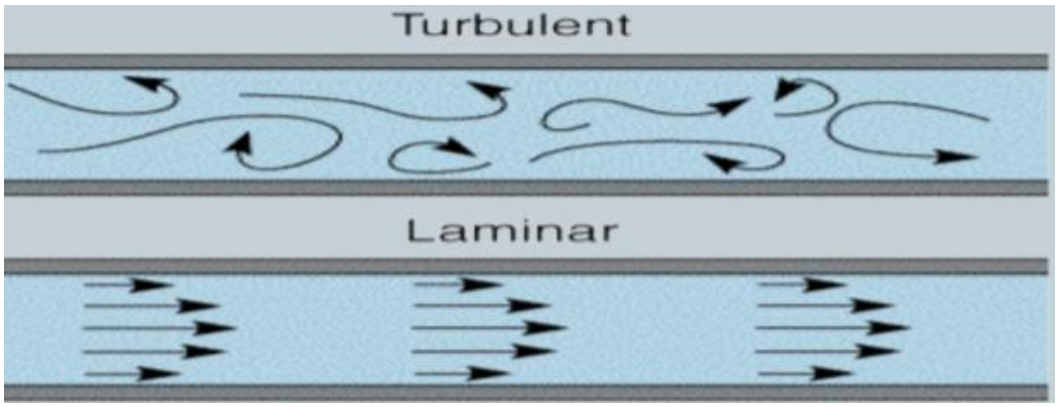
BOUNDARY LAYER SEPARATION:

- Where boundary layer breaks away from the ball
- The earlier the boundary layer separation, the greater the pressure gradient between the front and ack of the ball- leads to increase drag
- In laminar flow, the air flows in parallel layers, with no disruption between the layers
- In turbulent flow, the air mixes and is irregular in flow
- When an object moves through the air, the air which is closest to the ball interacts with the surface (it "sticks" to the surface) creating what is known as a "boundary layer"
- As the ball travels through the air, this boundary layer separates from the ball's surface creating a wake behind the ball
- This wake causes a drag affect in the ball (causing it to slow down)
- The type of airflow around the ball, combined with the velocity of the ball, determines how quickly the boundary layer separates from the ball's surface - the separation point changes position.
- The earlier the boundary layer separation point, the greater the pressure gradient between the front and the back of the ball (leads to an increase in drag)

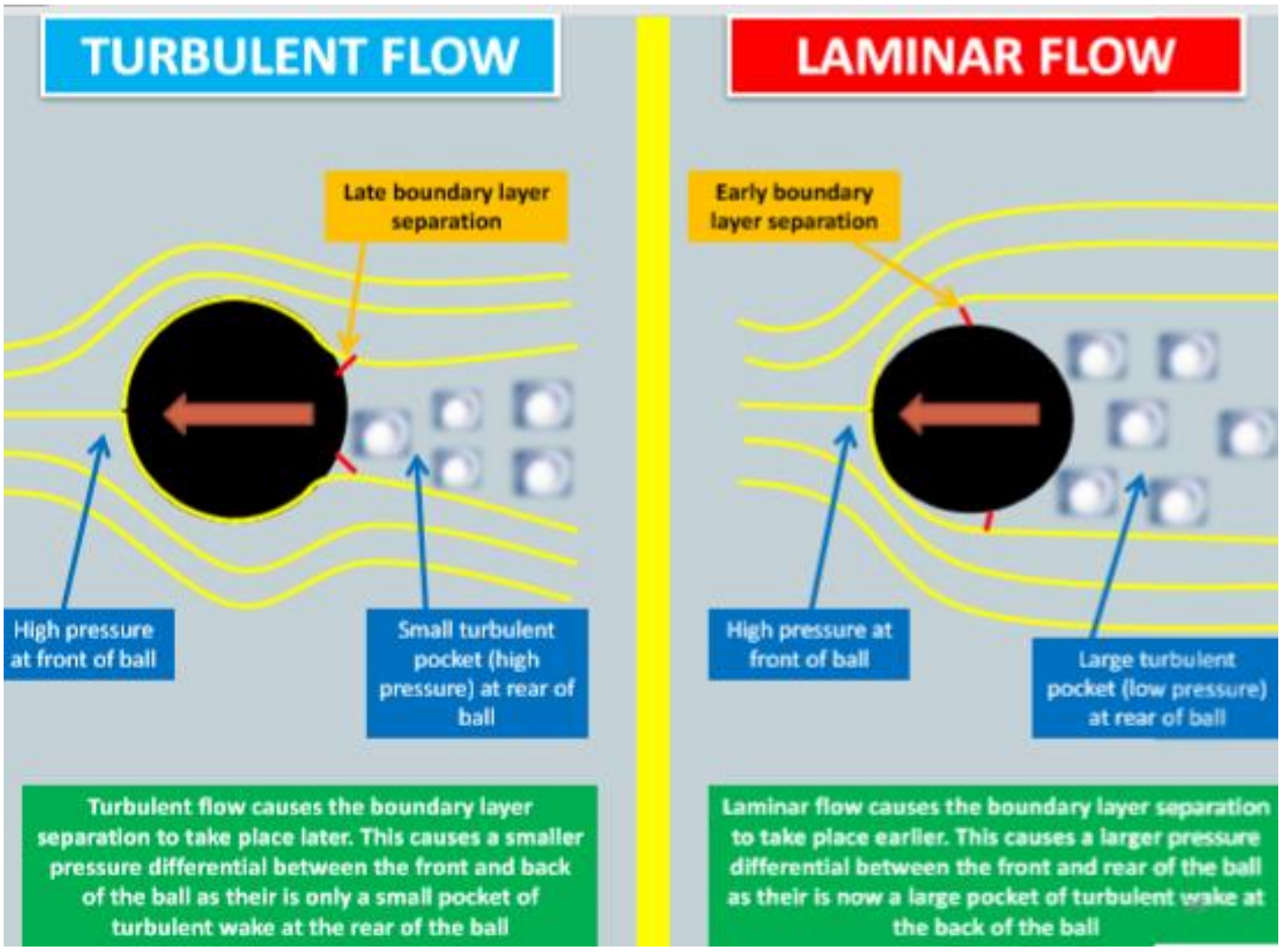
LAMINAR VS TURBULENT FLOW:

- Turbulent flow- flow in which the velocity at any point varies eratically

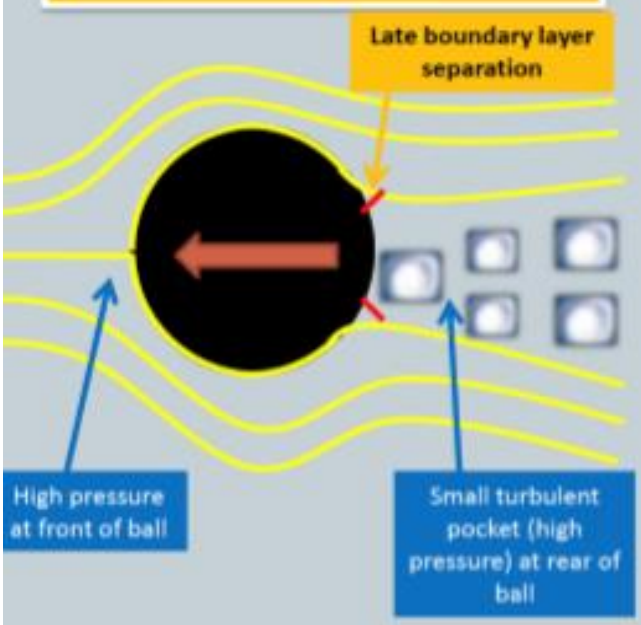
- Laminar flow- a type of fluid flow in which fluid moves smoothly in individual layers or streams



- Laminar flow describes fluid which occurs in sheets parallel to eachother. If there is a surface nearby the flowlines typically run parallel to it
- When the nice neat pattern breaks down the flow becomes turbulent. It no longer flows in parallel sheets, rather independent and largely randomly
- Fluid often changes from laminar to turbulent when they go over an abrupt feature. (such as wind going over a mountain)

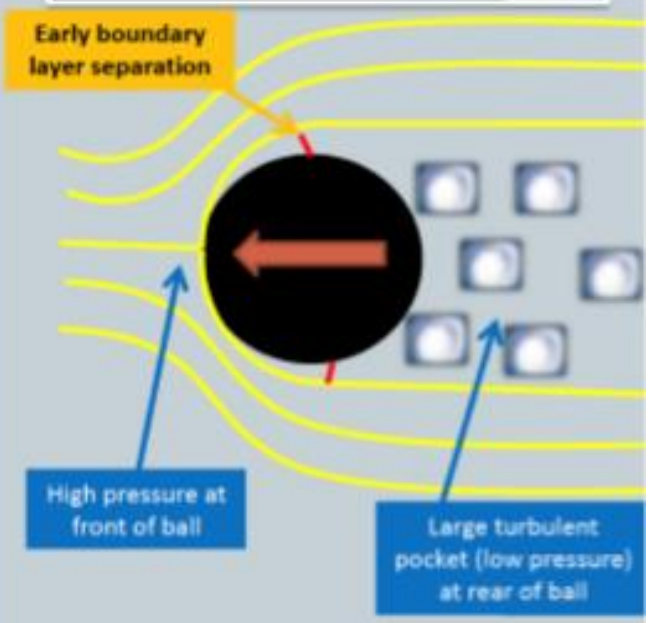


LOW VELOCITY



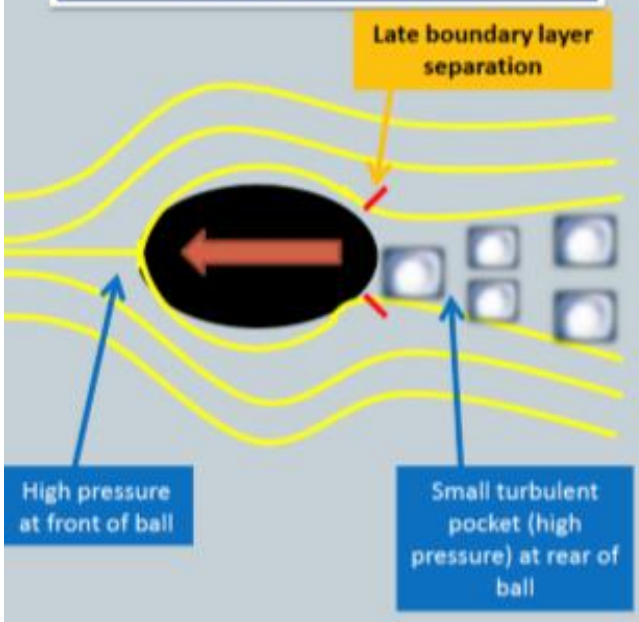
A low velocity causes the boundary layer separation to take place later. This causes a smaller pressure differential between the front and back of the ball as their is only a small pocket of turbulent wake at the rear of the ball

HIGH VELOCITY



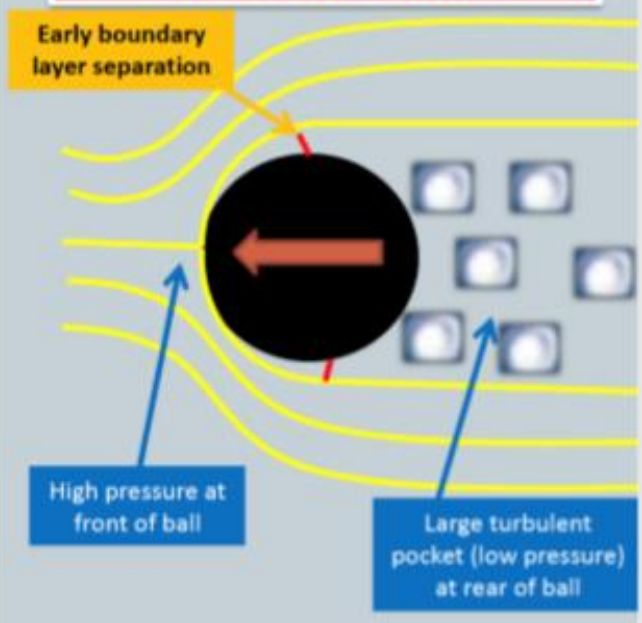
A high velocity causes the boundary layer separation to take place earlier. This causes a larger pressure differential between the front and rear of the ball as their is now a large pocket of turbulent wake at the back of the ball

OVAL BALL



An oval ball causes the boundary layer separation to take place later. This causes a smaller pressure differential between the front and back of the ball as their is only a small pocket of turbulent wake at the rear of the ball

ROUND BALL



A round ball causes the boundary layer separation to take place earlier. This causes a larger pressure differential between the front and rear of the ball as their is now a large pocket of turbulent wake at the back of the ball

FACTORS AFFECTING BOUNDARY LAYER SEPARATION POINT:

1. Velocity
- Low velocity;
- Boundary layer clings to surface, separation well towards rear
- Minor drag
- High velocity;
- Separation occurs further forward
- Increased drag
2. Surface roughness
- Rough surfaces create turbulent boundary layer, reducing the effect of drag
- Dimpled golf ball vs smooth golf ball
- Swim suit design are now a rough surface, designed to create a turbulent boundary layer which results in late separation and reduces the effect of drag on the athlete

FACTORS AFFECTING DRAG:

1. Drag coefficient
- Measure used to quantify the drag or resistance of an object in and environment
- Directly related to cross sectional area
2. Cross sectional area
- Linear relationship exists between CSA exposed to air and drag- increase CSA = increase drag
3. Speed
- The faster the ball moves through the air, the earlier the boundary layer separates from the ball creating a large pressure differential between the front and the rear of the ball and hence more drag
4. Surface roughness
- Rougher surfaces allow for the air stream to cling to the ball for longer periods, resulting in smaller pressure differential between front and back of the ball and hence less drag
5. Mass
- Greater the mass of the ball, the less the effect of drag
6. Shape
- Round vs oval ball
- Gridiron ball cuts through the air more cleanly than a soccer ball
- Oval shaped ball encourages the air stream to cling to the contours of the ball all the way to the end of the tail
- Results is smaller pressure differential between front and back of the ball and therefore less drag

ENVIRONMENTAL FACTORS AFFECTING DRAG:

1. Air density
- Higher altitude less drag
- Smaller the object, greater the effect
- E.g easier to hit a home run on higher altitude
2. Atmospheric pressure
- Higher pressure, higher density, higher drag

3. Humidity
- Higher humidity, higher density, higher drag
4. Temperature
- Higher temperature, less density, less drag- in summer air less dense and ball will travel further

SPORTING APPLICATION OF DRAG REDUCTION:

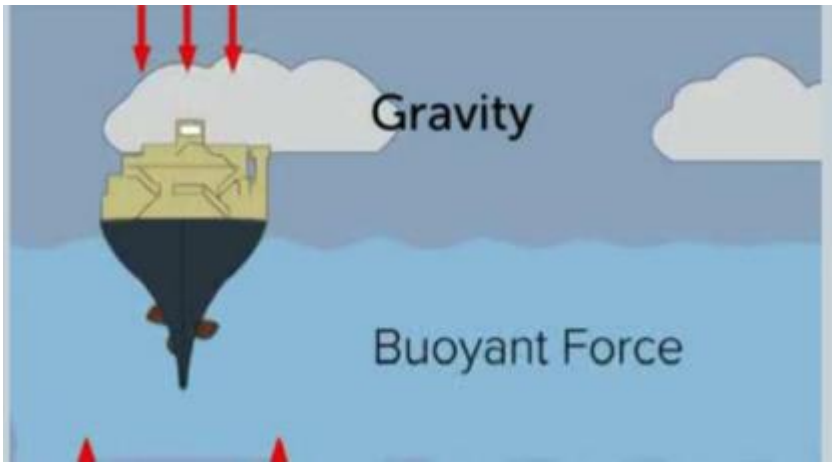
- With an understanding of the factors which affect drag, athletes and coaches are constantly looking for new ways to improve performance through drag reduction.
- Sporting examples include;
- swimming- swim suit designs have helped to improve buoyancy and reduce drag
- cycling- aerodynamic helmets, bike design and tight fitting clothing have all helped reduce drag

BUOYANCY:

- buoyancy- refers to the upward force that keeps things a float
- used to counteract the effects of gravity
- associated with how well a body floats or how high it sits in fluid

ARCHIMEDES PRINCIPLE:

- Archimedes principle- states that the buoyant force acting on an object is equal to the weight of the fluid displaced by the object
- When the forces of the objects mass are equal to or less than those of buoyancy, the object will float
- When forces of the objects mass is grater than those of buoyancy, the onject will sink
- E.g an ocean liner in the water is submerged and displaces a given volume of water. The weight of this displaced water equals the magnitude of the buoyant force acting on the boat in an upwards direction- the boat will float if its weight above the water line is less than or equal to the weight of the volume of water displaced



TYPES OF BUOYANCIES:

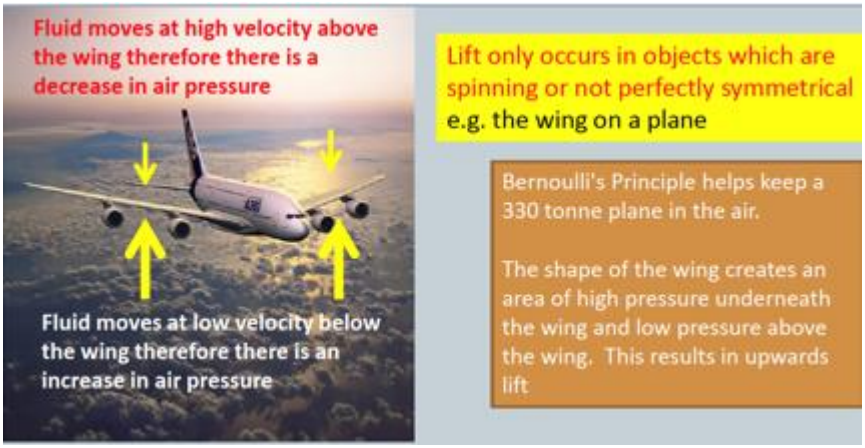
- Buoyancy can be described as positive, negative or neutral
- Positive buoyancy- displaces a volume of fluid equal to or greater than its weight and will float
- Negative buoyancy- displaces a volume of fluid less than its own weight and will sink

- Neutral buoyancy- when an object will neither sink or float but remains suspended in the fluid
- E.g a swimmer with positive buoyancy experiences less fluid resistance than a swimmer who is less buoyant. Positive buoyancy makes it easier to streamline which decreases the drag forces on a swimmer

MAGNUS EFFECT AND BERNOULLIS PRINCIPLE:

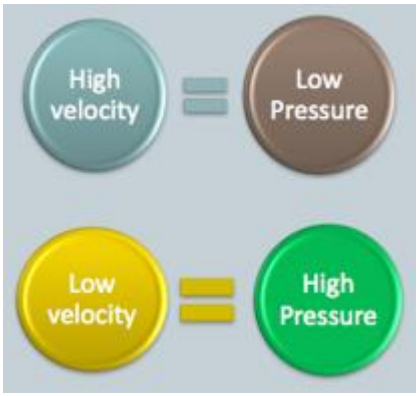
LIFT FORCES:

- Lift forces- refers to the component of force that acts perpendicular to the direction of flow
- Will act as a right angle to the direction of motion- this means it can act in both an upwards and downwards direction
- Only occurs in objects which are spinning or not perfectly symmetrical
- Lift is created by different pressures on opposite sides of an object due to fluid flow past the object
- E.g airplane wings creates lift in an upward direction to keep it in the air
- E.g racing car creates lift in a downwards direction to keep it on the ground



LIFT AND BERNOULLIS PRINCIPLE:

- Bernoulli's principle- states that velocity is inversely proportional to pressure

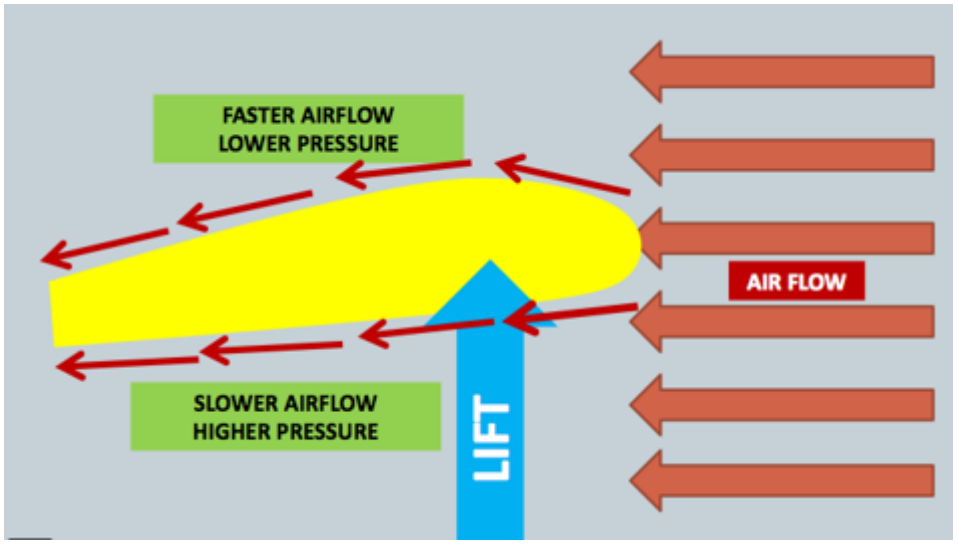


- While the spin applied and the subsequent curving effect on a ball is termed the Magnus Effect, the cause of this effect is related to the linking of air speed and pressure described by Bernoulli and Newton.

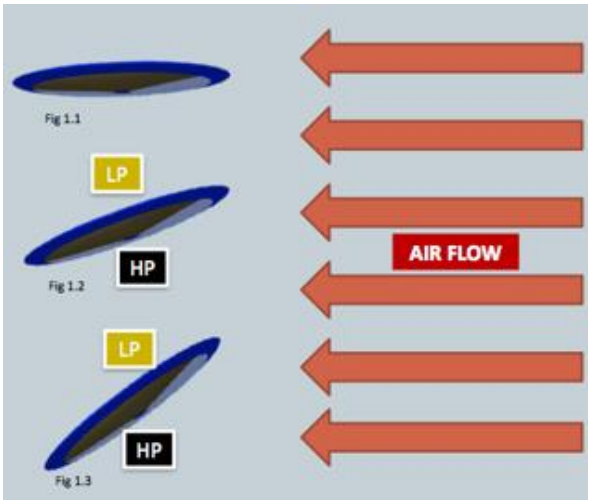
BASIC FLUID DYNAMICS:

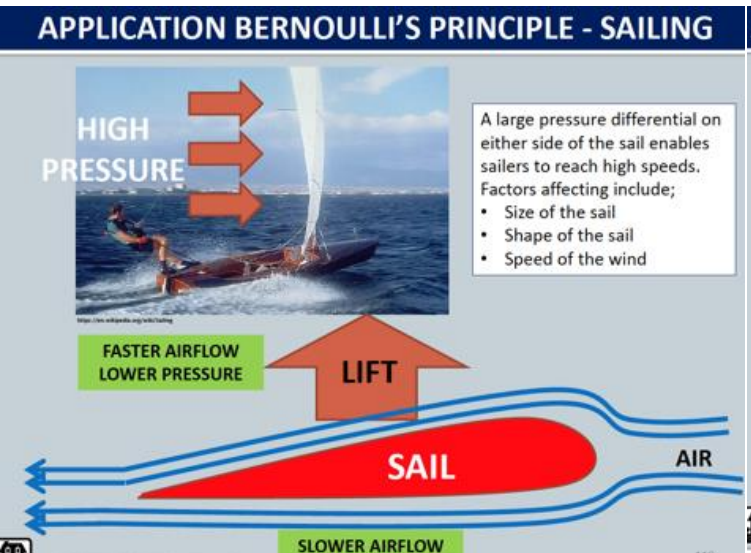
- A ball deviates in the air during various sporting activities because of uneven pressures created around the ball
- The boundary layer of air around the ball is susceptible to both the type of air flow (laminar and turbulent) and the spin of the ball (Bernoullis principal and Magnus effect)
- When a ball is not spinning the type of airflow is the key, whereas once spin is introduced the Magnus effect must also be considered.
- One must also study the speed, orientation, shape and skin of the object to fully understand the influence of air.

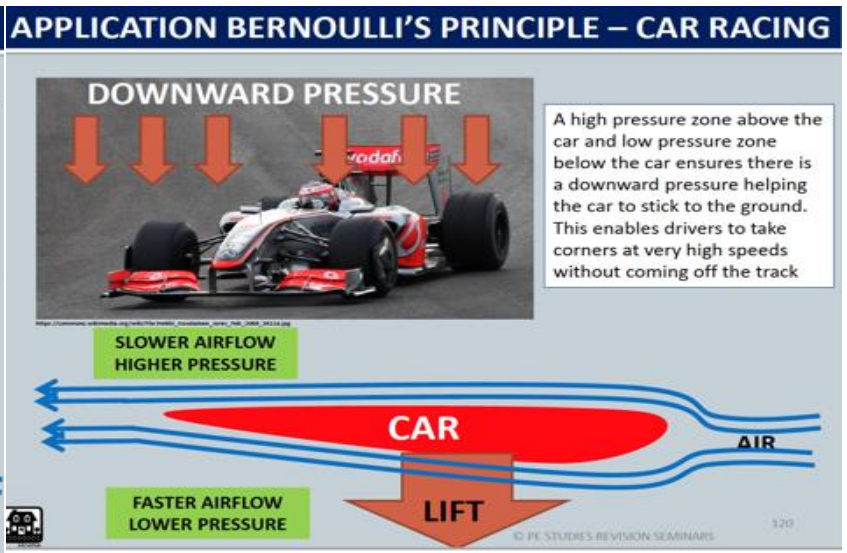
BERNOULLIS PRINCIPLE:



- Throwing a discus applies the concept of Bernoulli's principle just the same way as a an air foil on an airplane
- To maximise distance, an athlete must find the appropriate angle which will create sufficient lift whilst still presenting a relatively small CSA to help minimise drag.
- Too little angle (fig1.1) and it will not have sufficient time in the air
- Too much angle (fig1.3) and the discus will have too much lift







LIFT AND THE MAGNUS EFFECT:

- Magnus effect- term used to describe the effect of rotation on an objects path as it moves through a fluid
- It applies Bernoulli's principle to explain the effect of spin has on the trajectory or flight path of an object
- The application of spin plays an important role in determining the trajectory or flight path of an object

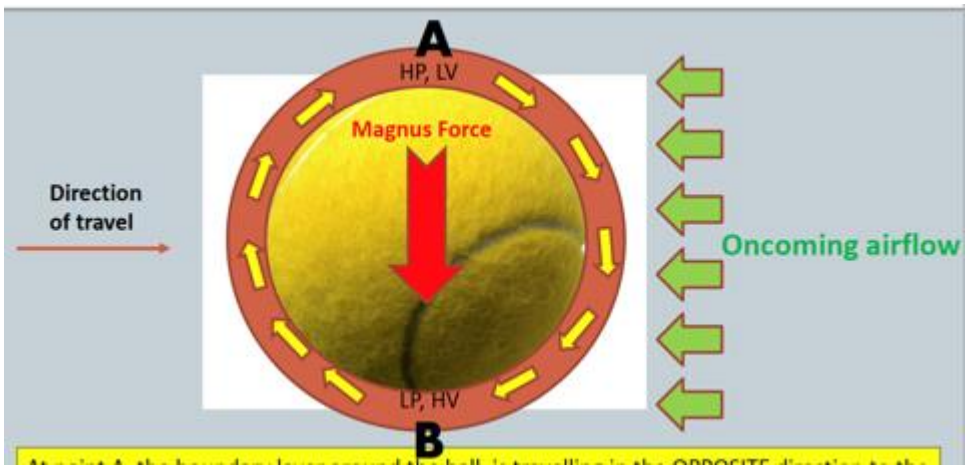
SPIN:

- When a ball is struck with an eccentric force (off centre), there is both linear and angular rotation
- The rotating ball interacts with oncoming air
- The resultant movement-curve- is refereed to as the magnus effect

TYPES OF SPIN:

- Spin affects both the flight path of a ball and the wayit bounces after amking contact with the surface
- Top spin;
- Ball drops quickly in flight
- Often used in racquet sports to increase the margin for error at the net
- Backspin;
- Spin causes the ball to stay in the air for longer giving it greater distance e.g golf
- Sidespin;
- Spin causes the ball to swerve left or right in-flight e.g free kick in soccer
- No spin;
- Application of concentric force causes the ball to move eratically through the air due to turbulent flow surrounding the ball. This can be further accentuated by the ball design

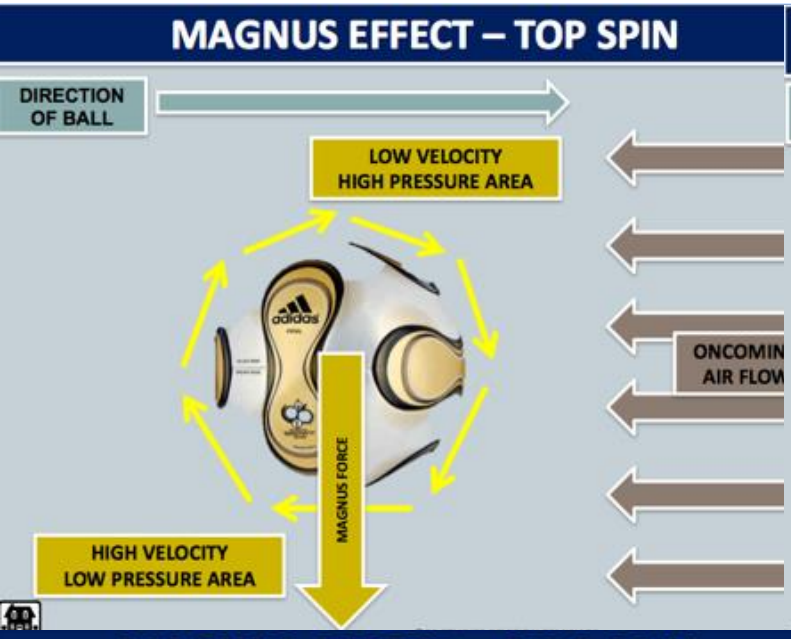
MAGNUS EFFECT- KEY CONCEPTS:

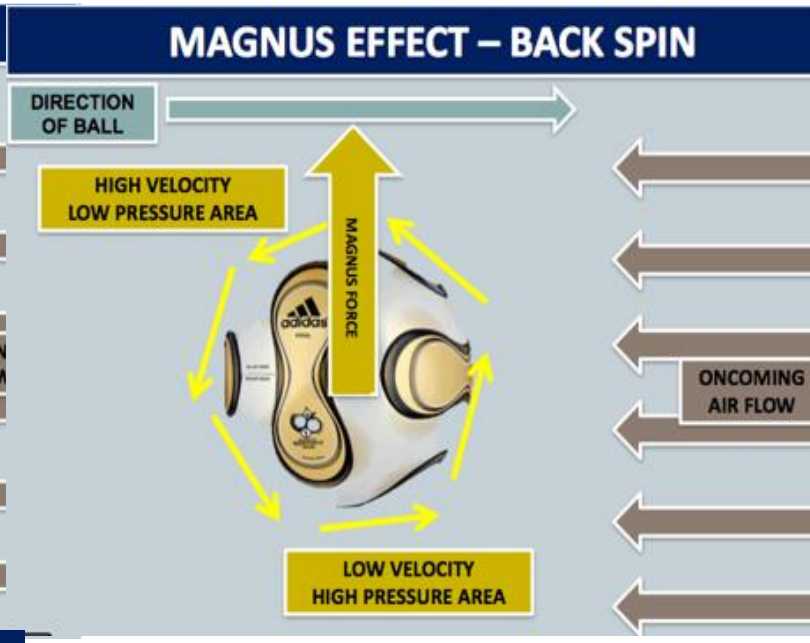


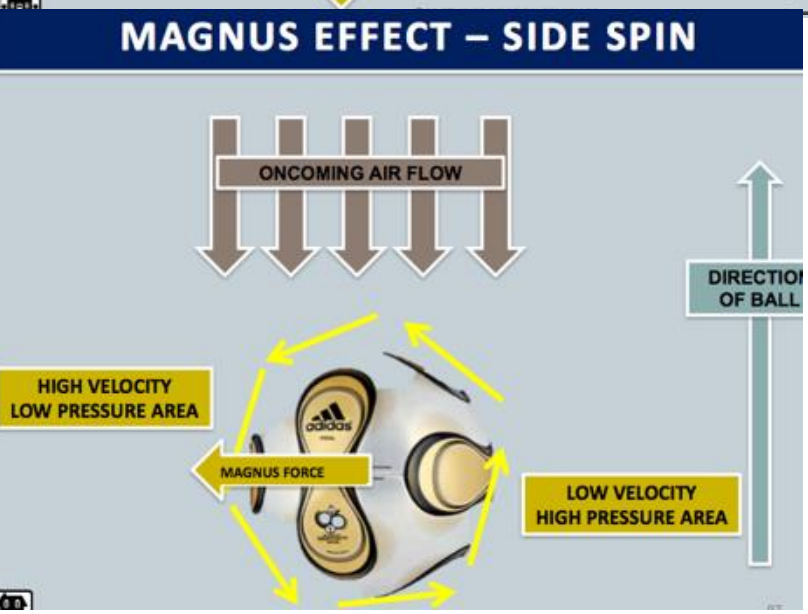
- At point A, the boundary layer around the ball is travelling in the opposite direction to the oncoming airflow resulting in a reduction in the velocity of the boundary layer. Low velocity results in an area of high pressure
- At point B, the boundary layer is travelling in the same diection as the oncoming air flow resulting in an increase in the velocity of the boundary layer and a reduction in pressure

- Objects move from areas of high pressure to areas of low pressure

ALUMAGNUS EFFECT AND TYPES OF SPIN:



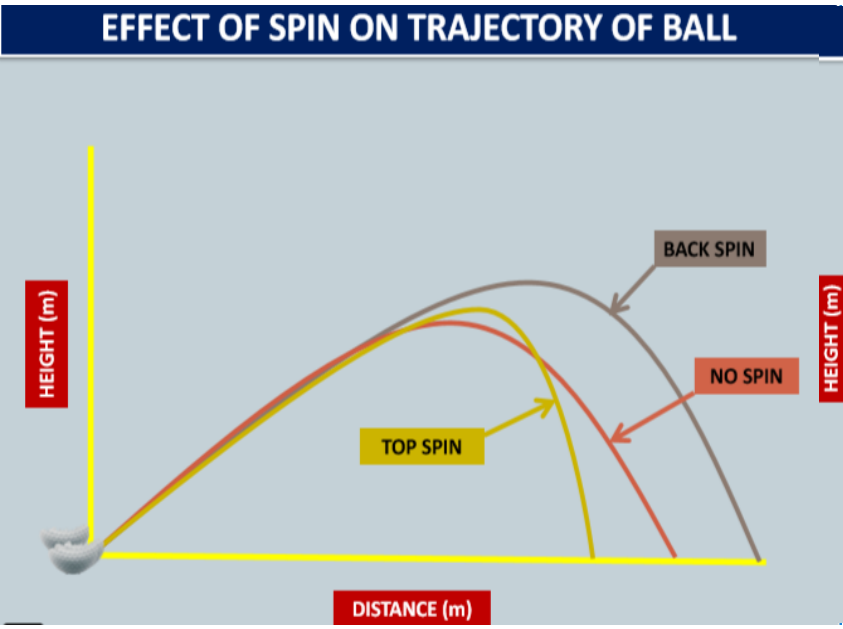


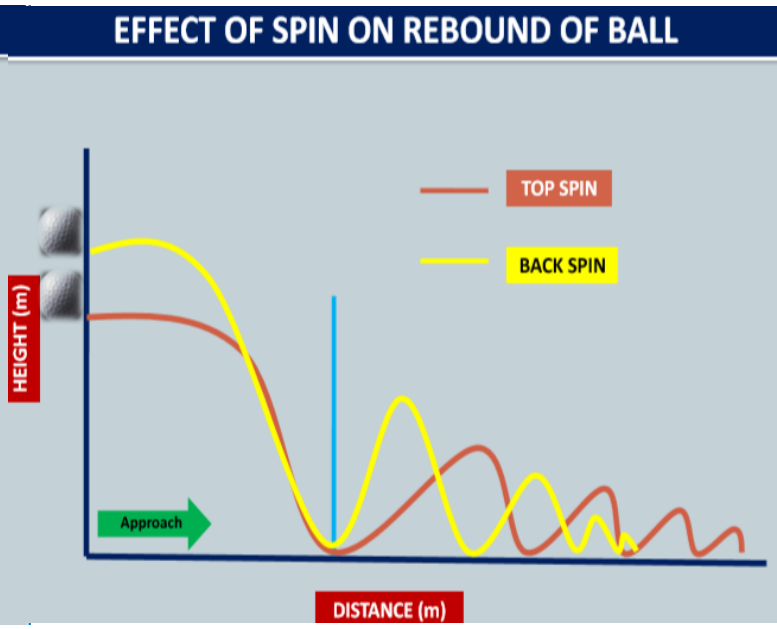


MAGNUS EFFECT- TOP SPIN TENNIS SPORT:

1. Spin occurs on the ball as a result of the application of an off centre, eccentric force
2. Bernoulli's principle indicates pressure is inversely proportional to velocity
3. The magnus effect applies to Bernoulli's principle to explain the effect spin has on an objects trajectory or flight path of an object
4. When a ball is hit with top spin, the boundary layer on top of the ball clashes with the oncoming air particles, therefore creating an area of high pressure and low velocity
5. Underneath the ball, the boundary layer of air is travelling in the same direction as oncoming air particles and therefore creates an area of high velocity

6. Objects move from an area of high pressure to low pressure and therefore the ball will be forced downwards





PRACTICAL APPLICATIONS OF SPIN IN SPORTS:

- Golf;
- Application of side spin (draw, fade) allows a player to work the ball around corners, reducing risk in gameplay
- Application of backspin allows players to attack the green, ensuring the ball approaches the flag from a steeper angle
- Tennis;
- Application of top spin allows the players to hit the ball with greater force whilst reducing risk as the ball will dip during its flight of path
- Application of back spin can be used as a defensive option, allowing the player to regain court position or as an attacking option, through use of the drop shot
- Soccer;
- The application of backspin used by players to kick the ball greater distances by increasing the amount of time the ball is in flight
- Application of side spin can also be used to score goals

Sport psychology

USING MENTAL SKILLS TO IMPROVE PERFORMANCE:

- What mental skills are we trying to maximise?
- Motivation
- Self-confidence
- Concentration
- Arousal regulation
- Stress and tension management
- What methods do we use to control / manage / improve mental skills?
- Imagery

- Self-talk
- Performance routines
- Goals setting

PERFORMANCE ROUTINE:

- Performance routine- A performance routine is a sequence of task-relevant thoughts and actions which an athlete engages in systematically prior to his or her performance of a specific sport skill. Or a performance routine is a ritual a performer follows in the preparation for or during the execution of a task or skill
- Performance routines assist with focus, concentration and arousal level of the performer. Routines decrease the chances of the performer being affected by intentional or external distractors
- Performance routines can be used, before, during, and after a performance

PERFORMANCE ROUTINE AND AROUSAL

- Athletes perform at their best when arousal levels are optimal whereas over aroused and under aroused athletes perform below optimal levels
- Performance routines can be used to increase /decrease arousal levels
- Some players increase their arousal levels before a game by following a set routine e.g find a quiet spot in the change room
- The pre-game routine varies from player to player as arousal levels are different and players use different methods to control their emotions
- Performance routines can be used to decrease arousal levels e.g listening to calming music before the game

PERFORMANCE ROUTINE AND STRESS:

- Many players suffer from stress and anxiety during a game when they are placed under pressure. Stress levels are at their highest during games and can affect the player physically and mentally
- Athletes can use performance routines to focus on the task at hand instead of worrying about possible outcomes of their actions

STRESS PROCESS:

- Stage 1 - Teacher asks you to demonstrate a skill in front of the class
- Stage 2 - This is too difficult for me (imbalance high); I have practiced this skill, I can do this (negligible imbalance)
- Stage 3 - Cognitive (worry, apprehension); Somatic (muscle tension, increased heart rate)
- Stage 4 - Over-anxious, perform poorly; control anxiousness through mental skills practice, perform the skill without error.

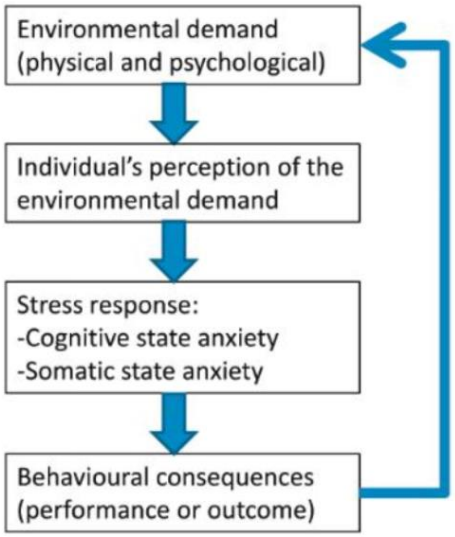


Figure 4.3: *The stress process according to McGrath (1970)*

PERFROMANCE ROUTINES AND MOTIVATION:

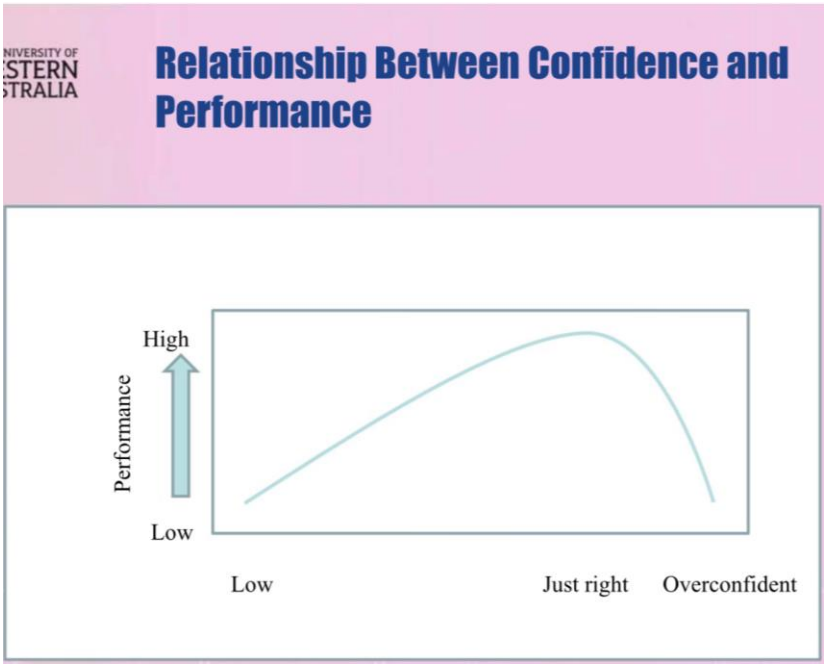
- An athletes intrinsic motivation and desire to perform well can be heightened by their game day routine (often starts the day before the game with a high carb evening)
- As part of the game day routine is completed, intrinsic motivation and excitements increases as game time gets closer

PERFORMANCE ROUTINES AND CONCENTRATION:

- Performance routines can help the athlete to focus on relevant cues in environment and ignore irrelevant cues which could detract from performance
- A routine allows the player to control their emotions and gather their thoughts and focus all their attention on performing the task required of them

PERFROMANCE ROUTINES AND SELF-CONFIDENCE:

- A self-confident athlete is more likely to perform at an optimal level than an athlete who has self-doubt
- Leading into a game, an athlete can have a routine which can include using imagery to increase self-confidence. An athlete who creates a mental image of themselves performing skills, with a successful outcome will have an increase in their self-confidence.
- Self-talk can be used prior to and during the game to increase self confidence and focus attention. Some players include self-talk in their pre-game routine



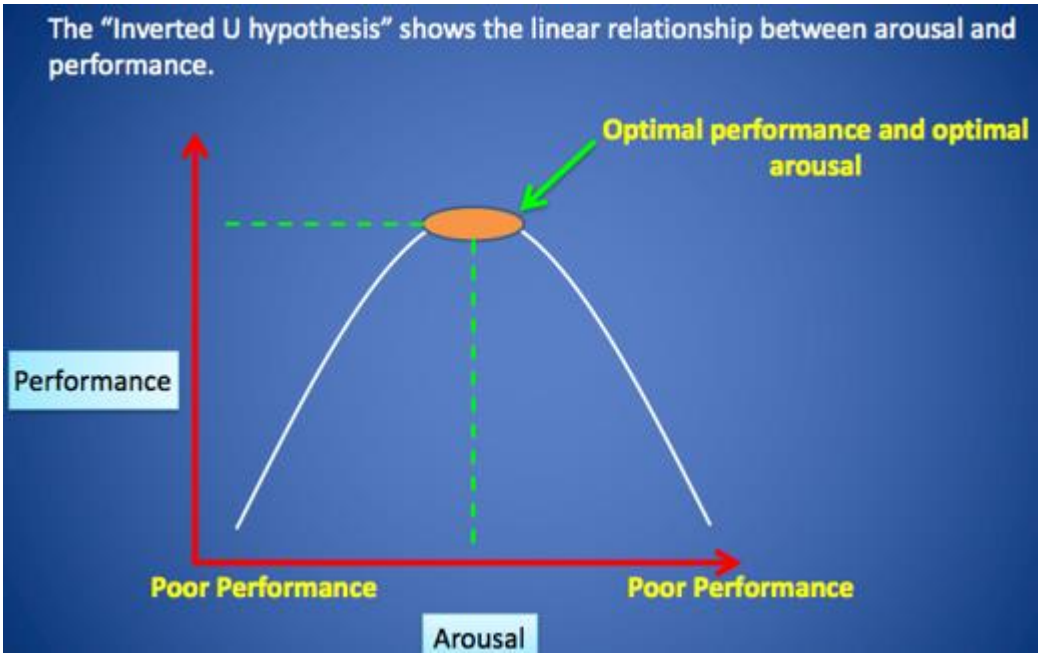
IMAGERY:

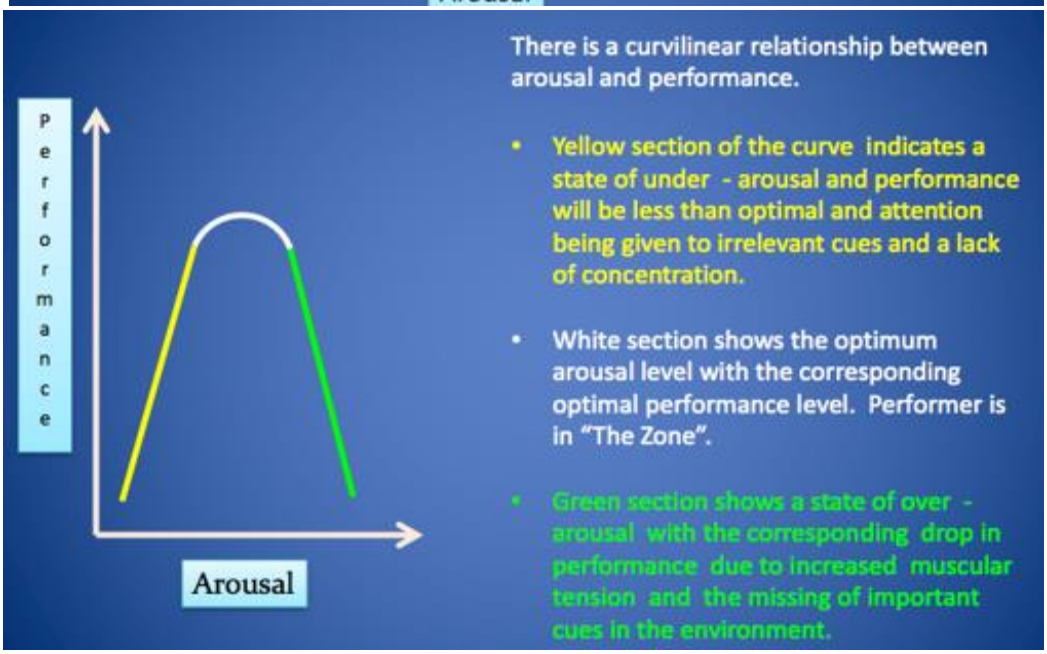
- Imagery- is the recreation of the performance, in the mind, of a skill or group of skills, a previous positive experience or the picture of new events to prepare an individual mentally for performance
- Imagery is also sometimes referred to as a visualisation although there is a difference between the two terms- imagery includes using as many body senses as possible as part of the recreation of performance, whereas visualisation is only a visual

- Imagery can be used before and during

IMAGERY AND AROUSAL:

- Athletes who are either under or over aroused do not perform at their optimal levels as these mental states can result in missing or imagining important cues in the environment and not focusing on the task at hand
- Over arousal can negatively impact on the production of physical skills
- Arousal can be increased by creating an image of an aggressive performance and decrease by creating a more relaxed image in the mind of an athlete





IMAGERY AND STRESS:

- Stress can have a positive or negative impact on performance

- Stress on highly skilled athletes can result in an improvement in performance particularly if the athlete perceives that the required performance to be a challenge they are capable of meeting
- Stress on a less skilled athlete, particularly an athlete who feels threatened by the demands of the task- perceives they are not capable of doing what is required will result in a decline in performance
- An athlete can use imagery to reduce stress by creating a mental picture of themselves performing the skill perfectly, its entirely, with desired outcome

IMAGERY AND MOTIVATION:

- Imagery can be used to motivate an athlete to strive for ongoing improvement
- E.g a state cricketer can imagine himself opening the bowling for Australia

IMAGERY AND SELF-CONFIDENCE:

- An athlete can increase their self-confidence by creating a mental picture of themselves performing the skill perfectly and achieving the desired outcome

RELAXATION:

- High levels of stress and tension have a negative impact on a performer;
- Physically it can affect coordination
- Mentally is can result in poor decision making/missing cues
- An athlete uses personal relaxation techniques to minimise the stress and tension which will result in improved performance
- Relaxation can be used before, during and after performance

METHODS USED TO PROMOTE RELAXATION:

- Meditation- helps control stress and arousal levels. It helps to lower blood pressure, heart rate and breathing rate
- Progressive muscle relaxation- reduces tension in the performer through sequentially contracting and relaxing muscle groups
- Flotation ranks- create an environment of minimal stimulation by reproducing weightlessness and removing sight and sound to reduce stress
- Music- can be used to alter arousal levels and can have a calming and relaxing effect on the performer. The type of music used varies between individuals
- Breathing techniques- can be used to promote relaxation often in conjunction with focusing and relaxing tense muscles. Slow deep breathing can help reduce tension

- Autogenic training- requires an athlete to focus on producing sensations of warmth and heaviness in specific areas of the body. This method of relaxation is quite time consuming

RELAXATION AND AROUSAL:

- Over aroused athletes do not perform at their optimal levels as they can experience difficulty shifting their attentional focus and miss important cues in the environment e.g an unmarked team mate
- Over arousal ca occur before the game and during performance and the athlete should use the most appropriate relaxation method to reduce their arousal levels

RELAXATION AND STRESS:

- Athletes can be stressed before, during and after a performance
- Stress can improve an athletes performance if the athlete perceives she has the ability to meet the demands of the situation and is challenged by the task
- If the athlete feels the demands of the situation are beyond her capabilities, her performance will drop as she feels threated by the task

RELAXATION AND MOTIVATION:

- Athletes who are very highly motivated can experience a decline in performance often associated with trying too hard to achieve their optimal performance
- Over motivated athletes can use relaxation techniques to try and control their thoughts and focus on their performance, rather than thinking about what the possible outcome of their performance might bring

RELAXATION AND CONCENTRATION:

- Sport related concentration revolves around 3 main parts aspects;
  1. Selective attention
  2. Maintaining attention
  3. Situational attention
- An athlete who loses attention or who focuses their attention on the wrong cues will under perform
- High-level performers have the ability to shift concentration quickly from broad to narrow. Over aroused performers have narrow focus, and this limits their ability to concentrate on the relevant cues in the environment
- Using relaxation techniques help the performer maintain on all relevant cues thereby improving performance

RELAXATION AND SELF-CONFIDENCE:

- Self-confidence- is the belief that a performer has in their own ability to successfully perform a desired skill or behaviour
- To produce optimal performance, an athlete must be physically and mentally at their peak. An athlete at the peak of their performance is said to be in the zone
- Athletes taper before major events and games to ensure they're both physically and mentally fresh
- Athletes who are mentally fresh and have an increase self-confidence in their ability to perform at their optimal level

SELF-TALK:

- Self-talk involves talking or thinking to yourself, prior or during performance

- 2 forms of self talk;
  1. Positive self-talk
- Can be motivational -'"I can do this"
  2. Negative self-talk
- Self-critical or demeaning- :I can't do this"
- A player must use thought stopping to stop negative thoughts, or performance will drop
- Self-talk can be used before, during and after game performance

SELF-TALK AND AROUSAL:

- Self-talk can be used to increase / decrease arousal levels
- By using motivational phases or terms, a performer can increase their arousal levels

SELF-TALK AND STRESS:

- Self-talk can be used to reduce stress during performance
- When placed in a stressful situation, the athlete can use terms such as "I have trained hard to be here, I can perform at this level'
- Athletes use terms such as relax and calm down to reduce effect of stress

SELF-TALK AND MOTIVATION:

- players who are experiencing low motivation will have a decline in their performance levels as the intensity and effort they put into training and games decreases
- Athletes can use self-talk to increase their motivation and performance

SELF-TALK AND CONCENTRATION:

- Athletes can use terms to help maintain their concentration or to change their level of concentration
- E.g a batsman in cricket might use key terms such as only the ball to remind himself to focus solely on the ball as the bowler runs

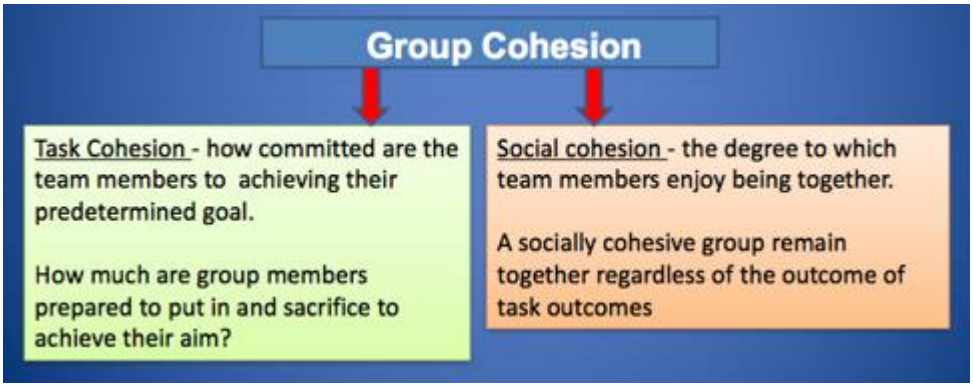
SELF-TALK AND SELF-CONFIDENCE:

- Positive self-talk increases self-confidence and the likelihood of success
- Negative self-talk decreases self-confidence

GROUP COHESION AND SOCIAL LOAFING:

GROUP CPHESION:

- Group cohesion is a term used to describe the extent to which a group stays together and united in the pursuit of the common goals and objectives
- Group cohesion has 2 components- task and social cohesion



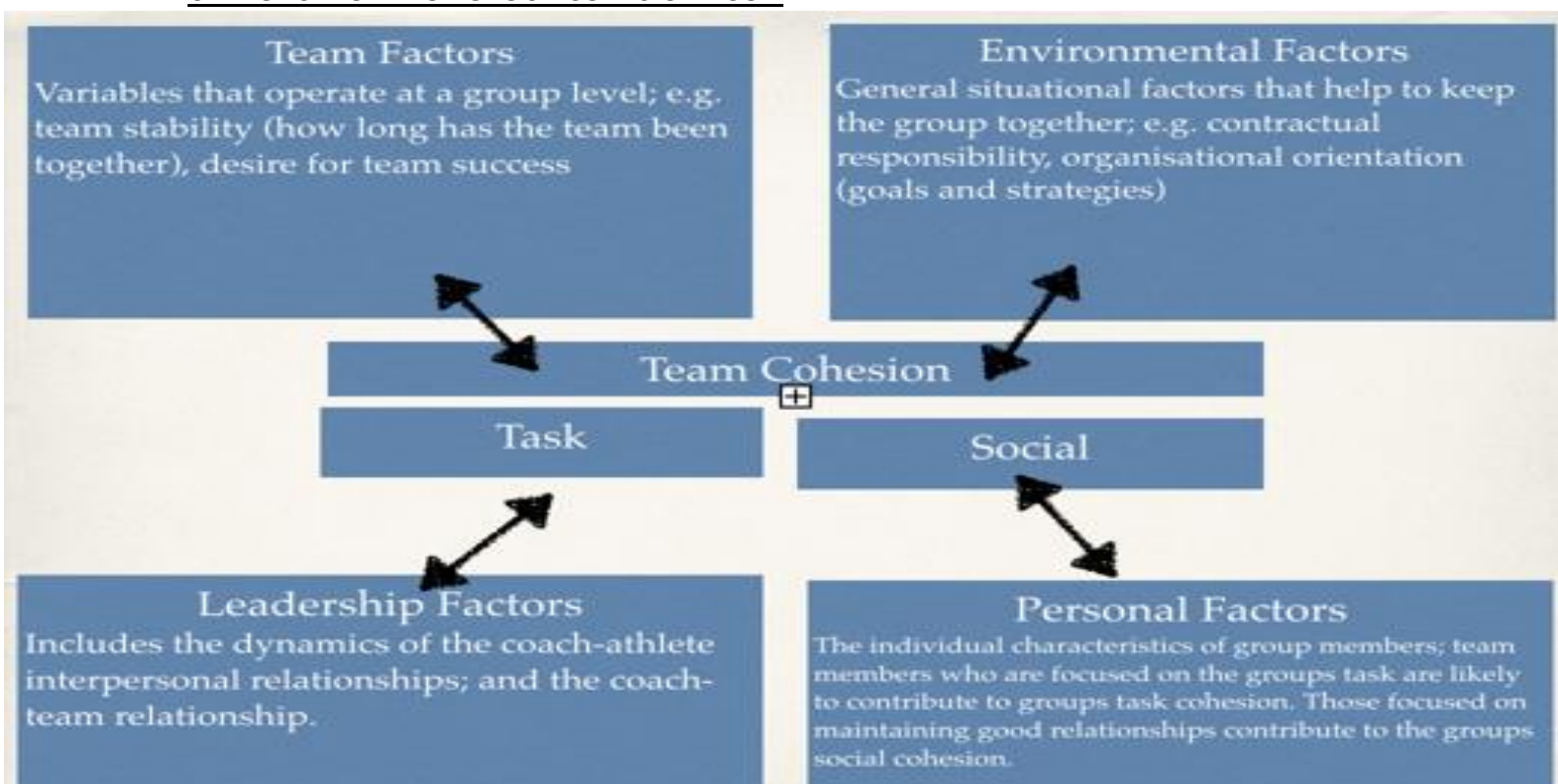
- Task and social cohesion can be independent of each other

- A highly skilled and motivated team can win even if they are not close friends, relying more on individual talents to achieve its goal
- A team in social competition and with little task cohesion can have high social cohesion if they enjoy the company of their team mates regardless of the game out come
- Cohesion can be regarded as the glue that holds people together

MEASURING COHESIVENESS IN SPORTING TEAMS:

- Cohesiveness is sporting teams can be measured in 3 ways;
  1. Sociograms;
- The players are asked to describe their interpersonal relationships within the group- who they like and dislike and a sociogram is developed from the responses. Coach can use them to try and improve cohesiveness within the team
  2. Questionnaires/self-reports;
- Group environment questionnaire which recognised that group cohesion was multi-dimensional and requires 18 responses covering 4 dimensions of cohesion. The responses cover the dimensions of
  - Group integration- task: perception of the group regarding degree of task orientation
  - Group integration- social: perceptions of the group on what needs to be done socially
  - Individual attractions in the group- task: individual perception of group task orientation
  - Individual attractions in the group-social: perception of the group as a social unit
- As the questionnaire covers 4 distinct dimensions, the coach is able to be more specific in interpreting the results and more specific in addressing a problem are
  3. Observation;
- A coach can use a checklist to observe how players in a group relate to each other, who they mix with, who they avoid, who they interact with. However, its not a valid method of assessment of group cohesiveness as it is dependant on players displaying their normal behaviour rather than what they consider the coach wants to see

CARRONS MODEL OF GROUP COHESION-1982:



FACTORS AFFECTING COHESION:

- Albert Carron (1982) developed a model which describes the 4 key factors that affect team cohesion. They are;
    1. Environmental factors
    2. Personal factors
    3. Leadership factors
    4. Team factors

ENVIRONMETAL FACTORS:

- These are the normative forces which hold a group together;
- Contracts
- Age
- Family/significant other expectations
- Geographical limitations
- Group size

PERSONAL FACTORS:

- Refers to the individual characteristics of group members, such as participation motives
- Players participate for 3 main reasons;
    1. Task motivation- associated with task cohesion and being involved in a successful team "I want to play in a team that can win"
    2. Affiliation motivation- associated with social cohesion and desire to be apart of a group
    3. Self-motivation- attempt to obtain personal satisfaction through improving personal performance
- A major personal factor affecting task and social cohesion is the individual satisfaction felt by each team member. This is more likely to occur if all the players have similar;

- Attitudes
- Goals
- Level of commitment
- expectations

LEADERSHIP FACTORS:

- good leadership is a key factor in developing a cohesive team
- the most appropriate style of leadership is used
- good leaders will set;

- team goals
- individual roles
- team rules
- standards of behaviour

- leaders must be consistent with their player and have a clear communication
- compatibility between the players and the leaders is essential in developing task cohesion

TEAM FACTORS:

- these factors include;
- stability
- the length of time the team has been together
- prior success and failures
- the type of sport being played- team /individual
- team norms for productivity
- the demands of the task also impact on interaction and cohesiveness, there are 3 levels of communication

1. co-acting activities

- there is little or no communication between players and the result is determined by tallying individual scores-e.g team surfing, golf, darts
- good results can achieve even with little communication between players

2. interacting activities

- require a high level of interaction between team members if the team is to achieve its goal
- ball games such as hockey, netball, rugby and football are interactive as they all require all players to communicate continuously if optimum performance is to be achieved
- high levels of communication are required

3. mixed activities

- have a combination of co-acting and interacting activities
- using cricket as an example;
- the only requisite communication on the batting team is that the two players currently batting communicate- the other 9 players in the team do not interact with them(other than calling out). The bowler is also able to bowl with limited communication with his team mates

COHESION AND PERFORMANCE:

- some teams are more cohesive than others and this contributes towards higher levels of enjoyment and satisfaction and an increased likelihood of team staying together

OTHER FACTORS IMPACTING ON COHESION:

- group size- depending on the sport being played, there is an optimal group size. if group becomes too big, its cohesiveness can decrease and social loafing can occur
- leadership- strong leadership improves group cohesion. weak leaders decreases cohesion. “attitude reflects leadership”

SOCIAL LOAFING:

THE IMPACT OF SOCIAL LOAFING ON INDIVIDUAL TEAM PERFORMANCE:

- individual athletes are prone to social loafing if they feel the team can still perform well without a maximum contribution from them- particularly in sports where everyone does the same thing
- social loafing by athletes in teams high in self- confidence. The individual athlete perceives the team will win even without every player performing at their best and consequently puts in less effort

- in both cases above, the individual and team performance is below optimum
- individual effort towards the team performance increases where each players input is identifiable and consequently individual and team performance improves
- social loafing has a negative impact on individual and team performance

HOW CAN SOCIAL LOAFING BE MINIMISED?

1. Write a team contract which states;
- Group expectations
- Individual responsibilities
- Forms of communication
- Methods of discipline
2. Develop rules of conduct;
- Establish rules expected behaviour which will help the team achieve goals and objectives
3. Create appropriate group sizes;
- Assigning too many members to an easy task encourages loafing
4. Evaluate all members of a group individually;
- Members will be more productive if they know that their individual contribution will be evaluated

DEVELOPING TASK COHESION:

- Task cohesion can be developed by;
- Communicating clearly and regularly so all members understand their roles and responsibilities
- Having a clear and understood expectations / norms
- Making clear what each clear individual must do in order for team to achieve its goals
- Developing pride within subunits-defence, midfield, attack
- Set challenging but realistic goals for the team as a whole and for individual players-players are involved in this process
- Being fair and consistent in dealing with the players and group
- Prioritise team goals over individual goals
- Promote high levels of motivation
- Have regular team meetings- provides an opportunity for players to voice their opinion

DEVELOPING SOCIAL COHESION:

- Social cohesion can be developed by;
- Encouraging social interaction away from the sport
- Maintain open and honest communication
- Resolve conflicts quickly
- Do team building activities
- Establish team standards of presentation
- Develop trust and respect within the group
- Develop informal roles within groups

STRATEGIES TO IMPROVE GROUP COHESION:

- Coach and leader behaviour can play a significant role in the development of team cohesion, including;
- Explain individual roles in tea, success
- Set challenging group goals
- Encourage group identity
- Avoid excessive team member turnover
- Know the team climate
- What group members can do

BARRIERS TO GROUP COHESION:

- Personality clashes between members
- Unclear/conflicting roles among group members
- Frequent changes to the group
- Disagreement on group objectives
- Lack of communication
- Power struggle between players

BENEFITS OF GROUP COHESION:

- Communication and motivation within group is extensive
- Increased feeling of the group as a whole rather than as individuals
- Players work together to achieve team goals ahead of personal
- Payers enjoy each other's successes
- A group that has high level of group cohesiveness is much more successful in achieving their goal
- The members in groups that are cohesive are much more satisfied with that group and are willing to stay in the group longer and when things are not going well

PEAKING:

- Peaking- the achievement of optimal performance at the appropriate time in training plan or term used to describe temporary training state which allows athlete to perform at their optimal performance level
- Happens when a well thought out annual plan

TAPERING:

- Tapering- reduction in training load prior to competition or decreasing the volume of training whilst maintaining or increasing intensity, an athlete does to allow the body time to recover from stresses placed on them during training
- Power athletes require 10-21 days (speed and power are supressed with intense periods of high volume training)
- Endurance athlete 7-10 days
- Peaking/tapering aims to prepare an athlete to be injury free, physically and mentally fresh
- Physically- taper period should be long enough to allow repair to tissue damaged during training and the re-fuelling of energy stores
- Mentally- the aim of a taper is to help the athlete reach their ideal performance state

STRATEGIES USED TO TAPER:

- Reduce training volume and maintain or increase training intensity to a level greater than, or equal to competition activity
- Increase use of recovery techniques between sessions to improve quality of recovery
- Monitoring diet to ensure athlete has adequate glycogen stores
- Individualise the program to ensure athletes needs are met

RECOVERY:

- During recovery the body adapts and over compensates to get training effect, if adequate recovery between each session is not allowed the athlete will become progressively more tired and fatigued resulting in decreased performance

TYPES OF RECOVERIES:

- Massage- believed to enhance the removal of waste products and decrease muscle soreness and swelling post exercise.
- Cool down- helps reduce muscle soreness and aid recovery (active recovery)
- Rest
- hydrotherapy
- Compression garments- may enhance the action of the venous muscular pump and reduce muscle soreness
- Cold water immersion- typically involves immersion of body in cold water <15 degress for 10-20mins after exercise to reduce blood flow, muscle spasms and inflammation
- Warm water immersion- may involve immersing body in warm water >37degrees for 10-20 mins which increases body temp and blood flow
- Contrast water therapy- athlete alternates between hot and cold water, reduces swelling, inflammation due to pumping action caused by blood vessels as they relax and constrict
- Stretching

3 MAIN TYPES RECOVERIES:

1. Nutritional
2. Physical
3. Psychological

OVERTRAINING:

- Overtraining- the result of an imbalance between training load and recovery which is characterised by; lack of energy, muscle aches, impaired performance, lack of enthusiasm, increased risk of injury
- Develops gradually and may go unnoticed for a considerable time period as it is often confused with a performance slump
- Risk of overtraining may be reduced by allowing 24-48hrs of recovery between heavy sessions and ensure adequate rest, sleep and nutrition

PREVENTIONS OF OVERTRAINING:

- Well planned training program
- Regular rest
- Keep hydrated
- Reduce training load

INJURIES:

- Athletes who obtain a soft tissue injury should;

- Increase protein intake to assist muscle repair and maintain carbohydrates if the injury does not reduce activity
- Increase protein intake and decrease carbohydrate intake if injury results in reduced activity levels otherwise weight gain may result
- Critical that athlete minimises amount of detraining that occurs during injury phase
- Cross training is effective
- Athletes must be both physiologically and psychologically ready before returning to the comp

MAINTENANCE:

- Fitness levels are sustained

Motor learning and coaching

TRANSFER OF LEARNING:

TRANSFER OF LEARNING:

- Transfer of learning- transfer of learning is the effect that a past experiences have on the learning of a new skill
- There are two factors which contributes towards transfer of learning:

1. There is a similarity in the physical skills required between 2 sports- the greater the similarity, the greater the amount of transfer, e.g serving in volleyball and throwing a cricket ball have similar techniques

2. Skills that require a particular type of cognitive processing transfer to skills with similar cognitive processing e.g if an athlete plays a game which requires a fats decision making skills to be performed in confined space, there will be a transfer of learning if they learn a new sport with similar cognitive demands.

- There is a transfer between sports where there is a similarity in tactics and strategies e.g field sports such as hockey and soccer have the same number of players, same aim, similar strategies etc

CATEGORIES OF TRANSFER OF LEARNING:

1. Skill to skill- when a skill previously developed in one sport has an influence on the learning of a skill in another sport.

- Occurs because of similar mechanics or technical aspects between the two skills. The influence can be:
- Positive (previous skill makes the learning of a new skill easier)
- Negative (previous skill makes the new skill harder)

2. Theory to practice- the transfer of theoretical skills into practice or performance scenario

- Coach explains, possibly with the use of a diagram, why different golf clubs produce different angles of release, different carry distances, different length of the ball rolling. Player then practices with different clubs understanding why each club hits a certain distance
- Coaches explains game tactics and strategies for opposing teams and individual players. Players then practice the identified tactics and strategies.
- Can also include developing specific strategies to deal with various game specific scenarios

3. Training to competition-refers to the transfer of skills developed at training into a competition situation

- Coaches must plan and implement training sessions which replicate the demands of the game and specifically the development of appropriate skills and energy systems

- Players should be exposed to game specific situations at training to allow them to develop their information processing and decision making mechanism
- Training should replicate the same conditions e.g space/intensity/pressure as the players will experience during a game which will increase the likelihood of players making the correct decisions when under game pressure

PROACTIVE TRANSFER OF LEARNING:

- Proactive transfer of learning- a previously learnt skill affects the skill currently being learnt e.g a player learning to throw a javelin would pic up the skill faster if he already knew how to throw a cricket ball/baseball
- Proactive transfer of learning can be positive when the previously learned skill helps with the learning of a new skill
- Proactive transfer of learning can be negative when a previously learned skill makes learning a new skill more difficult due to critical differences between the two sports e.g badminton/tennis

RETROACTIVE TRANSFER OF LEARNING:

- Retroactive transfer of learning- learning a new skill affects a previously learned skill e.g a netballer with poor footwork spends the off season playing touch rugby where she spends time working on a fast -feet ladder which then improves her footwork in netball

1. Negative retroactive transfer:
- An elite swimmer takes up water polo during the off season
- The swimming stroke in water polo is different to swimming
- A season of water polo can have a negative affect on his already learned swimming stroke

2. Positive retroactive transfer:
- A netballer practising her fast feet on the ladder for the games

EFFECTS OF TRANSFER OF LEARNING:

- 3 effects of transfer of learning:
  1. Positive transfer of learning-occurs when skills and/or information gained from a previous learning experience helps learning of a new skill
- Netball and basketball shots are often similar in some way. E.g free throw in basketball and netball goal shooting have similar cognitive demands
- There is a positive transfer of learning between aerial skiing, trampolining and gymnastics

  2. Negative transfer of learning- occurs when the learning from a previously learned skill negatively impacts on the learning of a new skill
- The skills can seemingly have similar action but there are critical differences in technique e.g squash and tennis are both racquet sports but with critical differences;

- Shot making in squash involves wrist movement
- Shot making in tennis does not involve wrist movement

3. Zero transfer of learning- occurs when the learning of a new skill is not affected either positively or negatively by previously learned skills

- There is no transfer of learning between golf and afl as the skills are completely different physically and cognitively

MOVEMENT ANALYSIS:

MOVEMENT ANALYSIS:

- Coaches analyse the performance of an athlete to determine;
  1. What the athlete is doing right
  2. What the athlete is doing wrong and limits performance
  3. What key aspects of the performance need attention
  4. When training activities are needed to rectify faults
  5. To track the athletes progress
- The coach and the athlete use the information gathered to improve future performance

3 FORMATS FOR ANALYSING PERFORMANCE:

1. Laboratory testing:
- Performance analysed in laboratory conditions so that various factors can be varied or manipulated
- Computerised analysis can be used
- Cameras can be very close for better observation

2. Field testing:
- An athletes performance is analysed at training in normal surroundings e.g the underwater observation of the pull phase in swimming stroke can be observed during the course of a training session

3. Competition analysis:
- An athlete is analysed while performing during competition

2 METHODS OF MOVEMENT ANALYSIS:

1. Quantitative analysis:
- uses numbers- body skin folds, blood lactate levels, angle and speed of release, instantaneous velocity, acceleration rate
- qualitive analysis is objective

2. Qualitive analysis:
- Refers to a description/analysis of the movement without using numbers

- A systematic approach of qualitative analysis is the Knudsen morrison model of skill analysis which is a 5 stage process aimed at analysing, then improving performance
- Qualitative analysis is subjective (based on opinion of observer)
- E.g good, short, poor, heavy

KNUDSEN-MORRISON MODEL OF QUALATATIVE ANALYSIS:

1. Preparation stage- coach is concerned with the process of developing a prerequisite knowledge base about a particular skill

- Coach must know the points of technique required to produce the skill correctly
- A checklist should be made up outlining key points of technique prior to analysis;

1. Preparation: to perform the skill

- Includes all movements that prepare the athlete for the performance of the skill
- Includes grip, runup, stance, backswing

2. Execution: of the skill

- Begins when preparation ends and finishes at point of contact/release of ball

3. Follow through: after execution phase

- Refers to all the movements after the execution

2. Observation stage- observation includes the systematic gathering of information about the performance or movement

- What is the best angle to observe the skill
- Direct observation or video
- Observe / record several trials to get more accurate results on the checklist
- How close to the subject are you going to be

3. Evaluation stage- identify the strengths and weaknesses of the performer, prioritise in order of importance of correction and identify methods which can be used to improve performance

- Mark off a checklist
- List weaknesses in order of priority of correction
- Determine which methods can be used to rectify and identify weaknesses
- Large changes to technique need a longer time to rectify and may be done during the off season
- Technical flaws which do not impact on performance may not always be addressed

4. Intervention stage – involves providing feedback and corrections to the performer, usually under practice conditions, to improve performance

- Coach explains what errors are occurring and why, describes what drills and activities should be done to address these identified problems
- Feedback has 3 main functions;

1. To motivate the performer:

- A coach can provide feedback which motivates the performer to re-assure the performer that progress is happening
- Motivational feedback must be realistic

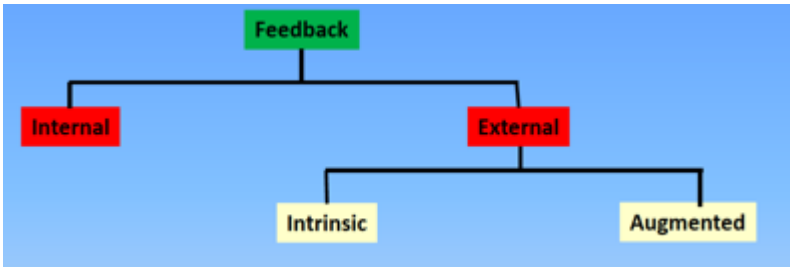
2. To change the performer:

- Feedback given to the performer aimed at changing the current level of performance
- It is information provided to the performer on what needs to be changed for future attempts
- Positive feedback should be included in the feedback as should dome words of encouragement

3. To reinforce learning:

- Feedback can be used to reinforce learning or performance which increases the chances of the behaviour being repeated

INTERNAL AND EXTERNAL FEEDBACK:



- Internal feedback refers to the information the performer receives from within the body about how the skill felt e.g a performer receives information via his sensory / kinaesthetic system that he is not balanced at the point of the skill execution and he makes the necessary adjustments to change this
- External feedback is the information received from outside the body and is received via sensory system- usually seen, felt or heard
- External feedback is to improve performance can be;

1. Intrinsic- a performer detects information as soon as a direct result of their actions e.g the performer sees her shot at a goal miss to one side of the target
2. Augmented- additional feedback about the performance provided by an external source, usually the coach

EXTERNAL INTRINSIC FEEDBACK:

- Feedback is received by the athlete as a result of their own performance through the senses of sight, sound, touch
- E.g golfer sees the ball, hears a good clean contact

EXTERNAL AUGMENTED FEEDBACK:

- During the intervention phase, the coach looks to provide the performer with different cues aimed at improving the identified problem

1. Visual cues- allows learners see what the movement requires

- Coach demonstrates the correct technique
- May involve showing performer what he is doing
- Coach emphasises 3-4 key points of technique for player to concentrate on

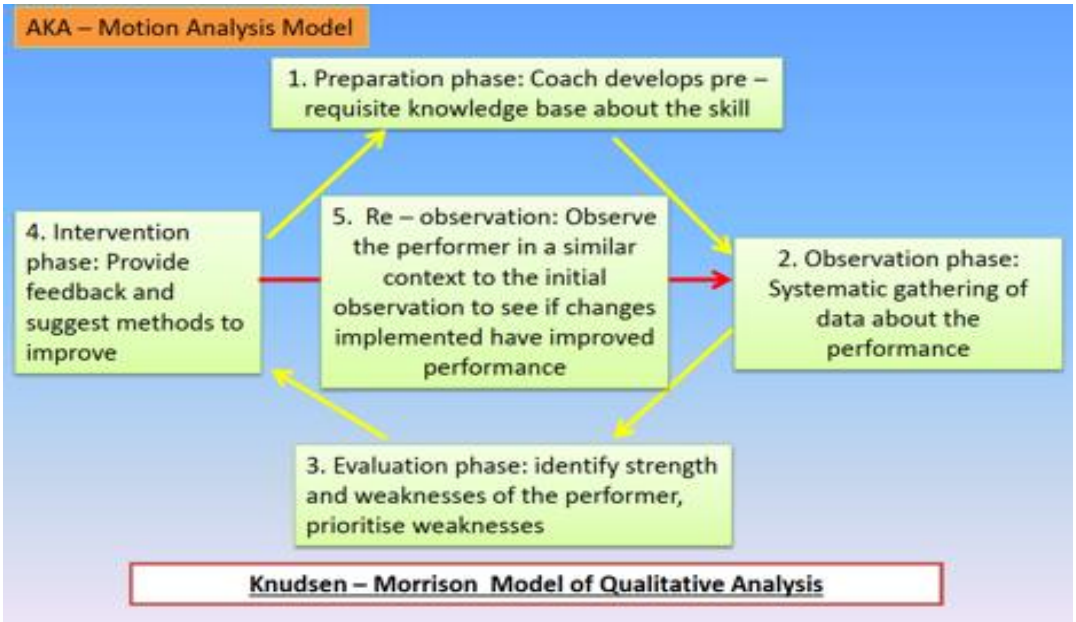
- May include video feedback

2. Verbal cues- coach provides verbal cues that performer can use to improve;
- Single words or short phrases e.g gooseneck in basketball

3. Proprioceptive cues
- Coach physically moves/adjusts the performer through the desired movement patterns to make them aware of how the movement should feel

4. Written cues
- the coach provides written feedback to the performer about the strength and weaknesses of the performance and details ways to improve future performances

5. re-observation stage- observe the performer in a similar context to the initial observation phase to see if changes implemented have improved performance
- did they make a difference and improve performance or is further intervention needed?



IMPROVING PERFROMANCE:

COMPLEXITY OF A SKILL:

- The complexity of a skill can be defined by several factors, including;

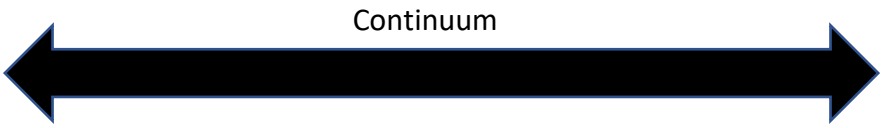
1. The no. of component parts involved in performing the skills
2. The amount of attention or information processing required to perform the skills
3. The required level of movement accuracy
4. How quickly the task needs to be performed

SIMPLE AND COMPLEX SKILLS:

- Simple skill- has few components and low demand on attention.
- Complex skill- has a large number of components and demand a lot of attentional resources.

1. The complexity of a skill can be defined by a number of factors, including;
2. The number of component parts involved in performing the skill
3. The amount of attention or information processing required to perform the skill
4. The required level of movement accuracy
5. How quickly the task needs to be performed

- A coach can adopt a number of strategies when coaching or training individuals to acquire complex motor skills.



SHAPING A MOTOR SKILL:

- When a simplified or incomplete version of a skill are rehearsed initially before missing components are gradually added
- Helps the performer to perform the basic skills
- Shaping motor skills are used to;

1. Demonstrating and/or explaining a skill
2. Practise a simplified version of the task
3. Make corrections and adjustments and then allowing further practise before adding missing components

- When shaping the simplified parts of the skills do not have be precise to the original skill

CHAINING A MOTOR SKILL:

- Broken down into components that are rehearsed separately (isolated skills)
- Over time put the isolated skills together to perform the whole skill
- Important which order to practise isolated skills
    1. Forward chaining- in order in which the skill is performed
    2. Backward chaining- last component is performed first and building whole skill backwards.

WHATS THE DIFFERENCE BETWEEN SHAPING AND CHAINING:

- When chaining a motor skill, the order of practising components of the skill is important.
- When shaping a motor skill, the order of the rehearsed components is less important.
- When chaining a motor skill, replication of movement components of the skill is important.
- When shaping a motor skill, replication of the movement components of the skill is not important.

SHAPING AND CHAINING- AN EXAMPLE OF TRANSFER OF LEARNING:

Transfer of learning- positive, negative or zero

- Shaping- Teaches/ coaches use shaping method by demonstrating and explaining the skill-- getting athlete to practice a simple version of task- to then allow for corrections before moving on , E.g. swimming- practicing exaggerated version of high elbow lift

- Chaining- Skill is broken down into components that are rehearsed separately (isolated skills), Over time components put together to complete task E.g. hockey- drag flick/ learning foot work first, then stick movement and angles

Simple skill **Complex skill**

- Principles of shaping and chaining skills take advantage or positive transfer or learning

- from simplified learning and allowing corrections/ adjustments to be made) then allow for further progress, more components can then be employed to ensure the whole skill can be rehearsed
- Idea is that- simplified component will have a positive transfer

SIMPLIFYING COMPLEX MOTOR SKILLS:

- When simplifying a motor skill the difficulty of a certain aspect of task reduced
- Number of ways a coach can simplify a motor skill, e.g a child learning to hit a foam ball can use oversized plastic bat to make it easier to hit the ball and make up for kids lack of coordination
- Shaping and chaining motor skills are methods that a coach can utilise to assist a learners performing of a complex skill breaking down the skill into simplified component

BREAKING DOWNMOTOR SKILLS:

- Large motor skills can broken down into different components which each individual skill could be practiced then put together to perform the motor skill
- However, this doesn't apply to all motor skills some are better to be practiced as a complete skill

- Motor skills that are high in complexity and low in organisation can be broken down into component part to be practiced separately
- Motor skills that are low in complexity and high in organisation are best practiced as a complete skill

THE DECISION TO BREAK DOWN A MOTOR SKILL:

- General principals in determining whether or not a skill can be broken down to be chained or shaped are:
- Motor skills that are high in complexity and low in organisation can be broken down into component parts to be practiced individually
- Motor skills that are low in complexity and high in organisation are best practiced as a complete skill and not broken down.

STATIC AND DYNAMIC DRILLS:

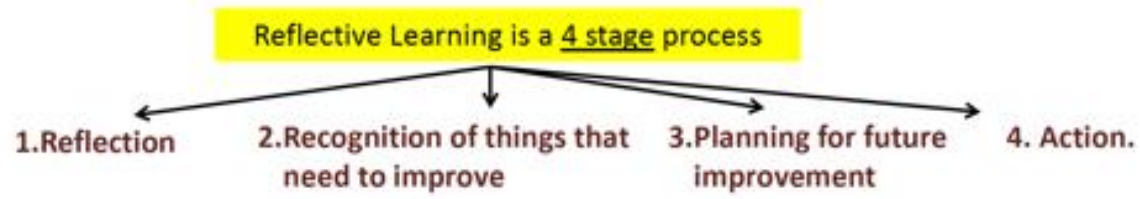
- Refers to whether individual is in motion – travelling forwards, backwards or sideways during a drill.
- Static drill: requires athlete to stay on same spot during performance of motor skill
- Dynamic drill: performed whilst athlete is in some form of locomotion
- Coach may choose to use static drill because: they are particularly useful; for learners in cognitive phase of learning, they assist by simplifying skill since they reduce attentional demands (reducing task complexity by limiting actions required), and they often reduce cognitive processing demands such as decision making and the need to respond to other stimuli
- Static drills can reinforce what coach is trying to enforce by allowing learner to hold points of the technique that coach is referring to
- In gymnastics coach may use static drill to familiarise gymnasts with the key positions that are apart of the skill before progressing to dynamic performance that incorporates the positions. This will also increase confidence of the gymnast and reduce risk of injury

REFLECTIVE LEARNING:

INCREASING PERFORMANCE LEVELS AND REFLECTIVE LEARNING:

- Increasing the optimal performance level of an athlete requires the athlete or coach to;
  1. Gather information about each performance
  2. Identify strengths and weakness of that performance
  3. Determine what factors limited the performance
- Once analysis is done, the athlete and coach determine what actions need to be taken to improve future performances. The intention is to guide the athlete from their current level of performance to their ideal performance.
- This method of self-analysis and planning is called reflective learning
- A reflective learner recognises the importance of looking back on past experiences to improve future performances

REFLECTIVE LEARNING PROCESS:



- Methods of reflection;
  1. Reflective journals
  2. Peer/mentor feedback
  3. Video analysis
  4. Questionnaires
  5. Checklists
- The reflective learner solves problems through self-evaluation and reflection. Reflective learning is only meaningful when the athlete can use it to make change

STAGES OF LEARNING PROCESS:

Stage 1- reflection

*5 methods used to reflect on performance:

1. video analysis;
- visual analysis of your own performance
- visual feedback of changes in performance
- self-evaluation used with checklists
- comparison with elite performer
2. mentoring;
- a significant other in the life of an athlete, the mentor provides critical and constructive feedback to help the performer continue to improve
- young players often relate better to a mentor that the coach
3. reflective journals;
- used to record feelings/emotions
- keeps a record of failure and successes
- coach/athlete suggestions for improvement
4. questionnaires;
- are given to players to gather information about individual players, the leadership, potential leaders
5. checklists;
- the athletes use checklists, statistics and observation schedules

stage 2-recognition of things to improve

- as a result of self-reflection on a performance, an athlete can determine what aspects of the performance could have been done better, or could be improved to enhance future performances

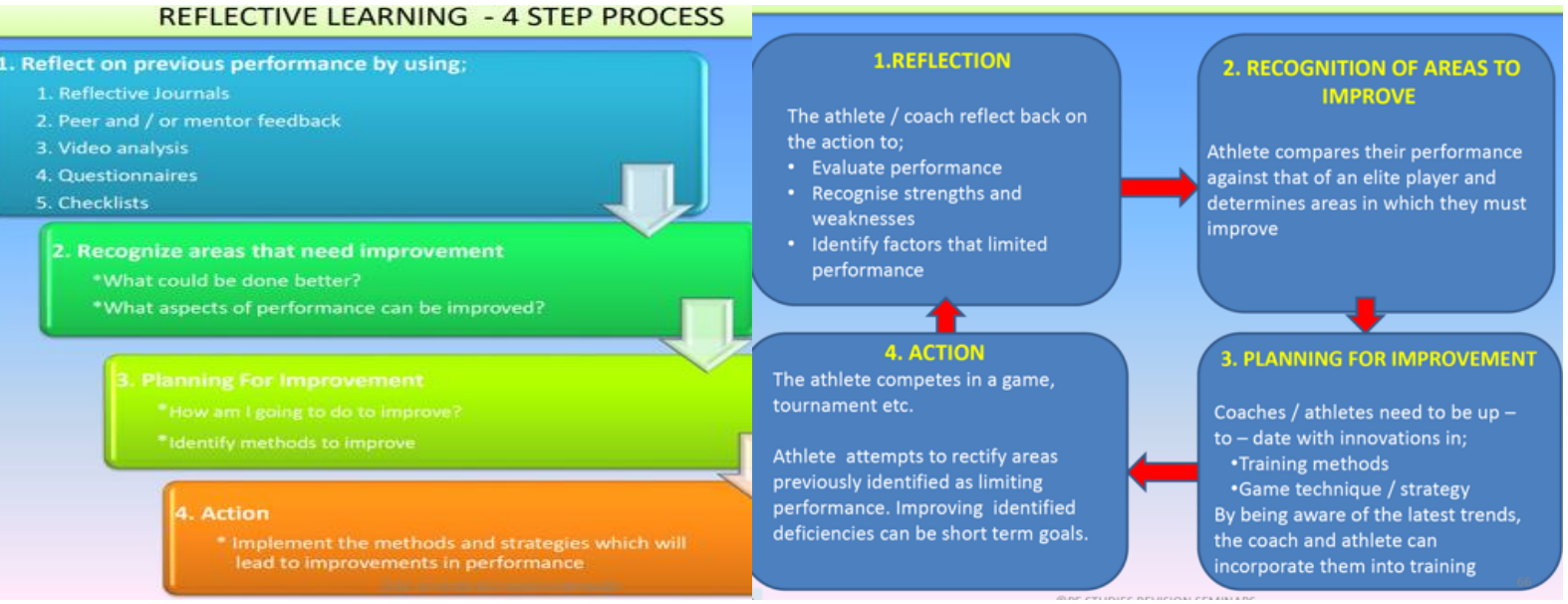
- gathering data about performances, and then recognising things to improve, has become more accurate with the latest technology

stage 3-planning for improvement

- it is important players and coaches are aware of, and can implement, the latest advancements in their sport. If they do not, they will not perform at their optimal levels as they will be using outdated methods

stage4- action

- action is the product of the reflective process e.g the batsman implements his strategies of extra training against the type of bowler that has been dismissing him
- having identified weakness, the athlete sets goals to address the areas identified as



LEADERSHIP STYLES:

COACHING/LEADERSHIP STYLES:

- coaches use different styles of coaching to get their message across to the players the coaching style use is dependant and influenced by;
- personality of the coach
- motivation to the performer
- the phase of the season
- experience of the players
- specific situation the coach is in

there are 3 coaching styles:

1. authoritarian/autocratic
2. democratic/co-operative
3. laissez faire/casual

AUTHORITARIAN COACH:

- tends to make all the decisions
- very strict style of coaching

- coach believes he has the knowledge and experience to impart on the players
- role of players is attended to
- less confident players are intimidated
- effective when team is winning/less effective when team is losing

characteristics:

- intense energy
- well organised
- demands attention by the players
- punish those who make mistakes
- winning is the only goal
- confrontational when challenged

suits:

- athletes who need direction and focus
- athletes who value extrinsic motivation
- athletes who want to know where they stand
- young athletes that are learning the game
- when safety is a concern

does not suit:

- athletes who want input in decision making
- athletes who want to do their own thing
- athletes who have an opinion

<u>DEMOCRATIC COACH:</u>

- maintains open communication with players
- players involved in decision making
- players feel they have a degree of ownership of the team
- positive and negative feedback used to reinforce learning
- very good for inexperienced players
- enjoyment is important
- liked by players
- may not provide enough motivation for some performers

characteristics:

- tends to be very flexible
- strives to create an atmosphere of mutual respect
- concerned for the welfare of the players

suits:

- experienced athletes who want input in decision making
- athletes who are intrinsically motivated
- athletes who want to create their own solutions to problems
- when there are plenty of time available for decisions to be made

does not suit:

- athletes who need direction
- athletes who are intensely focused and do not want input from other team members

LAISSEZ FAIRE:

- relaxed and easy going who establishes an informal learning environment
- no pressure on the players to perform
- tends to be less organised and prepared
- works best with experienced players who can make their own decisions
- offers guidance and advice when asked
- limited improvement
- inexperience players unsure of what to do
- serious players often find this style of coaching unsatisfactory

characteristics:

- provides little instruction and minimal guidance in organising activities
- creates relaxed atmosphere, there's lack of general direction
- coach exerts little influence on the players

suit:

- athletes who value extrinsic motivation
- athletes who want to learn, improve performance and win