HSC P.D./H./P.E.

Core 2 - Factors Affecting Performance

Summary

Energy:

- Energy is provided by the bonds occurring in the molecule *adenosine triphosphate (ATP)*.
- Energy is an invisible force.
- Chemical energy is stored in the intermolecular bonds of molecules.
  - Released through chemical reactions.
  - Provide energy for body to use.

Types of energy:

- Kinetic.
  - Moving energy.
- Chemical.
  - Energy stored in chemical bonds.
- Potential.
  - Stored energy.
- Mechanical.
  - Energy used to move by us.

Energy in foods:

- Carbohydrates (CHO):
  - 4.2 calories per gram.
- Fats:
  - 9.4 calories per gram.
- Protein:
  - 4.2 calories per gram.

***Note:** 1 calories = 4.4 kilojoules (KJ).

Energy use:

Activity	KJ/H
Sleep	240
Walk	1200
Cycling	1250
Swimming	2100
Jogging	3500

Energy creation:

- All energy created by ATP.
  - Through the process of ATP splitting.
    - Phosphate molecule split off ATP.
      - Creates free phosphate + *adenosine diphosphate (ADP)* + mechanical energy.
    - Creatine phosphate (CP) molecule splits to provide energy to *resynthesise* ATP.
      - Phosphate + ADP + Energy → ATP.

- Glucose/glycogen broken down to ATP through *glycolysis*.
  - Aerobic glycolysis (with oxygen).
    - Breakdown of glucose in the presence of oxygen.
      - Forms ATP.
    - Forms pyruvic acid.
      - Non toxic.
  - Anaerobic glycolysis (no oxygen).
    - Glycogen broken down in the absence of oxygen.
      - Forms ATP.
    - Toxic lactic acid formed.

Energy Systems:

- **Anaerobic:**
  - **ATP-PC (Alactacid system):**

- Provides *anaerobic energy* (without oxygen)
- How it provides energy:
  - Splitting of ATP molecule provides explosive, maximal burst of energy.
  - CP then used to resynthesise ATP molecules for further bursts of energy.
- Intensity:
  - Maximum.
- Duration:
  - One explosive movement.
    - ATP (Approx 90g in body):
      - 1-2 seconds.
    - CP (Approx 120g in body):
      - 10-12 seconds.
- Fuel source:
  - CP provides energy to resynthesise ATP.
  - Mechanical energy released by ATP stored in muscles.

- By-products:
  - ADP (non-toxic).
  - Heat produced during muscular contractions.
- Fatigue occurs when ATP & CP depleted.
  - Inability to continue to resynthesise ADP to ATP using CP.
  - CP stores quickly depleted.
- Recovery:

- 2-3 minutes, athlete able to repeat maximal effort.

- Efficiency:
  - Makes ATP readily available whether oxygen available or not.
  - Rapid supply of ATP due to high conc. of CP in cells.
    - Approx 5x greater.
  - ATP supply limited in sustained maximal work.
    - System can replenish very quickly.

Eg. Discus, long jump, weightlifting, 100m sprint.

- **Lactic Acid System:**

- Provides anaerobic energy (without oxygen).
- How it provides energy:
  - Provides energy after ATP-CP system exhausted.
  - When insufficient O_2 supplied for aerobic system to function.
    - Takes time to circulate O_2 from lungs to muscles (around 2mins).
  - Uses glucose in blood & glycogen in muscles.
    - Blood sugar = glucose.
    - Stored sugar = glycogen.
  - Converts glucose & glycogen to ATP through glycolysis.
    - Glycogen supply greater than CP, used with/without O_2.

- Intensity:
  - Moderate - high.
- Duration:
  - Up to around 3 minutes @ 70-80% MHR.
    - 10-30 seconds maximal effort.
    - Up to 3 minutes near maximal effort.
- Fuel source:

- Glucose.
  - Circulates in blood.
- Glycogen.
  - stored glucose.
  - In muscles, blood.
- Glucose quickly converted to ATP through *anaerobic glycolysis*.
  - Breakdown of glycogen in *absence of oxygen*.

- <u>By-products:</u>
  - Lactic acid (toxic) (pyruvic acid that doesn't receive sufficient O_2).
    - Acidification of muscle fibres;
      - Inhibits enzyme action in muscles creating glycogen.
    - Prevents muscle contraction.
  - Created during anaerobic glycolysis due to insufficient oxygen, resulting in partial breakdown of glucose.
  - Accumulates in blood, preventing diffusion from muscles.

- <u>Recovery:</u>
  - Up to 90 minutes.
  - Allows for restoration of glycogen to muscles, glucose to blood.
  - Lactic acid converted to pyruvic acid @ liver.
    - Can be re-used as fuel later on.
- <u>Efficiency:</u>
  - Anaerobic glycolysis provides quick, *limited* supply of ATP.
    - Due to production & accumulation of lactic acid.
  - ATP available at a cost.
  - 180g glycogen produces 3moles ATP.

Eg. 200m sprint, 400m & 800m run, acceleration in a game, sprint to

finish in endurance event.

- **Aerobic System:**

- Provides energy in the presence of oxygen.
- How it provides energy:
  - Breakdown of glycogen in the presence of oxygen.
    - Aerobic glycolysis.
- Intensity:
  - Low -moderate.
- Duration:
  - Dependent on;
    - Fuel stores.
    - Environmental factors:
      - Stress.
      - Heat.
      - Humidity.
      - Hydration level.
  - Body holds approx 350g glycogen.
    = 12hrs rest.
    = 1hr hard work.
    = 4-6hrs intermittent exercise (football, squash, tennis etc.).
    = 2hrs marathon runners.
  - Body has virtually unlimited supply of fat.
    - Used when glycogen depleted.
    - Well trained athlete:
      - Body will mix CHO & fat metabolism
        - *Glycogen sparing*.
        - Some fat used, glycogen available at end of event (more efficient release of energy).

- Fatigue not caused by lack of fuel.
    - Other environmental factors contribute to fatigue.
    - Lack of glycogen/glucose.
        - Fats very inefficient.
            - Produce excessive heat.
        - *Hitting the wall* refers to switching from glycogen to fats.
            - Increases body temp, rate of respiration.
- Fuel source:
    - 1st: CHO (glycogen, glucose).
    - 2nd: Fats (free fatty acids, triglycerides.)
    - 3rd: Protein.
- Each broken down to ATP through aerobic glycolysis.
- Production of ATP unlimited.

- By-products:
    - CO_2, H_2O.
        - Both non-toxic.
        - CO_2 removed through lungs.
        - H_2O used in cellular processes.
    - Pyruvic acid produced through aerobic glycolysis.
- Recovery:
    - Depending on event duration & intensity, 24+ hours.
- Efficiency:
    - Metabolism of fuel extremely efficient.
    - Produces 139moles ATP from 180g glycogen.
    - Allows sustained work for longer periods of time.

Summary of The Energy Systems					
	Fuel Used	**O_2 Requirements**	**Duration**	**ATP Production**	**Egs.**
ATP-CP	Creatine phosphate	Nil	10-15 seconds	Very limited	100m sprint Discus Long jump Weightlifting
Lactic acid system	Glucose/glycogen	Nil	3 minutes	Limited	200m sprint 400m,800m run Acceleration Sprint to finish
Aerobic system	CHOs, fats, protein	Required	Endurance events	Unlimited	1500m Marathon Aerobics Walking

Comparison of Energy Systems		
ATP-CP System	**Lactic Acid System**	**Aerobic System**
Anaerobic Maximum intensity 10secs Fuel: CP Very limited ATP 3mins recovery	Anaerobic High intensity 15+secs Glycogen Limited ATP 90mins recovery	Anaerobic Low intensity 3mins+ Glycogen, fats, protein Unlimited ATP 24+hrs recovery

Principles of Training:

- Progressive overload:
  - Adaptations will only occur when training load is greater than normal & progressively increased as improvements occur.
  - Used to improve all aspects of fitness.
  - As fitness / performance increases, body adapts to load as normal.
  - Load on energy systems / muscles increased to reach maximum results.
  - Load:
    - Intensity.
    - Time.
    - Resistance.
    - Frequency.
    - Distance.
  - If load is too small / too great:
    - Adaptations will not occur / body will become fatigued.

  - **Eg.**
    - Aerobic system:
      - Heart will pump more blood to muscles.
        - Increased C.O.
      - Muscles able to take up more oxygen delivered to them.
        - Increased VO_2 Max.
    - Strength training:
      - Increased cross-sectional area of muscle.
        - Hypertrophy.
      - Increased strength.
    - Flexibility training:
      - Ability to stretch further than normal length.
  - The most important training principle.

- No overload = no improvement.
- Not all adaptations take place at an = rate.

- Specificity:
  - *You get what you train for.*
  - Success of program closely related to how specific training is to performance.
  - Specific to muscle groups used, predominant energy system/s.
  - Greatest gains made when training resembles performance.
  - Metabolic specificity:
    - Identifying dominant energy system/s → developing them.

- Thresholds - the training effect:
  - Thresholds:
    - Specific point, when passed take performer to a new level.
  - Minimum efforts required for an improvement in fitness.
  - *Aerobic threshold*:
    - Lowest intensity required to improve fitness.
    - Intensity required to raise h.r., improve body's ability to use O_2.
    - Aerobic fitness only gained above aerobic threshold (approx 60% MHR).
  - Anaerobic threshold (approx 70%> MHR).
    - Point at which sufficient oxygen cannot be supplied, body produces energy anaerobically.
  - Aerobic training zone:
    - Area between aerobic threshold & anaerobic threshold.
    - Steady state exercise.
    - Improvements will occur.

Reversibility - the detraining effect:

- If training ceased, benefits lost.
  - Fast gain = fast loss.
  - Slow gain = slow loss.

- Variety:
  - To prevent boredom / loss of motivation, range of training activities, environments used.
  - Follow intense activities with relaxation / low intensity activities / rest.

- Warm-up / Cool-down:
  - *Warm-up*:
    - 1st part of training session / performance.
    - Increase body, muscle temp.
    - Stimulate C.R. system.
    - Mentally prepare, realise environment factors prior to performance.
    - Gross motor → Stretching → Callisthenics → Skill rehearsal.
  - *Cool-down*:
    - Last part of training session / performance.
    - Return body temp to normal.
    - Remove accumulated lactate.
    - Gross motor movements → Stretching.
  - Performance improved using warm-up & cool-down.
  - → less fatigued at end of session.
  - Reduces risk of soft tissue injury.
  - Preparation to perform physically, psychologically.
  - *Sweat before you stretch.*

Types of Training:

- Why do people train?:
  - Improve performance.
  - Decrease risk of injury.
  - Improved quality of life.
  - Personal gains.
  - Social benefits.
  - General health.
  - Develop tactics.
  - Develop skill.
  - Develop team work.

- Types of training:
  - Aerobic training.
  - Strength training.
  - Flexibility training.
  - Skills.

- Aerobic Training:
  - Uses aerobic system as dominant energy pathway.
  - Athlete must work in training zone to benefit.
  - Must follow the F.I.T.T. principle.
  - Pre-screening is recommended.
    - Includes:
      - Continuous training.
      - Fartlek training.
      - Interval training.
      - Circuit training.
      - Aerobics.

  - *Continuous training:*

- Sustained effort.
  - Effort without rest intervals.
  - Continued for minimum 20mins.
- H.R. must be above aerobic threshold, remain in training zone for entire session.
- 2 types:
  - Long, slow distance training.
    - Improve general condition.
    - Work between 60-80% MHR.
    - Focus on distance rather than speed.
  - High intensity work, moderate duration.
    - Athlete works at 80-90% of MHR.
    - Working at or near competition pace.
    - Essential for developing leg speed.

- *Fartlek training:*
  - Speed play.
- Athlete varies speed & terrain.
  - Utilising different energy systems.
- Aerobic system dominant energy supplier.
  - Due to continuous nature.
- Frequent bursts of speed use anaerobic system.

- *Interval training:*
- Alternating sessions of work / recovery.
- Develops aerobic & anaerobic systems.
- Player works for specified time, rests for specified time.
  - Repeated numerous times.
- Allows performer to work hard, avoids fatigue.
  - Recovery period.
  - Intensity is related to length of work interval.

- Overload principle easily applied.
  - Work intensity.
  - Work time.
  - Number of reps.
  - Work / rest ratio.
- Can be used to develop components other than endurance.
  - Work / rest intervals & type of activity manipulated.

- *Circuit training:*
  - Participant completes a battery of activities for specified time/reps @ specified intensity.
  - Produces minimal aerobic capacity improvements.
  - Usual aim is to complete in shortest amount of time.
  - Can be aerobic / anaerobic depending on activities.

- *Aerobics:*
  - Performed to music.
  - Can improve flexibility, strength & C.V. fitness.

- **<u>Strength Training</u>**:
  - 3 types of programs:
    - Isotonic.
      - Use weights to force eccentric / concentric contraction of muscle.
    - Isometric.
      - Use exercises that apply resistance without change to muscle length.
    - Isokinetic.
      - Use machines that provide constant load, muscle length changes through full range of movement.

- *Strength training used for*;
  - Developing strength / speed / power.
  - Aesthetics (lean body mass).
  - Rehab (usually isometric.
    - Body building.
- *Strength gains only occur when*;
  - Overload principle used.
    - Loaded beyond normal load.
  - Exercise specific.
    - Resemble task training for.
  - Progressive resistance.
    - Load increased as adaptations occur.
- *4 types of strength*:
  - Absolute.
    - Max force generated by a muscle.
  - Relative.
    - Max force generated by a muscle, relative to body mass.
  - Muscular endurance (strength endurance).
    - Ability of muscle to withstand fatigue.
  - Power (elastic strength / speed strength).
    - Ability to generate force at a rapid rate.

- Terms:
  - Repetitions.
    - Number of times exercise repeated without rest.
  - Repetitions maximum (RM).
    - Maximum weight that can be lifted a specified number of times.
  - Set.
    - Number of repetitions performed in succession.
  - Resistance.
    - Load applied.

- *The Development of Absolute Strength:*
  - Frequency.
    - 2-4 sessions per week.
  - Sets.
    - 1-3 sets per muscle group.
  - Repetitions.
    - 4-10 per set.
  - Resistance.
    - Sufficient to fatigue muscles.
    - 4-6RM most beneficial.
  - Exercise speed.
    - Slow / moderate.
  - Number of exercises.
    - 8-10, focussing on major muscle groups.
  - Effectiveness of program dependent on:
    - Frequency.
      - How often.
    - Volume.
      - Amount of work.
    - Mode.
      - How muscle fibres are stressed.
        - Free weights vs. isokinetic machines.
        - Isotonic vs. isometric exercises.
        - Concentric contractions vs. eccentric contractions.
    - Free weights more specific to requirements of most sports.
  - *Development of Muscular Endurance:*
    - Endurance requires muscle group to work repeatedly over a period of time.
    - Moderate intensity.
      - Require greater number of reps (10-25RM / set) & sets (approx 3).
      - Approx 3 times/week.

- Number of reps needs to be related to performance.
- When appropriate strength is developed, muscular endurance can be increased.

- *Development of Power:*
  - Specificity is important to effectively develop power.
    - Velocity specificity required.
      - Speed of practice related to speed of performance.
    - Quality power programs used to develop power (**Complex training**):
      - Heavy resistance used (80-85% of 1RM).
      - Followed by plyometric activities (forceful activities).
        - Jumping.
        - Throwing
        - Medicine ball work.
      - Provide significantly greater gains compared to other training methods.
      - Programs that develop strength will also develop power.
        - When sufficient strength is achieved, power should be the focus.

- **Flexibility**:

- Aimed at increasing length of muscles.
- *2 types*:
  - Static.
    - Stationary.
  - Dynamic.
    - Moving.
- *Essential for*:
  - Prevention of soft tissue injury.
  - Improve coordination between muscle groups.
  - Muscular relaxation.

- Decreasing soreness / tightness.
- Increase range of joint mobility.

- Affected by:
  - Age.
    - Muscles shorten & tighten with age.
  - Gender.
    - Females more flexible than males.
  - Temperature.
    - Increased temp → increased flexibility.
  - Exercise.
    - Frequent exercise → increased flexibility.
  - Specificity.
    - Flexibility is joint specific.
- *3 types of stretching*.
  - Static.
    - Isotonic contraction.
    - Muscle slowly stretched to end point, held for 15-30secs.
    - Safest method of stretching.
    - Used in warm-up, cool-down, rehab.
  - Ballistic.
    - Dynamic stretching.
      - Rapid movement.
    - Activates stretch reflex.
      - Involuntary muscle contraction.
      - Prevents muscle fibre damage from lengthening beyond range.
    - Should only be used by trained athletes, after static stretching.
    - Should be executed rhythmically.

  - Proprioceptive neuromuscular facilitation (PNF):

- Developed by physiotherapists in 1960s.
- Effective in muscle rehab.
- Lengthening of muscle against a resistance.
- Incorporates static stretching, strength development from isometric contractions & relaxation periods.
- Process:
  - Muscle group requiring stretching determined.
  - Stretched using static (isotonic) contraction.
  - Isometric contraction occurs while in the stretched position.
    - Held for 6-8secs.
  - Relaxes in lengthened position for 5secs.
  - Process repeated.
- Isometric contractions strengthen muscle.
- Important part of warm-up / cool-down.

The Basis of Aerobic Training:

- Must be sustained long enough to ensure that oxygen system is dominant energy pathway.
  - Usually long duration, moderate intensity.
  - Aims to increase strength & efficiency of C.V, respiratory system.

- <u>Pre-screening</u>.
  - Aerobic training stresses physiological capacities.
  - Creates health risk to unconditioned systems.
    - Cause health problems, injury.
  - People at risk should be pre-screened prior to commencing aerobic activity.
    - Especially:
      - Males 40+.
      - Females 50+.

- Asthmatics.
- Smokers.
- Hypertension.
- Poor family health history.

- Less risk in being pre-screened & exercising than not exercising.
- Benefits:
  - Provides beginners with basis for program.
  - Makes people aware of their limits.
  - Provide info about health status.
  - Provide medical records.
- Will specify:
  - Frequency.
  - Intensity.
  - Duration.
  - Type.

- <u>The F.I.T.T. Formula</u>.
  - Ensures program has quality & quantity to produce gains in fitness & health.
  - *Frequency:*
    - How often.
    - Seeking to improve fitness:
      - 3-4 times per week.
    - Endurance athletes:
      - Up to 6 times per week.
    - Aerobic training:
      - Exercise daily.
  - *Intensity:*
    - How hard.
      - In terms of:
        - H.R.

- Lactate conc.
- O_2 uptake.

- Beneficial when above 70% MHR (in aerobic training zone).
- Beginners & the elderly should begin at 60%MHR.
- Training below aerobic threshold will not improve fitness, may result in health gains.
- 85-90% of MHR considered maximum intensity (anaerobic threshold).
- Lactate begins to accumulate at this point.
- Intensity must increase as adaptations occur.
- Apply overload principle.

- *Time:*
- Duration of training session.
- Must be sustained longer than 20mins above 70%MHR.
- Best results achieved after 30-60mins sustained activity.

- *Type:*
- Activity must be dominantly aerobic.

- Physiological Responses To Training:

- Occur in specific body organs & tissues during exercise.

Immediate		**Long term (10-12 weeks)**
	Heart Rate	
- Increases. - Working muscles require more oxygen. - *Working heart rate* increases according to	Number of times the heart beats each minute.	- R.H.R. decreases. - Stronger heart. - Larger heart. - More efficient.

intensity & type of activity.		
	Stroke Volume	
- Increases. - More blood to muscles.	Volume of blood pumped out of the left ventricle with each beat. Difference between fit & unfit performer significant. (160mLs/beat:60mLs/beat)	- Increases. - Heart beats less often. - Larger, stronger. - Pumps out more blood with each beat.
	Cardiac Output	
- Increases. - More blood to working muscles. - Heart rate is increased.	Volume of blood pumped out of the left ventricle every minute.	- Little to no change. - Equal blood pumped out at rest, more efficiently.
	Lactate Levels	
- Increases. - Product of anaerobic glycolysis. - During low intensity work remains low.		- Lactate threshold increased. - Sustain higher intensity for longer.
	Ventilation Rate	
- Increases. - More O_2 required to fuel working muscles. - CO_2 needs to be removed.	Rate of inspiration & expiration.	- Increased lung capacity during exercise. - No real change, less is required for equal amount of work.
	O_2 Uptake	
- Increases.		- VO_2 Maxis increased.

- V.R. increases, muscles require more O_2.		
	Blood Pressure	
- Increases. - Blood pumped faster → increased pressure.		- Decreases. - Increased arterial elasticity.
	Lung Capacity	
- Minimal increases. - Deeper breathing.		- Relatively unchanged. - Small increase @ max intensity.
	Haemoglobin	
- Remains unchanged. - Not an immediate response.		- Increases. - More r.b.cs. to carry more O_2 to muscles.
	Muscles	
- Increased O_2 uptake. - Require more for respiration to release energy.		- More efficient at using O_2. - Hypertrophy in slow (red) twitch fibres.

Psychology of Performance:

- The psychology of performance has been a rising topic in recent times.
  - Few people see the value in it.
  - Values and improvements now coming to light.
  - Training must involve physical & mental preparation for optimal performance to be achieved.

- Motivation:
  - An internal state which activates, directs & sustains behaviour towards achieving a particular goal.
  - The driving force that allows players to perform at their optimal level & handle pain & discomfort.
  - When used with; relaxation, arousal control & mental rehearsal it provides a balanced package to support physical techniques required by performance.
  - Ability to harness motivation has greatest impact on consistency.
  - Level of motivation affected by:
    - Self esteem.
      - How we feel about ourselves.
    - Expectations.
      - Our goals & external pressures.
    - Standard of competition.
    - Impact of enviro. factors.
      - Weather, facilities.
    - Spectator support.
      - Reaction to the people watching.
    - State of the event.
      - Score line.
    - Ability of coach to motivate performer.
      - Encourage individual / team.

- *Types of motivation:*
  - Positive.
    - Individual's performance driven by previous reinforcing behaviour.
    - More effective than negative motivation.
    - *eg.* Crowd cheering.
  - Negative motivation.
    - Improvement in performance out of fear of consequences.
    - *eg.* Coach becoming aggravated because of poor performance.
  - Intrinsic motivation.
    - Motivation derived from within the individual.
    - *eg.* Player's interest / passion for sport.
  - Extrinsic motivation.
    - Occurs when internal state affected by external influences.
    - Provides focus & lifts athletes to next level.
    - *eg.* Crowd support.

- <u>Reinforcement:</u>
    - Form of reward / punishment that influences probability that an action or behaviour will reoccur.
  - An essential part of mental learning.
    - Entrenches desirable action.
  - More effective with individual than team
    - Unique to individual characteristics.

- *Types of reinforcement:*
  - Social.
    - Arises from social contact.
    - Develops in atmosphere of interaction, teamwork & cooperation.
    - May be positive.
      - *eg.* Admiration from peer.
    - May be negative.
      - *eg.* Coach's disapproval.
    - Affect of it depends on respect held for person/s & enviro.
  - Material.
    - Tangible items.
      - *eg.* Badges, trophies, money.
    - May be positive.
      - *eg.* Trophy.
    - May be negative.
      - *eg.* Bad stats sheet.
    - Important for younger children & those in development stages.
      - Not serious athletes.
  - Internal.
    - Not visible (intangible).
    - Often less aware of it.
    - *eg.* Proud of performance, learning from watching other player.

- <u>Anxiety:</u>
    - Psychological process characterised by fear / apprehension in anticipation of confronting a situation that is potentially threatening.
  - Complex emotion.
  - Disrupts, unsettle behaviour.
    - Lowers individual's muscle control
  - When uncontrolled; contributes to poor performance.

- *Types of anxiety:*
  - Trait anxiety.
    - General level of stress characteristic to individual.
      - In response to daily situations.
    - Varies, depending on stress management techniques, mental state.
    - Controlled through relaxation techniques.
  - State anxiety.
    - Heightened distress in response to a particular situation.
      - When required to perform.
    - May cause physical & mental paralysis.

- <u>Stress:</u>
    - Non-specific response of body to a demand placed on it.
  - Created by *adrenalin*, readies body for action.
  - Characteristics:
    - Increased blood supply to skeletal muscles.
    - More O_2 to lungs.
    - Increased $C_6H_{12}O_6$ production.
    - Increased sweat.
    - Muscles tension.
  - Can be:
    - Real.
      - *eg.* Chased by a dog.
    - Imagines.
      - *eg.* Thinking about stressful situation.
    - Mind cannot differentiate between real / imagined.
  - Personal attribute.
    - Dependent on person's perception of threat, genetic make-up, coping mechanisms.

- Past experience.
- Routines.
- Expectations (from self / others).
- Amount of support.

- Factors producing stress:
  - Stressors.

- <u>Optimum arousal:</u>
  - Arousal:
    - Level of anxiety before or during performance.
  - Anxiety is a psychological state.
  - Arousal is a physical state.
    - Can help or hinder performance.
  - Performance is best when arousal is at optimal level.
    - Dependent on performer & task.
  - Low arousal:
    - Depressed state.
    - Disinterest.
    - Low motivation.
  - High arousal:
    - Excessively tense.
    - Unable to concentrate.
  - Over arousal & under arousal lead to adverse performance.
    - Coach & athlete need to ensure optimal arousal is reached.
    - Manipulation of factors affecting anxiety can affect arousal.
  - Optimal arousal levels depend on:
    - Self expectation.
    - Peer expectation.
    - Experience.
    - Financial pressures.
    - Degree of difficulty.

- Skills finesse.
  - Lower difficulty = lower arousal to reach peak performance.
- Uncontrolled anxiety negatively influences performance.
- Lack of anxiety can lead to under performance.

- <u>Concentration / attention skills:</u>
  - Concentration:
    - Ability to link movement & awareness, allowing individual to focus on doing rather than thinking about doing.
  - Commonly agreed on to be the key to success.
  - Effective concentration involved doing & thinking about doing.
  - Improving concentration emphasises focussing on process not outcome.
    - Technique.
  - Ability to widen & narrow attention developed through training.

- <u>Mental rehearsal:</u>
    - Technique of mentally picturing performance / skill prior to performing it.
  - Enhances:
    - Performance.
    - Acquisition of motor skills.
  - Commonly used by:
    - Weightlifters.
    - Gymnasts.
  - Involves mental repetition of movements or sequences.
    - Increases familiarity with desired motion.
  - Improves concentration.
  - Removes total reliance on physical training.
  - Replaces physical training during injury or adverse weather.
  - Coach has inability to control athlete’s thoughts.

- Athlete may daydream.

- Effectiveness of mental rehearsal:
  - Elevates arousal.
  - Provides clear picture of task.
  - Increases concentration.
  - Eliminates negative thoughts.
- Totally effective rehearsal involves:
  - Realistic pictures of performance.
  - Exclusion of distracting thoughts.
  - More than 1 rehearsal.
  - A sense of experiencing performance.
  - Visualising success.
  - Practice.
    - Enables ability to ‘turn on’ technique.

- <u>Visualisation:</u>
  - Used in mental rehearsal.
  - Picturing specific aspect of performance or skill.

- <u>Relaxation:</u>
    - A series of techniques that seek to control body’s response to stress.
  - Reduce arousal.
  - Control arousal.
  - Techniques control autonomic nerve system.
    - Heart rate.
    - Blood pressure.
  - Assists concentration, visualisation & control of muscles.
  - Allows performer to reproduce skills practiced in competition.
  - Techniques include:
    - Progressive muscular relaxation.

- Mental relaxation.
- Self hypnosis.
- Mental rehearsal.
- Meditation.
- Centred breathing.

- <u>Goal setting:</u>
  - Establishing a target to achieve.
  - Performance or behaviour.
  - Maintains performer's focus on training, improving, reaching peak.
  - Short term goals.
    - Achieved in limited period of time.
    - Weeks or months.
  - Long term goals.
    - Achieved over large time period.
  - Behavioural goals.
    - Improve attitude.
  - Performance goals.
    - Relate to desired level of success.

The Role of Nutrition:

- A balanced diet requires:
  - Adequate intake of nutrients for growth & repair.
  - Balance of macronutrients to supple adequate fuel & maximise performance.
  - Adequate hydration.
  - Deficiency or unbalanced diet leads to poor performance.

- Macronutrients:
  - CHO.
    - 60-70% D.I. (for athletes).
  - Fats.
    - 25% D.I. (for athletes).
  - CHON.
    - 15% D.I. (for athletes).

- Micronutrients.
  - Vitamins, minerals, fibre.

- <u>Carbohydrates</u>:
  - Complex.
    - 70% D.I.
    - *eg.* Cereals, bread, pasta, rice, fruit, vegetables.
    - Don't usually look sugary.
    - Provide sustainable, non-erratic supply of energy.
      - Break down slowly.
  - Simple.
    - 30% D.I.
    - *eg.* Sugar, cakes, lollies.
    - Usually look sugary.

- Provide a short, erratic burst of energy, followed by a depression.
  - Breaks down quickly.
- 1st source of energy.
- Provides glycogen stores in muscles & liver.
  - 1hr. exercise depletes glycogen stores.
  - 2hrs. no glycogen left.
- Most efficient source of energy.
- CHO used for anaerobic glycolysis & by brain & nervous system.
- Glycogen:
  - CHO stored in muscle & liver.
- Glycogen sparing:
  - Metabolism of fat to preserve glycogen.

- <u>Fat</u>:
  - Provides energy during low intensity activity, prolonged activity.
  - Fuels body when glycogen stores are low / depleted.
  - Body's richest source of energy.
    - Inefficient.
      - Requires large amount of oxygen for metabolism.
      - Increased respiration rate.
      - Increased body temp.
      - Dehydrates.
  - Fat consumed should be unsaturated.
    - Breaks down, not 'sticky'.
  - Unused fat stored in fat cells (adipose tissue), with unused CHO, CHON.
    - Adds extra weight.
    - Burdens circulatory system.
    - Inhibits peak performance.

- Protein:
  - Minimal role in energy production.
  - Used in growth, maintenance & growth.
  - Energy source in extreme conditions.
  - Athletes should consume 1-2g of protein per Kg body weight.
  - Sources:
    - Fish.
    - Chicken.
    - Red meat.
    - Beans.

- Water:
  - Body stores water in cells (intracellular fluid) & outside cells (intercellular fluid).
  - Essential for life.
  - Does not provide energy.
  - 150% of H_2O loss should be consumed following performance.
  - Water loss has no dramatic effect on performance unless large quantities lost.

- Performance needs:
  - Maximise glycogen & hydration.
  - *Pre-event intake:*
    - Last food intake:
      - Large meal;
        - 3-4 hrs.
      - Small snack;
        - 1-2 hrs.
    - Avoid high fat, protein.
      - Take longer to digest.
    - Consume complex CHOs.

- Slow release of energy.
- Liquid meals recommended.
- Digest quicker.
- Begin hydrating days prior to competition.
- Weight provides indication of hydration level.
- Do not experiment with food.

- *During competition:*
- Aims to conserve glycogen in muscles.
- CHO supplementation avoids this.
- Liquid CHO delays glycogen by 30mins.
- Supplementation not required for low intensity events.
- Adequate hydration maintained.
- Drink before feeling thirsty.

- *Post-event intake:*
- Immediately after event:
- 1g simple CHO / Kg body weight with small amount of protein.
- Replace 150% fluid loss.
- Restore glycogen.
- High CHO foods.
- Avoid alcohol.
- Dehydrates.

- <u>Supplementation</u>:

- Forms:
- Vitamins.
- Minerals.
- ATP.
- Creatine.
- Protein.
- Amino acids.
- Glycogen.

- It is believed that a balanced diet does not require supplements.
- *Vitamins:*
    - Inorganic compounds essential for body functions.
  - Do not provide energy.
    - Act as catalysts for release of energy, tissue building.
  - Body cannot manufacture vitamins.
    - Must be supplied by diet.
  - Excess vitamin intake may lead to joint, muscle pain, fatigue, headaches.
- *Minerals:*
  - Inorganic substances that assist functioning of body.
  - Do not provide energy.
  - Most common deficiencies in athletes;
    - Fe.
      - Sports anaemia.
      - Lack of energy.
      - From heavy training programs.
      - Endurance athletes, females, vegetarians.
    - Ca.
      - Weak bones, teeth, joints.
      - Females, aged athletes.
- *CHO loading:*
    - Loading muscles with glycogen in prep for competition.
  - Muscles & liver completely depleted of glycogen.
  - Become ‘hungry’.
  - Store more glycogen than usual.
  - Starves brain of glucose, decreases motivation.
  - Tapering more approved method of allowing glycogen to replenish.

- Hydration:
  - Normal core body temp = 37^0C.
    - Balance between heat entering body & heat leaving body.
  - Hypothalamus regulates body temp.
  - Heat production:
    - Metabolism.
      - Heat produced by ATP splitting & resynthesis.
    - Exercise:
      - Heat produced by muscle contractions, movement.
  - Heat loss:
    - Radiation.
      - Loss of heat as infra-red rays.
      - Greater difference in heat between body & enviro → greater loss.
      - Accounts for 60% heat loss at rest.
    - Conduction.
      - Transfer of heat from body to object through contact.
      - 3% of heat loss.
    - Convection.
      - Transfer of heat by a moving fluid.
      - 12% of heat loss.
    - Evaporation.
      - Sweating.
      - Up to 25% of heat loss.
  - Balance of heat production with heat loss:
    - Vasoconstriction.
    - Vasodilation.
    - Hypothermia.
      - Heat production exceeds heat loss.
    - Hyperthermia.
      - Heat loss exceeds heat production.

Skill & Performance:

- Skill acquisition & development:
  - ***The learning process:***
    - A *cyclic process*.
      - **Perceiving**.
        - Input.
        - Perception comes in the form of cues.
        - Understanding skill using senses.
      - **Deciding**.
        - Learner decides how to use information.
        - *Processing.*
        - Works out how to convert cues to a physical response.
      - **Acting**.
        - Output.
        - After decision is made, neuromuscular system guides person to performing desired movement.
        - Person executes conceptualised plan in form of motor movement.
      - **Feedback**.
        - Learner will gain some internal feedback from performing skill & some external from coach.
        - Movement may or may not resemble skill as it was demonstrated.
    - Cyclic process will refine ability until learner is capable of desired movement.
    - Relationship between feedback & action important.
      - Highly unsuccessful skill:
        - Substitute skill or action.
      - Unsuccessful skill.
        - Modify & refine skill.

- Successful skill.
- Repeat action.

- Characteristics of the learner:

- Heredity:
  - Muscle fibre composition (white/red).
  - Somatotype.
  - Height.
  - Gender.
  - Conceptual ability.
- Personality:
  - Attitude.
  - Enthusiasm.
  - Social interactions.
  - Reasons / motivation.
  - Consistence.
  - Reliability.

  Positive learning attributes:
  - Cooperativeness.
  - Willingness to listen.
  - Determination.
  - Enthusiasm.
  - Dedication.
  - High motivation.
  - Aggressiveness.
  - Risk taking & learning ability.
- Confidence:
  - Firm belief in own ability.
  - Determined by experience. Learners lack confidence.
- Prior experience:

- Transfer of learning (skills from other activities).
    - Accelerates learning process.
- Ability:
    - Ease with which individual is able to perform.
    - Incorporates:
        - Sense acuity.
        - Perception.
        - Reaction time.
        - Intelligence.
- ***The learning environment:***
    - Physical environment.
        - Surrounding conditions in which a skill is being performed.
        - Includes climate conditions.
        - Effects motivation level, may restrict performance or limit playing time.
    - The nature of skill.
        - <u>Open & closed skills</u>.
            - Open skills occur in an unpredictable & changing enviro.
                - *eg.* Foot ball tackle.
            - Closed skills occur in a stable & predictable enviro.
                - *eg.* A golf swing.
            - Most skills placed on a continuum of open/closed skills.

        - <u>Gross motor & fine motor skills</u>.
            - Gross motor skills require large muscle groups.
                - *eg.* Running.
            - Fine motor skills require small muscle groups.
                - Finesse & limited movement.
                - *eg.* Catching.
            - Gross & fine motor skills placed on a continuum.

- Discrete, serial & continuous skills.
  - Discrete skills have a definite, identifiable beginning & end.
    - *eg.* A forward roll.
  - Serial skills involve a sequence of discrete skills.
    - *eg.* A place kick in football (off a tee).
  - Continuous skills have no distinct beginning or end.
    - *eg.* Running.

- Self paced & externally paced.
  - Pacing:
    - Performer's control over timing of skill execution.
  - Self paced movements are timed by performer.
    - *eg.* Kicking a football in practice.
  - Externally paced skills controlled by external sources.
    - *eg.* Rhythmic gymnastics (music sets pace).

- ***Practice methods:***
  - Massed vs. Distributed.
    - Massed involves a continuous session.
      - Rest intervals shorter than practice intervals.
      - Better for;
        - Motivated performers.
        - Experienced performers.
        - Older performers.
        - Simple, less complex tasks.
    - Distributed practice involves a broken practice session.
      - Rest or alternative activity intervals longer than practice.
      - Better for;
        - Younger performers / learners.
        - Unmotivated.

- Difficult tasks.
- More complex tasks.
- Fatiguing / uncomfortable tasks.

- Whole vs. Part.
  - Whole practice applied when skill is practised in its entirety.
    - All aspects of skill incorporated.
    - *eg.* A whole squash shot.
    - Best for:
      - Simple skills.
      - Advanced, skilled performers.
  - Part practise applied when skill is broken into small components & practised.
    - *eg.* Part of a shot is performed.
    - Best for:
      - Complex skills.
      - Beginners / cognitive stage.
      - Young children.
  - Coaches tend to use a combination of methods.
    - Allows learner to conceptualise more intricate parts of the skill.

  - Drill vs. Problem solving.
    - Drills use closed skills.
      - Skill follows a set pattern, predictable.
      - Beginners, cognitive / associative stage.
      - Young children.
      - Complex skills.
    - Problem solving uses open skills.
      - Provides a greater understanding of the skill & when & how

to use it.

- Associative stage / autonomous stage.
- Skilled performer.
- Simulate a game situation.

- Mental vs. Physical.
  - Mental tasks should be performed before physical.
  - A combination of both is the most effective method.

- Speed vs. Accuracy.
  - Speed practice is best when speed is predominantly required in game.
  - Accuracy best when accuracy is predominant in game.
  - Combination of 2 is best, except when accuracy is the predominant factor.

- Variety.
  - Varying practise keeps motivation & interest high.
  - In later stages of training specificity is most important.

Feedback:

- Provides guidance, assists performer to remove errors.
  - Reinforces successful performance / successful skill.
  - Provides basis for correction.
  - Motivates performer to continue effort.

- Internal (intrinsic):
  - Embodies feelings accompanied by sensory information.
    - Feeling a good shot.
    - Seeing / hearing a good shot.
  - Perception allows us to differentiate between successful skill & error.

- External (extrinsic):
  - External information received about a performance.
    - From:
      - Coach.
      - Peer.
      - Video.
      - Press.
      - Support network.
      - Results.

- Concurrent:
  - Received during performance.
  - Relayed through body through proprioceptive mechanism.
    - Coaching from sideline.

- Delayed:
  - Received after skill has been executed.
    - Post-match briefing.

- Knowledge of results:
  - Info about the outcome of a movement.
  - Suggests how successfully a skill was performed.
    - Score at end of match.
  - Provides info about skill execution.

- Knowledge of performance:
  - Info about pattern of movement during execution.
  - Specific to how a skill was performed.
    - Comment from coach about how a skill was performed.
  - Feedback on quality of skill execution.
    - Internal /external.

- Feedback is essential for improvement.
  - Must be accurate.
  - Most effective when immediate & positive.
  - Reinforces correct execution.
  - Must develop correct technique.

Stages of Skill Acquisition:

- Cognitive stage:
  - 1st stage of skill acquisition.
  - Fundamental that player gains understanding of what is required.
    - What to do, how to do it.
  - Conceptualism:
    - Mental picture of task.
    - Essential for good reproduction of movement.
  - Demonstrations, videos, information.
    - Coaches should avoid information overload.
  - Continuous feedback required.
  - Drills effective method of learning.
  - *Characterised by*:
    - Errors.
    - Awkwardness.
    - Lack of knowledge.
    - Low skill level.
    - Low motivation.

- Associative stage:
  - 2nd stage of skill acquisition.
  - Emphasis on practice.
    - Repeat movement to enhance synchronisation of mind & muscle.
  - Feedback essential.
  - *Characterised by:*
    - Less frequent errors.
    - Sense of fluency & smoothness.
    - Experience of some success.

- Autonomous stage:
  - 3rd stage of skill acquisition.
  - Execution is properly sequenced.
    - Performed instinctively.
  - Consolidated discrete skills of actions.
  - Ability to give attention to other parts of performance while performing skill.
  - Practice very important.
    - Should incorporate pressure drills.
      - Adapts athlete to real performance.
  - Movement has fluency (sub-routines sequenced).
    - Temporal patterning.

Cognitive Stage	**Associative Stage**	**Autonomous Stage**
- Basic or understanding stage of skill learning.	- Immediate or practice stage of learning.	- Advanced Stage. - Skills executed reflexively.
- Focus on **what** to do.	- Focus on **how** to execute skill.	- Focus on **other tasks**.
- Frequent, significant errors.	- Some errors.	- Able to detect & correct errors.
- Unable to recognise error.	- Need to practise.	- Need to adapt to pressure situations.
- Larger need to see, feel & experience movement.	- Kinesthetic sense developed through practice.	- Rehearsal under various conditions.
- Exploratory stage.	- Demonstration important.	- Demonstration only necessary for refining of some movements.
- Demonstration best method of communication.	- Emphasis on temporal patterning.	- Temporal & sequential patterning of subroutines automatic.
- Learners must identify subroutines.	- Moderate speed. - Reasonably efficient movement.	- Speed & efficiency relate to specific situations.
- Slow learning speed.	- Require practice of set patterns in controlled situations.	- Improvement requires manipulation of enviro to able skill to be reproduced in varying conditions.
- Support from teaching aids. - Focus is conceptualisation.	- Able to recognise errors.	- Very few errors.

Rates of Skill Acquisition:

- Learning curves & plateaus.
  - Illustrate relationships between practice & performance.

- Types:
  - *Linear curve*.
  - *Negatively accelerated curve*.
    - Physical / mental fatigue.
    - Poor physical condition.
    - Boredom.
    - Limited ability of coach.
  - *Positively accelerated curve*.
    - Increasing complexity.
    - Info overload.
    - Gradual development of interest.
  - *S-shaped curve*.
    - Mixture of simple & complex tasks.
    - Inability to stay focussed.

  - *Plateau*:
    - Levelling off of improvement.
    - Lack of practice.
    - Declining interest.
    - Low motivation.
    - Injury.

Implications To The Rate of Learning:

- Some skills are simple, while others are complex.
- Some learners progress rapidly, while others take more time to grasp skills.
- Coaches should be aware of individual's differences.
- Some skills can be practised in a group enviro, others require 1-on-1.

Skilled Performers vs. Unskilled Performers:

	Skilled Performer	Unskilled Performer
Kinesthetic sense	- Well developed kinesthesis. - Awareness of muscle effort during movement. - Allows to feel movement. - Aware of movement error.	- Lack of kinesthesis & muscle memory leads to mistakes. - Unaware of technical errors. - Require repetitive practice to develop kinesthetic sense.
Anticipation & timing	- Ability to predict what will happen. - Flight path of ball. - Direction of opponent. - Creates time to respond. - More attention to executing skill. - Most important in externally paced skills. - Have ability to deceive opponent. - Ability to time skill & movement.	- Not able to predict opponent of flight path of ball. - Little time to react. - Leads to more errors. - Time skill poorly. - Require repetition to develop timing. - Subroutines become automatic. - Concentration increases.

Mental approach	- Selective attention. - Respond to relevant actions. - Respond to multiple cues. - Mental rehearsal techniques. - High motivation. - Maintain optimal arousal. - Set goals. - Experience → confidence. - Anticipate.	- Lack confidence. - Little experience. - Poor arousal management. - Poor stress management. - Short concentration.
Consistency	- High level of consistency. - Ability to perform desired movement.	- Low consistency. - Many errors.

Objective Measurement of Skill:

- Subjective:
  - Judgement of performance quality.
    - Based on feelings, impressions, opinions.

- Objectivity:
  - Extent to which a measurement or test is independent of observer.

- Greater accuracy of measurement → greater reliability of results.
  - Subjective measurement less accurate than objective measurement.

- Use of measuring equipment makes data more credible.
  - Eliminates guesswork.
  - Increases objectivity.

- Use of criteria by judges increases objectivity.
  - Personal opinions avoided.

- Results made objective by:
  - Check lists.
  - Measurement systems.
  - Established criteria.
  - Rating scales.

- Skill related tests:
  - Designed to measure ability of athlete.
    - Assess improvement.
    - Determine weaknesses.
  - Must be specific to skill / sport.
    - Valid.

- Variable must be kept constant.
- Athlete must do their best.
  - Reliable.
- Should use objective measurement.
  - Accurate, valid & reliable.

- Validity:
  - Honesty of a test.
    - Accuracy of measurement to skill.
  - Determining strength of relationship between performance & test.

- Reliability:
  - Degree of consistency.
    - Ability to re-measure attributes in same conditions.

- Judging the quality of performance.
  - Adjudicators increase objectivity of movement by using established criteria or by placing numeric values on movement.
  - Physical performance represented by numbers that can be compared to other numbers from similar performances.

Characteristics of A Skilled Performer:

- Skilled player has ability to:
  - Anticipate responses.
  - Coordinate movements (fluency).
  - Time movements & maximise muscle power.
  - Focus on tactics.
  - Adapt to unfamiliar situations.
  - Perform at a high level consistently.
  - Resourcefulness.
  - Create time.

Outcomes of A Skilled Performance:

- Financial remuneration.
  - Sponsorship or money.

- Increased confidence.
  - Self-direction.

- Increased motivation.
  - Continue striving towards goals.

- Desire to improve.

- Improved ability to analyse & evaluate performance.
  - Developed kinesthesis & ability to adjust.

- Ability to transfer proficiency.
  - Transfer skills to similar tasks.

- Make informed evaluation about performance of others.

- Increased media profile.

- Higher self expectations.

- Increased intrinsic & extrinsic pressure.

Criteria:

- Personal criteria:
  - Perceived ideas & expectations when judging performance.
  - Used by coaches to select a team

- Prescribed criteria:
  - Criteria established by sport's governing body.
  - Organised competition.