

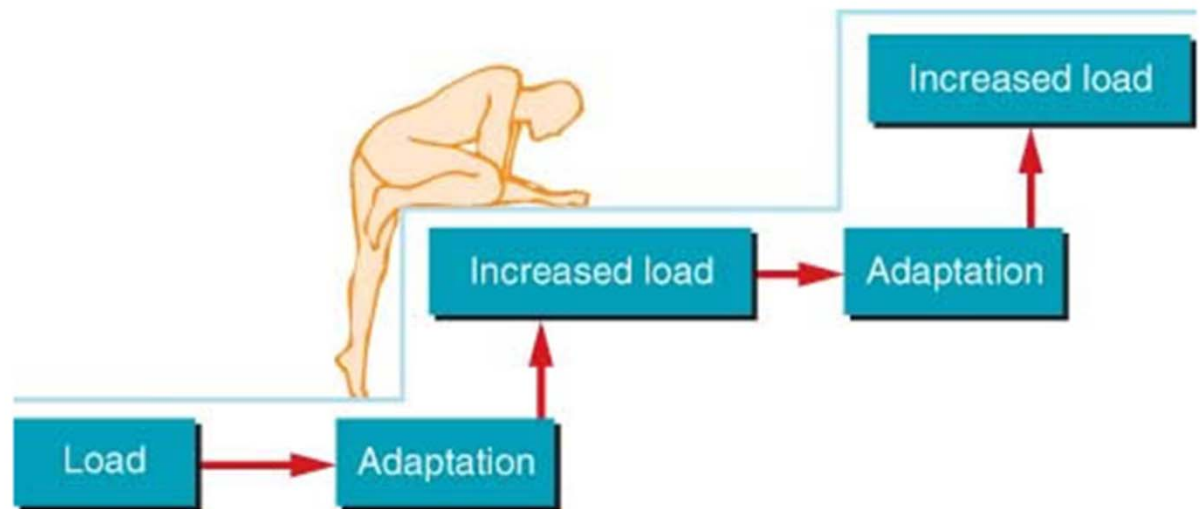
Principles of Training

- Progressive Overload
- Specificity
- Reversibility
- Variety
- Training Thresholds
- Warm-up & Cool-down

How can this principle be applied to:
Aerobic training?
Resistance (strength) training?

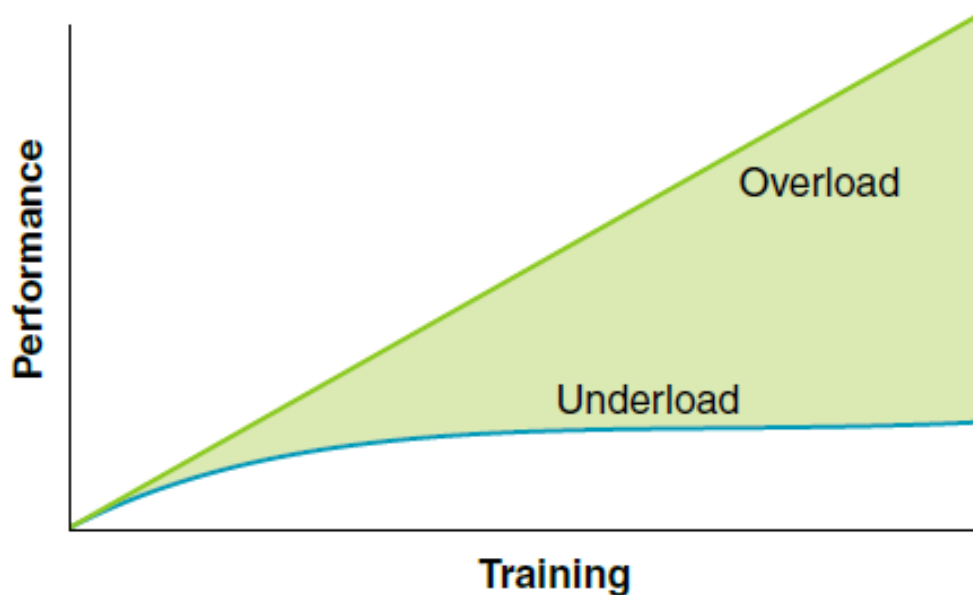
Progressive overload

- The overload principle implies that gains in fitness (adaptations) occur only when the training load is greater than normal and is progressively increased as improvements in fitness occur.



PO(cont)

- Adaptations will not take place if the load or resistance is either too small or too big:
- Too small = no adaptations
- Too big = causes fatigue and possible injury



Insufficient stress underloads the body, and training benefits are not maximised.

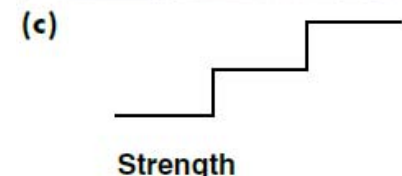
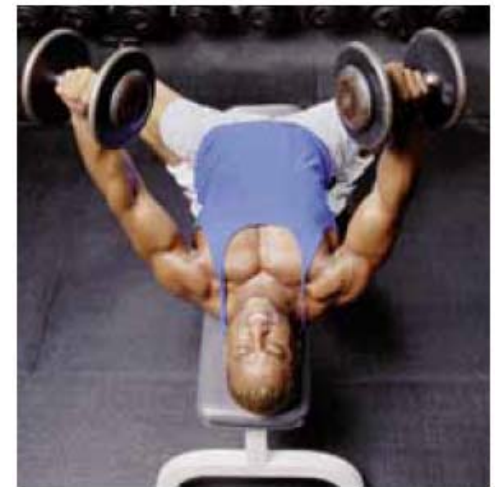
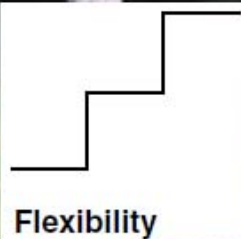
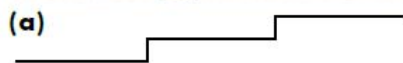
PO (Cont)

Examples of application of overload:

- *Aerobic training* —reflected in the heart's ability to pump more blood to the working muscles (increased cardiac output) and the ability of the working muscles to take up more of the oxygen as it is delivered to the cells (increased oxygen uptake).
- *Strength training* — results in muscle hypertrophy (enlargement of muscle fibres) which is usually directly related to an increase in strength.

PO (cont)

- PO is an important principle in aerobic, strength and flexibility training programs.
- Not all adaptations take place at the same rate.
- In endurance programs, the load (height of the step) needs to be small and the adaptations (length of the step) take place slowly.
- Fastest gains are made in flexibility programs where progressive increases in loads produce small adaptations.
- The loads need to be less for peak strength development, but the adaptations are more significant.



Specificity

- The specificity principle implies that greatest gains are made when activity in the training program resembles the movements in the game or activity.
- The principle of specificity is particularly important when considering the development of energy systems, muscle groups and components of fitness.
- Short-term, explosive activity requires development of the anaerobic systems while continuous, moderate, sustained activity requires development of the aerobic system.
- Try Multiple Choice Q11 2011 and Q11 2013 paper

2011 & 2013 HSC Past Paper

- 11 Which of the following principles of training would best explain why an elite lawn bowler may not necessarily be an elite basketballer?
- (A) Progressive overload
 - (B) Reversibility
 - (C) Specificity
 - (D) Variety
- 11 Which principle of training refers to aligning training activities with the demands of a particular sport?
- (A) Variety
 - (B) Specificity
 - (C) Reversibility
 - (D) Warm up and cool down

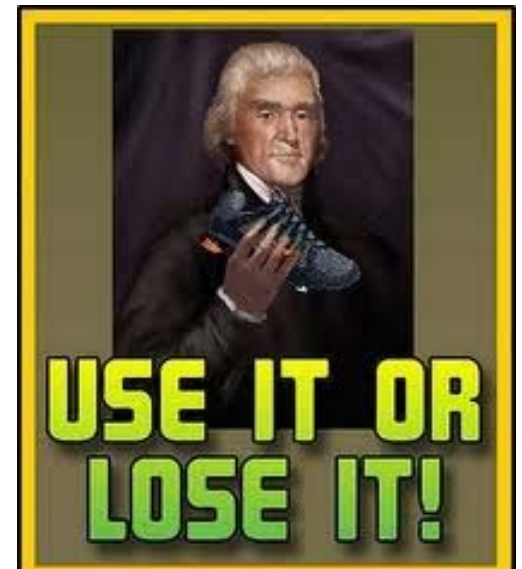
Specificity (cont)

Examples of application of the specificity principle:

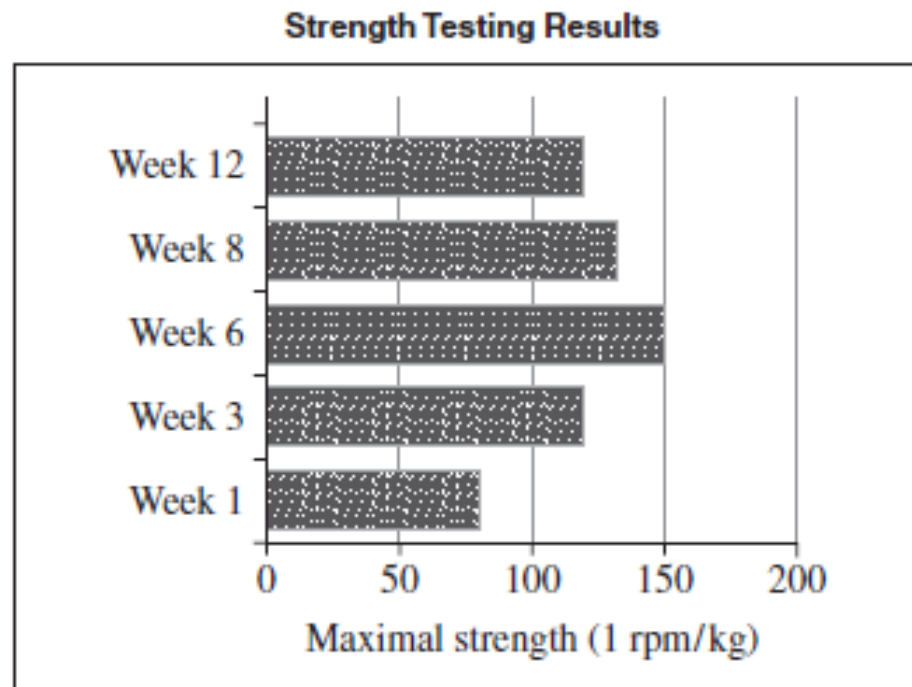
- *Aerobic training* — an athlete training for a marathon must target the aerobic system in training. The same athlete should choose activities in training that recruit slow-twitch muscle fibres so that aerobic enzymes in muscle fibres become more efficient in utilising oxygen.
- *Strength training* — if increased leg power is required to improve a person's ability to sprint, the training program must correctly address the speed and number of repetitions, load and time between sets correctly. For example, if the load is too high and the repetitions too low, the program causes bigger improvements to muscle bulk than muscle power.

Reversibility

- In the same way that the body responds to training by improving the level of fitness, lack of training causes the opposite to occur. This is referred to as the *detraining* effect.
- For example, in relation to cardiovascular endurance you can avoid reversing the effects of training only by continuing regular training at 70% MHR at least 3 times a week.
- Try Mult Choice Q18 2014 Paper



- 18 The graph shows results of testing an athlete's strength for competition. These strength levels were recorded at the start of training (Weeks 1–3), right before competition (Week 6) and after a break from training (Weeks 8–12).



Which principle of training has the athlete displayed from Weeks 6 to 12?

- (A) Peaking
- (B) Overload
- (C) Reversibility
- (D) Progressive overload

Variety

- Using the same drills and routines to develop fitness components in every training session is not productive, as repetition without creativity leads to boredom.

Examples of application of the variety principle are:

- *Aerobic training* can use a variety of activities such as swimming, running, cycling and circuit training.
- *Strength training* can use isometric and isotonic methods to increase strength, but do so using different equipment such as free weights, elastic bands and hydraulic devices.

Training thresholds

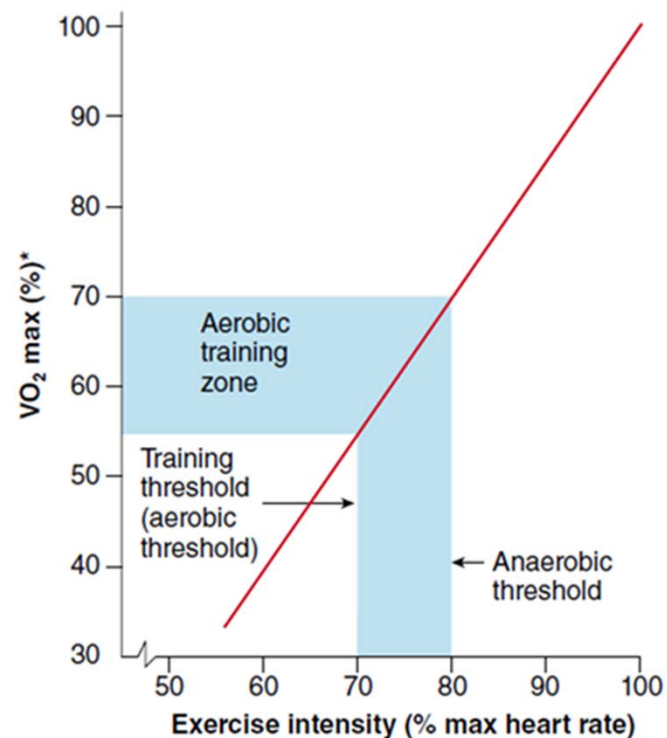


- Thresholds refer to a specific point that, when passed, take the person to a new level.
- The lowest level at which we can work and still make some fitness gains is called the training threshold or (where it concerns developing aerobic fitness) **aerobic threshold**.
- Thresholds are determined by work intensity, which can be calculated using heart rate.

TT (cont)

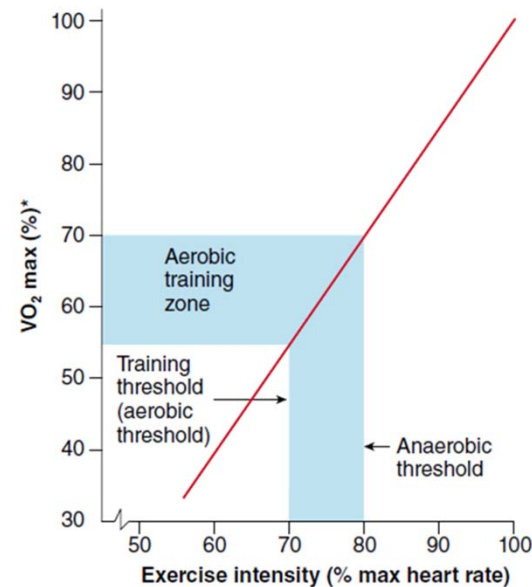
- A person's maximal heart rate (MHR) is estimated at 220 beats/minute minus age.
- Therefore, a 20-year-old person would have an MHR of 200 beats per minute.
- If the aerobic threshold is 70 per cent of MHR, the athlete would be working at a level of intensity that would cause the heart to beat at approximately 140 beats per minute.
- For most people between 16 and 20 years of age, this is equivalent to a moderately paced jog.

- When a person is working at a level of intensity above the aerobic training threshold and below the anaerobic threshold, they are working in the **aerobic training zone**. Exercise here is referred to as steady-state exercise and results in improvements in physical condition.

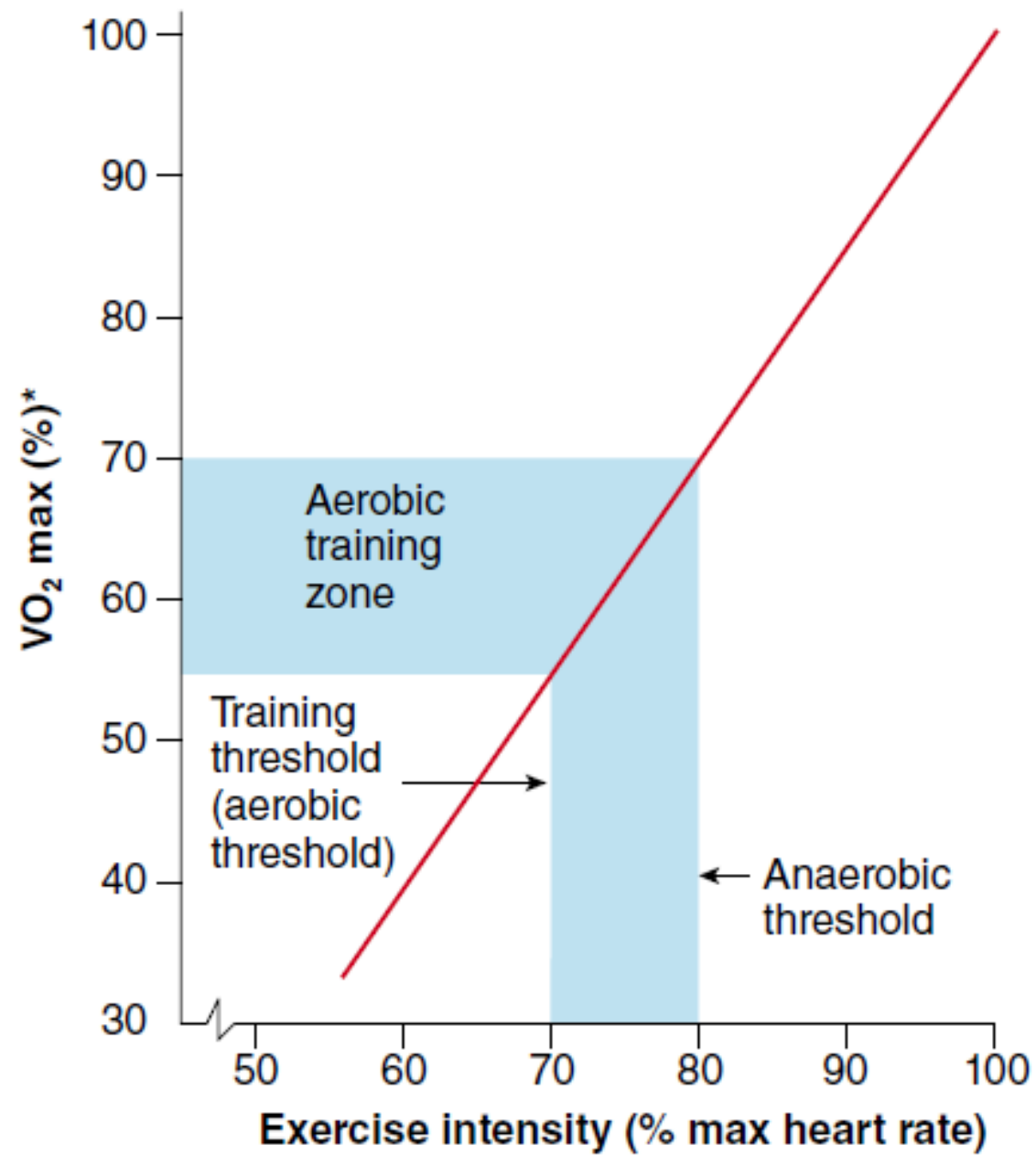


* $\text{VO}_2 \text{ max (\%)} = \text{percentage maximal volume of } \text{O}_2 \text{ that can be consumed in one minute}$

- The uppermost level is called the **anaerobic threshold** or, the **lactate inflection point (LIP)**, a point at which further effort is characterised by fatigue.
- The LIP reflects the balance between lactate entry and removal from the blood. If exercise intensity increases after the LIP is reached, blood lactate concentration increases substantially.



* $\text{VO}_2 \text{ max (\%)} = \text{percentage maximal volume of } \text{O}_2 \text{ that can be consumed in one minute}$



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TT (cont)

- Sometimes while exercising in the aerobic training zone, we wish to increase our intensity.
- An example is to increase the pace during the final half of a 12-minute run. This causes the muscles to require more oxygen, which is supplied by an increase in respiration and heart rates.
- If we increase the pace to a point where the cardiorespiratory system is unable to supply all the oxygen required at that point in time, energy will start to be produced anaerobically – this means, the body will metabolise glycogen in the absence of sufficient oxygen to fulfill immediate ATP requirements.
- (metabolise = chemical process in cell that transforms substances into energy)

TT (cont)

- The result is that the by-product of anaerobic glycolysis, lactic acid, starts to be produced in large quantities and permeates to the muscle cells.
- This point in training is called the anaerobic threshold.
- Well-trained endurance athletes can improve their performance by working close to and, in spurts, above the anaerobic threshold.
- This improves their tolerance of lactic acid, which is a feature of well-trained athletes.

TT (cont)

Applications of training thresholds:

- *Aerobic training* — the efficiency of the cardiorespiratory system is improved if the athlete works closer to the anaerobic threshold than the aerobic threshold. Working at this level increases the capacity and functioning of the cardiovascular system and the athlete's ability to tolerate inevitable rises in performance crippling lactic acid.
- *Strength training* — bigger gains in strength are made as resistance is progressively increased. If training for absolute strength, the threshold is represented by a high resistance or load ensuring that only a few repetitions can be completed. If training for strength endurance, the threshold is represented in terms of quantity, with a high number of repetitions being required to effectively challenge the threshold.

Warm-up

- The purpose of the warm-up is to:
 - *reduce the risk of injury* or soreness by increasing joint mobility and muscle stretch
 - *increase body temperature* and enzyme (enzymes accelerate chemical reactions) activity to promote faster and more powerful muscle contractions
 - *mentally prepare the athlete* for training
 - *stimulate the cardiorespiratory system.*

Cool-down

- The purpose of the cool-down is to minimise muscle stiffness and soreness and can include:
 - *aerobic work*, (for example, jogging), which gradually decreases in intensity and allows the body temperature to return to normal
 - the *stretching of muscle groups* used extensively during the training session(for example, leg muscles).

The cool-down helps to disperse and break down lactic acid concentration and to replenish the body's energy stores.

2012 Paper Q27 (homework)

Question 27 (6 marks)

How can THREE principles of training be applied to improve strength? Provide examples.

6

[illegible]



	Aerobic/anaerobic training	Strength training
Progressive overload	Increasing time or intensity of exercise [redacted]	Increasing weight lifted as sets can be completed easier
Specificity	Exercise at correct intensity (marathon runner trains at moderate pace)	Develop required muscles (shot-put: shoulders, chest, triceps)
Reversibility	Loss of CV fitness	Loss of muscle mass and strength
Variety	Different types of training (cycling and riding)	Different exercises (lat pull-downs and pull-ups)
Training thresholds	70–85% aerobic/ 85%+ anaerobic	For strength 6–10 reps / for endurance 15–30 reps
Warm-up/ Cool-down	General movements, stretching, dynamic movements	Aerobic, warm-up sets, static stretching between sets

Answer in 1 (max 2) sentences:

- 1 Define progressive overload.
- 2 What is specificity?
- 3 What is the principle of reversibility?
- 4 How can a coach provide variety while maintaining all other principles of training?
- 5 What is the aerobic training zone and what occurs if you exceed it?
- 6 What is the anaerobic threshold and what are the benefits of training around this mark?
- 7 What is the importance of a warm-up and cool-down.

Answers...

- 1 Progressive overload is consistently exercising at an intensity that is slightly greater than the body's current level of fitness or adaptation.
- 2 Specificity is ensuring that all aspects of training mimic the requirements of the sport.
- 3 If training stops, or slows, physical capacities will decrease.
- 4 New training venue, different activities, different equipment.
- 5 Exercising between 70 and 85 per cent of maximum heart rate (220 minus age).
Going over this utilises and develops anaerobic energy systems, and will cause greater fatigue
- 6 Exercising over 85 per cent of maximum heart rate (220 minus age). This is the most effective way to develop the CV system and to develop a tolerance for working under fatigue with high levels of blood lactate.
- 7 Warm-ups prepare body systems for intense activity and decrease the chance of injury. Cool-downs return body systems to a rested state, enhance the recovery