

GCE PHYSICAL EDUCATION

PE2 UNIT GUIDE

Content Title: Application of Principles of Training

Key points

- Application of the principles of training
- Specific examples of how to apply the principles of specificity, progression and overload.

Practical Application/Explanation

When developing your sporting performance, training is inevitably a key consideration if progress is to be made. Training can be beneficial to you whether it is burning calories when trying to lose body fat or trying to increase speed for your particular sport. However, in order to make steady continual training improvements the **principles of training** must be applied. In order to make training gains, the 3 principles of training that are of most importance are specificity, progression and overload.

Principles of Training – Specificity

At GCSE level, specificity was generally described as training specifically for your particular sport. While this remains the case at AS level, the amount of detail in terms of knowledge and understanding of specificity of training is greater.

With any sportsperson, before any form of training is undertaken then there must be clear understanding of the specific components of fitness and the specific skills requirements that are essential in that particular sport e.g. a shot putter will require a great deal of strength, power and a reasonable degree of flexibility, but will also spend a great deal of time on the technique for the putting action. Games players' main components of fitness can vary between positions, but generally, they train many components of fitness and have a wider variety of skills to develop. Hence knowledge and understanding of specific components of fitness required in your sport is vital, as is knowledge of the specific methods of training that is best suited to your sport or activity.

Training the components of fitness means working the aerobic or anaerobic energy systems, or in the case of flexibility, developing the range of movement around a particular joint. Training can

almost be split into high intensity near maximum effort training, seeking to develop components of fitness such as speed, strength, power, agility and reaction time. Coaches often in team games also need to develop speed endurance and muscular endurance. In such situations, the intensity of the exercise is high but the recovery between the bouts of exercise is short, not allowing for full recovery of the energy systems. Finally, there is the aerobic type training, which is of a lower intensity, exercising below the athlete's anaerobic threshold.

The following examples highlight this point.

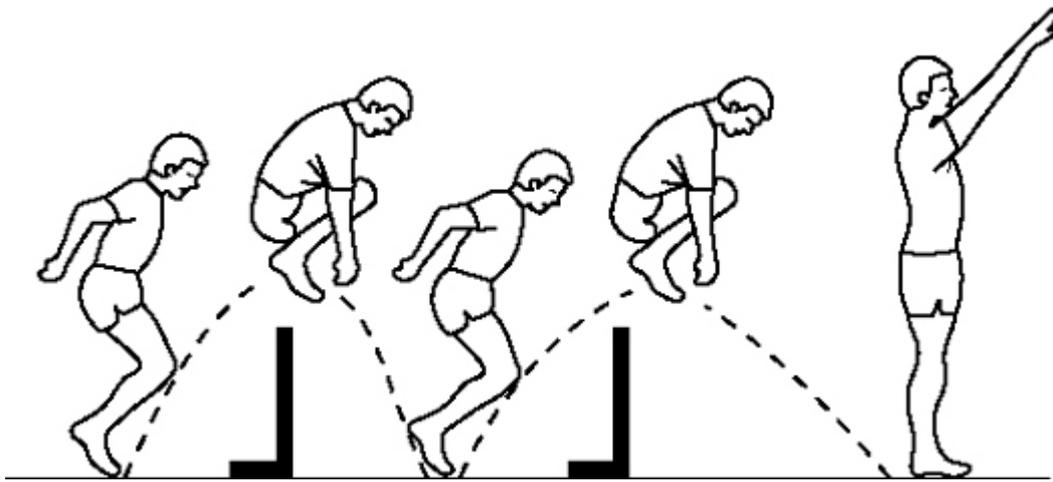
Development of Power in a Netballer

A netball player has just carried out fitness tests on speed, agility, cardiovascular fitness, flexibility and leg power. She has discovered that her leg power through carrying out the vertical jump is below the team average. She now needs to specifically develop this component of fitness.

How is specificity applied? – power is a combination of both strength and speed, so the netballer has a number of training options available to her. A highly specific method of training that would help develop leg power would be plyometrics, because of the amount of jumping that is involved in netball. Specific plyometric stations would involve equipment such as hurdles, benches, boxes and box tops. Specific training would involve bounding and hopping over the equipment or jumping off boxes and bounding over a hurdle (depth jumps). While an understanding of the method of training is important, it is also vital to understand the length of time the performer carries out a particular exercise and the length of recovery time required before the next exercise

e.g. Have a line of 5 hurdles, 1m in height. The performer bounds over the line of hurdles and walks back around allowing 30 seconds recovery before repeating. This is done a further 3 times, completing 1 set. 4 minutes recovery would then be completed before beginning a second set of 5 reps. 4 sets would be completed in total for this exercise.

Activity	Sets	Repetitions	Recovery between repetitions	Recovery between sets
1m hurdle bounds	4	5	30 seconds	4 minutes



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Specificity explained – As with speed and strength, power is a maximal activity. In order to train at or near to maximum effort, exercise duration must be less than 10 seconds (approximately the amount of time **creatine phosphate** system (CP) can work for) but carried out at or near 100% effort. Also, plenty of recovery time between bursts of exercise must be allowed for CP resynthesis. The duration of the bounding over the five hurdles is relatively short (4-5 seconds) but is carried out with maximum effort hence the predominant energy system being used is the (CP) system. With the exercise lasting only 4-5 seconds, not all the CP will be used. By allowing 30 seconds recovery between each rep almost all the CP will be restored (remember that 30 seconds restores almost 50% of CP). This means the performer can give almost 100% effort on the next rep. The 4-minute recovery between each set then allows further time for the CP to recover, ready for the next set.

Point to remember – whenever you specifically train maximum strength, speed and power, then the length of the specific exercise should not exceed 10 seconds e.g. during weight training for strength the weight must be above 80% of your 1 rep max (only above 80% of 1 rep max will you use your fast twitch fibres necessary for strength development). Also the set shouldn't last longer than 10 seconds (generally no more than 6 reps). Any longer than this and your muscle will begin to use muscle glycogen as the main fuel source because the CP stores will have run out. Muscular endurance rather than strength would then begin to become the component of fitness developed. Recovery between sets is also vital, 3-4 minutes allows between 95-98% of CP to be replenished, allowing the performer to give maximum effort for the next set. The same principles apply for speed training as well.

Progression and Overload

Progression and overload are inextricably linked, because in reality you must progress in order to overload and vice versa. In order to overload the 3 ways that are taught during GCSE lessons are frequency, intensity and time (F.I.T.). This remains the case at AS level, but as with specificity of

training, greater knowledge and understanding regarding progression and overload of each method of training is required.

Overloading the Anaerobic system

The development of strength

A rugby player wants to develop their leg strength during pre-season training. One of the exercises they carry out is half squats.



Half squat (balanced-life-fitness.com)

The player does the following sets of squats:

Exercise	Weight	Sets	Reps	Recovery (mins)
Half squat	140kg (90% of 1 rep max)	4	4	4

In order to overload for the next session, the player would carry out the following progression to the session:

Exercise	Weight	Sets	Repetitions	Recovery (mins)
Half squat	145kg (90% of 1 rep max)	4	4	4

The athlete is increasing the intensity of the session by increasing the weight by 5kg. This would be the most appropriate and effective way of developing strength.

Why?

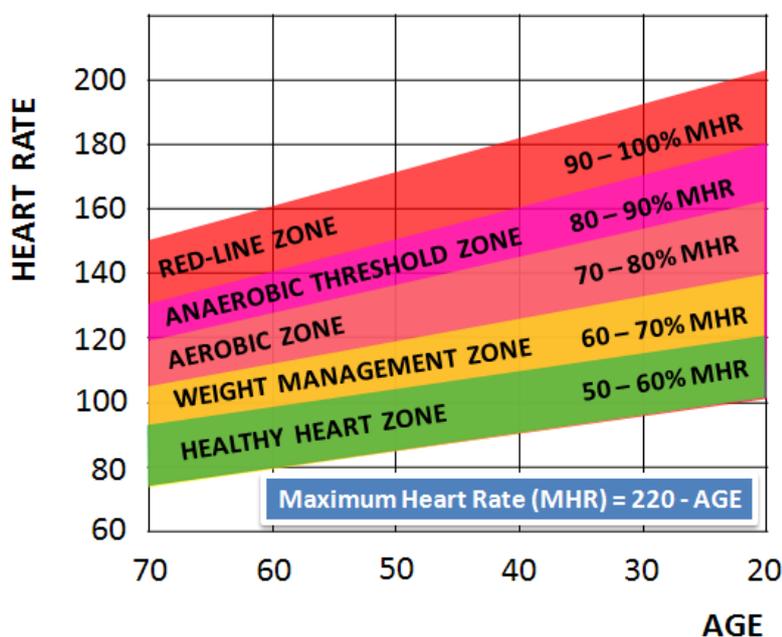
If the athlete were to reduce the recovery time to 1 minute as a means of overloading then there would be insufficient time for CP resynthesis. This would result in increased fatigue and incompleteness of the next set. Similarly if the number of repetitions were increased rather than the weight then as the player improved over time and the repetitions increased to 8 then 10 etc, then the component of fitness being developed would be muscular endurance rather than strength. The player could also overload by increasing the frequency of training from 3 times a week to 4. But it is also important not to stress the same muscle groups by doing the same exercises on two consecutive days. By doing so would not allow sufficient recovery time for growth and repair of the muscle fibres.

The development of speed endurance

If a coach or athlete is training to specifically develop speed endurance, lactic tolerance or muscular endurance for a 200m swimmer, interval training is often used. Reducing recovery time between sets and repetitions would be an effective method of achieving overload. Overload could be achieved by slightly increasing the distance swam for each repetition. The result of such training would be greater amounts of lactic acid entering the muscle, which over time would increase lactic tolerance levels.

Development of the Aerobic system

When training the aerobic system, applying the principles of training is also important in developing performance. A very basic method of increasing overload is by gradually increasing the distance that the athlete covers (equivalent to time) whether it is running, swimming cycling or any other endurance type activity. However, merely increasing the distance covered does not provide sufficient detail as to how overload is being achieved. It is also vital that an athlete has knowledge and understanding of intensity of exercise and the subsequent heart rate training zones.



As with 1 rep maximum in weight training, the endurance athletes must have knowledge of their maximum heart rate in order to train at the correct intensity (a poor estimation is $220 - \text{Age}$). The only way to accurately determine maximum heart rate is to perform a short, maximal stress test (to exhaustion). During the test, heart rate will rise steadily until a plateau is reached, despite the exercise intensity continuing to rise (assuming the individual is fit enough to last until such a time). This is a direct marker that the heart is beating as fast as possible. For example, if an athlete wants to stress the aerobic system and work just under their anaerobic threshold, then they would wear a heart rate monitor and work at approximately 80-85% of their maximum heart rate. Another problem is that even if maximum heart rate is measured accurately, prescribing exercise using standardised zones seen in the diagram makes no allowances for individual differences. Only through laboratory testing of an athlete, specific training zones and thresholds can be determined.

Quick revision

- The main principles of training that develop sporting performance are specificity, progression and overload.
- Training should be as specific to the sport as possible, whether the training focuses on specific skills or specific components of fitness.
- When applying both progression and overload, specific details of the training should be included e.g. sets, reps, distance, recovery time etc.
- When carrying maximal training, then a longer recovery is required between sets or bouts of exercise.
- For endurance type training, then shorter recovery times between sets or bouts of exercise are required.

Point to remember – the anaerobic threshold is the point at which the body begins to use more anaerobic rather than aerobic energy to sustain exercise intensity. If the intensity of exercise continues to rise, then the body will fatigue quickly because all anaerobic energy stores will become depleted. This means there will be a significant drop in performance or slowing down, which allows the aerobic system to supply the necessary energy and begin to repay the oxygen debt (link to oxygen debt in recovery). Training very close to the anaerobic threshold will result in an increase in your anaerobic threshold, thus improving aerobic fitness.

Top Tips:

The majority of candidates lose marks when answering questions on the principles of training because not enough **specific** information or detail is provided. A common answer often states that 'to overload in weight training you should increase the intensity of exercise'. While this statement is true, it does not provide sufficient information to warrant marks at AS. If the answer stated that 'you could increase the intensity of weight training by increasing the weight from 50kg to 55kg for bench press', then a mark would now be given. Also the amount of recovery time between sets or bouts of work is often misunderstood e.g. if there is a need for maximal effort within the training, then a long recovery is needed in order to replenish the CP stores (4 minutes allows 95 - 98% recovery of CP stores). For lower intensity, endurance type training, shorter recovery times between bouts of exercise are generally used.



Exam Style Questions

1.

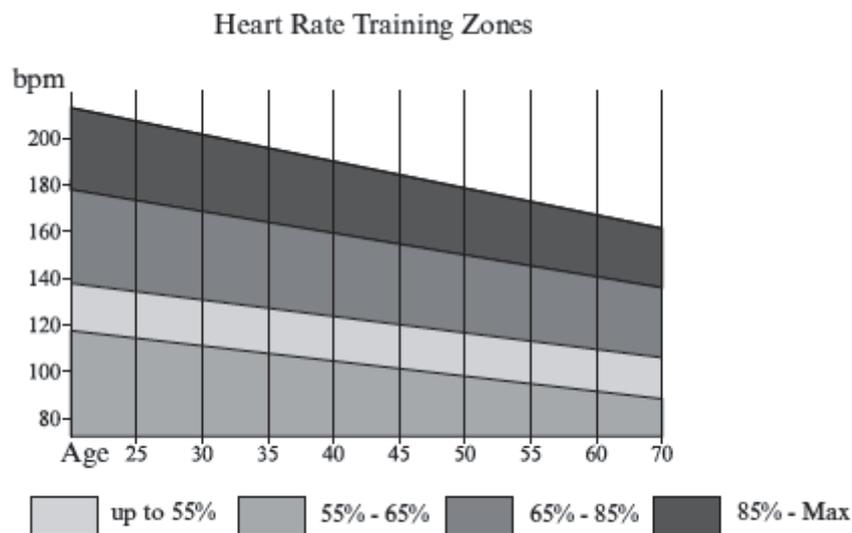


Fig. 1

Using information from Fig. 1 and your own knowledge, explain why an understanding of heart rate training zones is essential to a coach or performer.

[4]

