

UNIT 2 - APPLICATION OF THEORETICAL KNOWLEDGE FOR EFFECTIVE PERFORMANCE

See page 86 for a description of the Question Layout.

CHAPTER 5 – APPLIED EXERCISE PHYSIOLOGY IN PRACTICAL SITUATIONS

Text between pages 72 and 86, answers to questions on page 87 of the text book.

- 1) b) Explain why you would use the principles of training when developing a training programme to improve the fitness of 16+ physical education students. 8 marks

Answer

- **Specificity**
 - The need to make movements and energy system demands the same as the activity.
 - For example, hockey players would benefit from back-to-back stick shuttle sprints (stressing the fitness components speed and agility and developing the anaerobic lactic acid energy system).
 - This skill is sport specific because the players are replicating the movement patterns they use in their hockey game.
- **Progression**
 - Involves the gradual application of the overload principle in order to improve fitness.
 - The example below shows how progression is achieved by increasing the number of shuttle runs from session one to session three:
 - **Week one - session one:** 2 sets of 4 back-to-back shuttle sprints with 6 minutes recovery between sets.
 - **Week two - session two:** 3 sets of 4 back-to-back shuttle sprints with 5 minutes recovery between sets.
 - **Week three - session three:** 3 sets of 5 back-to-back shuttle sprints with 4 minutes recovery between sets.
- **Overload**
 - Describes training activities which get harder, more intense or longer.
 - Overload is achieved by increasing the intensity and or time or duration of training – these two overload principles form part of what is commonly referred to as the **FITT principles**.
 - In the example above, progression made from session one to session three demonstrates the increase in anaerobic exercise as shuttle reps increase and recovery between sets decreases (intensity) and duration (time) of the exercise period increases.
- **Reversibility**
 - ‘Use it or lose it’ which means that if the training stimulus is not maintained, gains previously made from training are lost.
 - This means that our hockey players will need to maintain or even continue the increase the volume of work stressing the anaerobic lactic acid energy system, otherwise anaerobic adaptations will reverse.
- **Tedium**
 - Refers to training that lacks variety and causes boredom.
 - If our hockey players continue to do the same training session (with the same outcomes and feelings) week in and week out, they may become de-motivated as the feelings of mastery of the activity are reduced.
 - This can be overcome by setting goals for sessions which vary (even though the activity itself may be the same), or completely change the activity while retaining the same goals (for example goals to improve strength or endurance).
 - Changing activities in training with the specific aim of reducing tedium is called **variance**, and is a crucial feature of a successful training programme.

- 2) b) A group of students wish to create an aerobic weight training programme. Suggest how they could calculate working intensities that would give them optimal strength endurance gains. Illustrate your answer with examples.

Answer

8 marks

- **IRM**
- Working intensities can be measured as a proportion of a performer's one repetition maximum or **IRM**.
- IRM represents the highest successful lift
- that can be achieved for one complete repetition of an exercise.
- having failed at the final lift.
- Once the IRM's values are known the students then **calculate a percentage of the IRM** in order to create an aerobic weight training programme.
- In this case, training done at **less than 50% of IRM** with high repetitions would **stress** the aerobic energy system.
- For example a student achieves a IRM of 50 kg on bench press. This IRM value can then be used to calculate a working intensity for optimal strength endurance gain chosen at 40% of IRM.
- **Bench press session:** 3 sets (20 kg x 20 repetitions) short recovery of 60 seconds between sets.
- This method can be used to create an interval weight training programme for a variety of exercises that would aerobically stress major muscle groups.
- With strength gains achieved as a result of regular systematic training, it is important to retest IRM values at regular intervals (say once a month) so that percentage training values can be adjusted accordingly.

- 3) b) Explain why fitness testing is necessary for both the coach and the athlete.

8 marks

Answer

- Provide **objective measures** about the individual's current state of fitness or health.
- Highlights **strengths**.
- Highlights **weaknesses**.
- Enhances **self-confidence**.
- Evaluates effects of a **training programme**.
- **Motivates** individual to reach optimal test scores.
- Adds **variety** to training programme.

- 4) b) The aim of Cooper's 12-minute run and walk test is to run as far as possible in 12 minutes.

What aspect of physical fitness does the 12-minute run and walk measure?

Briefly outline the strengths and limitations of this maximal test as a test for aerobic capacity, and identify some of the external variables that could influence the validity and reliability of this test if the test was performed outdoors on a school field.

8 marks

Answer

Cardio-respiratory endurance: ($\dot{V}O_{2max}$) or stamina.

Strengths:

- Easy to administer and can involve many participants.
- Cheap to administer – only needs tape measure to mark out running surface, a stopwatch to time the 12 minutes and a table to convert distance achieved to a predicted $\dot{V}O_{2max}$ value.

Limitations:

- Difficulty in ensuring the subject is **exerting** maximum effort.
- Dependent on level of **motivation** (arousal levels).

External variables which may affect the results of the test:

- Effect of **audience** or peers.
- **Footwear** - running spikes would give a better grip than flat training shoes.
- **Clothing** - excess weight might be carried during the 12 minute run.
- **Weather conditions** - a major variable which could affect motivation or pace. Wind and rain can be big demotivators.

- 5) b) Identify **two** valid and reliable submaximal tests that measure endurance or stamina. Why are submaximal tests often favoured over maximal tests? 8 marks

Answer*Tests:*

- PWC-170 test.
- Queen's College Step test.
- Harvard Step test.

Submaximal tests are often favoured over maximal tests because:

- Data from submaximal tests can be used to extrapolate and estimate maximal capacities.
- There is less stress on the performer.
- As field tests, submaximal tests can often test many subjects at one time.
- Greater reliability of results.

- 6) b) Explain, using examples, why the Illinois agility run test may be of more value to a games player than a 30 metre sprint test. 8 marks

Answer

- The Illinois agility run test is a flat-out sprint during which the performer has to weave around a series of cones.
- This action requires change of direction and position very similar to the agility required in many games such as rugby and hockey when dodging a player or creating a dummy move is an important agility skill.
- On the other hand a 30 metre sprint is a linear flat out sprint test that is less sport specific.

- 7) b) From a physiological standpoint, explain why warm-up and cool-down are important within an exercise programme. 8 marks

Answer*Warm-up:*

- Raises body temperature, increases metabolic rate, raises energy release, reduces response times.
- This temperature increase reduces blood viscosity, and therefore increases blood flow to working muscles.
- Slightly increased demand for oxygen will increase heart rate and breathing volume, which makes more oxygen available to working tissue.
- Blood supply is redistributed to working tissue (**vascular shunt**).
- A warm-up also prepares the body for skill demands of the activity - reducing the risk of injury.

Cool-down:

- Continued low level exercise and stretching keeps the **capillary beds open** within active (muscle) tissue.
- This enables the **flushing out of waste products** from the metabolic processes, such as lactic acid.
- Enables the body's systems to gradually return to their resting state.
- Which limits muscle soreness.
- And **enhances recovery** from the exercise period.
- Stretching during cool-down can **increase flexibility of joints** because the body is still very warm after full effort exercise.

- 8) b) You have been asked to prepare a mobility training session for a group of A-level Physical Education students who wish to improve their flexibility for their chosen individual activity. Explain, with examples, how you would use static, active, passive and ballistic stretching to create a session in the context of safe practice. 8 marks

Answer

- All stretching should be preceded by a light jog or similar activity to warm-up the body prior to stretching.

Static stretching:

- Should be used at the start of the mobility session.
- These stretches are slow, relaxed, gradual and sustained, achieved without assistance and where an end point position can be held for a few seconds (hence static stretch).
- For example, the sit and reach stretch stretching the hamstring muscle group.
- This is a very safe form of stretching.

Active stretching:

- Is a form of stretching, involves using only the strength of the opposing muscles (antagonist) to generate a held stretch within the agonist.
- For example: stand on one leg, lift the free leg at right angles to the hip and hold the leg straight out for between 10-15 seconds (again a static stretch).
- Active stretching is a very effective form of conditioning.

Passive stretching:

- Is a more aggressive form of slow static stretching.
- Useful in helping to attain a greater range of movement.
- This is because an external resistance, such as partner or apparatus, aids this type of stretch.
- For example, it is possible to increase the range of motion for the sit and reach stretch. A partner places their hands on the performer's middle back region and gently pushes forward to increase the range of movement.
- When using a partner it is imperative that no jerky or bouncing force is applied to the stretched muscle.
- The stretch is held at the increased end point for a few seconds.
- The stretch must feel comfortable and so must stop if the muscle is stretched to a point of pain.

Ballistic stretching:

- Involves vigorous, rapid, bouncing or swinging movements during which the contraction of the agonist forces the antagonist to relax.
- Is recommended towards the end of the mobility session because of its vigorous nature and risk of muscle tear injury.
- Fails to allow the stretched muscle time to adapt to the stretched position and instead may cause the muscle to tighten up by repeatedly triggering the stretch reflex.

When using all forms of stretching it is important to:

- Stretch both agonists and antagonists to maintain muscle equilibrium.
- Select a range of stretches that stretch all joints and associated muscles, tendons and ligaments.
- Breathe slowly and easily while stretching.

- 9) b) Your PE group has been asked to devise a running training schedule for an elite 1500m runner. Using your knowledge of both intermittent and continuous training methods show how you could use this information to produce both aerobic and anaerobic adaptations. 8 marks

Answer

Intermittent training:

- Is also known as **interval** training and can be manipulated by using the following variables:
- **Duration** of the exercise period.
- **Intensity** of the exercise period.
- Number of **repetitions** (reps) within a set.
- Number of **sets** within a session.
- Duration of the rest interval (rest relief) or **recovery**.

Our 1500 m athlete would benefit from the following track interval sessions:

- **Lactate acid intervals** increase lactate tolerance.
- Working between medium to high intensity effort i.e. 60-80% of maximum effort.
- Lasting between 30-90 seconds.
- For example, 3 sets x (8 reps x 200m) with 30 seconds rest relief between reps and 5 minutes rest relief between sets.
- **Frequency** of sessions at least 3 times per week to benefit from anaerobic adaptations.
- **Aerobic intervals** increase aerobic capacity or $\dot{V}O_{2max}$.
- Working at low intensity effort i.e. below 50% of maximum effort.
- For example, 6 reps x 2000m with 3 minutes recovery.

Continuous training:

- Involves continuous activity in which there is **no rest or break**.
- Is normally associated with developing aerobic capacity ($\dot{V}O_{2max}$).
- Recommended intensity should be between 60-75% of maximum heart (HR_{max}).
- For example, **session 1**: 45 minute steady run at 65% of HR_{max} , **session 2**: 3 km run – 1st km steady at 60% of HR_{max} , 2nd km 70% HR_{max} and 3rd km 75% HR_{max} .
- Frequency of sessions at least 3 times per week to benefit from aerobic adaptations.

- 10) b) Justify the content of your training programme for an elite 1500m runner, with regard to the expected respiratory adaptations. 8 marks

Answer

Expected respiratory adaptations resulting from the interval and continuous sessions would be:

- *Improved strengthening of respiratory muscles* would enable athlete to train for longer.
- *Increased pulmonary blood flow*, particularly to upper lobes of lungs, and hence greater utilisation of *alveoli* would increase gaseous exchange and $\dot{V}O_{2max}$.

The major training adaptations noted during maximal or high intensity sessions are:

- *During a maximal training session, such as during the lactate interval session, long-term adaptations would result from increased breathing rates and increased gaseous exchange.*
- *Resulting in a large increase in minute ventilation.*
- *These adaptations would enable the athlete to increase intensity of training session by delaying the onset of blood lactate accumulation (OBLA) because more oxygen would be available for tissue site respiration.*
- *During submaximal workloads, such as during the 45 minute run, breathing rate and $\dot{V}O_{2max}$ would be less because of greater efficiency of respiratory musculature.*
- *Greater O_2 uptake and increase in lung volumes such as tidal volume.*
- *The $a-\bar{v}O_{2diff}$ would increase with training, reflecting greater oxygen extraction by the tissues and more effective blood distribution to the active tissues.*
- *Frequency of training sessions would ensure that the respiratory system was stressed sufficiently to ensure that the above adaptations occurred.*