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## 5.5 Module 2566: Exercise and Sport Physiology and the integration of knowledge of principles and concepts across different areas of Physical Education



C3.1a C3.1b C3.2 C3.3

LP3.1, PS3.3;

### 5.5.1 Introduction.

This module builds on the knowledge and understanding gained by applying the principles that the candidates have learned about how the body performs and responds to physical activity (Module 2562 Section A). Exercise Physiology looks at how the structure and function of the body changes as a result of exercise. Sport Physiology applies concepts from Exercise Physiology with the aim of enhancing sports performance through training. Therefore, the focus of study is on how a candidate may improve their own physical performance and that of others. This involves the measurement, appraisal and critical analysis of performance, and the application of Exercise and Sport Physiology concepts, in order to formulate a plan of action for improvement. Candidates are able to relate their knowledge and understanding to the performance of elite athletes involved in global competition, and to start to consider the ethical questions surrounding performance enhancement. Application consists of a synthesis of theory and practice as reflected in the aims and objectives of the specification, together with exemplars to illustrate links between physical performance and theoretical study.

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### 5.5.2 Candidate's Learning Experience

Candidates should gain knowledge and understanding as a result of involvement in, and a reflection on, practical experiences. These experiences are recorded during the A2 half of the Advanced GCE course, building an even greater awareness of the interaction between the theory and practice of Physical Education explored in the AS. This process also helps the candidate to prepare for the synoptic assessment in Unit 2566 (Section B) and in Unit 2567. The tables in Section 5.5.5 provide examples of possible learning experiences.

### 5.5.3 Unit Assessment

Candidate's knowledge and understanding of module 2566 is assessed in Unit 2566 Section A, where a candidate answers one compulsory question. (15 marks). The question is structured into a series of short sub-questions. Candidates may be required to interpret and to sketch graphs and diagrams. The use of technical language is expected.

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### 5.5.4 Module Content

Analysis should relate to the activities that the candidate has chosen for their practical assessment.

#### Energy Concepts

- Definitions of energy, work and power and the units they are expressed in. Forms of energy to include chemical, kinetic and potential.

#### ATP

The role of ATP. The breakdown and re-synthesis of ATP. The principle of coupled reactions and exothermic and endothermic reactions.

**The following concepts of ATP re-synthesis, the energy continuum, the recovery process and principles of training should be applied to the practical implementation of each fitness component.**

#### ATP Re-synthesis

Knowledge of the three energy systems; ATP/PC (alactic) the lactic acid system and the aerobic system. Detail required to include the type of reaction (aerobic or anaerobic), the chemical or food fuel used, the specific site of the reaction, the controlling enzyme, energy yield, specific stages within a system, and the by-products produced. Candidates are **not** expected to know the detailed pathways of each energy system, but to have a basic overview of each system and the contribution that it makes when related to the duration and intensity of exercise.

#### Energy Continuum

- The predominant energy system used related to the type of exercise (duration and intensity), and the inter-changing between thresholds during an activity (for example, the onset of blood lactate accumulation /OBLA). The effect of level of fitness, availability of oxygen and food fuels, and enzyme control on energy system used.

### **The Recovery Process**

- Returning the body to its pre-exercise state. The oxygen debt/excess post exercise oxygen consumption (EPOC), both the alactacid and lactacid debt components, to include the processes that occur and the duration of each component. Replenishment of myoglobin stores and fuel stores and the removal of the carbon dioxide. Implications of recovery process to be considered when planning training sessions, for example training intensities, work/relief ratios.

### **Principles of Training**

Overload, progression, specificity and reversibility, moderation and variance. The physiological implications of a warm-up and cool-down (for example, reduce the delayed onset of muscular soreness - D.O.M.S.). Periodisation of training to include the macro, meso and micro cycle. The planning and development of a personal fitness programme for one of the candidate's chosen practical activities.

### **Components of Fitness**

- It is essential that candidates evaluate their own level of fitness and that of other students within the group. Candidates need to analyse the fitness demands of their own chosen activities and plan a programme of improvement that they can then follow. This enables candidates to re-evaluate their level of fitness at a later date and to appraise the effectiveness of their training programme. They are also more aware of the physiological adaptations that have occurred as a result of training.

### **Aerobic Capacity**

- Provide a definition of aerobic capacity and be aware of how an athlete's  $VO_2$  max. is affected by individual physiological make-up, training, age and sex.
- Identify and carry out methods of evaluating aerobic capacity (for example, multi-stage fitness test, PWC170 test). A candidate should assess their own  $VO_2$  max. and match their result against the aerobic demand of their chosen activities.
- Identify and perform different types of training used to develop aerobic capacity - continuous running, repetition running, fartlek and interval training. Use of target heart rates as intensity guide.
- Identify the energy system and food/chemical fuels used during aerobic work.
- Identify physiological adaptations that take place after aerobic training, for example, increase in stroke volume.

Candidates should plan a programme of aerobic training based on (a) their own assessment of their aerobic capacity and (b) the requirements of their activity.

### Strength

- Provide definition of types of strength to include strength endurance, maximum strength, explosive/elastic strength, static and dynamic strength. Be aware of the factors that affect strength, for example, fibre type and cross sectional area of the muscle. Identify and carry out methods of evaluating each type of strength, for example, grip strength dynamometer.
- Identify and perform different types of training used to develop strength. The repetition, sets and resistance guideline's used to improve each type of strength. Use of multi-gym, weights, plyometrics and circuit /interval training (work intensity: work duration: relief interval: number of work/relief intervals).
- Identify the energy system and food/chemical fuels used during each type of strength training.
- Identify physiological adaptations that take place after training, to include neural and physiological changes to skeletal muscle.

Candidates should plan a programme of strength training based on (a) their own assessment of their strength and (b) the strength requirements of their activity.

### Flexibility

- Provide definition of flexibility to include static and dynamic flexibility. Be aware of the factors that affect flexibility, for example, type of joint, length of surrounding connective tissue.
- Identify and carry out methods of evaluating flexibility, for example, sit and reach test, or goniometer (angle measure).
- Identify and perform different types of training used to develop flexibility to including static (active and passive), ballistic and Proprioceptive neuromuscular facilitation (PNF).
- Identify physiological adaptations that take place after training, to include physiological changes to skeletal muscle and connective tissue.

Candidates should plan a programme of flexibility training based on (a) their own assessment of their flexibility and (b) the flexibility requirements of their activity.

### Body Composition, Balance, Co-ordination, Agility, Reaction Time and Speed

- These components do not have to be studied in as great a depth, but a definition and method of evaluation of each is needed. A candidate should be aware of the contribution of each of these components to their chosen practical activities, and where appropriate, how they might improve each component.

### **Fitness testing:**

**Note that maximal testing is not always appropriate and care should always be taken to screen participants before any fitness testing, for example, use of Physical Activity Readiness Questionnaire/PARQ). It is also important to ensure that the test protocol and guidelines are strictly followed. Teachers should refer to 'Safe Practice in Physical Education' by the Physical Education Association and BAALPE.**

### **Performance Enhancement**

#### **Ergogenic aids**

- An ergogenic aid is any substance that enhances performance. Candidates need to be aware of current methods of performance enhancement. Candidates should know the effects of the aid being used and which athletes would benefit from its use.
- Aids should include:
  - use of dietary manipulation (for example, carbo-loading), pre/post competition meals and food/fluid intake during exercise ( nutritional );
  - use of creatine supplements ( nutritional );
  - blood doping and Rh EPO/ recombinant erythropoietin ( physiological );
  - use of nasal strips.
- Other aids can be considered and candidates should already have prior knowledge of the effects of alcohol, caffeine and anabolic steroids.

### 5.5.5 Module 2566: Examples of Learning Experiences

The following tables highlight a progressive approach to the development of knowledge, understanding and application by the candidate.

**Required Knowledge:** The recovery process

| Theoretical learning experience   | Practical learning experience   |
|---|---|
| List the changes that take place within the muscle as a result of exercise, for example, an increase in lactic acid.<br><i>(acquire)</i>  | Monitor heart rate after you have completed a practical lesson and record how long it takes for the heart rate to return to normal.<br><i>(acquire)</i>   |
| Identify the endothermic reactions that need to take place in order to return the body to its pre-exercise state.<br><i>(acquire, apply)</i>  | Compare results within the group and suggest reasons why some people recover quicker than others.<br><i>(acquire, apply, evaluate)</i>  |
| Predict what would happen to phosphocreatine stores, glycogen stores and the amount of lactic acid in the muscle tissue during a circuit training session. Use the test books available to evaluate your answer.<br><i>(acquire, apply, evaluate)</i> | As a group perform a series of shuttle runs with a variety of recovery times. Use your results to determine the optimum recovery time needed to maintain performance times.<br><i>(acquire, apply, evaluate)</i>                        |
| Discuss the implications of recovery times on the planning and implementation of different types of training programmes.<br><i>(acquire, apply, evaluate, appreciate)</i>   | Identify the opportunities that exists within your chosen practical activity for either full or partial recovery. Suggest strategies/tactics to increase the opportunity for recovery.<br><i>(acquire, apply, evaluate, appreciate)</i> |

**Required Knowledge:** Aerobic capacity

| Theoretical learning experience  | Practical learning experience  |
|--|--|
| Define the term 'aerobic capacity' and identify typical values for VO <sub>2</sub> max in relation to age, gender and fitness.<br><i>(acquire)</i>                               | Measure your aerobic capacity. Compare your VO <sub>2</sub> max with others in the group.<br><i>(acquire)</i>  |
| Suggest reasons why VO <sub>2</sub> max values differ in relation to age, gender and fitness.<br><i>(acquire, apply)</i>   | Identify and attempt a suitable method of training to improve your aerobic capacity, in line with the requirements of your chosen practical activity.<br><i>(acquire, apply)</i>   |
| Predict physiological adaptations that may take place after a period of aerobic training. Use available text books to evaluate your answer.<br><i>(acquire, apply, evaluate)</i> | Work out your training target heart range. Monitor a training session and appraise your training intensity.<br><i>(acquire, apply, evaluate)</i>   |
| Discuss the varying contributions of each energy system during a fartlek training session.<br><i>(acquire, apply, evaluate, appreciate)</i>                                      | Plan and implement a training programme to improve your own aerobic capacity in line with the requirements of your chosen practical activity. Re-evaluate your aerobic capacity to determine the effectiveness of your programme.<br><i>(acquire, apply, evaluate, appreciate)</i> |

**Required Knowledge:** Performance enhancement: the use of RhEPO

| <b>Theoretical learning experience</b>  | <b>Practical learning experience</b>  |
|---|---|
| Briefly outline what EPO is and how it enhances performance.<br><br><i>(acquire)</i>  | Identify activities that rely heavily on the aerobic system and therefore athletes who might consider using this performance aid.<br><br><i>(acquire)</i>     |
| Compare the use of EPO with the results gained from blood doping and altitude training.<br><br><i>(acquire, apply)</i>              | Identify a governing body of sport that are trying to deter the use of RhEPO and highlight the problems they are experiencing.<br><br><i>(acquire, apply)</i> |
| Explain why the use of RhEPO has resulted in the death of some athletes.<br><br><i>(acquire, apply, evaluate)</i>                   | Why is it so difficult to accurately test the use of EPO in endurance events?<br><br><i>(acquire, apply, evaluate)</i>  |
| Discuss the ethical and health issues that are associated with the use of EPO.<br><br><i>(acquire, apply, evaluate, appreciate)</i> | Discuss the effectiveness of random blood tests to deter the use of RhEPO.<br><br><i>(acquire, apply, evaluate, appreciate)</i>                               |