PROVISIONAL

DELIVERY GUIDE

Theme: Energy for Exercise

July 2015

A Level Physical Education

A LEVEL REFORM

OCR
Oxford Cambridge and RSA

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CONTENTS

Introduction

Delivery guides are designed to represent a body of knowledge about teaching a particular topic and contain:

- Content: A clear outline of the content covered by the delivery guide;
- Thinking Conceptually: Expert guidance on the key concepts involved, common difficulties students may have, approaches to teaching that can help students understand these concepts and how this topic links conceptually to other areas of the subject;
- Thinking Contextually: A range of suggested teaching activities using a variety of themes so that different activities can be selected which best suit particular classes, learning styles or teaching approaches.

If you have any feedback on this Delivery Guide or suggestions for other resources you would like OCR to develop, please email resourcesfeedback@ocr.org.uk.

KEY

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Curriculum Content

Candidates will develop their knowledge and understanding of the roles of the three energy systems in the performance of exercise of differing intensities and durations and during recovery.

Topic Area

Adenosine triphosphate (ATP) and energy transfer

Details

- ATP as 'energy currency'
- principle of energetically coupled reactions:
  - breakdown of ATP to ADP (adensosine diphosphate) + P (phosphate)
  - resynthesis of ATP from ADP + P

Topic Area

Energy systems and ATP resynthesis

Details

- energy systems:
  - ATP-PC (phosphocreatine) system
  - glycolytic system
  - aerobic system
- for each system:
  - type of reaction (aerobic or anaerobic)
  - chemical or food fuel used
  - specific site of the reaction
  - controlling enzyme
  - ATP yield
  - specific stages within the system
  - by-products

Curriculum Content

Topic Area

ATP resynthesis during exercise of differing intensities and durations

Details

- energy continuum
- predominant energy system used during exercise:
  - how intensity and duration of exercise influence which energy system is predominantly used to resynthesise ATP
  - interpretation of figures relating to the contribution of the three energy systems to exercise of different intensities and durations
- interplay of energy systems during intermittent exercise and factors that affect this interplay
  - intensity of exercise
  - duration of exercise
  - recovery periods
  - fitness levels

Curriculum Content

Topic Area

The recovery process

Details

- how the body returns to its pre-exercise state:
  - excess post exercise oxygen consumption (EPOC)
- rapid components of EPOC, the processes that occur and the duration:
  - replenishment of blood and muscle oxygen stores,
  - resynthesis of ATP and PC
- slow components of EPOC, the processes that occur and the duration:
  - elevated circulation
  - elevated ventilation
  - elevated body temperature
  - lactate removal and conversion to glycogen
- effect of exercise intensity on EPOC and implications of the recovery process for planning exercise or training sessions

Thinking Conceptually

Approaches to teaching the content

This unit will develop knowledge and understanding of the roles of the three energy systems in the performance of exercise of differing intensities and durations and during recovery. The crucial role of adenosine triphosphate (ATP) is explored within this topic area. This should be taught as visually and practically as possible, and can include video clips, experiments and role plays. The biological nature of this topic, and the specialist terminology, can cause some angst amongst learners and practical activities can help them to understand the content quicker. The initial focus should be on the key characteristics of ATP and its role in movement, and this area must be consolidated before introducing the three energy systems. There are a plethora of video clips that can be utilised to introduce ATP.

The three energy systems can be introduced through the observation of a range of sports, for example, the triple jump for the ATP-PC system; the 400 metres for the Lactic Acid system and the Marathon for the Aerobic system (don't show all of it!). It is important that learners become clear that one energy system will usually be the predominant one, but that all will be contributing. Sports in which all three systems are important can then be considered, with particular focus on getting the learners to identify the situations within the sport when each one is predominant (for example, in Tennis the aerobic system will be predominant between points and during the changeovers).

Common misconceptions or difficulties students may have

The biological nature of this topic area can be a cause for concern for learners. Some learners initially struggle with the complex terminology of this topic area, and it is important that they are encouraged to use this terminology regularly in order to build their confidence. Regular testing can be used during starter activities and plenary activities to ensure that learners become familiar with the meaning of key words and their role within the energy systems (adenosine triphosphate, creatine phosphate, ATPase, creatine kinase, glycolysis, electron transport chain, etc). Spelling tests can be used to develop literacy skills and fully embed the vocabulary.

Conceptual links to other areas of the specification – useful ways to approach this topic to set students up for topics later in the course

If the learners gain a thorough understanding of this topic area it will enable them to gain a quick understanding of the Energy Continuum topic which follows. Understanding 'when' an energy system is predominant is important, and also 'why' it is predominant. The energy systems can also be linked with the components of fitness section of the syllabus. For example, linking the ATP-PC system with explosive strength, the Lactic Acid system with dynamic strength or muscular endurance, and the aerobic system with VO2 Max. This can then link with training methods, with learners required to have an understanding of how to develop and train each energy system, for example, undertaking plyometric training to improve the ATP-PC system or circuit training to improve the lactic acid system.

ACTIVITIES

The importance of adenosine triphosphate (ATP) to muscular contractions can be taught in many, fun interactive ways. Getting the learners to be active and undertaking the roles of the chemicals can really bring this topic to life and generate enthusiasm within the class (Learner Activity 1, 2 and 3).

Practical sessions should be used to allow the learners to experience a variety of activities in which a particular system is more likely to be predominant (Learner Activity 4, 5 and 6).

A significant focus should be given upon getting the learners to be familiar and confident at using the key terminology. This can be done through a range of written and verbal activities (Learner Activity 8, 9 and 10). This can also allow for literacy skills to be highlighted with spelling tests at the start of lessons.

The complex nature of this topic can be simplified by breaking each energy system down into the key characteristics (as required by the syllabus). Regular testing as part of starter or plenary activity should be conducted and self and peer assessment (Learner Activity 7).

Learners can be directed to external activities that they can access for further guidance and consolidation of learning. Interactive activities for the energy systems can be accessed by registering on to the following website:

Mypeexam website

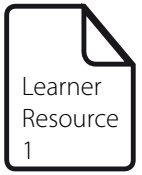
www.mypeexam.org

An interactive website containing video tutorials and interactive quizzes covering the PE syllabus.

Thinking Contextually

Activities	Resources
Learner Activity 1 **ATP** This activity will involve the learners performing a role play of the breakdown of ATP to produce movement. Get four learners together, give them three blue bibs and one red bib and three balloons. Tell them to turn themselves into a visual representation of ATP. The rest of the class can contribute and help during this initial task, with teacher input where and when necessary. The expected result will be one learner wearing the red bib (adenosine) and 3 learners wearing blue bibs (phosphates). They should be closely linked and a balloon being held between each connection. The balloon with the most air in should be held between the 2nd and 3rd phosphates to represent the high energy. One learner should be acting as a sports performer who needs the energy to perform a press-up, but is told not to do so until the energy has been released. Another learner will be acting the role of ATPase, and will pop the balloon between the second and third phosphates, releasing the energy (and the third phosphate) and allowing the press up to be performed. This will then leave ADP and P.	
Learner Activity 2 **ATP** This activity provides a fun and practical starter activity and follows from Learner Activity 1, but this time the learners are performing the role play without any teacher support. Coloured bibs and balloons are provided and they work in groups of approximately six (1x adenosine, 3 x phosphates, 1 x ATPase, 1 x sports performer). The teacher will observe and ask questions of each learner during the activity, for example, 'what are you and what is your role?' etc.	
Learner Activity 3 **ATP-PC System** This activity will further develop the previous activity on ATP and will focus on resynthesis. In addition to the roles required in Learner Activity 1, there will also be phosphocreatine (1 x phosphate and 1 x creatine) and creating kinase. A further two students will represent PC and another will represent creatine kinase. The process will start exactly as Learner Activity 1 did, but will continue with the involvement of PC. Upon the breakdown of ATP, the learner performing the creatine kinase role will pop the balloon between PC and the P will join the ADP to resynthesize ATP.	

Thinking Contextually

Activities	Resources
Learner Activity 4 **ATP-PC practical** The learners will experience a range of sporting situations in which this energy system will be predominant. This can be any action in which the learner is working maximally and for a duration of between 3-10 seconds. Examples of activities can include: 40 metre sprint, long jump, badminton rally, plyometric session, etc.	
Learner Activity 5 **Lactic Acid system practical** The learners will experience a range of sporting situations in which this energy system will be predominant. This can be any action in which the learner is working at a high intensity and for a duration of between 10-180 seconds. Examples of activities can include: 400 metres, 60 seconds press-ups, basketball game, circuit training session, etc.	
Learner Activity 6 **Aerobic system practical** The learners will experience a range of sporting situations in which this energy system will be predominant. This can be any action in which the learner is working at a low-moderate intensity and for a duration of more than three minutes. Examples of activities can include: jogging, cycling, etc.	
Learner Activity 7 **Review** A regular starter or plenary activity can be used to test the learners' knowledge of the key characteristics of each energy system. The assessment table in Learner Resource 1 should be used, and the learners can work in pairs to complete this.	

Thinking Contextually

Activities	Resources
Learner Activity 8 **Key terminology** The learners will be given a set of key word cards and required to link the card with the appropriate energy system. For example, the creatine kinase card will be associated with the ATP-PC system. The cards should be placed in to three columns, to represent each of the energy systems.	Learner Resource 2
Learner Activity 9 **The Numbers game** Learners are given a worksheet containing different numbers. Each number can represent an aspect of the energy systems (for example, 10 = the duration of the ATP-PC system). The learners are required to work individually to complete this activity and then share their answers with a partner. It should be noted that some numbers may be representative of more than one possible answer (for example, 2 = the number of ATP resynthesized by the LA system, or alternatively, 2 = the number of ATP resynthesized at the Krebs Cycle stage of the Aerobic system).	Learner Resource 3
Learner Activity 10 **What am I?** This is another activity that will allow learners to demonstrate their understanding of the key terminology of this topic area. They are provided with a worksheet and have to answer each question with the correct terminology.	Learner Resource 4
Learner Activity 11 **Which energy system?** Provide the learners with a range of sports and particular moments from sports, and ask them to identify the predominant energy system. Some obvious examples can be included (such as 60 metre sprint, Marathon, etc) and some less obvious (such as Badminton, Netball, etc). Consideration should be given as to the specific action occurring and the position of the performer if relevant (for example, a goalkeeper in football as opposed to a midfielder).	

Learner Resource 1

See Page 11

Exercise Physiology – Energy Systems Review

	ATP/PC	Lactic Acid	Aerobic
Alternative name			
Type of reaction			
Chemical or fuel			
Site of reaction			
Controlling enzymes			
Energy yield			
Specific stages			
By-products			
Duration			
Intensity			
Examples of typical athletic events			
Examples of typical games activities			

Learner Resource 2

See Page 12

Keyword Cards

PHOSPHOCREATINE	GLYCOGEN	FAT
LACTIC ACID	CARBON DIOXIDE	OXYGEN
VERY HIGH INTENSITY	HIGH INTENSITY	LOW-MODERATE INTENSITY
1 ATP	2-3 ATP	38 ATP
HIGH JUMP	400 METRES	MARATHON
10 SECONDS	2-3 MINUTES	SEVERAL HOURS
ANAEROBIC	ANAEROBIC	AEROBIC

Learner Resource 3

See Page 12

Energy Systems – The Numbers Game!

What could each of these numbers represent?

38	
10	
2	
180	
2	
30	
1	
2-3	

Learner Resource 4

See Page 12

What Am I?

I am the only useable form of energy in the human body.	
I am the enzyme that breaks down ATP.	
I am a by-product of the aerobic system that is easily removed.	
I am the part of the muscle where Glycolysis takes place.	
I am the enzyme that breaks down Creatine phosphate.	
I am the third stage of the aerobic system.	
I am the enzyme that breaks down Glycogen.	
I am the part of the muscle where stages 2 and 3 of the aerobic system takes place.	
I am the enzyme that breaks down Glucose.	
I am a fuel that can be broken down by the aerobic energy system but I require more oxygen.	
I am the second stage of the Aerobic system.	
I am a chemical reaction that releases energy as it progresses.	
I am the fatiguing by-product of the second energy system.	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ocr.org.uk/alevelreform

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