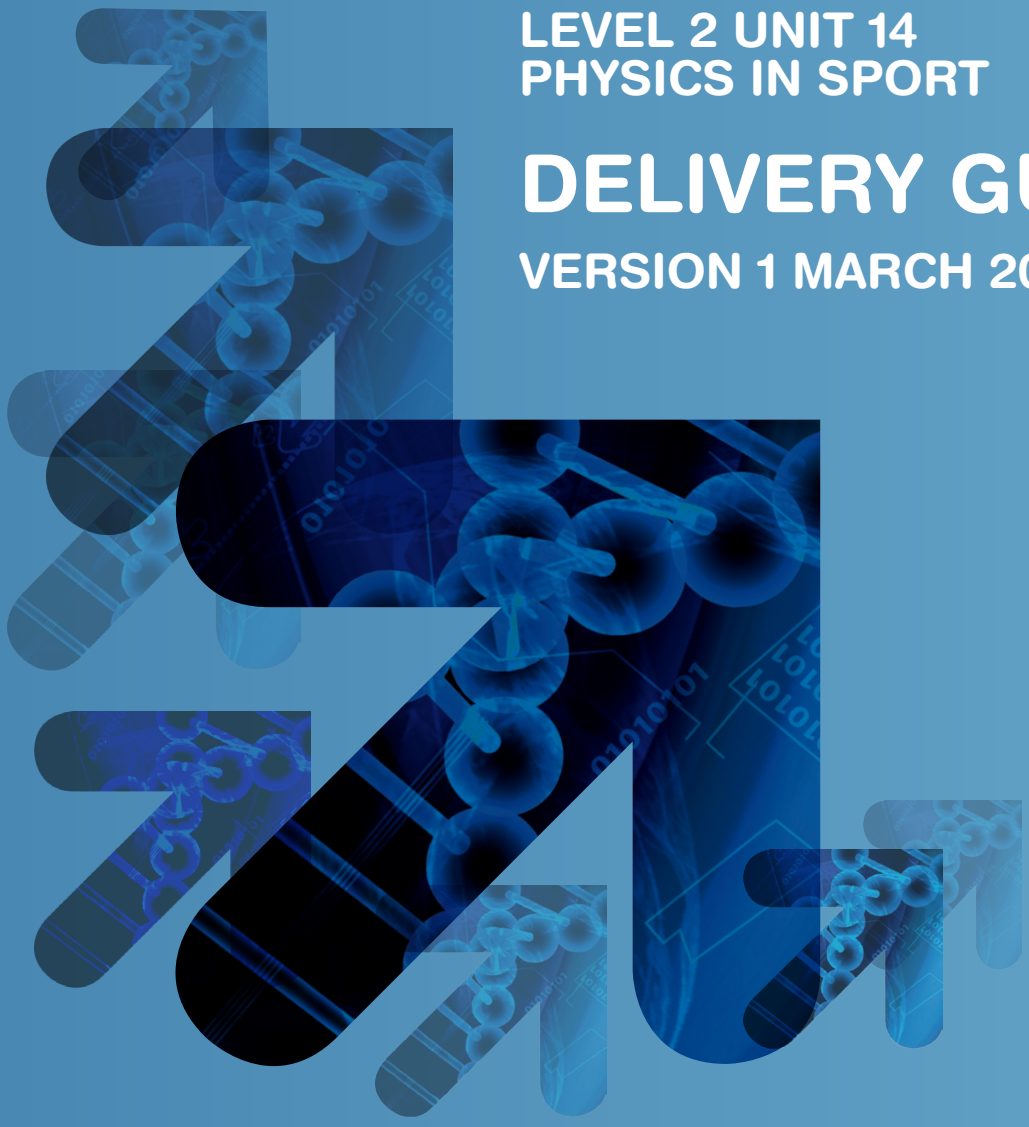
Cambridge TECHNICALS

Accredited

OCR LEVEL 2 CAMBRIDGE TECHNICALS IN SCIENCE



LEVEL 2 UNIT 14 PHYSICS IN SPORT

DELIVERY GUIDE

VERSION 1 MARCH 2014

OCR
Oxford Cambridge and RSA

CONTENTS

To give us feedback on, or ideas about the OCR resources you have used, email resourcesfeedback@ocr.org.uk

INTRODUCTION

This Delivery Guide and Plan has been developed to provide practitioners with a variety of creative and practical ideas to support the delivery of this qualification. The Guide is a collection of lesson ideas with associated activities, which you may find helpful as you plan your lessons. The Plan offers one way to deliver this unit, with suggestions on how many lessons to spend on a particular topic and the resources you could use.

OCR has collaborated with current practitioners to ensure that the ideas put forward in this Delivery Guide are practical, realistic and dynamic. The Guide is structured by learning outcome so you can see how each activity helps you cover the specification.

We appreciate that practitioners are knowledgeable in relation to what works for them and their learners. Therefore, the resources we have produced should not restrict or impact on practitioners' creativity to deliver excellent learning opportunities.

Whether you are an experienced practitioner or new to the sector, we hope you find something in this guide which will help you to deliver excellent learning opportunities.

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.

PLEASE NOTE

The activities suggested in this Delivery Guide MUST NOT be used for assessment purposes. (This includes the Consolidation suggested activities).

The timings for the suggested activities in this Delivery Guide DO NOT relate to the Guided Learning Hours (GLHs) for each unit.

Assessment guidance can be found within the Unit document available from www.ocr.org.uk.

The latest version of this Delivery Guide can be downloaded from the OCR website.

OPPORTUNITIES FOR ENGLISH AND MATHS DEVELOPMENT

The Wolf Review of Vocational Education recommended that all learners studying post-16 qualifications have the opportunity to further develop their English and maths skills, with the aims of:

- achieving a GCSE in English and/or maths at grade A*-C if they have not already done so or
- making significant progress towards GCSE entry and success if this is some way off for the individual.

We believe that being able to make good progress in English and maths is essential to learners in both of these contexts and on a range of learning programmes. To help you enable your learners to progress in these subjects, we have signposted opportunities for English and maths skills practice within this resource. These suggestions are for guidance only. They are not designed to replace your own subject knowledge and expertise in deciding what is most appropriate for your learners.

OPPORTUNITIES FOR WORK EXPERIENCE

The Wolf Report also recommended that learners have the opportunity to apply their skills and extend their learning outside the classroom through work experience, part time jobs, work shadowing and work placements. There are lots of opportunities within these qualifications to take some of the teaching and learning outside of the classroom and into a work environment. We are working to provide you with resources to support you in achieving this, please visit www.ocr.org.uk shortly for more information.

KEY

English

Maths


Work experience

UNIT 14 - PHYSICS IN SPORT

Guided learning hours : 60

Credit value: 10

PURPOSE OF THE UNIT

Participation in sport involves applying knowledge of the effect of forces. In some sports forces are used to cause an effect and in others they have to be overcome or compensated for in some way. The equipment used to improve performance, in some sports, has often been developed by using an understanding of the way in which forces behave.

This unit considers some of the ways in which forces affect the motion of objects that are involved in different sporting activities. Learners will discover how understanding the effects that forces have on moving objects can assist the trainers of professional athletes and participants in sport such as archery, swimming, cycling, tennis, cricket and rowing to maximise their attainment.

Learning Outcome The learner will:	Assessment Criteria The learner can:	Merit	Distinction
1 Understand the application of levers in sport.	P1 Apply knowledge of the science of levers to levers used in sporting situations	M1 Explain how changing the position of the load and effort changes the mechanical advantage of a lever, and how this is applied in sport	
2 Know that forces affect the movement of objects in sport.	P2 Describe the different forces that affect the movement of objects in sport	M2 Describe how the resultant force affects the movement and speed of objects in sport	D1 Analyse the link between force and rate of change of speed in different sporting contexts
3 Know how to vary the effect of friction on moving objects.	P3 Describe the effect of streamlining an object and the different methods used in sport	M3 Apply knowledge of streamlining to a practical application in sport and justify how this could improve performance	
4 Know how physics can be used to predict and improve techniques in sport.	P4 Describe conditions that make a moving object change its speed or the direction in which it moves	M4 Describe how the path of an object, moving at a constant speed on a frictionless surface, can be predicted	D2 Describe how the independence of the vertical and horizontal motions of an object moving under the influence of gravity results in a parabolic path

P = Pass, M = Merit, D = Distinction

INTRODUCTION TO THE UNIT

Suggested content	Suggested Activities	Suggested timings	Links to Assessment Criteria
Introduction to the unit	The tutor could introduce the unit to learners using the introductory PowerPoint	5 minutes	
	Learners could watch a video this video of a sports technologist talking about their job (www.nationalstemcentre.org.uk/elibrary/resource/1039/sports-technologist) and/or read the Physics and Sport article from the Institute of Physics (www.iop.org/resources/topic/archive/sport/index.html). From these materials learners could list the range of different applications of physics in sport, and groups could then be assigned different sports and identify how these different applications could be used to monitor and improve performance in their given sport.	15-30 minutes	
	Learners could watch the 'A *brief History of Science*' video from the Royal Institute channel (www.richannel.org/collections/2012/engineering-sport#/a-brief-history-of-sport) as an introduction to carrying out some research and constructing a timeline of how scientific and technological advances have changed how we play sport through time. This could be done individually or individuals/groups could be tasked with researching particular time periods and a timeline could be constructed during a class discussion. Alternatively, the video could be used as stimulus for a class debate on whether using technology in sport could represent cheating (e.g. the debate around whether Paralympic sprinters can compete in Olympic running events or whether their blades give them an unfair advantage and the debate around length of blades used by different Paralympic runners; the debate around the use of high performance swimming costumes in the Olympics; potential issues with the use of high performing materials in things like tennis rackets, pole vaulting poles, javelins etc.).	30 minutes - 1 hour	
	The journal article 'A physics heptathlon: simple models of seven sporting events' (http://iopscience.iop.org/0031-9120/45/6/003?fromSearchPage=true) provides background information and worked examples of the physics content of this unit. While the physics included extends beyond the level expected of learners in this unit, tutors may find this useful in terms of the examples given and extension possibilities.	Reference	
	As an introduction to the unit, learners could use a spring balance or newtonmeter to measure the downward force on objects that have a known mass. The data collected could be tabulated and analysed using graphical and/or mathematical techniques to establish that the force, in newtons, with which gravity pulls an object downwards, can be calculated by multiplying its mass, in kilogrammes, by 10.	30 minutes	
	Learners could carry out a visit to a gym/sports centre in order to get them thinking about physics in sport. While carrying out the visit learners could make notes of examples where physics is used in sport and this could be followed up with a group discussion. Additionally, learners could speak to a gym instructor to discuss the different techniques they employ to improve people's techniques in the gym. This could then be followed up with the learners carrying out further research into some of the difference areas brought up during discussion.	2-3 hours	Work experience

LEARNING OUTCOME 1 – UNDERSTAND THE APPLICATION OF LEVERS IN SPORT

Learning Outcome The learner will:	Assessment Criteria The learner can:	Merit	Distinction
1 Understand the application of levers in sport	P1 Apply knowledge of the science of levers to levers used in sporting situations	M1 Explain how changing the position of the load and effort changes the mechanical advantage of a lever, and how this is applied in sport	

Suggested content	Suggested Activities	Suggested timings	Links to Assessment Criteria
1 Introduction to levers	Learners could, by working individually, identify scenarios in sport where objects are made to turn or rotate. They could then continue, using a combination of prior knowledge and research to identify the mechanism that causes the rotation. Through the medium of small group discussion learners could then try to identify what all the mechanisms identified have in common, leading to an understanding that forces can produce a turning effect.		
2 Levers in the body	Learners could complete this worksheet as a simple introduction to identifying different classes of levers in the body (www2.mbusd.org/staff/pware/labs/LeversBody.pdf)	20 minutes	P1
3 Levers in the body and sport	Learners could quantitatively explore the effects of changing the position of a load in relation to a lever by building a model arm and testing the 'effort force' required to lift a fixed load placed at different positions along the 'arm'. Activity sheets can be found on pages 44-46 of this University of York Science Education Group activity book (on pages 56-58 of the pdf, (www.nationalstemcentre.org.uk/elibrary/resource/3812/sports-science; free registration required).		P1, M1
4 Levers in the body and sports equipment	Learners could carry out some research to identify the range of levers within the body used within certain sports and certain exercises. [e.g. 1st class levers – butterfly rig, hand grippers some rowing machines; 2nd class levers - chest press, shoulder press, push ups and leg lifts – the body acts as a lever; 3rd class levers – baseball bats, tennis racquets, golf clubs, boat paddles, leg extensions and hamstring curls where the body acts as a lever.] Learners could then design a targeted exercise regime making use of first, second and third class levers to improve the performance of a sports person in a particular aspect of their sport. Alternatively, learners could design a piece of fitness equipment that makes use of levers to target a specific area of the body. Learners could then present their findings as an online information leaflet, webpage etc.	1 hour	P1, M1
5 Levers and improving sport techniques	Learners could create a guide for a particular sport of their choice which explains how a technique can be improved through understanding of different types of levers and the relationship between the position of the load and the effort required. This would involve the learners carrying out some research via the internet. The guide could be presented in any format such as a blog, PowerPoint presentation, leaflet etc.	1 hour	P1, M1

LEARNING OUTCOME 2 – KNOW THAT FORCES AFFECT THE MOVEMENT OF OBJECTS IN SPORT.

Learning Outcome The learner will:	Assessment Criteria The learner can:	Merit	Distinctiion
2 Be able to describe the factors that govern the rate and yield of a chemical process	P2 Describe the different forces that affect the movement of objects in sport	M2 Describe how the resultant force affects the movement and speed of objects in sport	D1 Analyse the link between force and rate of change of speed in different sporting contexts

Suggested content	Suggested Activities	Suggested timings	Links to Assessment Criteria
1 Introduction to forces in a sporting context 	As an introduction to forces in a sporting context, learners could work through the introductory forces section of the OUP Health and Physical Education chapter 'Applying biomechanics to sport' (pages 85-89 and complete the Questions on page 89 (actually pages 14-19 in the pdf) www.oup.com.au/titles/secondary/health__and__physical_education/physical_education/queensland/9780195573862/03_RUS_QSPE_3pp.pdf)	45 mins - 1 hour	P2
2 Equal and opposite forces	Learners could carry out the Practical Physics activity 'Skateboard forces' to explore the idea that when two bodies interact they exert equal and opposite forces on each other (www.nuffieldfoundation.org/practical-physics/skateboard-forces).	45 mins - 1 hour	P2
3 Making predictions 	Learners could be asked to predict and explain what would happen to a cricket ball or football as it rolls across a flat surface and design a simple experiment to test their prediction. This could lead to the formal teaching that friction is a force that opposes motion and slows down a moving object. Learners could research how friction affects cyclists and swimmers.	1 hour	P2
4 Gravity - friend or foe 	Learners could adopt the role of a participant in a specific sport e.g. ski jumpers, divers, cyclists, high jumpers, shot putters and weight lifters, and in small groups they could debate whether gravity is a friend or foe. Learners could produce a balanced written report of their discussion, which could be supported by additional research from the internet.	1 hour	P2
5 Sporting actions and forces	Learners could observe someone carrying out a sporting action and draw diagrams to represent different stages of the movement and label the different forces acting in different directions (e.g. a high jumper, a discus being thrown etc.). Learners could then identify the direction and of any resultant force acting on the person or object and use their diagrams of later stages of the movement to explore how the resultant force affected the motion and speed of the person or object.	1 hour	M2

Suggested content	Suggested Activities	Suggested timings	Links to Assessment Criteria
6 Using knowledge of forces to improve performance 	After a brief explanation of what a 'force plate' is, learners could watch the Royal Institute channel video which shows how a diving coach uses force plate data to help them feed back to their athletes and improve their movements. (www.richannel.org/collections/2012/engineering-sport#/what-do-i-tell-my-athlete). Learners could then explore how a force plate could be used by a coach in a sport of their choice to provide information about how to improve an individual's performance. This could be supported by additional research from the internet. Learners could present their findings in a variety of different formats e.g. wiki, webpage, online leaflet etc.	1 hour	M2, D1
7 Forces needed to kick a football	Learners could carry out the Practical Physics activity investigating the force used to kick a football (www.nuffieldfoundation.org/practical-physics/force-used-kick-football) in order to explore ways in which the force applied can be calculated.	1 hour	P2, M2, D1

LEARNING OUTCOME 3 – KNOW HOW TO VARY THE EFFECT OF FRICTION ON MOVING OBJECTS

Learning Outcome The learner will:	Assessment Criteria The learner can:	Merit	Distinction
3 Know how to vary the effect of friction on moving objects	P3 Describe the effect of streamlining an object and the different methods used in sport	M3 apply knowledge of streamlining to a practical application in sport and justify how this could improve performance	

Suggested content	Suggested Activities	Suggested timings	Links to Assessment Criteria
1 Mind map of the effect of friction on sports people	Learners could work in groups to create a mind map of the range of situations in which sports people find it useful to increase or to minimise friction and/or air resistance. Learners could then share the range of situations they have identified and create a classification system to group types of solutions that different sports people use (i.e. approaches that change the surface area or shape, approaches that involve changing the texture or materials used for particular surfaces etc.).	30 - 45 minutes	P3, M3
2 Which running shoe has the best grip? 	Learners could examine scenarios where friction is useful in sport. For example, learners could build a 'force measurer' and use this to investigate the grip of the soles of a range of different sport shoes using the activity sheets on pages 5 and 6 of the Museum of Victoria 'Sportsworks' activity pack. (http://museumvictoria.com.au/pages/2613/sportsworks-activities-forces-and-physics.pdf). Learners could then identify different types of sports in which having 'good grip' (or increasing friction) is useful.	1 hour	P3
3 Introduction to air and fluid resistance 	"Learners could be introduced to friction in fluids by, for example, studying small objects of varying shapes and masses falling through a viscous liquid in a tall jar and through air. Learners could be guided to appreciate that an object falls more slowly through the liquid than through air and recognise that increased friction in the liquid is responsible for the difference in behaviour. Learners could carry out the Practical Physics activities 'Falling through air' and 'falling through water' as an introduction to air and fluid resistance (www.nuffieldfoundation.org/practical-physics/falling-through-air www.nuffieldfoundation.org/practical-physics/falling-through-water)	1 hour	P3

Suggested content	Suggested Activities	Suggested timings	Links to Assessment Criteria
4 Air resistance, what a drag!	Learners could investigate the impact of streamlining by carrying out the the 'Air Resistance, what a drag!' activity from pages 2-4 of the Museum of Victoria 'Sportsworks' activity pack. (http://museumvictoria.com.au/pages/2613/sportsworks-activities-forces-and-physics.pdf). In this activity learners build and suspend 3D models of cyclists in upright and racing positions and create a 'mini-wind tunnel' effect using a hair dryer.	1- 2 hours	P3, M3
5 Controversial swimsuits	Learners could research the materials and forms of swimsuits used in the Olympics, through time, and explain the methods that have been developed to improve streamlining and the controversy that this has caused. There is a wide range of information available online e.g.: http://news.bbc.co.uk/sportacademy/hi/sa/swimming/features/newsid_3909000/3909817.stm History of swimwear www.npr.org/blogs/pictureshow/2009/07/the_evolution_of_olympic_swimw.html Pictures of historic and modern swimwear www.nhm.ac.uk/about-us/news/2004/aug/news_4044.html	1 hour	P3, M3
6 Evaluating sporting techniques 	Learners could research and try out a range of techniques for applying spin in bowling a ball or in serving a tennis ball. Learners could then evaluate the different techniques and explore how they affect the air resistance experienced by the ball (for example using '*The Physics of Spin in Sport*' website http://24594.stem.org.uk/index.html). Learners could then explain the science behind the most successful technique in a format designed to help people develop their skills in that sport. Where possible the outcome of this piece of work could then be presented to someone who a coach in the area related to the learners work. This would create an interesting discussion point about the science behind techniques and the reality of coaching sports people.	2 hours	P3 M3

LEARNING OUTCOME 4 – KNOW HOW PHYSICS CAN BE USED TO PREDICT AND IMPROVE TECHNIQUES IN SPORT.

Learning Outcome The learner will:	Assessment Criteria The learner can:	Merit	Distinction
4 Know how the chemical industry maintains a good safety record in the manufacture and transport of chemicals	P4 Describe conditions that make a moving object change its speed or the direction in which it moves	M4 Describe how the path of an object, moving at a constant speed on a frictionless surface, can be predicted	D2 Describe how the independence of the vertical and horizontal motions of an object moving under the influence of gravity results in a parabolic path

Suggested content	Suggested Activities	Suggested timings	Links to Assessment Criteria
1 Independence of vertical and horizontal motion	Learners could carry out one of these Practical Physics activities which demonstrate the independence of vertical and horizontal motion (www.nuffieldfoundation.org/practical-physics/independence-vertical-and-horizontal-motions and www.nuffieldfoundation.org/practical-physics/multiflash-photographs-projectiles)	15 minutes - 1 hour	P4
2 Testing projectile motion 	Learners could carry out the Practical Physics 'testing projectile motion' activity in order to explore how motion under the influence of gravity can be predicted (www.nuffieldfoundation.org/practical-physics/testing-projectile-motion-drawn-parabola).	30 minutes - 1 hour	P4, M4, D2
3 Visualising parabolic motion 	Learners could observe the '*Water jets through rings*' activity from Practical Physics in order to visualise parabolic motion (www.nuffieldfoundation.org/practical-physics/water-jet-through-rings).	30 minutes - 1 hour	P4, M4, D2
4 Using knowledge of parabolas to improve performance 	Learners could write a training guide in a sport of their choice to explain how to exploit knowledge of parabolas to improve performance. The guide would be tailored to the desired outcomes of the particular sport (e.g. longest distance in discus, tight dive but away from the board in diving, height control in football to get the ball under the bar) and then explain the principles.	1 hour	D2
5 Designing new moves in sport	Learners could explore how using physics to model movements in sport allows scientists to identify the physical limits and possibilities and therefore design new moves – for example the Einstein Flip (www.sciencedaily.com/releases/2005/01/050131225346.htm).	30 minutes	D2

Suggested content	Suggested Activities	Suggested timings	Links to Assessment Criteria
6 How knowledge of parabolic movement can improve performance	Learners could carry out a practical activity where half the group observes the others attempting to throw a tennis ball into a shallow container and then a tall narrow container at a distance. The group could then discuss the strategies used by different people and identify the different parabolic paths that are required to drop a ball into the different containers. After this discussion the second half of the group could carry out the same activity and then the number of attempts needed by each half of the group could be compared to see if a greater awareness of parabolic movement can help people adjust their movements to improve performance.	1 hour	P4, M4, D2
7 Hawk-eye system 	Learners could research and produce a report on the development of the 'Hawk-eye' system that has been designed to predict the behaviour of the ball in, for example, cricket and tennis. They could be asked to describe its component parts, the need for the precise positioning of the cameras used, the methods used to process data and identify any developments, in this field, that can be expected in other sports, for example football, in the future. Any limitations of the system could be considered. Learners could complete their report by describing how a professional coach may use the analysis of the behaviour of moving objects to improve the technique of an athlete.	1 hour	P4, M4, D2
8 Developing a 'Grand Unifying Theory' of sport 	Summative activity Learners could watch '*The Grand Unified Theory of Tennis*' video from the Royal Institute channel (http://www.richannel.org/the-grand-unified-theory-of-tennis). Between 33 seconds and 2 minutes and 25 seconds a number of aspects of physics that researchers have to consider in order to develop a computer model of tennis are listed. Learners could work in groups to identify the aspects of physics that they would have to consider in order to develop a 'Grand Unifying Theory' of a different sport. Individuals could then be tasked with exploring how the effect of individual factors could be tested either in the lab or in a sports setting (e.g. the effect of air humidity or the surface used – a number of examples are mentioned later in the video). The work could be brought together through a series of group presentations to the class.	1 hour	

CONTACT US

Staff at the OCR Customer Contact Centre are available to take your call between 8am and 5.30pm, Monday to Friday.

We're always happy to answer questions and give advice.

Telephone 02476 851509
Email cambridgetechnicals@ocr.org.uk
www.ocr.org.uk