Cambridge NATIONALS

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CAMBRIDGE NATIONALS IN ENGINEERING

R103 - SUSTAINABLE ENGINEERING

DELIVERY GUIDE

VERSION 1

OCR
Oxford Cambridge and RSA

CONTENTS

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INTRODUCTION

This Delivery Guide 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.

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 objective 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 SKILLS DEVELOPMENT

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.

KEY

English

Maths

UNIT R103 – SUSTAINABLE ENGINEERING

Guided learning hours : 30

PURPOSE OF THE UNIT

This unit will develop learner's knowledge and understanding of responsible and sustainable policies applied to engineered products. Learners will consider the influence and importance of sustainability when selecting materials, designing manufacturing processes and estimating energy requirements to manufacture. This unit covers the principles of 'design for sustainability' and considers the importance of recycling and product life cycles.

Learners will consider the impacts of global manufacturing on sustainability and how engineered products and systems are designed and built to perform consistently through their working life. This unit also covers how businesses responsibly manage the process of end of product use.

On completion of this unit learners will develop knowledge and understanding of sustainability related to engineered products. This will include the influence and importance of considering sustainability when selecting materials, manufacturing processes/energy requirements, design for sustainability, recycling and product life cycles.

Learning Outcome — The learner will:
LO1: Know about the sustainability of engineering materials and products
LO2: Know about sustainable design for engineered products
LO3: Understand the impact of global manufacturing

LO1: KNOW ABOUT THE SUSTAINABILITY OF ENGINEERING MATERIALS AND PRODUCTS

Learning Outcome — The learner will:
LO1: Know about the sustainability of engineering materials and products

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 The types of materials used in engineered products	Teachers could introduce learners to the different classification of materials and specific material types, material characteristics and common uses. Metals might be usefully split into two types; ferrous metals and non-ferrous metals.	1 hour	R102 (LO1)
	Learners could be asked to identify beneficial properties of each type of metal to gain an understanding of why certain metal types are used in particular applications, such as hardness, corrosion, conductivity, availability.	1 hour	
	Learners could watch the video 'How it's made - How Train Rails are made' by accessing the following web link: http://www.youtube.com/watch?v=TXRaXHEKW5E	1 hour	
	Learners could be introduced to types of materials used in engineering products by considering what materials are used in the manufacture of products.	1 hour	
	Learners could research different manufacturing methods to observe and note materials used and the processes employed in manufacturing to gain an understanding of materials usage.	1 hour	R102 (LO1)
	Teachers could introduce learners to different types of polymers with examples of products to gain an understanding of the difference s between thermoplastics and thermoset plastics.	1 hour	
	Learners could watch the video 'Design & Technology - Thermoplastics' BBC Learning by accessing the following web links: http://www.youtube.com/watch?v=VDHWNNRXiXo http://www.youtube.com/watch?v=eUthHS3MTdA	1 hour	
	Learners could complete an exercise to demonstrate their knowledge of different materials. See Lesson Element: Materials, Material Types and Applications.	1 hour	

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 The types of materials used in engineered products	Learners could be asked to consider different types of ceramics and their properties, research engineering applications such as medical uses and engine components.	1 hour	R102 (LO4)
	Teachers might introduce composite materials by making links to common applications using fibreglass, carbon fibre concrete, and metal matrix composite applications such as automotive brakes.	1 hour	
	Learners could complete an exercise to explore different material uses for a specific product. See Lesson Element:Types of materials used in engineered products.	1 hour	
2 Sustainability of the types of materials used in engineered products.	Learners could be introduced to sustainability of materials by researching how materials are recycled and reused. Learners could research information about recycling plastics, identifying commonly used marking systems (symbols) for plastic products and their meanings. The following web link may helpful: http://www.bpf.co.uk/Sustainability/Plastics_Recycling.aspx#identifyingplasticsmarkingsystemsforplasticsproducts	1 hour	R102 (LO4)
	Learners could research recycling Aluminium and other materials accessing the following web link: http://www.recycling-guide.org.uk/science-aluminium.html	1 hour	
	Teachers might begin explaining what is meant by finite resources. Learners could be asked to research a range of finite resources and consider how manufacturing is changing to reduce the use of finite resources.	1 hour	
	Learners could be asked to carry out an exercise to consider which materials, parts and components of a manufactured product they are familiar with could be reused or recycled, eg a car. Learners could be asked to list the different types of materials used for a variety of components and state if the materials and component can be repaired, recycled or reused.	1 hour	R112 (LO4)

Suggested content	Suggested activities	Suggested timings	Possible relevance to
3 Environmental considerations affecting the sustainability of engineered products.	Learners could be introduced to the 6Rs by the teacher explaining each of the 6Rs. Learners could work in pairs to consider an everyday engineered product and state how easy is it to take the product apart and identify which parts are repairable.	1 hour	
	Learners could research products that are re-made into something else. Learners could be asked to identify items suitable for Primary, Secondary and Tertiary recycling and possible new products as a result of recycling. Learners could initially consider the example from the following web links: http://www.save-a-cup.co.uk/plastic_cups.php Learners could also access the following web link http://www.bpf.co.uk/Plastipedia/default.aspx	1 hour	
	Teachers could explain fair trade concepts, and give examples of fair trade. The teacher could organise a group discussion to discuss fair trade values and principles. Learners could access information the from the following web link: http://www.fairtrade.org.uk/	1 hour	
	The teacher could ask the learners to research products and applications of manufacturing that use renewables such as oil rape seed in plastics and as a bio fuel.	1 hour	

LO2: KNOW ABOUT SUSTAINABLE DESIGN FOR ENGINEERED PRODUCTS

Learning Outcome — The learner will:
LO2: Know about sustainable design for engineered products

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 Considerations for the sustainable design of engineered products. 	The teacher might begin with a group discussion about how sustainability may influence material selection in designing engineering products.	1 hour	R102 (LO4)
	Learners could be asked to research energy sources used in manufacture and present examples back to the group. Teachers could explain lean manufacturing concepts and link this to saving energy sources through efficient manufacturing processes.	1 hour	
	Working in small groups, learners could carry out a product Life Cycle Analysis of a product of their choice and report back to the class their findings.	1 hour	R105 (LO3), R112 (LO4)
	Learners could be asked to consider the trends of an engineered product and identify examples of design for obsolescence.	1 hour	
	Teachers could use examples of workshop equipment to demonstrate design for maintenance considerations, such as lathes, pillar drills, photocopiers.	1 hour	R105 (LO2)
	Learners could be asked to record examples of these engineered products where maintenance has been considered in the design.	1 hour	R104 (LO1)
	Learners could be given an exercise to research energy usage of products and energy ratings.	1 hour	R102 (LO4)
	Learners could be given an exercise to research energy usage of products and energy ratings. Teachers could use a group discussion about carbon footprint of a product from manufacture to end of life disposal. Learners could choose an engineered product to carry out an ecodesign web. See Lesson Element: Sustainable Design.	1.5 hours	

LO3: UNDERSTAND THE IMPACT OF GLOBAL MANUFACTURING

Learning Outcome — The learner will:
LO3: Understand the impact of global manufacturing

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 Impact of global manufacturing on sustainability of engineered products.	Teachers could introduce learners to the impact of global manufacturing on sustainability by asking learners to consider the applications of technical advances used to manufacture products globally.	1 hour	R102 (LO4)
	The teacher could lead a group discussion about the impact of global manufacturing on the labour market, including local employment, availability of labour and skills, materials supply and remote manufacture.	1 hour	R112 (LO4)
	Learners could work in small groups to discuss sustainability factors for transportation and distribution eg cost of transportation and time compared to manufacture nearer to sources of materials. As part of this, learners could identify possible environmental factors of transporting materials and products. Learners could provide feedback to the remainder of the class for further discussion.	1 hour	R102 (LO4), R112 (LO4)
	Teachers could get learners to carry out research on advances in materials to support sustainability and preserve resources.	1 hour	
	The teacher could lead a group discussion about ethical procurement and ask learners work in small groups to research examples to feed back to the group.	1 hour	

POSSIBLE INTERNET SOURCES

Source	Website
BBC Bitesize	http://www.bbc.co.uk/schools/gcsebitesize
Health & Safety Executive	http://www.hse.gov.uk/work-equipment-machinery/declaration-conformity.htm
Open University	http://www.open.edu/openlearn/science-maths-technology/engineering-and-technology/supply-chains-smart-cars
Royal Academy of Engineering	http://www.raeng.org.uk/events/pdf/Engineering_for_Sustainable_Development.pdf
YouTube	www.youtube.com

Contact us

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

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