OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

# APPLIED SCIENCE

## Unit 13 – Environmental surveying
## DELIVERY GUIDE

Version 2

ocr.org.uk/science

# CONTENTS

# 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 outcome so you can see how each activity helps you cover the requirements of this unit.

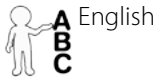
We appreciate that practitioners are knowledgeable in relation to what works for them and their learners. Therefore, the resources we have produced should not restrict or impact on practitioners' creativity to deliver excellent learning opportunities.

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 resources.feedback@ocr.org.uk.

## OPPORTUNITIES FOR ENGLISH AND MATHS SKILLS DEVELOPMENT AND WORK EXPERIENCE

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. We've also identified any potential work experience opportunities within the activities. 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.



English

Maths


Work

**Please note**

The activities suggested in this Delivery Guide **MUST NOT** be used for assessment purposes. 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 http://www.ocr.org.uk/. The latest version of this Delivery Guide can be downloaded from the OCR website..

## UNIT AIM

Understanding environments is essential in many roles and industries, from conservation of vulnerable habitats or sites of special scientific interest, to built environment planning, industrial development and mining and oil and gas activities. In order for this to be done effectively, a sound, evidence-based, scientific approach is required so that meaningful outcomes of studies are obtained, and informed recommendations enacted.

In this unit, you will take a practice-based approach to understanding, evaluating, interpreting and reporting on environmental information and data, drawing on your learning in fundamental science, and your practical and analytical skills. You will examine various types of environment and how they interact. You will then apply relevant scientific methods and analytical techniques in the field and the laboratory. You will survey different environments and information in the scientific literature to address scientific questions relevant to you, and report your findings and recommendations..

| Unit 13 Environmental surveying | |
|---|---|
| LO1 | Understand environmental impacts of human activity and natural processes |
| LO2 | Understand environmental surveying |
| LO3 | Be able to use field and laboratory techniques to conduct environmental investigations |
| LO4 | Be able to analyse and present environmental survey findings |

To find out more about this qualification, go to: http://www.ocr.org.uk/qualifications/vocational-education-and-skills/cambridge-technicals-applied-science-level-3-certificate-extended-certificate-foundation-diploma-diploma-extended-diploma-05847-05849-05879-05874-2016-suite/

Cambridge TECHNICALS 2016

### *2016 Suite*

- **New suite for first teaching September 2016**
- **Externally assessed content**
- **Eligible for Key Stage 5 performance points from 2018**
- **Designed to meet the DfE technical guidance**

# RELATED ACTIVITIES

The Suggested Activities in this Delivery Guide listed below have also been related to other Cambridge Technicals in Applied Science units/Learning Outcomes (LOs). This could help with delivery planning and enable learners to cover multiple parts of units.

| This unit (Unit 13) | Title of suggested activity | Other units/LOs | |
|---|---|---|---|
| **LO1** | Defining your environment | Unit 14 Environmental management | LO1 Understand practical characteristics of environments<br>LO2 Be able to identify pollution in the environment |
| | | Unit 15 Sustainability and renewable energy | LO1 Understand the impacts of energy consumption |
| | | Unit 16 Waste management | LO1 Understand how to manage waste<br>LO2 Understand how to manage air emissions<br>LO3 Understand how waste water is managed |
| | What is your impact? Part 1 | Unit 14 Environmental management | LO1 Understand practical characteristics of environments |
| | | Unit 15 Sustainability and renewable energy | LO1 Understand the impacts of energy consumption |
| | | Unit 16 Waste management | LO3 Understand how waste water is managed |
| | What is your impact? Part 2 | Unit 14 Environmental management | LO1 Understand practical characteristics of environments<br>LO2 Be able to identify pollution in the environment |
| | | Unit 15 Sustainability and renewable energy | LO1 Understand the impacts of energy consumption |
| | | Unit 16 Waste management | LO1 Understand how to manage waste |
| | | Unit 17 Food technology | LO1 Understand the main features of food manufacturing operations |
| | | Unit 19 Crop production and soil science | LO1 Understand how common crops are grown for commercial production in the UK |
| | Water, water everywhere | Unit 14 Environmental management | LO1 Understand practical characteristics of environments<br>LO2 Be able to identify pollution in the environment |
| | | Unit 15 Sustainability and renewable energy | LO1 Understand the impacts of energy consumption |
| | Destruction and construction | Unit 14 Environmental management | LO1 Understand practical characteristics of environments<br>LO2 Be able to identify pollution in the environment<br>LO3 Understand how legislation, regulation and agreements impact on managing natural and built environments |
| | | Unit 16 Waste management | LO1 Understand how to manage waste<br>LO2 Understand how to manage air emissions |
| | Beneath our feet | Unit 14 Environmental management | LO1 Understand practical characteristics of environments |
| | | Unit 19 Crop production and soil science | LO2 Understand factors affecting the growth of crops<br>LO4 Be able to carry out soil testing |

| This unit (Unit 13) | Title of suggested activity | Other units/LOs | |
|---|---|---|---|
| **LO2** | Why survey environments? | Unit 13 Environmental surveying | LO1 Understand environmental impacts of human activity and natural processes |
| | | Unit 14 Environmental management | LO1 Understand practical characteristics of environments<br>LO2 Be able to identify pollution in the environment<br>LO3 Understand how legislation, regulation and agreements impact on managing natural and built environments |
| | | Unit 15 Sustainability and renewable energy | LO1 Understand the impacts of energy consumption |
| | | Unit 16 Waste management | LO1 Understand how to manage waste<br>LO2 Understand how to manage air emissions<br>LO3 Understand how waste water is managed |
| | | Unit 19 Crop production and soil science | LO1 Understand how common crops are grown for commercial production in the UK<br>LO2 Understand factors affecting the growth of crops<br>LO3 Be able to monitor the growth of a crop plant species |
| | Environmental impact assessments<br>Protecting people<br>Planning to protect locally<br>Protecting globally | Unit 13 Environmental surveying | LO1 Understand environmental impacts of human activity and natural processes |
| | | Unit 14 Environmental management | LO1 Understand practical characteristics of environments<br>LO2 Be able to identify pollution in the environment<br>LO3 Understand how legislation, regulation and agreements impact on managing natural and built environments<br>LO4 Understand environmental management assessments |
| | Environmental surveying for living | Unit 13 Environmental surveying | LO1 Understand environmental impacts of human activity and natural processes |
| | | Unit 14 Environmental management | LO1 Understand practical characteristics of environments<br>LO2 Be able to identify pollution in the environment<br>LO3 Understand how legislation, regulation and agreements impact on managing natural and built environments<br>LO4 Understand environmental management assessments |
| | | Unit 16 Waste management | LO1 Understand how to manage waste<br>LO2 Understand how to manage air emissions<br>LO3 Understand how waste water is managed |
| **LO3** | Defining an investigation 1: what do you want to find? | Unit 2 Laboratory techniques | LO1 Understand the importance of health and safety and quality systems to industry |
| | | Unit 3 Scientific analysis and reporting | LO1 Be able to use mathematical techniques to analyse data<br>LO5 Be able to draw justified conclusions from data |
| | | Unit 13 Environmental surveying | LO1 Understand environmental impacts of human activity and natural processes<br>LO2 Understand environmental surveying |
| | | Unit 14 Environmental management | LO2 Be able to identify pollution in the environment<br>LO4 Understand environmental management assessments<br>LO5 Be able to carry out and report outcomes of an environmental management study |

| This unit (Unit 13) | Title of suggested activity | Other units/LOs | |
|---|---|---|---|
| **LO3** | Defining an investigation 2: how will you do it? | Unit 2 Laboratory techniques | LO1 Understand the importance of health and safety and quality systems to industry<br>LO3 Be able to determine the concentration of an acid or base using titration<br>LO4 Be able to examine and record features of biological samples |
| | | Unit 3 Scientific analysis and reporting | LO1 Be able to use mathematical techniques to analyse data<br>LO5 Be able to draw justified conclusions from data<br>LO6 Be able to use modified, extended or combined laboratory techniques in analytical procedures |
| | | Unit 6 Control of hazards in the laboratory | LO1 Understand the types of hazard that may be encountered in a laboratory<br>LO2 Be able to use health and safety procedures to minimise the risk presented by hazards in a laboratory |
| | | Unit 13 Environmental surveying | LO1 Understand environmental impacts of human activity and natural processes<br>LO2 Understand environmental surveying |
| | | Unit 14 Environmental management | LO2 Be able to identify pollution in the environment<br>LO4 Understand environmental management assessments<br>LO5 Be able to carry out and report outcomes of an environmental management study |
| | Health and safety in the investigation | Unit 2 Laboratory techniques | LO1 Understand the importance of health and safety and quality systems to industry |
| | | Unit 6 Control of hazards in the laboratory | LO1 Understand the types of hazard that may be encountered in a laboratory<br>LO2 Be able to use health and safety procedures to minimise the risk presented by hazards in a laboratory |
| | Recording data 1: in the field<br>Recording data 2: in the laboratory | Unit 3 Scientific analysis and reporting | LO1 Be able to use mathematical techniques to analyse data<br>LO2 Be able to use graphical techniques to analyse data<br>LO4 Be able to analyse and evaluate the quality of data<br>LO5 Be able to draw justified conclusions from data<br>LO6 Be able to use modified, extended or combined laboratory techniques in analytical procedures<br>LO7 Be able to record, report on and review scientific analyses |
| | What did you find? | Unit 3 Scientific analysis and reporting | LO1 Be able to use mathematical techniques to analyse data<br>LO2 Be able to use graphical techniques to analyse data<br>LO4 Be able to analyse and evaluate the quality of data<br>LO5 Be able to draw justified conclusions from data<br>LO6 Be able to use modified, extended or combined laboratory techniques in analytical procedures<br>LO7 Be able to record, report on and review scientific analyses |
| | | Unit 14 Environmental management | LO5 Be able to carry out and report outcomes of an environmental management study |

| This unit (Unit 13) | Title of suggested activity | Other units/LOs | |
|---|---|---|---|
| **LO4** | Looking at environmental data 1: how certain are you?<br>Choosing statistics: what test should you use?<br>Interpreting statistics: cause and effect | Unit 3 Scientific analysis and reporting | LO1 Be able to use mathematical techniques to analyse data<br>LO2 Be able to use graphical techniques to analyse data<br>LO4 Be able to analyse and evaluate the quality of data<br>LO5 Be able to draw justified conclusions from data |
| | Looking at environmental data 2: is your result significant? | Unit 2 Laboratory techniques | LO3 Be able to determine the concentration of an acid or base using titration<br>LO4 Be able to examine and record features of biological samples |
| | | Unit 3 Scientific analysis and reporting | LO1 Be able to use mathematical techniques to analyse data<br>LO2 Be able to use graphical techniques to analyse data<br>LO4 Be able to analyse and evaluate the quality of data<br>LO5 Be able to draw justified conclusions from data |
| | Thinking about your investigation | Unit 3 Scientific analysis and reporting | LO5 Be able to draw justified conclusions from data<br>LO6 Be able to use modified, extended or combined laboratory techniques in analytical procedures<br>LO7 Be able to record, report on and review scientific analyses |
| | | Unit 14 Environmental management | LO5 Be able to carry out and report outcomes of an environmental management study |

# KEY TERMS

| Explanations of the key terms used within this unit, in the context of this unit | |
|---|---|
| **Key term** | **Explanation** |
| **Climate change** | Changes in the Earth's climate have occurred throughout its history, from high temperatures and little or no ice cover, as at the end of the Cretaceous period 65 million years ago, to extremely cold periods such as the most recent glaciation which ended about 10,000 years ago. The causes of climate change are varied and can be slow, such as those caused by changes in the Earth's orbit or rapid, due to, for example, massive volcano events or meteor impacts. In recent times, evidence has emerged that links human activities to possible climate change, in large part caused by $CO_2$ emissions from transport and industry. |
| **Control** | A scientific control is a method for minimising the effect of variables in an experiment. In an environmental context, it could be as simple as using a well-known sample to calibrate or verify the correct working of a procedure, or it might be more complex, such as splitting an area under investigation into sections where interventions take place (the experiment, for example, cultivating a field) and those where no interventions are carried out (the control, for example, leaving a field fallow). |
| **Environment** | This is a very broad term, but for the purposes of this unit, we can understand it as all natural and human areas inhabited by life (air, oceans and land environments) as well as the sub-surface environment of underlying geology. |
| **Epicentre** | Not to be confused with the hypocentre, the epicentre is the point at the Earth's surface directly above the hypocentre. |
| **Human activity** | These are actions by humans which affect environments. These can be immediate, as in land clearance for agriculture or building, or as a consequence of activity (for example, mining activities might affect water and air quality). Human activities need not be negative, but can be positive as well, for example where action is taken to conserve or repair environments. |
| **Hypocentre** | An earthquake usually occurs at a particular point in the Earth's crust, which is referred to as the hypocentre or alternatively as the focus. Depending on the geology, the hypocentre may be near or within a few tens of kilometres of the surface for the shallowest earthquakes to several hundred kilometres for the deepest. The shallow earthquakes are the most damaging, transmitting more of their energy to the surface. |
| **Hypothesis** | In science, a hypothesis is generally a proposed explanation for an observation, ideally containing something which can be tested. We will also use the term hypothesis when talking about statistical tests, where we're looking at the validity of outcomes based on probability. |
| **Natural processes** | In contrast to human activity, natural processes arise as a result of non-human activity and events. This can include weather events, earthquakes, volcanoes and water transport and action (for example, erosion, flooding) both at the surface and through underlying rocks. |
| **Planning** | In the context of development and construction, planning is the legal process which ensures the need for a development and the suitability of the site and construction methods. It also ensures impacts on local people, facilities and the human and natural environment are minimised. |
| **Scientific method** | To conduct an investigation which has scientifically valid outcomes, we need to apply the scientific method. In outline, we first define our problem based on observations, then conduct appropriate tests, draw valid conclusions and refine our knowledge accordingly. |
| **Site of Special Scientific Interest (SSSI)** | A Site of Special Scientific Interest (in England, Scotland and Wales – Area of Special Scientific Interest or ASSI in Northern Ireland) is a legal designation protecting an area from development or change of use. The SSSI designation may be connected with any aspect of the area – for example, the area may contain a habitat that supports rare species, have important monuments, contain interesting landscapes and geology, or be historically important. |
| **Tsunami** | A tsunami (from the Japanese 'harbour wave') is a surface water wave caused by the displacement of large volumes of water, often due to rapid movements of the sea bed in an earthquake, though other events such as meteor impacts and landslides can have the same effect. Tsunamis are sometimes called tidal waves, but it is important to be clear that they have nothing to do with the normal tides caused by the sun and moon. |
| **Variable** | In science, a variable is any quantity which we can measure or control. |

# MISCONCEPTIONS

| Some common misconceptions and guidance on how they could be overcome | | |
|---|---|---|
| **What is the misconception?** | **How can this be overcome?** | **Resources which could help** |
| **The different meanings of 'climate change' and 'global warming'** | Learners may confuse the terms 'climate change' and 'global warming' to the extent that that they are seen as interchangeable.<br><br>Tutors could show learners specific examples, such as temperature maps showing global trends in temperature, whilst pointing out that there are local variations. Tutors could also emphasise that climate change encompasses global warming and includes factors such as changes in wind and ocean current patterns, trends in weather and shifts in seasons.<br><br>Learners could research examples where the terms have been used, and discuss whether they have been used suitably, thereby reinforcing correct understanding. | What is climate change?<br>Met Office<br>http://www.metoffice.gov.uk/climate-guide/climate-change<br>Definitions and consequences of climate change:<br><br>Climate feedbacks<br>Met Office<br>http://www.metoffice.gov.uk/climate-change/guide/science/explained/feedbacks<br>A discussion of mechanisms affecting climate.<br><br>The science of climate change<br>Committee on Climate Change<br>https://www.theccc.org.uk/tackling-climate-change/the-science-of-climate-change/<br>Presents some of the scientific evidence behind climate change.<br><br>What's the difference between global warming and climate change?<br>Climate.gov: National Oceanic and Atmospheric Administration (NOAA)<br>https://www.climate.gov/news-features/climate-qa/whats-difference-between-global-warming-and-climate-change<br>Makes the distinction between climate change and global warming. |
| **Climate versus weather** | The terms 'climate' and 'weather' are frequently considered to mean the same thing, and learners need to be aware of the key differences to use these terms scientifically.<br><br>Learners could be asked to carry out a weather observation for their locality, and then compare this to a long-term average for the area, allowing them to define both the climate and current weather variations. | What's the Difference Between Weather and Climate?<br>NASA<br>http://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html<br>A resource discussing the distinction between weather and climate.<br><br>What is the difference between weather and climate?<br>National Oceanic and Atmospheric Administration<br>http://oceanservice.noaa.gov/facts/weather_climate.html<br>A resource discussing the distinction between weather and climate.<br><br>Understanding weather and climate<br>Met Office<br>http://www.metoffice.gov.uk/media/pdf/a/4/Understanding_weather_and_climate_presentation.pdf<br>A presentation on weather and climate from the UK Meteorological Office. |

| Some common misconceptions and guidance on how they could be overcome | | |
|---|---|---|
| **What is the misconception?** | **How can this be overcome?** | **Resources which could help** |
| **All human activities are harmful to the environment** | Whilst there are many examples of environmental harm due to human activities, there are cases where the reverse is true, with environments either being preserved against harm, or restored after either natural events or damage due to human activity..<br><br>Tutors could use specific case studies where positive human action has preserved or restored environments.<br><br>Tutors can also ask students to explore the corollary to this, i.e. that all natural processes are *good* for the environment. | All EA services and information<br>Gov.uk<br>https://www.gov.uk/government/organisations/environment-agency<br>The UK Environment Agency has responsibility for protecting the natural and human environment, and has many examples of successul initiatives.<br><br>Protecting the environment<br>D+C Development and Cooperation<br>http://www.dandc.eu/en/article/how-people-brazil-can-contribute-preventing-natural-catastrophes-protecting-environment<br>An example of environmental preservation protecting against natural disasters.<br><br>Environmental impacts of volcanic eruptions<br>V.Yu. Kirianov<br>http://www.eolss.net/sample-chapters/c12/E1-07-01-08.pdf<br>A paper discussing the destructive (and constructive) effects of volcanoes. |
| **The scientific meanings of 'hypothesis' and 'theory'** | In common language, the terms 'hypothesis' and 'theory' are often used synonymously to mean an idea or a best guess. Likewise, in many disciplines, such as philosophy, the term 'theory' means a particular field of study or school of thought.<br><br>Tutors could introduce these 'common' definitions before defining the terms for the purposes of science. Tutors should further sub-divide 'hypothesis' into its meaning as a proposed explanation and 'statistical hypothesis' as a formal statement subject to statistical testing. | Scientific theory and Hypothesis<br>Wikipedia<br>https://en.wikipedia.org/wiki/Scientific_theory<br>https://en.wikipedia.org/wiki/Hypothesis<br>Discussions and definitions of theory and hypothesis in science.<br><br>"It's just a theory": trainee science teachers' misunderstandings of key scientific terminology<br>James David Williams<br>http://sro.sussex.ac.uk/52500/1/Its_just_a_theory_published.pdf<br>An article showing how common scientific terms can be misunderstood. |

| Some common misconceptions and guidance on how they could be overcome | | |
|---|---|---|
| **What is the misconception?** | **How can this be overcome?** | **Resources which could help** |
| **Correlation means causation** | It's a common mistake to believe that if two quantities show a statistical relationship, then there is a causal link between them. It needs to be stressed that statistics are 'blind' to causation.<br><br>Tutors could address this in two ways, from the comical (the classic 'number of pirates vs. global temperature') to the serious and potentially dangerous (vaccinations and autism).<br><br>Tutors should also ask students to think more deeply about correlation and causation – for example, is there a third factor which affects both the correlated quantities simultaneously? | Correlation does not imply causation<br>Wikipedia<br>https://en.wikipedia.org/wiki/Correlation_does_not_imply_causation<br>A good discussion of correlation vs. causation, and a look at alternative scenarios.<br><br>Why doesn't correlation imply causation?<br>Quora<br>https://www.quora.com/Why-doesnt-correlation-imply-causation<br>Some useful answers to the question: why doesn't correlation imply causation?<br><br>Association and Causation: Pirates and Global Warming<br>Australian Bureau of Statistics<br>http://abs.gov.au/websitedbs/CaSHome.nsf/Home/MAT+19+ASSOCIATION+AND+CAUSATION+PIRATES+AND+GLOBAL+WARMING<br>A potential activity, including some 'comic' scenarios. |
| **Health and safety procedures are obstructive to scientific work** | This is a common view, often supported by 'myths' and sensational reporting around 'health and safety gone mad'. Learners need to understand that a sensible health and safety protocol for an investigation protects both themselves and the scientific data and outcomes.<br><br>Tutors could start by debunking many of the health and safety myths, followed by learners engaging in health and safety assessments of common activities.<br><br>In designing a health and safety protocol for an investigation, learners should also be encouraged to think about how the protocol protects the integrity of their data and outcomes. | Busting the health and safety myths<br>Health and Safety Executive<br>http://www.hse.gov.uk/myth/<br>A good resource debunking H&S myths. |

# SUGGESTED ACTIVITIES

| LO No: | 1 | | |
|---|---|---|---|
| **LO Title:** | **Understand environmental impacts of human activity and natural processes** | | |
| **Title of suggested activity** | **Suggested activities** | **Suggested timings** | **Also related to** |
| **Defining your environment** | As an Ice-breaker activity for this unit, learners could review and describe their local environment: either their homes, or their learning institution.<br><br>Learners could use the Environment Agency's interactive maps to investigate current and past activities which affect their local environment – for example, flood risks, landfill sites and air pollution.<br><br>What's In Your Backyard?<br>Environment Agency<br>http://apps.environment-agency.gov.uk/wiyby/default.aspxt<br>Interactive maps that allow users to find out more about the environments where they live. | 30 minutes | Unit 14 LO1, LO2<br>Unit 15 LO1<br>Unit 16 LO1, LO2, LO3 |
| **What is your impact? Part 1** | Learners could make estimates of their environmental impacts, using the following resources:<br><br>Water Energy Calculator<br>Energy Saving Trust<br>https://tools.energysavingtrust.org.uk/Heating-and-hot-water/Saving-money-on-water/Water-Energy-Calculator<br>Allows users to assess their daily water use.<br><br>Home Energy Check<br>Energy Saving Trust<br>http://hec.est.org.uk/<br>Allows users to assess their domestic energy consumption.<br><br>Carbon Calculators<br>Carbon Footprint<br>http://www.carbonfootprint.com/calculator1.html<br>Carbon footprint calculators for small businesses and domestic users, respectively. | 45 minutes | Unit 14 LO1<br>Unit 15 LO1<br>Unit 16 LO3 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **What is your impact? Part 2** | The previous activity looked at direct impacts. It's also important for learners to think about indirect impacts, such as energy and water use related to food production, and impacts of resource production for items such as smartphones. Learners could examine the resources needed to produce typical food items or the impacts of mining and manufacturing for producing a smartphone.<br><br>Product gallery<br>Water Footprint Network<br>http://waterfootprint.org/en/resources/interactive-tools/product-gallery/<br>Allows learners to compare how much water is used to make a variety of products.<br><br>Fairphone Blog: Mining<br>Fairphone<br>https://www.fairphone.com/category/on-mining/<br>Series of articles on how the materials required for phone components are sourced. | 45 minutes | Unit 14 LO1, LO2<br>Unit 15 LO1<br>Unit 16 LO1<br>Unit 17 LO1<br>Unit 19 LO1 |
| **Water, water everywhere**<br>  <br> | The aim of this activity is to focus the learner on water as a key component of many environmental processes, both human and natural.<br><br>Learners could examine, and report back to the group on, aspects of water and the environment such as:<br>• The impact of deforestation on soil erosion<br>• The potential impact of sea level changes driven by natural cycles and anthropogenic climate change<br>• The action of water in natural and human environments – for example, the importance of flood plains and sub-surface aquifers<br>• Water as a corrosive agent – weathering, erosion and cave formation, and how this might relate to the 'drawdown' of $CO_2$<br>• The importance of the oceans – for example, how persistent ocean currents affect environments (the Gulf Stream warming Europe and the Humboldt Current being responsible for the arid climate of the Atacama desert in South America) and how transient events (such as El Niño in the Pacific) can lead to extreme weather events elsewhere.<br><br>The report could take the form of drafts of newsletters or information leaflets compiled collaboratively by small groups of learners. | 1 hour | Unit 14 LO1, LO2<br>Unit 15 LO1 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Destruction and construction** | This activity will aim to help learners critically assess the destructive and constructive aspects of human activities and natural processes. This outcome can be accomplished by learners examining case studies of current and historical environmental events, and drawing conclusions as to their benefit or otherwise. Examples could include:<br>• The Bazalgette sewer system as the first attempt to control pollution in the Thames (19th century)<br>• The Chernobyl nuclear accident in Ukraine (20th century)<br>• The eruption of Surtsey near Iceland<br>• The end of the most recent glaciation in Europe (about 12,000 years ago).<br><br>Learners could use their chosen case study as an exercise in presenting their findings to their group. | 1 hour | Unit 14 LO1, LO2, LO3<br>Unit 16 LO1, LO2 |
| **Beneath our feet** | Natural environments often reflect the underlying geology, by the nature of the soil (or lack thereof) and by the types of plant found in the area. In this activity, learners could examine qualitatively their local area, or look at selected areas using the UK Soil Observatory soils map viewer and then compare with the underlying geology.<br><br>Soils map viewer<br>UK Soil Observatory<br>http://mapapps2.bgs.ac.uk/ukso/home.html<br>The maps allow users to learn more about the different soil properties in the UK.<br><br>Geology of Britain viewer<br>British Geological Survey<br>http://mapapps.bgs.ac.uk/geologyofbritain/home.html<br>This resource allows users to learn more about the geology of different parts of the UK.<br><br>Learners could complete the activity by discussing as a group how the geology they've identified impacts the surface conditions. | 30 minutes | Unit 14 LO1<br>Unit 19 LO2, LO4 |

# SUGGESTED ACTIVITIES

| LO No: | 2 | | |
|---|---|---|---|
| **LO Title:** | **Understand environmental surveying** | | |
| **Title of suggested activity** | **Suggested activities** | **Suggested timings** | **Also related to** |
| **Why survey environments?** | Tutors could open this activity by asking learners to list reasons for carrying out environmental surveys. Learners may refer back to activities in Learning Outcome 1, and answers may initially include:<br>• The need to count species in an existing environment<br>• The need to determine the levels of pollutants<br>• The need to measure risks to an environment (human and natural).<br><br>Depending on the scope of the reasons given, tutors could follow up with a deeper discussion, guiding learners to identifying reasons such as:<br>• Providing baseline evidence for industrial, domestic and transport planning<br>• Repeated surveys over time allow trends in an environment to be identified<br>• Changes in pollution can be monitored, and regulations enforced<br>• Environmental surveys can inform local and global strategies and policies in conservation and environmental management. | 45 minutes | Unit 13 LO1<br>Unit 14 LO1, LO2, LO3<br>Unit 15 LO1<br>Unit 16 LO1, LO2, LO3<br>Unit 19 LO1, LO2, LO3 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Environmental impact assessments** | The aim of this activity is for learners to explore how environmental surveying plays a key role in environmental impact assessments, which are a vital part of the planning process.<br><br>Tutors could ask learners to examine case studies of environmental impact assessments, and summarise key aspects, such as:<br>• What is the nature of the planned work? (e.g. new buildings, change of agricultural use etc)<br>• Is the site already protected (e.g. is it a Site of Special Scientific Interest, or SSSI?)<br>• Are any species likely to be affected, and if so, how?<br>• Are there any special matters to consider? For example, what is the potential for flooding?<br><br>Learners could source examples from their local area (e.g. local council planning offices) or look at examples from other countries. In this latter case, it is important for learners to note that planning regimes outside the developed world may not be as rigorous as the UK and Europe.<br><br>Learners could make use of UK government guidance on environmental impact assessments.<br><br>Environmental Impact Assessment<br>Planning Practice Guidance, Department for Communities and Local Government<br>http://planningguidance.communities.gov.uk/blog/guidance/environmental-impact-assessment/<br>Explains requirements of Town and Country Planning (EIA) Regulations 2011.<br><br>The effectiveness of Environmental Impact Assessment for uncultivated land and semi-natural areas<br>English Nature<br>http://publications.naturalengland.org.uk/file/118012<br>An example source for some case studies and other information.<br><br>An Environmental Risk Assessment for shale gas exploratory operations in England<br>Environment Agency<br>https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296949/LIT_8474_fbb1d4.pdf<br>This is an example of an environmental impact assessment for an industry or activity as a whole, and not just for a particular locality. | 1.5 hours | Unit 13 LO1<br>Unit 14 LO1, LO2, LO3, LO4 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Environmental surveying for living** | An important objecvtive in Learning Outcome 1 was learners gaining an understanding of their personal environmental impacts. In this activity, learners could look at the infrastructure supporting their lives, which could include:<br>• Utilities (water, gas and electricity)<br>• Communications (mobile phone networks)<br>• Transport<br>• Waste management.<br><br>At the heart of the activity, learners could select and examine closely one particular infrastructure, and debate with their group and tutors the relative value, in respect of their personal environmental impact, of a particular plan versus an alternative, and what survey information they would need to make a sound judgement.<br><br>For example, in waste management, how do landfill disposal and incineration compare in contributing to an individual's environmental impact?<br><br>The links below are to some resources that could be used to support such a debate.<br><br>Incineration Versus Recycling: In Europe, A Debate Over Trash<br>Environment 360, Yale University<br>http://e360.yale.edu/feature/incineration_versus_recycling__in_europe_a_debate_over_trash/2686/<br><br>Waste to Energy<br>Renewable Energy Association<br>http://www.r-e-a.net/renewable-technologies/energy-from-waste<br><br>Energy from waste: A guide to the debate<br>Defra<br>https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/284612/pb14130-energy-waste-201402.pdf<br><br>Is incineration or landfill better?<br>Friends of the Earth<br>https://www.foe.co.uk/faqs/incineration-or-landfill-better | 1 hour | Unit 13 LO1<br>Unit 14 LO1, LO2, LO3, LO4<br>Unit 16, LO1, LO2, LO3 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Protecting people** | How can environmental surveying and monitoring protect people and the human environment?<br>Tutors could use this activity to lead a discussion session with learners to explore possible reasons and methods, and to think about how environmental surveys could inform actions. Some of these aren't necessarily obvious! Reasons for environmental surveys could include:<br>• Monitoring air and noise pollution from roads or industrial sites to control and enforce environmental regulation<br>• Hydrological surveys for, for example, flood protection or water quality monitoring<br>• Examination of soils to determine levels of toxins where, for example, old industrial land or landfill sites are to be reused for housing or agriculture<br>• Measurement of species populations (such as rats) deleterious to human health.<br><br>Air pollution measurement and monitoring<br>Lancaster City Council<br>http://www.lancaster.gov.uk/environmental-health/environmental-protection/air-quality/air-pollution-measurement-and-monitoring<br>This is a good example of a set of records for air pollution monitoring.<br><br>Tutors could also guide learners to thinking about natural processes affecting human populations. Examples here which need surveying and monitoring could include:<br>• Seismic and emissions surveys and monitoring as warnings for volcanic eruptions (important in, for example, Indonesia, Japan etc)<br>• Monitoring of the near-Earth space environment, providing warnings against, for example, geomagnetic storms which can affect power, navigation and communications systems.<br><br>Space Weather Enthusiasts Dashboard<br>Space Weather Prediction Center<br>http://www.swpc.noaa.gov/communities/space-weather-enthusiasts<br>This is a good resource for informing debate on geomagnetic events. | 45 minutes | Unit 13 LO1<br>Unit 14 LO1, LO2, LO3, LO4 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Planning to protect locally** | The previous activity concerned using environmental surveying to protect the human population. In this activity, learners could research the ways in which environmental surveying protect environments locally by supporting and informing the planning process.<br><br>A good way for this to be carried out could be for learners to examine a case study of a development, and to draw conclusions from impact assessments about the benefit or otherwise of that development.<br><br>As an example, the Hindhead Tunnel in the south of England re-routed a major road away from a Site of Special Scientific Interest and bypassed a village. Learners could assess the relative environmental costs and benefits, both during the construction phase and the current operational phase.<br><br>Hindhead Tunnel<br>Wikipedia<br>https://en.wikipedia.org/wiki/Hindhead_Tunnel<br>General information for the Hindhead Tunnel.<br><br>A3 Hindhead Scheme<br>Highways England<br>http://webarchive.nationalarchives.gov.uk/20120810121037/http://www.highways.gov.uk/roads/documents/61_nts_may2004.pdf<br>A summary of the environmental impact assessment for the Hindhead Tunnel.<br><br>If using the above example, learners could work individually or in small groups to examine particular aspects of the tunnel in respect of the natural environment; for example:<br>• Noise impact<br>• Air pollution impact<br>• Local water quality<br>• Soil and geology<br>• Ecological impact. | 45 minutes | Unit 13 LO1<br>Unit 14 LO1, LO2, LO3, LO4 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Protecting globally** | This activity will look at methods and strategies for global surveying and protection.<br><br>Learners could research the means by which environmental data is collected globally. This could cover historic, stratigraphic and current examples.<br><br>HMS Beagle Voyage<br>AboutDarwin<br>http://www.aboutdarwin.com/voyage/voyage03.html<br>A historic example of global surveying: Darwin's voyage.<br><br>Challenger expedition<br>Wikipedia<br>https://en.wikipedia.org/wiki/Challenger_expedition<br>The Challenger ocean sampling voyage, 1872–76.<br><br>Centre for Ice and Climate<br>Niels Bohr Institute, University of Copenhagen<br>http://www.iceandclimate.nbi.ku.dk/research/past_atmos/<br>Has material on surveying stratigraphically, such as ice cap cores, recording pollutant levels.<br><br>Ocean Surface Topography from Space<br>Jet Propulsion Laboratory, California Institute of Technology<br>http://sealevel.jpl.nasa.gov/missions/jason3/<br>An example of current remote sensing using environmental observation satellites such as the JASON series of satellites – the most recent being JASON-3.<br><br>Tutors could lead a discussion on the means of global protection, covering the role of the United Nations and non-governmental bodies.<br><br>United Nations Environment Programme<br>http://www.unep.org/<br>The United Nations Environment Programme (UNEP) helps set the global environmental agenda and promotes the coherent implementation of the environmental dimension of sustainable development within the United Nations system.<br><br>Environment<br>European Commission<br>http://ec.europa.eu/environment/index_en.htm<br>Covers the work of the department responsible for EU policy on the environment. | 1.5 hours | Unit 13 LO1<br>Unit 14 LO1, LO2, LO3, LO4 |

# SUGGESTED ACTIVITIES

| LO No: | 3 | | |
|---|---|---|---|
| **LO Title:** | **Be able to use field and laboratory techniques to conduct environmental investigations** | | |
| **Title of suggested activity** | **Suggested activities** | **Suggested timings** | **Also related to** |
| **Defining an investigation 1: what do you want to find?** | The first two activities suggested for Learning Outcome 3 will concentrate on developing an environmental investigation to be conducted by the learners, and then reported on in the activities suggested for Learning Outcome 4. In general, it is suggested that learners conduct their investigations in pairs or small groups; lone working should be discouraged. It is recommended that all groups conduct the same investigation.<br><br>In this first activity, tutors could ask learners what aspects of their local environment they consider important, and guide the learners into choosing a suitable investigation. Such an investigation should include:<br>• A field survey<br>• A laboratory investigation<br>• Scope for a statistical analysis.<br><br>Examples could include:<br>• Water quality (for example, nitrate levels) measurements at different locations in a river; for example, up-stream and down-stream of a drain outflow<br>• Variations of air quality (for example, particulates) in built-up areas as a function of time<br>• Invertebrate biodiversity, again in a water environment or in soils.<br><br>Tutors should guide learners towards an investigation suitable for their local environment, and with regard to apparatus and capabilities available. For example, water quality clearly requires a local river or stream and the capability to measure, for example, nitrate levels; and air quality requires air sampling apparatus and microscopic analysis of collected samples.<br><br>Tutors also need to guide learners towards defining statistically testable hypotheses (and corresponding null hypotheses). | 30 minutes | Unit 2 LO1<br>Unit 3 LO1, LO5<br>Unit 13 LO1, LO2<br>Unit 14 LO2, LO4, LO5 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Defining an investigation 2: how will you do it?** | Once learners have selected an investigation, tutors could guide learners into thinking about how they're going to carry it out. Points to consider include:<br>• Considering field sampling sites and/or times<br>• The number of samples to be collected<br>• How the samples will be collected<br>• What laboratory tests will be needed<br>• How will tasks be distributed amongst members of the group?<br><br>Acadia Learning for Participatory Science:<br>http://participatoryscience.org/welcome<br>A good set of resources to inform and inspire tutors. | 1 hour | Unit 2 LO1, LO3, LO4<br>Unit 3 LO1, LO5, LO6<br>Unit 6 LO1, LO2<br>Unit 13 LO1, LO2<br>Unit 14 LO2, LO4, LO5 |
| **Health and safety in the investigation** | Having defined the investigation, learners could now devise a health and safety protocol for their investigation. A risk assessment template which can be adapted to help learners with this process is available from the HSE:<br><br>Risk assessment and policy template<br>Health and Safety Executive<br>http://www.hse.gov.uk/risk/risk-assessment-and-policy-template.doc<br>Downloadable Word document.<br><br>This is a good opportunity for learners to engage in peer-review; the learner groups could exchange their H&S protocols with other groups, and review and be reviewed. This will enable learners to include risks and hazards they may not have considered, but which have been spotted by other learners.<br><br>At the end of the activity, tutors could discuss with the whole group their protocols, and, with the group draw up a single protocol for all learners to follow.<br><br>As well as personal protection, learners and tutors also need to consider protocols to protect:<br>• The environment they'll be studying<br>• The integrity of the data (e.g. avoiding contamination of data, data labelling and storage). | 1 hour | Unit 2 LO1<br>Unit 6 LO1, LO2 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Recording data 1: in the field** | This activity runs alongside the sample collection in the field. Setting as a separate activity ensures proper recording and notekeeping is taken seriously by learners, and conducted fully.<br><br>Tutors could introduce notekeeping in the classroom through a short tutorial on what makes a good notebook and field record. This could include looking ats some historic notebook samples:<br><br>Darwin Papers & Manuscripts<br>Darwin Online<br>http://darwin-online.org.uk/manuscripts.html<br>Darwin's Beagle notes, both original images and transcripts.<br><br>These are links to guidance notes (which may need adapting):<br><br>Notes on keeping a field journal<br>Western University, Canada<br>http://instruct.uwo.ca/biology/320y/fj.html<br>Expains what a journal really is about, and gives examples of typical entries.<br><br>Ecology Lab: How to keep your field notes and journal<br>Stockton University<br>http://loki.stockton.edu/~cromartj/ecology/fieldnotes<br>Note, despite what this says, notes should be kept using permanent, waterproof ink.<br><br>The main bulk of the activity will be in the field. Depending on group sizes, it may not be practicable for all learners to keep their own logs continuously (e.g. making records whilst collecting samples in a river), but tutors should ensure that at least one log is kept per group, and that all learners contribute to it.<br><br>Learners should not feel restricted to paper logs only, but should be encouraged to use technology such as smartphones to record location data (e.g. photographs, GPS coordinates etc). | 2 hours | Unit 3 LO1, LO2, LO4, LO5, LO6, LO7 |
| **Recording data 2: in the laboratory** | As with the previous activity, this will run alongside the investigation and analysis of samples collected. Since each group member will be conducting a different aspect, each should keep their own notes. As with the field notes, tutors could provide examples of laboratory notes.<br><br>The Alexander Graham Bell Family Papers<br>The Library of Congress<br>http://hdl.loc.gov/loc.wdl/dlc.11375<br>Alexander Graham Bell's laboratory notebook. | 2 hours | Unit 3 LO1, LO2, LO4, LO5, LO6, LO7 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **What did you find?** | To conclude the investigation, this activity could take the form of a tutor-led debrief, where learners report back on, for example:<br>• Initial impressions and qualitative observations (take care that these do not introduce confirmation bias later on)<br>• Describing issues arising in the investigation<br>• Discussing factors which may affect their outcomes.<br><br>They should also make reflections on the execution of the investigation, which could include:<br>• Were there factors that should have been considered (for example, extraneous and confounding variables)<br>• Were there things that might have been done differently, such as choice of experimental methods, organisation of groups and division of tasks? | 30 minutes | Unit 3 LO1, LO2, LO4, LO5, LO6, LO7<br>Unit 14 LO5 |

# SUGGESTED ACTIVITIES

| LO No: | 4 | | |
|---|---|---|---|
| **LO Title:** | **Be able to analyse and present environmental survey findings** | | |
| **Title of suggested activity** | **Suggested activities** | **Suggested timings** | **Also related to** |
| **Looking at environmental data 1: how certain are you?** | Understanding experimental uncertainties is an important skill in any scientific investigation. This activity could help learners assess and interpret their experimental uncertainties.<br><br>Tutors could reinforce the idea of uncertainties through simple examples, showing that there are natural variations in common quantities. For example:<br>• Coin tossing – all members of the group could toss coins and record the number of heads. Repeating the experiment a number of times will result in a varying number of heads. Learners can examine this variation, and assess the uncertainty in the number of heads expected from a given number of tosses.<br><br>Building on this understanding, tutors could introduce methods of calculating and combining uncertainties. There are numerous resources available to assist in this, an example being:<br><br>Error Propagation<br>Michigan State University<br>http://lectureonline.cl.msu.edu/~mmp/labs/error/e2.htm<br>How to state answers for the combined result of measurements and their uncertainties scientifically. | 30 minutes | Unit 3 LO1, LO2, LO4, LO5 |
| **Choosing statistics: what test should you use?** | The data collected in the field and laboratory investigations can now be used to test hypotheses devised in the first activity suggested for Learning Outcome 3 and it is necessary to choose a suitable test. The groups could look at the characteristics of their data sets, and choose an appropriate statistical test. Two common statistical tests in environmental science are the Student's t-test and the Mann-Whitney U test. As a guide:<br><br>Use of the t-test holds the following assumptions:<br>• The populations follow normal distributions<br>• The two independent samples are equal in size<br>• The variances for both populations are identical.<br><br>The Mann-Whitney U test holds the following assumptions:<br>• The populations do not follow any specific parametrised distributions<br>• The populations of interest have the same shape<br>• The populations are independent of each other.<br><br>Learners may also consider the use of correlation coefficients in assessing the validity of relationships between properties of samples or populations. | 30 minutes | Unit 3 LO1, LO2, LO4, LO5 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Interpreting statistics: cause and effect**  | The aim of this activity is to help learners be able to critically assess statistics, especially with regard to causal links between parameters.<br><br>Learners could review serious cases where correlation has been used as evidence for causation, as in vaccinations versus autism, which is discussed in length with references at:<br><br>MMR vaccine controversy<br>Wikipedia<br>https://en.wikipedia.org/wiki/MMR_vaccine_controversy<br>Reports on the controversy started with the 1998 publication of a research paper that lent support to the later discredited claim that colitis and autism spectrum disorders are linked to the MMR vaccine.<br><br>Learners could also think more deeply about correlation and causation, discussing examples given in these links:<br><br>Correlation does not imply causation<br>Wikipedia<br>https://en.wikipedia.org/wiki/Correlation_does_not_imply_causation<br>Explains why a correlation between two variables does not imply that one causes the other.<br><br>What's the difference between Causality and Correlation?<br>Analytics Vidhya<br>http://www.analyticsvidhya.com/blog/2015/06/establish-causality-events/<br>Explains the difference between causation and correlation using some examples.<br><br>Although it is ridiculous to argue that a drop in the number of pirates has caused global warming, is it possible that there is a third factor, such as industrialisation, which, through stronger navies, led to a decline in pirate numbers *and* generated pollution that is contributing to a rise in global temperatures? Equally, is it possible that the causation is the other way around – namely that a rise in global temperatures caused more extreme weather in the pirates' environment (the Caribbean!) and hence reduced their numbers? | 30 minutes | Unit 3 LO1, LO2, LO4, LO5 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Looking at environmental data 2: is your result significant?** | The purpose of this activity is not so much to look at the results of the environmental investigation, but rather to look at it in the context of other areas of science and ask how the 'burden of proof' varies across disciplines.<br><br>Tutors could introduce this by reinforcing the idea of 'statistical significance' learners used when doing the statistical analysis of their data. For example, learners might have been able to reject a null hypothesis at the 10% level, which, in essence, can be interpreted as meaning the result they obtained has a 10% probability of being due to random events.<br><br>Learners could then investigate the implications and consequences of confidence limits in other disciplines.<br><br>What are confidence intervals and p-values?<br>Huw T.O. Davies, Professor of Health Care Policy and Management, University of St Andrews and Iain K. Crombie, Professor of Public Health, University of Dundee<br>http://www.medicine.ox.ac.uk/bandolier/painres/download/whatis/what_are_conf_inter.pdf<br>Covers confidence levels in medical research.<br><br>Does 5-sigma = discovery?<br>Physics Central<br>http://www.physicscentral.com/buzz/blog/index.cfm?postid=5248358123737529836<br>In physics – especially particle physics – a 5-sigma confidence limit is often used in announcing important discoveries such as the Higgs Boson.<br><br>Five sigma and all that<br>The Guardian<br>https://www.theguardian.com/science/life-and-physics/2014/sep/15/five-sigma-statistics-bayes-particle-physics<br>Article explaining why particle physicists demand 99.9999% certainty before they believe a new discovery. | 30 minutes | Unit 2 LO3, LO4<br>Unit 3 LO1, LO2, LO4, LO5 |

| Title of suggested activity | Suggested activities | Suggested timings | Also related to |
|---|---|---|---|
| **Presenting your data: choosing a method**<br>  | How data is presented is important in ensuring it can be understood and interpreted correctly by a target audience and, crucially, is not misinterpreted (deliberately or otherwise – especially important in environmental science).<br><br>Using their data, learners could think about the best way to present their outcomes to a series of target audiences such as:<br>• A scientific publication (that is, academic readership)<br>• The general public (for example, in a planning consultation)<br>• Journalists (unambiguity is important here)<br>• Planning committees (information needs to be clear and targeted).<br><br>Points to think about include:<br>• To what extent is the raw data to be shown, or are just final outcomes important?<br>• What number of significant figures is suitable in the measurements and calculations, given the quality and amount of data available, and the level of accuracy and precision necessary in the final interpretations?<br>• What is most useful to the target audience – numbers, graphics or narrative descriptions? In particular, what type of plot (scatter diagram, bar chart, pie chart etc) best represents the data, and enables the audience to readily interpret the outcomes?<br>• How can learners ensure their presentation of outcomes is unbiased?<br>• How can learners reduce the opportunities for their outcomes to be mis-represented?<br>• What technological tools (for example, mapping) could be used?<br><br>This activity could be a good opportunity for cross-curricular work with other disciplines – for example, combining with journalism or media studies students in presenting outcomes for the public and media, or law students for planning. | 1 hour | |
| **Thinking about your investigation**<br>  | This activity relates to reflective practice in science, and could involve learners:<br>• Peer-reviewing each others' final reports<br>• Reviewing their experimental procedure in the light of their outcomes and identifying, for example:<br>– Variables not taken into account or inadequately controlled (e.g. temperature, river flow rate etc)<br>– Procedures which may have affected their outcomes (e.g. sampling protocols)<br>• Thinking about actions or recommendations their investigations suggest – especially important if the investigation is part of a planning process. | 30 minutes | Unit 3 LO5, LO6, LO7<br>Unit 14 LO5 |

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