Cambridge TECHNICALS

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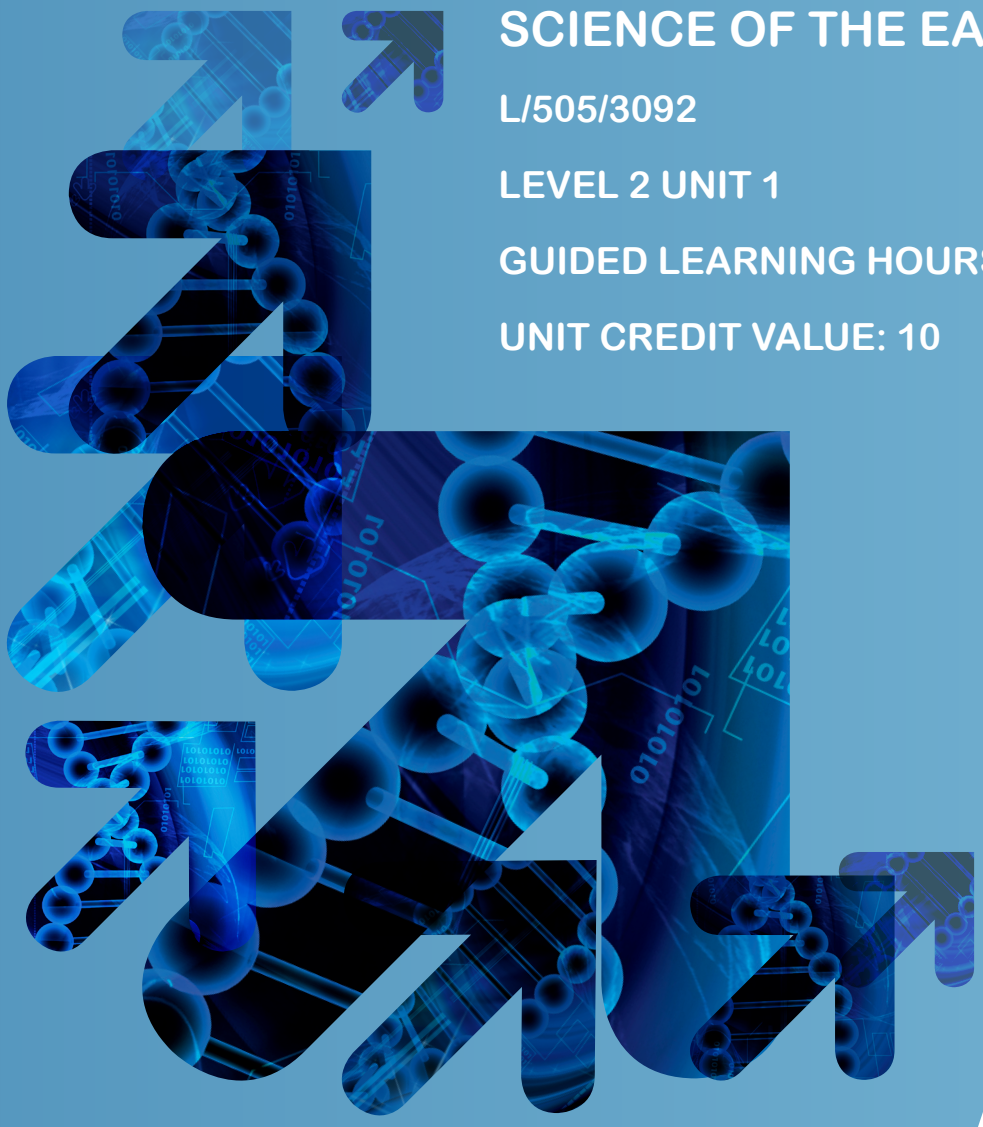
# OCR LEVEL 2 CAMBRIDGE TECHNICAL

## CERTIFICATE/DIPLOMA IN

# SCIENCE



## SCIENCE OF THE EARTH

L/505/3092

LEVEL 2 UNIT 1

GUIDED LEARNING HOURS: 60

UNIT CREDIT VALUE: 10

OCR

# SCIENCE OF THE EARTH

## L/505/3092

## LEVEL 2

## AIM AND PURPOSE OF THE UNIT

This unit aims to introduce learners to ideas about the changing nature of the Earth and to our place as humans living on the Earth. The unit looks at how the Earth provides the necessary conditions for life and also at our responsibilities as stewards of the Earth.

The unit begins by looking at the dynamic nature of the Earth and traces the scientific theories behind our understanding of the processes that have led to changes in the Earth's surface. The unit moves on to look at how the atmosphere provides the necessary conditions for life and how we use the hydrosphere as a resource. The unit culminates with a study, either individual or group based, in which learners trace the full life cycle of the exploitation of a natural resource from the Earth. This study gives learners the opportunity to think about issues relating to the responsible uses of the Earth's resources and sustainability.

## ASSESSMENT AND GRADING CRITERIA

| Learning Outcome (LO)<br><br>The learner will: | Pass<br><br>The assessment criteria are the pass requirements for this unit.<br><br>The learner can: | Merit<br><br>To achieve a merit the evidence must show that, in addition to the pass criteria, the learner is able to: | Distinction<br><br>To achieve a distinction the evidence must show that, in addition to the pass and merit criteria, the learner is able to: |
|---|---|---|---|
| 1 Understand the structure of the Earth and the development of ideas and theories about the processes that change the Earth's surface. | P1 summarise the model for the structure of the Earth and describe current scientific theories about the processes that change the Earth's surface and lithosphere | M1 describe how ideas and scientific theories about changes to the Earth's surface and the lithosphere have developed and how each idea or theory was supported by the evidence available at the time | D1 evaluate the different ideas and theories about changes to the Earth's surface and the lithosphere in terms of their strengths and weaknesses in the light of accumulated evidence |
| | P2 identify reasons why it is important that scientists continually monitor changes to the Earth's surface and the lithosphere | M2 describe how scientists minimise the impact of changes to the Earth's surface and lithosphere in populated areas | |
| 2 Know how the Earth's atmosphere has evolved and how it supports life. | P3 describe the structure and composition of the Earth's atmosphere and the importance of the atmosphere to life | M3 explain some of the processes occurring in the atmosphere that are important to life | |
| | P4 outline the key stages in the development of the atmosphere | | D2 describe how scientists collect data about the Earth's atmosphere and how the data is interpreted |

| Learning Outcome (LO)<br><br>The learner will: | Pass<br><br>The assessment criteria are the pass requirements for this unit.<br><br>The learner can: | Merit<br><br>To achieve a merit the evidence must show that, in addition to the pass criteria, the learner is able to: | Distinction<br><br>To achieve a distinction the evidence must show that, in addition to the pass and merit criteria, the learner is able to: |
|---|---|---|---|
| 3 Understand the importance of the hydrosphere for supporting human life. | P5 identify ways the hydrosphere supports human life | M4 describe the composition of sea water and how useful products are extracted from sea water | |
| | P6 outline how and why water is treated before and after use | M5 explain why it is necessary to treat water before and after use and why it is important to economise on the amount of water we use | |
| 4 Understand how we extract and use resources in the lithosphere, hydrosphere, atmosphere and biosphere, and the long-term effects on the Earth. | P7 summarise information and research data about how a named natural resource is extracted and used | M6 discuss the effects on the Earth of the long-term extraction and use of the natural resource | D3 evaluate the sustainability of the use of the natural resource and outline future developments that are needed to ensure sustainability |

## TEACHING CONTENT

The unit content describes what has to be taught to ensure that learners are able to access the highest grade.

Anything which follows an i.e. details what must be taught as part of that area of content.

Anything which follows an e.g. is illustrative, it should be noted that where e.g. is used, learners must know and be able to apply relevant examples to their work though these do not need to be the same ones specified in the unit content.

**LO1 Understand the structure of the Earth and the development of ideas and theories about the processes that change the Earth's surface.**

- The Earth has a central inner core of solid iron and an outer liquid core of iron, surrounded by a solid mantle of rock, all surrounded by a solid crust.
- The Earth contains the lithosphere, hydrosphere, atmosphere and biosphere.
- The lithosphere is the outer-layer of the Earth and is made up of the crust and uppermost mantle.
- Ideas and theories about how the surface of the Earth and the lithosphere have changed over time.
- Different ideas and theories were supported by the evidence available at the time (e.g. creation stories, stories of global floods, myths to explain rock formation, shrinking Earth theory).
- The rock cycle and tectonic plate theory, as the currently accepted models linked to available evidence.
- Rocks are formed and recycled through the rock cycle
  - Igneous rocks are formed by the crystallisation of molten material from the mantle (called magma if inside the Earth or lava if on the surface of the Earth), which can either emerge from volcanoes and sea-floor ridges e.g. basalt, or cool slowly within the crust e.g. granite.
  - Most sedimentary rocks are formed when weathered and eroded material is deposited and compressed.
  - Metamorphic rock is rock which has been altered by high temperature and pressure deep within the crust.
- Material in the crust is slowly recycled in the rock cycle
  - Rocks are weathered by the physical and chemical action of the atmosphere and by living organisms, breaking them up.
  - Rain and rivers transport the weathered material to the oceans where it builds up in layers on the sea floor, which breaks the material down further.
  - Movement of tectonic plates can subduct sedimentary rocks into the mantle where they melt, where the material can rise through the crust to form volcanoes, or where the material can be assimilated into the mantle again (a simple model).
- Evidence for moving tectonic plates:
  - Sea floor spreading of the growing Atlantic ocean.
  - Patterns in the distribution of earthquakes, volcanoes and mountain ranges across the globe.
  - The ring of earthquakes, live volcanoes and mountains around the shrinking Pacific ocean.
  - The 'jigsaw fit' of continents suggesting that they once were part of a single land mass.
  - The distribution of similar fossils and rock types between continents.
  - Magnetic patterns in the oceanic crust.
- Reasons for monitoring changes to the Earth
  - Collection of data over time is used to identify patterns and develop models of Earth movements.
  - Use of models to predict the timing and likely severity of future natural hazards (e.g. volcanic eruptions, earthquakes, tsunamis or landslides).
- How scientists minimise impact on populated areas
  - Predictions of seismic and volcanic activity and land movement, early warnings, evacuations, provision of aid.
  - Recommendations for emergency procedures.
  - Innovations in structural design (e.g. Maximum height of buildings, design features of buildings, shock absorbing structural foundations).
  - Monitoring the effectiveness of innovations (e.g. San Andreas fault).

**LO2 Know how the Earth's atmosphere has evolved and how it supports life.**

- Structure and processes in the Earth's atmosphere
  - The 'layers' in the atmosphere: troposphere, stratosphere, mesosphere, thermosphere/ionosphere and exosphere.
  - The main characteristics of each 'layer' (e.g. temperature, density and types of particles).

- The harmful nature of ionising electromagnetic radiation from the sun (high frequency radiation including UV and X-ray).
- The role of other parts of the atmosphere (i.e. absorption of UV in the stratosphere, UV and X-rays in the ionosphere and protection from meteors by mesosphere).
- Ionisation and formation of radicals from gaseous atoms and molecules in terms of radiation breaking bonds and removing electrons.
- The absorption of energy by these processes.

- Composition and processes in the troposphere
  - The percentages of the main gases.
  - The tropospheric temperature gradient traps all water as it rises and condenses, resulting in all weather occurring within the troposphere.
  - The role of photosynthesis and respiration in maintaining the balance of oxygen and carbon dioxide gases.
  - The process of photosynthesis and why it is essential to life.
  - The process of respiration and why it is essential to life.
  - Carbon dioxide and other natural greenhouse gases and how the natural greenhouse effect occurs.
  - Comparison of surface temperatures of planets, with and without atmospheres, with their distance from the sun.
  - The importance of the natural greenhouse effect to life.

- Development of the atmosphere
  - Outgassing of the early atmosphere.
  - The condensation of water to form the hydrosphere.
  - Evolution of plants and the effect of photosynthesis on oxygen levels.
  - Evolution of animals and the stabilisation of oxygen and carbon dioxide levels.

- Collection of data
  - Analysis of gases from volcanoes to model the likely composition of the early atmosphere.
  - Use of ice core samples for providing data on the recent history of the atmosphere.

**LO3 Understand the importance of the hydrosphere for supporting human life.**

- Water circulates through the hydrosphere via the Water Cycle.

- The hydrosphere is important for supporting human life
  - The importance of the circulation of water in the oceans to moderate climate and carry heat energy around the globe.
  - The hydrosphere as a source of food.
  - The hydrosphere as used for the disposal of waste, including sewage and nuclear waste.
  - The hydrosphere as a source of fresh water for drinking, industry and agriculture.
  - The hydrosphere as used to generate electricity.

- Sea water as a source of useful materials
  - Sea water contains dissolved salts. The salts enter sea water when soluble compounds from the weathering and erosion of rocks are washed into the sea by the action of rain and rivers.
  - Salts are extracted from sea water by evaporation and are used for preserving and flavouring foods
  - Uses of elements in sea water (e.g. uses of bromine, iodine and chlorine).
  - Sea water can be electrolysed to produce hydrogen, chlorine and sodium hydroxide.
  - The products of electrolysis are useful in industry (for example hydrogen for making margarines, chlorine for water treatment and making bleach, sodium hydroxide for making soaps, cleaners, textiles and paper)

- Water treatment and use
  - Water for drinking needs to be treated before use.
  - Some countries provide drinking water by desalination (for example by distillation).
  - Water for drinking is treated in a series of steps (for example filtration, removing tastes and odours).
  - Chlorination is used to kill bacteria.
  - The benefits and effectiveness of chlorination (for example processing historical or contemporary data on the effectiveness of chlorination on diseases transmitted by water supplies).
  - The importance of economy of water use (e.g. to ensure enough water is available, to reduce water processing and waste, to save energy).
  - Reasons for treating sewage before returning it to water courses.

**LO4 Understand how we extract and use resources in the lithosphere, hydrosphere, atmosphere and biosphere, and the long-term effects on the Earth.**

This part of the unit may be taught via an individual research study or the tutor may choose to lead the learners through a chosen example. The resource chosen should be a naturally occurring resource that humans extract and use. The study should follow the 'story' of the resource from its extraction,

through its use to the end of its useful life, taking into account issues such as energy use, waste, benefits and risks at each stage.

Where possible, the examples chosen should link to one of the other learning outcomes, e.g. geothermal energy, tidal or wave energy, extraction of a mineral resource from the lithosphere (sulfur, limestone, granite, metals, copper, iron), use of the atmosphere as a resource (extraction of gases for commercial use, wind power), using the hydrosphere (drinking water, extraction of minerals from sea water), using the biosphere (fishing the sea, extracting plant resources from a natural environment such as the rain forest).

The study will vary depending on the context chosen, but may include:

- an account of the extraction of the resource, with an explanation of any underlying scientific principles involved.
- data relating to the use of the resource, where appropriate (e.g. amount extracted, transport data, world demand)
- an account of the importance and use of the resource
- issues relating to the effect on the environment of the extraction and use of the resource
- energy considerations at each stage of the extraction and use of the resource
- waste issues relating to the disposal of products made from the resource
- actions to counteract any adverse effects on the environment
- whether the long-term use of the resource is sustainable
- future issues related to the continued use of the resource.

## DELIVERY GUIDANCE

Resources to support teaching may be found on the National Stem Centre website (for example Nuffield resources and Salters' Restless Earth). There are DVDs which cover some of the ideas, such as 'Earth Story', 'Earth, the power of the planet' and 'Raging Planet'.

**LO1 Understand the structure of the Earth and the development of ideas and theories about the processes that change the Earth's surface.**

Learners start the unit by talking about what they already know about the structure of the Earth and consider what the different parts of the Earth are called. Poster work could be used to produce visual representations of the structure of the Earth to feed into the learners' assignments.

Learners could work in groups to make presentations about different ideas about the Earth, for example different creation myths, myths about how rocks were formed (e.g. the Gorgon myths, the Giant's causeway), flood myths to explain sea shell and fish fossils in mountain ranges, the shrinking Earth theory. Each group could make a presentation to explain their 'story' and to identify the features of the Earth that each story explains.

The tutor may then provide evidence in support of tectonic theory e.g. the jigsaw fit of continents, data about fossils or rock formation in Africa and South America and introduce the idea of tectonic plate theory. Learners may plot the locations of earthquakes and volcanoes around the globe and compare these to the location of plate boundaries. There are many web-based resources that allow students to see visual representations of moving tectonic plates linked to the location of earthquakes and volcanoes (a search engine will bring up a selection).

Learners may look at data about the location of earthquakes or volcanoes, their severity and the number of casualties. They may consider reasons why the degree of severity of seismic activity is not always linked to the number of people affected. Learners may research news stories of 'real' events. They may also research ways that scientists act to minimise damage in populated areas.

**LO2 Know how the Earth's atmosphere has evolved and how it supports life.**

The unit could begin by learners processing data about the regions of the Earth's atmosphere, for example interpreting or constructing diagrams with information about relative depth above the Earth's surface, temperature and density of gases. Different groups of learners could research different regions of the atmosphere to make a complete class presentation to show why each region is important to life. The tutor will need to support learners to understand the more complex processes involved in the absorption of high energy radiation.

Learners could write some cartoon strips or short stories based on a science fiction theme of 'life on Earth without the mesosphere/ionosphere/stratosphere' to describe what the conditions on Earth would be like if any of these important layers were missing.

Learners may process data on the relationship between distance from the Sun and surface temperature for the planets and moons in our Solar System to appreciate the importance of the presence of an atmosphere in moderating surface temperature.

Data and graphs are widely available on the internet to show how the composition of the atmosphere has changed over time. Learners may draw graphs and annotate them to identify why the changes to the atmosphere occurred. They may also carry out some comparative data analysis by comparing emissions from volcanoes with the composition of the current atmosphere and putting forward explanations for the differences. Another approach is to compare the atmosphere of other planets, such as Venus or Mars, with Earth, identifying the differences and attempting explanations for them.

Learners could research the work of scientists who collect data. They may write 'a day in the life' type articles to explain what such scientists do and what their jobs involve.

In learning about the troposphere, the section on photosynthesis and respiration may be extended to provide opportunities for practical work, for example by including experiments on testing the gases involved in respiration and photosynthesis.

**LO3 Understand the importance of the hydrosphere for supporting human life.**

Learners could start this section of the unit by looking at tables showing the ions in sea water and the labels from bottles of mineral water. The learners may think about the elements the water contains and how the elements 'got into' the water. This leads to a discussion of how water is continuously cycled in the Water Cycle.

An interesting illustration is to think about what the Mars probes looked for when they were searching for evidence of water on Mars. They contrasted the elements found in the rock in valleys to those found in rock on higher ground to look for evidence of transport of soluble salts by water. This data is available on the internet. Learners could research the uses of some of the elements in sea water, perhaps taking the opportunity to practise presenting data about their uses in charts and graphs. Learners could look at chlorine-based products, such as bleaches and toilet cleaners, and consider their uses as well as the safety implications of their labelling and storage.

The tutor could then lead learners to think about how the oceans support life, for example in terms of the circulation of heat energy and the supply of food. Learners may research local ocean currents and find out about concerns relating to the slowing of the Gulf Stream near the UK. Learners may consider the 'truth' behind 'sensationalised' headlines of newspaper reports into concerns about the changing nature of ocean currents.

A demonstration or small scale practical to investigate the electrolysis of brine could be carried out. Learners should appreciate that chlorine extracted from sea water is then used to treat drinking water. This leads to a consideration of water as an important commodity for human life.

Learners could do practical work related to water treatment such as filtration, distillation, use of carbon to remove colours, testing the effectiveness of different concentrations of bleach to kill bacteria. An interesting problem solving activity is to ask learners to design water filters using sand and gravel. 'Dirty' water can be made by mixing soil into tap water.

Learners could make a blog or a photo diary to show their water use and quantity of waste water produced in a typical day. Many websites have tables of data to show typical volumes used in standard activities such as taking a bath, shower or flushing the toilet. They may find out about new technologies for economising on water use, such as re-using 'grey water' to flush toilets.

Learners can investigate the effectiveness of water chlorination by looking at case study type data into cholera or typhoid. Such data is widely available on the internet. Learners may discuss why some people choose deliberately to remove chlorine from water using water filters, and the advantages and hazards of doing this.

**LO4 Understand how we extract and use resources in the lithosphere, hydrosphere, atmosphere and biosphere, and the long-term effects on the Earth.**

One way of starting this part of the unit would be to introduce the idea of the Gaia Principle which discusses the Earth as behaving as a single organism. This leads to the idea that we are responsible for ensuring that our use of the Earth as a resource for commodities does not disrupt the natural cycling of resources within the Earth. Learners then look at a specific example of the way that humans exploit one of the Earth's natural resources and evaluate the effect that this exploitation has on the longer term future of the Earth.

This part of the unit could be managed as an individual research project or as a tutor led study. Learners may choose to carry out original research. For example, if learners choose to study the extraction and use of a metal such as iron, they could take a photo diary of its use, visit a local car dealership, collect data about the scale of iron extraction and use or visit a scrap dealer to take a photo diary. The study could then be presented as a commentary on their research. Alternatively, learners could do their research based on websites. It may be advisable to provide some structure or writing frames to support learners in their research.

If learners work in groups to collect information it is important that they produce an individual report for assessment.

## SUGGESTED ASSESSMENT SCENARIOS AND GUIDANCE ON ASSESSMENT

| Criteria | Assignment | Scenario | Assessment |
|---|---|---|---|
| LO1 | Structure of the Earth | The learner produces a storyboard for a documentary about the structure of the Earth. | P1 The structure of the Earth may be represented by an annotated diagram to show the different parts. Learners should consider the visual impact of the diagrams they choose with an eye to catching the imagination of the audience for the documentary. The storyboard could lead on to show a series of images with annotations to describe an outline of the rock cycle and the theory of tectonic plates linked to observations such as earthquakes, volcanoes and mountain formation.<br><br>M1 Learners could make a flow chart or annotated series of images to summarise different 'stories' or 'theories' for the formation of rocks and other changes to the Earth's surface, linking each idea to how the evidence fitted at the time. A substantial amount of evidence should be presented in support of accepted ideas about tectonic plates.<br><br>D1 Learners need to evaluate how different theories about changes to the Earth's surface both fitted or did not fit with evidence available at the time. The learners should make it clear how the development of theories was driven by the accumulation of evidence over time, making it clear how new evidence drove the need for new theories.<br><br>P2 A short script for a 'voiceover' could be written, with appropriate images chosen to explain why monitoring seismic activity is important to make predictions about the likelihood of earthquakes or other seismic events.<br><br>M2 Learners should present images, data or research to show how scientists minimise the impact of seismic activity on populated areas. They should focus on how individuals can act to minimise the risk to themselves and how towns and populated areas in 'earthquake zones' are designed to withstand earth movements. |

| Criteria | Assignment | Scenario | Assessment |
|---|---|---|---|
| LO2 | How did the atmosphere evolve and how does it support life? | The learners present information about the 'history of life and the atmosphere'. Possible assignment formats include an outline plan for a glossy photo book or a series of images or photographs with slide notes to support a talk. | P3 Learners produce a diagram to show the structure of the Earth's atmosphere with annotations to show how each part is essential to life. Points to include are that the atmosphere protects us from harmful radiation and space 'debris' such as meteors, that the atmosphere has a warming effect and the essential nature of carbon dioxide and oxygen in the troposphere.<br><br>M3 Learners need to expand their work at pass to explain the science behind the way the atmosphere supports life, in terms of how the atmosphere protects us, how the greenhouse effect occurs and an explanation of the processes of photosynthesis and respiration.<br><br>P4 Learners produce a time line or flow chart to show the key stages in the development of the atmosphere and the reasons for the main changes in the composition of the atmosphere over time.<br><br>D2 Learners could prese nt some data taken from active volcanoes and recent ice core samples and annotate the data to give an outline of how the data was collected and how the data links to scientists' accounts of how the atmosphere evolved. |
| LO3 | How do humans use the hydrosphere? | The learner writes an overview of the importance and usefulness of the hydrosphere. | P5 Learners could present the importance of the hydrosphere to human life diagrammatically using spider diagrams, annotations on a diagram of the water cycle, or by annotating images relating to the different ways that the hydrosphere supports human life.<br><br>M4 Learners could annotate data in tables about the composition of sea water and mineral water to draw attention to the elements they contain and their relative amounts. Learners describe how products are extracted from sea water by evaporation and electrolysis and link each product to its uses to show its importance.<br><br>P6 Learners outline how humans use water and why it is important that water is treated before and after use to stop the spread of water-borne disease.<br><br>M5 Learners should discuss the treatment of water in terms of the different ways that pathogens can enter and be transmitted through untreated water. Learners may produce a water use diary, and use the outcomes of the diary to discuss issues relating to conserving the amount of water we use. |

| Criteria | Assignment | Scenario | Assessment |
|---|---|---|---|
| LO4 | Case study | The learner researches a case study into the 'life' of a resource that humans extract from the Earth. They could present their case study as a slide show with notes, a series of annotated photographs, a formal report or a magazine article. | P7 Learners present information to show how a natural resource is extracted and used, drawing attention to the importance of its use and application.<br><br>M6 Learners extend their report to highlight issues relating to the effect of the extraction and use of the resource on the longer term quality of the Earth's environment.<br><br>D3 Learners should evaluate the use of the resource using ideas about sustainability, and identify what further developments are needed to ensure that the quality of the Earth's environment can be maintained. |

## 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 delighted to answer questions and give advice.

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