SCQF level 6
Unit Specification

Environmental Science: Earth's Resources

SCQF: level 6 (6 SCQF credit points)

Unit code: J264 76

Unit outline

The general aim of this Unit is to develop skills of scientific inquiry, investigation, analytical thinking and independent working, along with knowledge and understanding of the Earth's resources. Learners will apply these skills when considering the applications of the Earth's resources on our lives, as well as the implications on society and the environment. This can be done by using a variety of approaches, including investigation and problem solving.

The Unit covers the key areas of the geosphere; the hydrosphere; the biosphere; the atmosphere.

Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Learners who complete this Unit will be able to:

1 Apply skills of scientific inquiry and draw on knowledge and understanding of the key areas of this Unit to carry out an experiment/practical investigation

2 Draw on knowledge and understanding of the key areas of this Unit and apply scientific skills

This Unit is available as a free-standing Unit. The Unit Specification should be read in conjunction with the *Unit Support Notes*, which provide advice and guidance on delivery, assessment approaches and development of skills for learning, skills for life and skills for work. Exemplification of the standards in this Unit is given in *Unit Assessment Support*.

Recommended entry

Entry to this Unit is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by one or more of the following or equivalent qualifications and/or experience:

- National 5 Environmental Science Course or relevant component Units
- National 5 Geography Course or relevant component Units
- National 5 Biology Course or relevant component Units

In terms of prior learning, relevant experiences and outcomes may also provide an appropriate basis for doing this Unit.

Equality and inclusion

This Unit Specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence. For further information, please refer to the *Unit Support Notes.*

Standards

Outcomes and assessment standards

Outcome 1

The learner will:

1 Apply skills of scientific inquiry and draw on knowledge and understanding of the key areas of this Unit to carry out an experiment/practical investigation by:

1.1 Planning an experiment/practical investigation
1.2 Following procedures safely
1.3 Making and recording observations/measurements correctly
1.4 Presenting results in an appropriate format
1.5 Drawing valid conclusions
1.6 Evaluating experimental procedures

Outcome 2

The learner will:

2 Draw on knowledge and understanding of the key areas of this Unit and apply scientific skills by:

2.1 Making accurate statements
2.2 Solving problems

Evidence Requirements for the Unit

Assessors should use their professional judgement, subject knowledge and experience, and understanding of their learners, to determine the most appropriate ways to generate evidence and the conditions and contexts in which they are used.

The key areas covered in this Unit are:

- the geosphere
- the hydrosphere
- the biosphere
- the atmosphere

The *Unit Support Notes* (Appendix) provide details of skills, knowledge and understanding sampled in the Unit assessment.

The following table describes the evidence for the Assessment Standards.

Assessment Standard	Evidence required
Planning an experiment or practical investigation	A plan that must include: ♦ a clear statement of the aim ♦ a dependent and independent variable ♦ variables to be kept constant ♦ observations and/or measurements to be made ♦ necessary equipment and/or materials ♦ a clear and detailed description of how the experiment or practical investigation should be carried out, including safety considerations
Following procedures safely	Record showing that the learner was observed following procedures safely.
Making and recording observations/measurements correctly	Raw data recorded in a relevant format, for example a table. Repeated measurements, where appropriate. Where measurements are repeated, averages must be calculated.
Presenting results in an appropriate format	One format from: line graph, bar graph, scatter graph or other appropriate format
Drawing a valid conclusion	A conclusion that includes reference to the aim, and is supported by the data.
Evaluating experimental procedures	Two evaluative statements, with justifications, about the procedures used.
Making accurate statements and solving problems	Achievement of at least 50% of the total marks available in a holistic assessment. The assessment must **not** be split into smaller sections, such as individual key areas.

Exemplification of assessment is provided in *Unit Assessment Support*.

Assessment Standards thresholds

Outcome 1
Learners are not required to show full mastery of the Assessment Standards to achieve Outcome 1. Instead, five out of the six Assessment Standards for Outcome 1 must be met to achieve a pass. Learners must be given the opportunity to meet all Assessment Standards.

Outcome 2
Learners are assessed using a holistic test that covers Assessment Standards 2.1 and 2.2. To gain a pass for Outcome 2, learners must achieve 50% or more of the total marks available in the assessment.

Transfer of evidence

Evidence for the achievement of Outcome 1 for this Unit can be used as evidence of Outcome 1 in the SCQF level 6 Units: *Environmental Science: Living Environment* (J261 76) and *Environmental Science: Sustainability* (J266 76).

Evidence for the achievement of Outcome 2 for this Unit is **not** transferable between the SCQF level 6 Units: *Environmental Science: Living Environment* (J261 76) and *Environmental Science: Sustainability* (J266 76).

Re-assessment

SQA's guidance on re-assessment is that there should be only one or, in exceptional circumstances, two re-assessment opportunities. Re-assessment must be carried out under the same conditions as the original assessment and must be of equal demand.

Outcome 1
Learners can either re-draft their original Outcome 1 report or carry out a new experiment/practical investigation.

Outcome 2
Learners must have a full re-assessment opportunity that consists of a holistic assessment. For Outcome 2, learners must achieve 50% of the total marks available in the re-assessment.

Development of skills for learning, skills for life and skills for work

It is expected that learners will develop broad, generic skills through this Unit. The skills that learners will be expected to improve on and develop through the Unit are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and drawn from the main skills areas listed below. These must be built into the Unit where there are appropriate opportunities.

1 Literacy

1.2 Writing

2 Numeracy

2.1 Number processes
2.2 Money, time and measurement
2.3 Information handling

4 Employability, enterprise and citizenship

4.6 Citizenship

5 Thinking skills

5.3 Applying
5.4 Analysing and evaluating
5.5 Creating

Amplification of these is given in SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work.* The level of these skills should be at the same SCQF level of the Unit and be consistent with the SCQF level descriptor. Further information on building in skills for learning, skills for life and skills for work is given in the *Unit Support Notes.*

Appendix: Unit Support Notes

Introduction

These support notes provide advice and guidance on developing skills, knowledge and understanding for the Unit assessment. They should be read in conjunction with:

- *Unit Assessment Support*

Developing skills, knowledge and understanding

Teachers and lecturers are free to select the skills, knowledge and understanding, and contexts that are most appropriate for delivery in their centres.

Skills, knowledge and understanding for the Unit assessment

The following information provides details of skills, knowledge and understanding sampled in the Unit assessment.

Earth's Resources

1 Geosphere

Learners should be familiar with the definitions of the following terms, and be able to use them appropriately:

Bauxite, chemical weathering, constructive plate boundary, convection, convection currents, convergence, core, crust, destructive plate boundary, district heating scheme, divergence, earthquake magnitude, extrusive rock, fault, fold mountains, frictional heat, geothermal energy, geothermal gradient, gravitational contraction, gravitational potential energy, greenhouse gas, ground source heat pump, hydrothermal vent, intrusive rock, kinetic energy, laterite, lava, leaching, magma, mantle, metallic mineral, ocean trench, open cast mining, ore, ore deposit, overburden, particulates, percolation, plate boundary, plate tectonics, radioactive decay, rift valley, runoff, smelting, subduction zone, superheating, tailings

This list is not exhaustive, and terms listed here may apply in more than one area.

a. Earth's internal heat

- **Sources of Earth's internal heat**

  Extra-terrestrial impacts — during Earth's formation the kinetic energy contained in colliding extra-terrestrial bodies was converted to heat energy upon impact.

  Gravitational contraction — in the early stages of formation, the Earth contracted into a smaller volume, resulting in gravitational potential energy converting to heat energy. At the same time, frictional heat was generated by denser iron and nickel-rich material sinking to the core.

  Decay of radioactive elements — disintegration of natural radioactive elements in the mantle and crust generates heat energy.

- **Heat flow — convection**

  Convection occurs in both the mantle and the core. This is a circulation pattern in which warmer low-density material rises and cooler high-density material sinks. This transfers heat to the Earth's surface and drives plate tectonics.

b. Mechanisms of plate boundaries

- **Plate tectonics**

  The surface of the Earth is covered by seven large rigid plates and a number of smaller plates. These plates are all in motion, and not all in the same direction or at the same speed. The movement is caused by convection currents occurring in the underlying mantle. Intense geological activity occurs at plate boundaries,

where plates move away from each other, past one another, or towards each other.

- **Constructive plate boundaries**
  These occur where convection currents in the upper mantle are diverging. If this occurs below a continent, a rift valley will form. This type of plate boundary is mostly found in oceans, where the plate type is oceanic on both sides. As the plates move apart, the underlying mantle melts, forming magma. The magma rises upwards, erupting through the crust and filling the gap between the plates, creating new oceanic crust. A chain of underwater volcanoes is created along the spreading plate margins.

  Hydrothermal vents are often located near constructive plate boundaries. Deep faults form when the oceanic plates move apart. Cold seawater percolates down through the faults and is superheated through contact with the magma, before returning to the seafloor via hydrothermal vents.

  The superheated fluids often contain dissolved metallic minerals. As the fluids make contact with the seawater and cool, the dissolved minerals are deposited on the sea floor. The minerals often accumulate in substantial volumes, which can potentially be exploited.

- **Destructive plate boundaries**
  These margins occur where convection currents in the upper mantle are converging, forcing the plates above to move towards each other. Subduction zones occur where continental plate and oceanic plates converge. The oceanic plate moves below the continental plate because it is denser, also carrying down oceanic sediments and seawater. The addition of the sediments and seawater lowers the melting point of the plate materials. The magma generated from subduction zones has high levels of gas present and is very explosive. This molten material forces its way up through faults to the surface of the continental plate, erupting as a volcano. Molten material reaching the surface is known as lava, and cools to form extrusive rock. Magma that cools and solidifies before reaching the surface forms intrusive rock.

  The magma carries concentrated metallic minerals into the upper crust. Significant metallic mineral deposits are often found near ancient plate boundaries.

  As the oceanic plate moves below the continental plate, a deep ocean trench forms at the junction. Subduction also causes crumpling along the edge of the continental plate, forming fold mountain chains. Earthquakes at this boundary can be of high magnitude due to the release of frictional pressure that builds up between the two plates.

c. Aluminium

- **Formation of bauxite ore deposits**
  Bauxite is an ore rich in aluminium oxide and is found in extractable quantities in areas associated with subduction zones.

  Bauxite forms in tropical areas around the Equator, where high temperatures and abundant rainfall result in extreme chemical weathering of rock. As water percolates through the soil in the hot, humid climate, nutrients dissolve and leach downwards. The soil that remains, known as laterite, can be rich in aluminium oxides and form rich ore deposits near the surface.

- **Environmental impacts of mining and processing bauxite ore**
  The majority of world bauxite production is from surface mines, extracted by open cast mining.

  Environmental issues associated with bauxite mining include:
  - landscape changes through removal of timber, vegetation, rock, and soil, with associated impacts on ecosystems and biodiversity
  - control of erosion and runoff from the mine
  - mining disturbs the movement, quality, and distribution of water in the area
  - disposal of the overburden, tailings, and other waste
  - dust, noise, and emissions caused by mining operations and transport

  Environmental issues associated with processing of bauxite include:
  - smelting and processing require enormous inputs of electricity, water, and resources, such that power plants are often constructed nearby
  - smelting and processing releases high levels of greenhouse gases, particulates, and other harmful substances
  - bauxite is often transported long distances to countries with processing plants

c. Geothermal energy

- **Geothermal gradient**

- **Sources of geothermal energy**
  - groundwater: steam and hot water
  - ground source: ‘hot rocks’

- **Production of geothermal energy**
  - steam or hot water can be extracted and used to generate electricity or piped directly to district heating schemes
  - ground source heat pumps

- **Benefits and challenges of using geothermal energy**

2 Hydrosphere

Learners should be familiar with the definitions of the following terms, and be able to use them appropriately:

Aquifer, condensation, Coriolis effect, evaporation, evapotranspiration, global ocean conveyor belt, groundwater, Gulf Stream, infiltration, ocean circulation, ocean gyre, percolation, precipitation, runoff, sublimation, thermohaline circulation, transpiration, upwelling

This list is not exhaustive, and terms listed here may apply in more than one area.

a. Hydrological cycle

- **Movement processes**
  Evaporation, condensation, precipitation, infiltration, percolation, transpiration, evapotranspiration, sublimation, runoff

- **Storage**
  — surface: atmospheric moisture, snow, ice, watercourses, lakes, oceans
  — subterranean: groundwater, aquifers

b. Oceanic circulation

- **Global ocean conveyor belt**
  The global ocean conveyor belt is a constantly moving system of deep ocean circulation driven by thermohaline circulation and surface wind currents.

  As ocean water in polar regions cools it forms sea ice, drawing out the freshwater and causing the surrounding water to get saltier. This increases its density, and the cold water starts to sink. Surface water is pulled in to replace the sinking water, which then also becomes cold and salty enough to sink. This initiates the deep ocean currents driving the global ocean conveyor belt.

  The Gulf Stream transports warm water away from the Equator. As more warm water is transported north, the cooler water sinks and moves south of the Equator down towards Antarctica. Eventually, the cold bottom waters return to the surface through mixing and upwelling, continuing the ocean conveyor belt that encircles the globe.

  The water that returns to the surface through upwelling is usually rich in nutrients. These boost the growth of primary producers, which support the marine food web.

- **Factors affecting oceanic circulation**
  Thermohaline circulation, continental location, surface winds, Coriolis effect

- **Ocean gyres**
  Global winds drag on the water's surface, causing it to move and build up in the direction that the wind is blowing. The wind direction is influenced by the Coriolis effect, resulting in the deflection of major surface ocean currents to the right in a

clockwise spiral in the northern hemisphere and to the left in an anti-clockwise spiral in the southern hemisphere. These major spirals of ocean-circling currents occur north and south of the Equator, but not at the Equator as the Coriolis effect is absent there. The edges of a gyre and its content constantly change with ocean currents and winds, but the circulating nature of ocean gyres traps marine debris and can distribute this over huge surface areas and throughout the top of the water column.

3 Biosphere

Learners should be familiar with the definitions of the following terms, and be able to use them appropriately:

Bio-crude oil, biodiesel, bioethanol, biofuel, biological weathering, biomethanol, brown earth soil, capillary action, chemical weathering, climate, decomposition, eluviation, humification, illuviation, leaching, parent material, physical weathering, podzol soil, pore space, processed biofuel, relief, soil profile, soil structure, soil texture, translocation, weathering

This list is not exhaustive, and terms listed here may apply in more than one area.

a. Soils

- **Inputs**
  Parent material, organisms, relief, climate, time

- **Formation processes**
  - weathering: physical, chemical, and biological
  - decomposition and humification
  - translocation: leaching, eluviation, illuviation, capillary action

- **Composition**
  - mineral matter, from disintegration and decomposition of rocks
  - organic matter, from the decay of plant residues, animal remains, and microbial tissues
  - water, from the atmosphere and reactions in the soil (chemical, physical, and microbial)
  - air or gases, from the atmosphere and from reactions of roots, microbes, and chemicals in the soil
  - organisms: macro (worms, insects) and micro (bacteria)
  - impact of mineral particle size (sand, silt, clay), organic matter, and pore space on soil structure, soil texture, water and nutrient retention, drainage, aeration, and land use

- **Characteristics of brown earth and podzol soil profiles**
  - learners should be able to draw and annotate brown earth and podzol soil profiles
  - formation of brown earths and podzol soils
  - the role of temperature and precipitation, and the resulting biological conditions

- **Commercial uses of brown earth and podzol soils**

b. Processed biofuels – biodiesel, bio-crude oil, biomethanol, bioethanol

- **Sources**

- **Advantages and disadvantages of using processed biofuels**

4 Atmosphere

Learners should be familiar with the definitions of the following terms, and be able to use them appropriately:

Albedo, biome, Coriolis effect, equatorial rainforest, Ferrel cell, global energy budget, Hadley cell, hot desert, ice sheet, insolation, latitude, Milankovitch cycles, natural climate change, natural greenhouse effect, Polar cell, solar flare, solar radiation, sunspot, surface wind patterns, temperate rainforest, tri-cellular model, tundra

This list is not exhaustive, and terms listed here may apply in more than one area.

a. Composition of the atmosphere

Nitrogen, oxygen, argon, carbon dioxide, methane, water vapour, and small amounts of other gases

b. Atmospheric circulation

- **Global energy budget**

  Refers to the balance between incoming and outgoing solar radiation. Insolation varies at different times of the year and for different latitudes. Approximately two-thirds of incoming solar radiation is absorbed by the atmosphere (clouds, water vapour, gases, dust) and Earth's surface (land, water, plants). The remainder is reflected by Earth's surface, clouds, atmospheric gases and dust.

  The proportion of solar radiation that is reflected by a body or surface is known as the albedo. This can range from a value of 0 (no reflection) to 1 (100% reflection). The average albedo for Earth is 0.31. The amount of reflected energy changes with surface character. Snow and ice reflect solar energy back into space and have a high albedo, whereas the albedo for forests, oceans, and deserts is low as more energy is absorbed by ground and water.

- **Tri-cellular model**
  There is a net gain of solar energy in tropical latitudes and a net loss towards the poles due to the angle at which insolation strikes the Earth's surface. Atmospheric and oceanic circulation redistributes this energy, so energy is moved from areas of surplus (between 38° north and south) to areas of deficit (above 38° north and below 38° south). This process maintains the global energy balance.

  The tri-cellular model explains the redistribution of energy from areas of surplus to areas of deficit:
  - Hadley, Ferrel and Polar cells
  - surface wind patterns
  - Coriolis effect

- **Biomes**
  - influence of temperature and precipitation in determining geographic distribution of plants and animals
  - high atmospheric pressure — hot desert, tundra
  - low atmospheric pressure — rainforest (equatorial and temperate)

c. Natural climate change
Geological records spanning millions of years indicate a number of significant variations in Earth's climate, evidenced by ice ages and warmer interglacial periods.

- **Long term**
  Orbital changes (Milankovitch cycles), plate tectonics

  Milankovitch cycles — as Earth orbits around the Sun, cyclical variations in Earth– Sun geometry combine to produce variation in the amount of solar energy reaching Earth. These include changes in:
  - The shape of Earth's orbit around the Sun. This varies from elliptical to nearly circular. When the orbit is circular, the amount of insolation received on an annual basis is greater and the Earth's temperature increases.
  - The tilt of Earth's axis towards or away from the Sun. The angle of tilt varies over time. Greater tilt means more severe seasonal variation (warmer summers, colder winters), and vice versa. Cool summers allow snow and ice to persist at high latitudes, building up into ice sheets. The high albedo of snow and ice causes additional cooling.
  - The orientation of the Earth's axis of rotation. This changes over a period of time, and is driven by tidal changes influenced by the Sun and the Moon. This results in one polar hemisphere being closer to the Sun than the other, changing the amount of insolation reaching each.

Plate tectonics — geological and fossil evidence supports the theory that Earth's continental plates have changed position and shape. Once part of a giant landmass at the South Pole, the breaking up and movement of the continental plates to their current positions has impacted on atmospheric and oceanic circulation, both of which have affected climate.

- **Short term**
  Volcanic activity, sunspot activity

  Volcanic activity reduces the Earth's temperature due to the introduction of ash and other particulates into the upper atmosphere. This results in less insolation reaching Earth. In the longer term, volcanoes introduce higher levels of carbon dioxide and other greenhouse gases into the atmosphere, which trap heat.

  Sunspot activity — sunspots are storms on the Sun's surface that are marked by intense magnetic activity, resulting in solar flares and ejection of hot gases. During periods of maximum sunspot activity, the Sun emits more energy.

Apparatus and techniques

In addition to the skills, knowledge and understanding listed above, learners must have knowledge of the following pieces of apparatus and techniques. Where it is not possible to carry out a fieldwork technique, learners should be made aware of the purpose and methodology of the technique through teaching.

Apparatus

- beaker
- balance
- measuring cylinder
- dropper/pipette
- test tube
- stopwatch
- funnel
- crucible
- oven
- thermometer
- test kits: soil pH, soil nitrate and/or nitrite

Techniques

- interpreting case study documentary evidence, including Ordnance Survey map content, sketch maps, photographic evidence, tabular data, and/or short passages of text. The ability to read and provide grid references is not required.

Reporting experimental and/or fieldwork

Learners should be familiar with the following:

- setting an aim and/or hypothesis
- selecting information: quantitative and qualitative, discrete and continuous
- planning, designing and undertaking experimental/field work procedures safely
- summarising experimental/field work procedures
- drawing labelled diagrams of experimental/field work apparatus
- presenting data in tabular form, with appropriate headings and units of measurement
- presenting data in graphical form: bar graph, line graph, scatter graph, or other graphical form appropriate to environmental science, with appropriate scales, labels, keys and units, and including a line of best fit (straight or curved) if appropriate, to represent the trend observed in experimental/field work data
- processing data (using calculations and units, where appropriate)
- comparing and/or analysing data sets
- drawing valid conclusions from the data and giving explanations supported by evidence/justification, and related to the aim
- evaluating experimental/field work procedures and suggesting and justifying improvements
- citing and referencing sources of data/information

Calculations

Learners should be familiar with the following methods of calculation:

- measures of average: mean, median
- measures of spread: standard deviation, interquartile range
- ratio
- percentage increase and decrease
- calculations involving number substitution in formulae

Administrative information

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Superclass: QA

History of changes to National Unit Specification

Version	Description of change	Authorised by	Date
2.0	Page 1 – the description of key areas under 'Unit outline' has been revised to give more information Page 3 – in Outcome 1.3, the word 'accurately' has been replaced by 'correctly'; information has been added on Transfer of Evidence Page 4 -the Evidence requirements have been rewritten to better explain what is required	Qualifications Development Manager	April 2014
3.0	Assessment Standards 2.2 & 2.3 removed	Qualifications Development Manager	June 2014
3.1	Assessment standard thresholds added	Qualifications Manager	September 2018
4.0	Unit code updated	Qualifications Manager	July 2019
5.0	Refined guidance on Evidence Requirements; removed option for assessment-standard-specific evidence for Outcome 2. Added 'Assessment Standards thresholds' heading to existing information. Refined guidance on re-assessment. Some changes made to the format throughout the document to improve accessibility. Required knowledge, understanding, and skills added to the unit support notes. **What you need to do differently** ♦ If you are already assessing outcome 2 holistically at the end of the unit, by	Qualifications Manager	August 2025

Version	Description of change	Authorised by	Date
	using the assessment as a single test with marks and a cut-off score, you don't need to do anything differently. ♦ If you have been assessing outcome 2 atomistically, by assessing each key area and each problem-solving skill separately, you must change to using the holistic approach for outcome 2. You must do this by administering the test in a single sitting, at the end of the unit, and applying the marks and cut-off score in the unit assessment support pack.		