

**EDUQAS GCSE LEVEL GEOLOGY compared with EARTH LEARNING IDEAS – an analysis by Geopix and Earth Learning Idea.**

*Earth Learning Idea and Geopix wish to thank Eduqas for their kind permission to reproduce these sections of their specification.*

NB With effect from May 2020, Earthlearningidea has posted a set of teaching videos and Powerpoint presentations on the website. These have been produced to help teacher educators to continue their courses online during the Covid-19 lockdown and its aftermath, but they are also of value for teachers of A Level and GCSE Geology. Many activities are demonstrated which can enliven your own teaching, either used selectively for online lessons or face-to face classes, once these can be resumed. See: [https://www.earthlearningidea.com/home/Teaching\\_videos\\_workshops.html](https://www.earthlearningidea.com/home/Teaching_videos_workshops.html)

<b>GCSE GEOLOGY and EARTH LEARNING IDEAS</b>	
<b>Key Idea 1: Rock exposures contain evidence of how rocks were formed and subsequently deformed</b>	
<b>1.1 Minerals</b>	
a. Minerals are formed by: <ul style="list-style-type: none"> <li>• crystallisation from a melt [quartz, feldspar, mica, olivine and augite]</li> <li>• metamorphic recrystallisation [calcite, garnet]</li> <li>• crystallisation from solution in evaporating water [halite]</li> <li>• crystallisation as cement from flowing pore waters [quartz, calcite]</li> <li>• crystallisation from hydrothermal fluids [in veins and faults: gangue minerals - quartz, calcite; ore minerals - haematite, galena].</li> </ul>	
b. Modern laboratory techniques can be used to image mineral samples on a small scale and determine their chemistry e.g. the scanning electron microscope and electron microprobe.	
Use appropriate tests of: <ul style="list-style-type: none"> <li>• physical properties of minerals [observation of colour, hardness, streak, cleavage, lustre]</li> <li>• [reaction with 0.5 mol dm<sup>-3</sup> hydrochloric acid] to identify and distinguish between the minerals on the data sheet.</li> </ul> Interpret data from the data sheet	Identifying minerals - use your sense(s)! Mineral expert 1 Mineral expert 2 Mineral expert 3 (ELI+) Mineral expert 4 - Recycle your mobile phone Eureka! - detecting ore the Archimedes way
<b>1.2 Igneous Rocks and Processes</b>	

a. Igneous rocks have diagnostic properties; colour and texture [crystal size, equicrystalline, porphyritic and orientation].	Crystallisation in a pudding dish Volcano in the lab (ELI+)
b. Igneous rocks [peridotite, basalt, andesite, granite] can be classified by: • texture • mineralogy.	Unfair 'build your own crystal' race (ELI+) Why do igneous rocks have different crystal sizes? (ELI+)
Identify the named igneous rocks in hand specimen/rock exposures, diagrams and photomicrographs from observation of their colour, crystal size [coarse >3 mm, fine <1 mm], random crystal orientation of phenocrysts/groundmass and mineralogy.	Building Stones 2 - Igneous rocks  Rock grain cut out How can you tell which grains come from which rock?
c. Crystal size in igneous rocks is related to the cooling rate of magma.	A rock is a time capsule – a message from the past: Bringing to life the extraordinary stories of ordinary rocks
d. Magma viscosity affects the type of volcanic activity and the shape of volcanoes – the differences between relatively passive [fissure] and violent eruptions [central vent].	Collapsing volcanoes - cauldron subsidence (ELI+) Hotspots (ELI+) Partial melting - simple process, huge global impact (ELI+)
Recognise and interpret the differing shapes of volcanoes from diagrams/photographs.	Eruption through the window Blow up your own volcano! Bubble-mania Best classroom eruption? Which type of classroom eruption best shows how volcanoes erupt?
Investigate factors affecting the length of lava flows using the 'Jelly lava flow' simulation experiment or equivalent. Factors investigated to include viscosity (related to temperature) and slope angle.	See how they run
e. Igneous bodies can be distinguished by: • structure [columnar jointing, pillow lava] • form [lava flows, sills, dykes and plutons] • field relationships.	Volcano and dykes/jelly and cream - radial dykes (ELI+) <i>Opengeoscience</i> 1: igneous intrusions and lavas Cracking the clues:
Identify the characteristics of igneous bodies [crystal size, structures, field relationships] as seen in hand specimen/rock exposures, diagrams and photographs.	
Analyse simplified geological maps and cross-sections to interpret their contrasting modes of formation.	
<b>1.3 Sedimentary Rocks and their Fossil Content</b>	

<p>a. Rock is disaggregated by weathering and erosion into particles of various sizes and dissolved materials that are transported and deposited to form new sediments.</p>	<p>Watery world of underground chemistry (ELI+)  Cracking apart (ELI+)  Ice power (ELI+)  Karstic scenery - in 60 seconds  Weathering limestone - with my own breath! (ELI+)  Weathering - rocks breaking up and breaking down  Will my gravestone last?  Breaking up – classroom freeze-thaw weathering:  Showing how freezing and thawing can break porous rocks in the classroom</p>
<p>Distinguish between the processes of weathering and erosion and evaluate their significance in the sedimentary characteristics and the geological history of sedimentary rock.</p>	<p>Teacher - 'What's the difference between weathering and erosion?'  How can storms affect erosion rates? Predict what will happen to a landscape if it is affected by a storm</p>
<p>b. The grain size, shape and sorting of the resultant sediment is influenced by the energy of the transporting medium and the depositional environment [screes, rivers, shallow/deep seas, wind-formed dunes].</p>	<p>Changing coastlines  Dust bowl  Grinding and gouging  Mighty river in a small gutter  Mighty river in a small gutter: Investigating small-scale sedimentary processes AND modelling mighty rivers  Rock, rattle and roll  Rolling, hopping, floating and invisibly moving along  Earth science out-of-doors: preserving the evidence  Recreating the rocks – step by step: simulating a dipping sedimentary rock sequence though a sequence of Earthlearningideas</p>
<p>Interpret:  • the distance of transport from the shape and sorting of sediment  • the energy level of the environment of deposition from sediment grain size.</p>	<p>Modelling for rocks: what's hidden inside - and why?  What was it like to be there - in the rocky world?</p>
<p>c. Porosity and permeability of sedimentary rock depends upon the characteristics of the original sediment and the degree of compaction and cementation.</p>	<p>Space within - the porosity of rocks  Does my rock hold water and will water flow through it?</p>
<p>Distinguish permeable from impermeable rocks by observing the effects of dropping water on specimens and/or by immersing them in water.</p>	

<p>d. Sedimentary rocks [breccia, conglomerate, sandstone, shale, evaporites, limestone] have diagnostic properties [colour, texture, reaction with acid] mineralogies and other diagnostic features.</p>	<p>A rock is a time capsule – a message from the past: Bringing to life the extraordinary stories of ordinary rocks</p>
<p>Identify the named sedimentary rocks in hand specimen, rock exposures and diagrams/ photographs from observation of their colour, texture [use of sediment comparators to determine grain size, shape and sphericity], [coarse &gt;2 mm, fine &lt;1/16 mm], reaction with 0.5 mol dm<sup>-3</sup> hydrochloric acid, mineralogy and other diagnostic features.</p>	<p>Under pressure (ELI+)          Make your own rock          Rock grain cut out How can you tell which grains come from which rock?          What colour was the world in the past? Using rock evidence and 'the present is the key to the past' to colour the geological world</p>
<p>Construct and apply a classification system/key to identify the named sedimentary rocks.</p>	
<p>e. Sedimentary rock type is dependent upon the environment of deposition:</p> <ul style="list-style-type: none"> <li>• Shallow marine: [limestone, sandstone, conglomerate]</li> <li>• Deep marine: [turbidites, black shale]</li> <li>• Terrestrial:             <ol style="list-style-type: none"> <li>1. deposited in rivers and deltas [shale, sandstone, conglomerate, coal]</li> <li>2. deposited by wind and water in deserts [breccia, desert sandstone]</li> <li>3. deposited by precipitation from saline water during evaporation [evaporites - halite and gypsum]</li> <li>4. deposited by ice [glacial till/tillite].</li> </ol> </li> </ul>	<p>Evidence from the deep freeze          What was it like to be there? – clues in sediment which bring an environment to life          Environmental detective          Building Stones 3 - Sedimentary rocks          Calcium carbonate question - 'I'm pure calcium carbonate'          Rock around your school          Rock detective - rocky clues to the past          Darwin's 'big coral atoll idea'          Salt of the Earth</p>
<p>Use the characteristics of sedimentary rocks, including their distinctive sedimentary textures, structures, mineralogy and their fossil content, as seen in hand specimens, rock exposures, diagrams and photographs to interpret their environments of deposition.</p>	<p>Why is the Dead Sea dead? Measuring salinity          From river sediment to stripey rocks Modelling the build up of different layers of sediment as seen in sedimentary rocks          Atmosphere and ocean in a lunchbox - A model for all pupils – of hot, cold and cloudy density currents          Beach, river, dune, mountain, plain – what layers might be preserved here? A discussion on what evidence might be preserved in rocks from different environments          How do sedimentary beds form? – and why can we see them? Demonstrating how the beds in sedimentary rocks are deposited          Playground continents: A palaeogeography in your school yard.</p>

Analyse sedimentary rock formations on simple geological maps, cross-sections and graphic logs to interpret geological structure and the history of sedimentation.	
Construct a simple graphic log from bed thickness and grain size data.	
f. Distinctive sedimentary structures [lamination/bedding, cross bedding, graded bedding, ripple marks, desiccation cracks] are characteristic of their environments of deposition.	<p>Cracking the clues</p> <p>Sandcastles and slopes</p> <p>Sand ripple marks in a tank</p> <p>Sand ripple marks in a washbowl</p> <p>Sedimentary structures - cross-bedding and ancient currents</p> <p>Sedimentary structures - graded bedding</p> <p>Sedimentary structures - imbrication</p> <p>Sedimentary structures - load casts</p> <p>Sedimentary structures - sole marks</p> <p>Sedimentary structures - cross-bedding, 'way-up'</p> <p>Laying down the principles</p> <p>What is the geological history?</p> <p>Sedimentary structures – make your own cross-bedding: classroom activities to make and explain how cross-bedding forms</p> <p>Which sedimentary structures can you make?:-</p> <p>Making sedimentary structures in the classroom using simple apparatus and materials</p>
g. Fossils are indicators of past environments:	<p>Ammonites: the ups and downs</p> <p>Who ate the ammonite?</p> <p>Fossil or not?</p> <p>How could I become fossilised?</p> <p>Running the fossilisation film backwards</p> <p>Trace fossils - burrows or borings</p>
<ul style="list-style-type: none"> <li>• reef-building corals [marine, shallow, warm]</li> <li>• trilobite [marine], ammonite [marine]</li> <li>• plants [terrestrial, indicating past climate]</li> <li>• trace fossils [tracks indicating terrestrial, burrows indicating shallow water].</li> </ul>	<p>Trail-making</p> <p>What was it like to be there? - bringing a fossil to life</p> <p>Curious creatures</p> <p>Fifty million years into the future</p> <p>Sea shell survival</p>
Identify the following fossil groups on the basis of their morphology [trilobite, ammonite, coral, plants, trace fossils - burrows, footprints], as seen in hand specimens, diagrams/ photographs.	
<b>1.4 Metamorphic Rocks and Processes</b>	
a. Metamorphic rocks are the result of increased temperature and/or pressure on pre-existing rocks causing recrystallisation to form new minerals and textures.	Metamorphic aureole in a tin (ELI+)

Identify the named metamorphic rocks in hand specimen from observation of their crystal size [coarse, fine], crystal orientation [aligned, random]; reaction with 0.5mol dm <sup>-3</sup> hydrochloric acid.	Metamorphism - that's Greek for 'change of shape' isn't it? Building Stones 4 - Metamorphic rocks
b. Metamorphic rocks [slate, schist, marble, metaquartzite] have diagnostic textures [crystal size and orientation]: • non-foliated texture • foliated texture [slaty cleavage and schistosity].	A rock is a time capsule – a message from the past: Bringing to life the extraordinary stories of ordinary rocks
c. Metamorphic rocks [schist, marble and metaquartzite] have diagnostic mineralogy.	
Identify the characteristic features of a metamorphic aureole on diagrams and simplified geological maps and cross-sections.	
Use the characteristics of metamorphic rocks [texture, mineralogy, acid reaction] as seen in hand specimens/rock exposures, diagrams and photographs, simplified geological maps and cross-sections to interpret their contrasting modes of formation [contact and regional metamorphism].	Rock grain cut out: How can you tell which grains come from which rock?
<b>1.5 Deformational Structures</b>	
a. The rock record provides evidence of tectonic activity.	
Describe safety precautions to be taken when visiting field exposures.	The 'What could hurt you here?' approach to field safety -teaching how to keep safe during fieldwork and other outdoor activities
Measure strike and dip.	Do-it-yourself dip and strike model (with DIY clinometer) (ELI+)
Analyse strike and dip measurements to describe and interpret rock structures in 3D.	
b. Folding is caused by tectonic stress [compressional].	Margarine mountain-building Squeezed out of shape Deformed Trilobites: Using fossils to estimate the distortion of rocks <i>Opengeoscience 2</i> : tilted and folded rocks Banana benders Swiss roll surgery
Interpret characteristic features of folding in field exposures, diagrams, photographs, simplified geological maps and cross-sections: • horizontal beds • dipping beds • folded beds [antiform, synform, axial plane trace, limb].	Modelling by hand 'when the youngest rock is not on top'
c. Faulting is caused by tectonic stress [compressional, tensional, shear].	Right way up or upside down? - modelling anti- and synforms by hand Use your hands to show how the beds in folds can be the right way up or inverted. Valley in 30 seconds - pulling rocks apart Himalayas in 30 seconds!
Interpret features of rock deformation by faulting in field exposures, diagrams, photographs, simplified geological maps and cross sections: • normal fault • reverse/thrust fault • strike-slip fault	

<ul style="list-style-type: none"> <li>• fault displacement.</li> </ul>	<p>The sliced Jelly Babies™ approach to understanding 3D geological maps: use Jelly Babies™ cut at the dip angle to highlight structures on geological maps</p> <p>Visualising plunging folds - with your hands and a piece of paper Using your hands and folded/torn paper to show the patterns made by plunging folds.</p> <p>Modelling Earth stresses with your hands - Hand modelling of compression, tension and shear in the Earth</p> <p>Modelling folding – by hand: -using your hands to demonstrate different fold features</p> <p>Modelling faulting – by hand: Using your hands to demonstrate different fault features</p>
<p>d. Unconformities are gaps in the rock record. Angular unconformities are formed by a sequence of events including deformation, uplift, erosion and later deposition.</p>	<p>Filling the gap – picturing the unconformity ‘<i>abyss of time</i>’?</p>
<p>Identify unconformities in the field, in diagrams, photographs, geological maps and cross-sections. Use unconformities in interpreting the geological history of exposures.</p>	<p>Rocks from the big screen</p> <p>Modelling unconformity – by hand: using your hands to demonstrate how unconformities form</p>
	<p>Geological mapwork from scratch 1: a conical hill (ELI+)</p> <p>Geological mapwork from scratch 2: valley with simple geology (ELI+)</p> <p>Geological mapwork from scratch 3: valley with dipping geology (ELI+)</p> <p>Geological mapwork from models 1: plain with simple geology (ELI+)</p> <p>Geological mapwork from models 2: cuesta with simple geology (ELI+)</p> <p>Geological mapwork from models 3: valley with horizontal floor (ELI+)</p> <p>Geological mapwork from models 4: sloping ridge and valley (ELI+)</p> <p>Geological mapwork from models 5: folded geology on block models (ELI+)</p> <p>Geological mapwork from models 6: plain with faults in the direction of dip (ELI+)</p> <p>Geological mapwork from models 7: plain with faults parallel to the beds (ELI+)</p> <p>Geological mapwork from models 8: plain with different types of fault (ELI+)</p> <p>Geological mapwork: using surface geology to make a geological map (ELI+)</p>
<p><b>Key Idea 2: Major concepts and techniques underpin our current understanding of the Earth and its history</b></p>	
<p><b>2.1 The Rock Cycle</b></p>	

<p>a. Sedimentary, metamorphic and igneous processes and rocks are linked by the rock cycle [energy transfer] over geological time.</p> <p>Interpret rock cycle diagrams.</p> <p>b. Rock cycle processes take place at different rates, from seconds to millions of years [catastrophism v gradualism - e.g. meteorite impact v river erosion].</p> <p>Distinguish between processes reflected in the rock record that occurred at different rates.</p>	<p>Rock cycle at your fingertips  Rock cycle in wax  Rock cycle - laying out the rock cycle: product and process  Rock cycle through the window  Rock cycle: Not misunderstanding the rock cycle  James Hutton - or 'Mr. Rock Cycle'? (ELI+)  How long does it take?  William Smith - 'The Father of English Geology' (ELI+)  Model the stages of the rock cycle- with your pupils  View to the future – and the past: Using a viewpoint or overview educationally  From 'Rock detective' to 'Laying out the rock cycle'..</p>
<p><b>2.2 Plate Tectonics</b></p>	
<p>a. The Earth has a concentric structure based on its:</p> <ul style="list-style-type: none"> <li>• chemical properties [crust, mantle and core]</li> <li>• mechanical behaviour [lithosphere, asthenosphere].</li> </ul>	<p>Merry waves - all year round (ELI+)  Bouncing, bending, breaking (ELI+)  From clay balls to the structure of the Earth (ELI+)  Core activity (ELI+)</p>
<p>b. The mechanical behaviour of the outer Earth involves the lithosphere [cold, rigid outer shell composed of crust and uppermost mantle]. It is underlain by the asthenosphere [weaker layer composed of upper mantle].</p>	<p>Journey to the centre of the Earth - on a toilet roll  Waves in the Earth 1 - the slinky simulation (ELI+)  Waves in the Earth 2 - the slinky simulation (ELI+)</p>
<p>c. The lithosphere is divided into a number of rigid 'tectonic plates' which move relative to one another by mechanisms not yet completely understood.</p>	<p>From an orange to the whole Earth  What drives the plates?  The slinky seismic waves demo: Using slinkies to show how earthquakes produce P-, S- and surface waves</p>
<p>d. With new evidence, plate tectonic theory developed from continental drift.</p> <ul style="list-style-type: none"> <li>• Continental drift was proposed by Wegener (1915)</li> <li>• Evidence for sea floor spreading was discovered by Hess (1960) Vine and Matthews (1963) J. Tuzo Wilson (1965).</li> </ul>	<p>Plate riding (ELI+)  Plate tectonics through the window (ELI+)  Wegener's 'Continental drift' meets Wilson's 'Plate tectonics' (ELI+)  Wandering continents What evidence enables us to reconstruct the ancient supercontinent of Pangaea?</p>
<p>Analyse the evidence for plate tectonics [jigsaw pattern fit, fossil distributions, heat flow, magnetic stripes, age of the ocean floor, Global Positioning System (GPS) data].</p>	<p>Continental jigsaw puzzle (ELI+)  Earth time jigsaw puzzle</p>



<p>e. There is a range of evidence supporting the theory of plate tectonics and the direction and rate of plate movements.</p>	<p>Did the continents move for you? (ELI+)  Magnetic stripes (ELI+)  What drives the plates? – the evidence. Examine the evidence for the different plate tectonic driving mechanisms.  What drives the plates? in slab pull, what is it that pulls? Understanding how slab pull works through examining the data.  What drives the plates? Modelling slab pull  Modelling and discussing the slab pull plate-driving mechanism in the classroom  Frozen magnetism (ELI+)  Magnetic Earth (ELI+)  Human magnets!  Geobattleships</p>
<p>Use maps to interpret the global distributions of present day earthquakes, volcanic activity and mountain belts in the context of processes at or near to plate boundaries</p>	
<p>f. The relative movements between plates produce a range of magmatic types, structures and topography identified at different types of plate boundary.</p> <ul style="list-style-type: none"> <li>• Divergent plate boundaries [basalt extrusion, sea floor spreading, the origin of basaltic magma by partial melting of the upper mantle, ocean ridges, high heat flow, rift valleys, abyssal plain] e.g. Mid-Atlantic Ridge.</li> <li>• Conservative plate boundaries [earthquake activity, transform faults]; San Andreas fault zone</li> <li>• Convergent plate boundaries: <ol style="list-style-type: none"> <li>1. oceanic-oceanic [island arc/trench systems] e.g. Java-Sumatra/Caribbean.</li> <li>2. oceanic-continental [active continental margins; subduction zones, Benioff zone, partial melting producing andesitic and granitic magmas] e.g. the Andes.</li> <li>3. continental-continental [mountain building, folding, thrust faulting, partial melting of the crust producing granites, associated regional metamorphism] e.g. the Himalaya.</li> </ol> </li> </ul>	<p>Continental split - the opening of the Atlantic Ocean  Model a spreading ocean floor offset by transform faults  Continents in collision (ELI+)  Partial melting - simple process, huge global impact: A “mantle plume” in a beaker – but not driving plates  Mantle plumes ‘yes’ – but convection currents driving plates, probably ‘No’. Replacement for 86.  ELI+  Opening of the Atlantic  Plate margins and movement by hand  Faults in a Mars™ Bar Pulling apart a Mars™ Bar to model a divergent plate margin  Melting and boiling – the influence of pressure: how does a reduction in pressure lower melting and boiling points?  The deep rock cycle explained by plate tectonics: deformation and metamorphism: A model showing how plate tectonics can explain metamorphism and rock-deformation  Sounding the Pacific Ocean: An echo sounder traverse of the eastern Pacific</p>

	Marie Tharp: 'The valley will be coming up soon' -. Bruce Heezen: 'What valley?' 'A woman scientist in a man's world' – what was it like?
Interpret the relative movement of plates from their plate boundary context shown in maps and diagrams.	Hotspots: Modelling the movement of a plate across the globe Which is the fastest spreading oceanic ridge? A map-based activity to find the most active oceanic spreading ridge
Interpret the type of plate boundaries from data [magmatic, seismic and topographic] provided in text, diagrams/photographs and maps.	
g. Plate theory is being continually re-evaluated in the light of new evidence e.g. seismic tomography and ocean drilling - RRS James Cook, Joides Resolution 360 (2016).	All models are wrong' – but some are really wrong: plate-driving mechanisms Many textbook diagrams of plate-driving forces have arrows in the wrong places. Updates: a) Follow the <i>Joides Resolution</i> research ship at sea. b) Recent research in plate tectonics. What do the top and bottom of a tectonic plate look like? Questions to test understanding of plate tectonic processes
<b>2.3 Geochronological Principles</b>	
a. Geological events are dated and interpreted using stratigraphic principles: • uniformitarianism - the present is the key to the past • the concepts of original horizontality, lateral continuity and superposition of strata • the relative dating of rocks on the basis of included fragments, cross cutting relationships.	Working out the age of the Earth - moving backwards as time moved forwards Time-line in your own backyard Toilet roll of time Sorting out the evolution of evolution headlines (ELI+)
Investigate the link between ancient and modern processes by applying the principle of uniformitarianism.  Apply the principles of relative dating to interpret the evidence in rock exposures in the field, in diagrams/photographs and simplified maps and cross-sections for the sequence of geological events that formed/deformed them.	What is the geological history? Environmental detective Fieldwork: Applying 'the present is the key to the past' What happened when?: sorting out sequences using stratigraphical concepts Are the age-based stratigraphical concepts principles or laws? – and how do you use them? Now and then – spotting the difference

b. Rocks can be dated and correlated using the evolutionary change of zone fossils over time.	
c. The following zone fossil groups have morphological changes with time that are used in dating/correlation: <ul style="list-style-type: none"> <li>• cephalopods [goniatites, ceratites, ammonites - suture line]</li> <li>• graptolites [stipes, thecae].</li> </ul>	
Use the named fossils, as seen in specimens and diagrams/photographs to interpret the geological history of a rock sequence.	
d. The decay of radioactive materials provides a method of absolute dating for some rocks and minerals.	
Carry out a simple analysis of the age of a radioactive mineral based on the half-life concept [parent - daughter ratio, unstable parent, stable daughter].	
e. The development of the concept of <i>Deep Time</i> [Ussher (The Bible), Hutton, Kelvin, Joly and Holmes] has extended the age of the Earth back to around 4.6 billion years.	Working out the age of the Earth – moving backwards as time moved forwards Dating the Earth – before the discovery of radioactivity: Charles Lyell and Mount Etna, 1828
<b>2.4 Global Climate and Sea Level Change</b>	
a. There is evidence for global climate change through geological time [icehouse to greenhouse conditions].	
Deposition of glacial deposits in regions close to the equator [Carboniferous tillites], deposition of limestone in areas outside the Tropics [Cretaceous limestones/chalk].	
b. Evidence for change in the climate of the British area caused by a change in its latitude.	Back in time “Alligators spotted in London” @ELI_Earth - July 1 Retrieving and communicating information
Interpret the evidence from hand specimens of rocks and fossils, maps, diagrams/ photographs for the changes in latitude of the British area from the Lower Palaeozoic to the Cenozoic. Interpret data from the data sheet.	
c. There is evidence for changes in sea level [drowned forests].	
d. The major sources of carbon dioxide in the atmosphere are volcanic emissions and the burning of fossil fuels.	

Evaluate the relative roles of volcanic emissions and fossil fuels in current rates of climate change.	
e. There is evidence for changes in atmospheric carbon dioxide levels over geological time [ice cores and sedimentary rock].	The oxygen isotope sweet simulation Interpret Earth temperatures from simulated deep-sea and ice cores. How can the ice core evidence for climate change be explained? An educational opportunity for discussing evidence, hypotheses and possible responses
f. There is both positive [reduction of icecap albedo accelerating warming] and negative [carbon dioxide dissolved in sea water, absorption by organisms to form limestone] feedback on the carbon dioxide content of the atmosphere [subduction, volcanic emissions, chemical weathering and marine storage].	
g. Global warming/cooling affects continental ice sheet dimensions and global sea level.	Melting ice and sea level change 1 – sea ice: does sea level change when floating sea ice melts? Melting ice and sea level change 2 – ice caps Does sea level change when ice caps melt?
Investigate the evidence from the internet, maps and aerial images for past and current fluctuations in continental ice and the effect on global sea levels.	
h. Carbon sequestration/capture is a geological strategy for reducing atmospheric carbon dioxide.	
<b>2.5 The Origin and Development of Life on Earth</b>	
a. Life probably originated from the oceans or hydrothermal pools 3500 Ma [black smokers].	
b. The development of diversity in the evolution of life [through single cells, multicellular organisms, animals with hard parts, fish, amphibians, reptiles, mammals, birds and humans] is identified from the fossil record.	Sorting out the evolution of evolution headlines
Use simple evolutionary trees diagrams [cladograms] to demonstrate evolutionary trends.	
Interpret data from the data sheet.	
c. The development of life on Earth was punctuated by major extinction events [Cretaceous/Palaeogene (K/Pg) mass extinction].	
d. Major fossil finds show: • rare and exceptional preservation [Burgess shale fauna]	Dinosaur death - did it die or was it killed? Dinosaur in the yard How to weigh a dinosaur

<ul style="list-style-type: none"> <li>• the links in macro fossil evolution through the morphology of modern reptiles and birds [<i>Archaeopteryx</i>]</li> <li>• that complex fossil skeletons have to be interpreted from incomplete and disarticulated remains [dinosaurs]</li> <li>• features of early hominids ["Lucy"].</li> </ul>	Mary Anning - Mother of Palaeontology Meeting of the dinosaurs - 100 million years ago Dig up the dinosaur How could I become fossilised?
Evaluate the significance of the incomplete nature of the fossil record.	Shell shake - survival of the toughest
<b>Key Idea 3: Comparisons of the Earth with other planetary bodies within the Solar System provide evidence for the origin and evolution of both</b>	
<b>3.1 Planetary Geology</b>	
a. There are similarities and differences between the Earth and its planetary neighbours [rocks, landscapes, atmosphere, temperature, pressure and gravity].	
b. Meteorites provide evidence for the composition of the Earth.	
c. The relationship between landforms and geological processes on Earth provides an analogue for interpreting landforms on planetary bodies within the Solar System.	
Use the principle of uniformitarianism to interpret the geological processes operating on planetary bodies within the Solar System.	
Use evidence from space imagery and other planetary exploration data [maps, diagrams/ photographs] to interpret the landforms and processes operating on planetary bodies within the Solar System e.g. Moon and Mars.	
d. Planetary landforms provide evidence for unseen Earth processes e.g. Moon impact craters.	Craters on the Moon
e. Impacts from meteorites/comets may have had a significant effect on the evolution of the Earth and its biosphere.	
<b>Key Idea 4: Human interaction with the Earth can increase or reduce risk</b>	
<b>4.1 Earth Hazards and their Mitigation</b>	
a. Geological events can be hazardous: <ul style="list-style-type: none"> <li>• earthquakes [shaking triggering landslides]</li> <li>• volcanic eruptions [lava, ash, pyroclastic and mud flows]</li> <li>• landslides [and related subsidence]</li> <li>• tsunamis.</li> </ul>	Merry waves - all year round (ELI+) Earthquake in your classroom Earthquake through the window - what would you see, what would you feel? Jelly/biscuit modelling of how earthquake waves amplify and devastate Krakatoa - The balloon goes up at Krakatoa
Investigate and interpret geological data relating to the distribution, measurement and	

<p>possible causes of earthquakes, volcanic eruptions, landslides and associated tsunamis.</p>	<p>See how they run: investigate why some lavas flow further and more quickly than others  Tsunami alert! Run for the hills or stay by the sea?  Tsunami through the window - what would you see, what would you feel?  Tsunami!  Earthquakes in art - developing a scientific report based on evidence in historic paintings.  If a sedimentary bed were laid down outside now – what would it be like? A discussion of beds and catastrophic processes  Which natural hazards could damage the area where you live? How safe is your home area?</p>
<p>b. The level of risk of a hazard is associated with life and property and relates to:</p> <ul style="list-style-type: none"> <li>• population density</li> <li>• technology [buildings]</li> <li>• development [economic situation, education, communication].</li> </ul>	<p>Surviving an earthquake</p>
<p>Use examples to contrast the risk of naturally occurring hazards in areas of contrasting development - LEDC and MEDC.</p>	<p>Danger - quicksands!  Failing slopes  Landslide through the window - what would you see, what would you feel?  Sink hole!  Testing rocks 2 - 'Splat'  Testing rocks 3 - that shrinking feeling</p>
<p>c. The level of accuracy of hazard prediction is limited.</p>	
<p>d. The methods of reducing risk include:</p> <ul style="list-style-type: none"> <li>• building design and regulation</li> <li>• prediction</li> </ul> <ol style="list-style-type: none"> <li>1. hazard interval patterns [seismic gaps]</li> <li>2. ground deformation [tiltmeters]</li> <li>3. groundwater changes</li> <li>4. gas emissions</li> </ol> <ul style="list-style-type: none"> <li>• warning schemes and evacuation</li> </ul>	<p>Quake shake - will my home collapse?  Shaken but not stirred?  Earthquake prediction - when will the earthquake strike?  Party time for volcanoes! (ELI+)  Take a 'Chance' on the volcano erupting (ELI+)  When will it blow? - predicting eruptions  Fluids, friction and failure</p>

<b>4.2 Earth Resources and Engineering</b>	
<p>a. There is a distinction between Earth's:</p> <ul style="list-style-type: none"> <li>resources - naturally occurring useful substances</li> <li>reserves of a resource - the calculated amount that is economic to extract.</li> </ul>	<p>Gold prospectors  Hydrothermal mineralisation - interactive (ELI+)  Riches in the river</p>
<p>b. Mineral resources are important in construction, industrial manufacturing and energy generation.</p>	<p>Building Stones 1 - a resource for several ELI activities  Building Stones 2 - Igneous rocks  Building Stones 3 - Sedimentary rocks  Building Stones 4 - Metamorphic rocks  Roadstone - which rock?  Testing rocks 1 - bouncing back  Rock around your school: Investigating the building materials  Urban fieldwork – the stories from materials, colours, lines and shapes: find out the stories told by materials used in building and for decoration</p>
<p>Investigate the uses of the following minerals</p> <ul style="list-style-type: none"> <li>Limestone for aggregate in construction</li> <li>Haematite in the steel industry</li> <li>Uranium in energy generation.</li> </ul>	<p>Smelter on a stick (ELI+)  What is it made of? Relate each mineral or rock to the everyday object containing it.  Mineral or not? Discussion about what is a mineral and what is not</p>
<p>c. Geologists prospecting for new reserves use a variety of techniques:</p> <ul style="list-style-type: none"> <li>geological mapping</li> <li>borehole correlation [using microfossils]</li> <li>geophysical [seismic, magnetic and ground penetrating radar]</li> <li>geochemical [soil and river sediment analysis].</li> </ul>	<p>Modelling remote sensing geophysics (ELI+)  Electrical ground probing  Where shall we drill for oil?  Boring chocolate!</p>
<p>Interpret prospecting data [geological mapping, geophysical, geochemical] to identify possible valuable mineral resources.</p>	
<p>d. There are characteristic structures and rock properties associated with the migration and accumulation of oil and gas in potential onshore and off-shore gas/oilfield resources:</p> <ul style="list-style-type: none"> <li>source rock</li> <li>contrasting porosity and permeability of reservoir and cap rocks</li> <li>the main types of trap for oil and gas [anticline, fault, unconformity, salt dome].</li> </ul>	<p>Make your own oil and gas reservoir  Trapped! Why can't oil and gas escape from their underground prison?  Fracking: Recipe for the perfect fracking fluid  Where does offshore oil come from?</p>
<p>Interpret data from maps, cross-sections and seismic surveys to identify possible gas/oilfields.</p>	

e. There are technological difficulties and environmental issues involved in exploring for and extracting oil and natural gas [including fracking].	What is/are the least bad option(s) for plugging the future global energy gap?
f. Factors affecting the extraction of underground water from aquifers include: <ul style="list-style-type: none"> <li>• height of the water table</li> <li>• porosity/permeability of the aquifer</li> <li>• the presence of natural springs</li> <li>• the distribution of wells.</li> </ul>	From rain to spring: water from the ground Water pressure - underground (ELI+) Water – a matter of taste or a taste of matter? Does my rock hold water and will water flow through it?
Analyse different rock types for their suitability as an aquifer.	
g. The impact of domestic and hazardous waste disposal on vulnerable aquifers depends on: <ul style="list-style-type: none"> <li>• geological factors [permeability]</li> <li>• engineering factors [geomembranes]</li> <li>• monitoring of potentially polluted water</li> <li>• restoration of contaminated ground.</li> </ul>	
Use data from descriptions, diagrams/photographs, maps and cross-sections to: <ul style="list-style-type: none"> <li>• investigate the suitability of a potential landfill site for the disposal of domestic waste.</li> <li>• investigate the suitability of a potential site for the long term storage of hazardous waste.</li> </ul>	
h. Geological factors affect the siting of engineering projects e.g. reservoirs, dams, tunnels and cuttings [permeability, stability of bedrock, dip of strata, the presence of faults and joints].	Dam burst danger
Use data from descriptions, diagrams/ photographs, maps and cross-sections to investigate the geological factors affecting the siting of major engineering projects.	