Innovative teaching ideas for the OCR A-Level Specification – Earthlearningidea

The Earth Science Education Unit (ESEU) was recently asked to present a day of Professional Development to the two members of the geology department in a nearby sixth form college. This was beyond the realms of normal ESEU activity (which presents National Science Curriculum-based workshops to science and primary teachers and trainees) – but nevertheless, ESEU was happy to help.

The remit was to provide, *'practical ideas for our syllabus and more innovative teaching ideas/student led activities/group work'* – and the syllabus in question was the OCR A-level specification. The most straightforward way of doing this seemed to be to match the components of the OCR specification to Earthlearningideas (found on the ELI website, http://www.earthlearningidea.com).

The result is the table below – and I was pleased and surprised at how many ELIs seemed to be relevant to teaching the specification. On the Professional Development day, as many of the activities as possible were demonstrated and discussed in terms of practicality, their use with students and how to implement them in 'innovative' teaching most effectively.

Was the day a success? I can only respond by saying that I enjoyed the day, and that later on that evening, I received the following email from the Assistant Headteacher at the college, *'thanks so much for your valuable inputs today – *** and *** I were really enthused!! It has given them some really good ideas to develop teaching and learning.'*

Hopefully, if you are an A-level teacher of the OCR specification – this table might help you too.

To find the relevant Earthlearningideas, access the ELI website (eg. through Google), open the search engine, and type in a key word from the title you are searching for – the list of ELIs relevant to that term will soon appear and, by clicking on the title, you can open its pdf file. In each Earthlearningidea, the activity is described first, followed by the 'Back up' section of teacher notes, which includes: the appropriate age range of pupils; the time needed to complete the activity; the learning outcomes, the context (including 'answers'); following up the activity; underlying (scientific and geographical) principles; thinking skill development; resource list; useful links; and the source (of the activity).

The ideas listed are the ones published so far – but a new idea is added every two weeks and some of those to come will also be very useful for teaching the OCR specification. So, if you have found these ideas useful – keep an eye on the ELI website in the future.

Note that many of the activities form part of Earth Science Education Unit workshops – and these are offered by the ESEU free of charge (apart from travelling expenses) to all secondary science departments. So, if you would like a nearby ESEU facilitator to visit your school – just convince your science department to book a 90 minute ESEU workshop through eseu@keele.ac.uk

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OCR AS/A Level GCE Geology OCR Advanced Subsidiary GCE in Geology H087; OCR Advanced GCE in Geology H487	
Specification topic	**Appropriate Earthlearningideas**
AS Unit F791: *Global Tectonics*	
Module 1 – Earth structure	
1.1.1 An overview of planetary geology and ideas for the origin of the solar system	• Craters on the Moon: why are the Moon's craters such different shapes and sizes?
1.1.2 Build up a cross-section knowledge of the internal structure of the Earth	• From an orange to the whole Earth: using an orange to model different densities of the Earth's layers
1.1.3 Understand the asthenosphere and lithosphere and their role in plate tectonics	• Bouncing, bending, breaking - modelling the properties of the Earth's mantle with Potty Putty™ from a toy shop
1.1.4 Understand how the internal structure of the Earth can be inferred using direct evidence	
1.1.5 Understand how the internal structure of the Earth can be inferred using indirect evidence	• From clay balls to the structure of the Earth - a discussion of how physics can be used to probe Earth's structure
1.1.6 Know about the Earth's magnetic field	• Frozen magnetism - preserving evidence of a past magnetic field in wax • Magnetic Earth – modelling the magnetic field of the Earth.
Module 2 Earthquakes	
1.2.1 Understand characteristics of seismic waves (P, S and surface) generated by earthquakes	• Waves in the Earth 1: The slinky simulation - using a long spring to find out how earthquake waves travel through the Earth. • Waves in the Earth 2: human molecules
1.2.2 Know the terms used to describe and define earthquake activity	
1.2.3 Know about the use of the Richter and Mercalli scales	
1.2.4 Understand why earthquakes occur when stored stress is released and how they are detected and measured	• Earthquake prediction – when will the earthquake strike? Modelling the build-up of stress and sudden release in the Earth that creates earthquakes
1.2.5 Appreciate the social and economic effects of earthquake activity	• Surviving an earthquake - learn the earthquake drill and increase your chances of survival • Quake shake – will my home collapse? When an earthquake strikes – investigate why some buildings survive and others do not • Danger – quicksands! Why do some rocks give way when it rains hard? • Tsunami: what controls the speed of a tsunami wave? • A tsunami through the window - what would you see, what would you feel? Asking pupils to picture for themselves what a tsunami through the window might look like • A landslide through the window - what would

	you see, what would you feel? Asking pupils to picture for themselves what a landslide through the window might look like • Earthquake through the window - what would you see, what would you feel? - asking pupils to picture for themselves what an earthquake through the window might look like
1.2.6 Know about methods of earthquake prediction and their social consequences; know about measures designed to reduce the impact of the effects of earthquakes	• Shaken but not stirred? How earthquakes affect buildings • Fluids, friction and failure - How can unseen fluids affect the movement along faults and glacier beds?
Module 3: Continental drift, sea floor spreading and plate tectonics	
1.3.1 Know about the main features of the oceans and continents	
1.3.2 Know about the evidence for the drift of continents	• The continental jigsaw puzzle - can you reassemble a super-continent from a 'jigsaw puzzle'? • Wegener's 'Continental drift' meets Wilson's 'Plate tectonics' - how Wegener's continental drift evidence matches up with evidence for plate tectonics
1.3.3 Know about the evidence for sea floor spreading	• Magnetic stripes - modelling the symmetrical magnetic pattern of the rocks of the sea floor
1.3.4 Know about the pattern of earthquake activity around the world	• Geobattleships - do earthquakes and volcanoes coincide?
1.3.5 Understand that plate tectonics provides a model of how the outer part of the Earth operates	
1.3.6 Understand the nature and distribution of oceanic and continental tectonic plates	• Partial melting - simple process, huge global impact: how partial melting, coupled with plate tectonics, has changed the chemistry of our planet
1.3.7 Know about the evidence for plates and plate boundaries and the theory of plate tectonics	• Continents in collision - modelling processes at a destructive (convergent) plate margin • Margarine mountain-building - making mountains every time you make a sandwich
1.3.8 Understand possible mechanisms for the movement of plates	• A "mantle plume" in a beaker - modelling processes at a constructive (divergent) plate margin
Module 4: Geological structures	
1.4.1 Understand dip and strike in rocks	• The do-it-yourself dip and strike model - using a model to measure and understand dip, dip direction, strike and apparent dip
1.4.2 Understand how rocks are deformed by stress and undergo strain	
1.4.3 Recognise and identify geological structures	• Banana benders - using a banana to simulate geological structures
1.4.4 Recognise and know about faults and the features associated with them	• The Himalayas in 30 seconds! Making a miniature fold mountain range in an empty box • A valley in 30 seconds - pulling rocks apart: investigating faulting in an empty box
1.4.5 Recognise and know about folds and the outcrop patterns associated with them	• Squeezed out of shape: detecting the distortion after rocks have been affected by Earth movements
1.4.6 Understand how cross-cutting structures	• *Opengeoscience* 1: igneous intrusions and lavas -

can be used on maps and cross-sections	opening geological maps to the world
AS Unit F792: *Rocks – Processes and Products*	
Module 1: The rock cycle	
2.1.1. Understand the rock cycle and the processes which operate within it	• The rock cycle in wax: using a candle to demonstrate the rock cycle processes • Rock cycle through the window: the rock cycle processes you might be able to see - and those you can't
2.1.2. Understand the broad classification of rocks and the major rock-forming minerals	
2.1.3 Know and understand the geological column	
Module 2: Igneous processes and products	
2.2.1. Classify igneous rocks as silicic, intermediate, mafic and ultramafic	
2.2.2 Understand how crystal grain size is related to rates and depths of cooling	• Why do igneous rocks have different crystal sizes? - investigating the relationships between crystal sizes and different rates of cooling • The unfair 'build your own crystal' race: A crystal-building 'race' showing the greater the time available, the larger the crystals • 'Crystallisation' in a pudding dish: simulating the formation and growth of crystal lattices
2.2.3 Understand the formation of igneous textures within rocks	• Bubble-mania: the bubbling clues to lava viscosity and eruptions
2.2.4 Know the characteristics and understand the origin of silicic, intermediate, mafic and ultramafic igneous rocks	
2.2.5 Understand the generation of magmas at plate margins and hotspots	
2.2.6. Understand the differentiation of magmas	
2.2.7 Understand the intrusion of concordant and discordant bodies as both major and minor intrusions	• *Opengeoscience* 1: igneous intrusions and lavas - opening geological maps to the world
2.2.8 Distinguish between intrusive and extrusive igneous rocks	• Volcano in the lab - modelling igneous processes in wax and sand
2.2.9 Understand the characteristics and distribution of volcanic products	• Blow up your own volcano! Demonstrate the importance of gases in volcanic eruptions
2.2.10 Understand the characteristics of volcanoes	• See how they run: investigate why some lavas flow further and more quickly than others • The balloon goes up at Krakatoa - using a tank and balloon to simulate the huge tsunamis caused by the eruption of Krakatoa • An eruption through the window: how could an eruption transform your view?- lava, ash, lahar or something worse
2.2.11 Appreciate the social and economic effects of volcanic activity	• When will it blow? – predicting eruptions: how a simple tiltmeter can demonstrate the bulging of a volcano before eruption • Party time for volcanoes! - How much force does it take to set off a party popper "volcano"?

	• Take a 'Chance' on the volcano erupting - how hazardous is the volcano?
Module 3: Sedimentary processes and products	
2.3.1 Understand weathering processes producing soluble products and insoluble residues by chemical, mechanical and biological means	• Cracking apart - simulating the weathering of rocks in a desert environment • Weathering - rocks breaking up and breaking down: matching pictures and descriptions of weathered rocks with the processes of weathering that formed them
2.3.2 Understand the influence of gravity, wind, ice, the sea and rivers in the formation of sediment	• Rock, rattle and roll: investigating the resistance of rocks to erosion by shaking in a plastic container • Mighty river in a small gutter: sediments on the move • Dust bowl: investigating wind erosion • Grinding and gouging: how moving ice can grind away rocks
2.3.3 Classify sedimentary rocks	
2.3.4. Describe and identify clastic and non-clastic sedimentary rocks using observations of their characteristic features	
2.3.5 Understand the characteristic features, environments of formation and uses of sedimentary structures	• Sand ripples in a washbowl: how asymmetrical ripple marks form in sand • Sand ripple marks in a tank: how symmetrical ripple marks form in sand • Cracking the clues: making your own cracking clues to the Earth's past
2.3.6 Understand processes of diagenesis	• Make your own rock: investigating how loose sediment may be stuck together to form a "rock"
2.3.7 Understand the characteristic products and processes of sedimentation and be able to use the evidence from rocks, fossils and sedimentary structures to interpret a range of sedimentary environments	• Salt of the Earth: who can make the biggest salt crystal? • High flow. Low flow? - atmosphere and ocean in a tank: hot, cold and particle-filled density currents as they flow in the atmosphere and ocean • What was it like to be there – in the rocky world? Bringing the formation of solid rock to life – by imagining yourself there when it formed • Environmental detective: imagining how the evidence of modern environments could become preserved
Module 4: Metamorphic processes and products	
2.4.1 Understand the relationship between metamorphism and different temperatures and pressures	
2.4.2 Describe, identify and explain the origin of metamorphic rocks using observations of their characteristic features	• Metamorphism – that's Greek for change of shape, isn't it? What changes can we expect when rocks are put under great pressure in the Earth?
2.4.3 Understand the formation of metamorphic textures within rocks	

2.4.4 Understand contact metamorphism	
2.4.5 Understand regional metamorphism	
A2 Unit F794: *Environmental Geology*	
Module 1: Water supply	
4.1.1 Understand the terms used to describe how water is stored and can move through rocks	• The space within - the porosity of rocks: investigating the amount of pore space between the 'grains' of a model 'rock'
4.1.2 Understand the geological conditions necessary for aquifers, artesian basins and water supply from wells and boreholes	• Groundwater – from rain to spring: water from the ground: demonstrating how water flows through the ground – and how it can be used and polluted
4.1.3 Understand the geological conditions leading to the formation of springs	
4.1.4 Know about water supply from river, reservoir and underground sources Understand the advantages and disadvantages of surface and underground supply Understand that water resources are both renewable and sustainable if carefully developed	
Module 2: Energy resources	
4.2.1 Understand the origin of oil and natural gas and migration from source rock to reservoir rock	• Trapped! Why can't the oil and gas escape from their underground prison? Demonstrate how oil and gas can be trapped in reservoir rocks beneath the surface • Make your own oil and gas reservoir: demonstrating how oil and water flow through permeable rocks
4.2.2 Know how geophysical exploration techniques and exploration drilling are used to find hydrocarbons	• Where shall we drill for oil? Sorting out the sequence - oil prospect
4.2.3 Know about reserves of oil and natural gas Understand the methods of primary and secondary recovery	
4.2.4 Understand the environmental, safety and technological problems of oil and natural gas extraction and pipeline transportation	
4.2.5 Know about the occurrence of oil and natural gas in and around the British Isles Understand that oil and natural gas are examples of non-renewable energy resources	
4.2.6 Know the origin of peat and coal Understand the development of rank and the properties of lignite, bituminous coal and anthracite	
4.2.7 Know about reserves of coal and methods of extracting economic deposits of coal by opencast and underground mining Understand the geological factors that affect safety and can make coal mining uneconomic	
4.2.8 Know the broad structure and distribution of coalfields in the British Isles Understand the environmental consequences of coal mining operations Understand that coal is an example of a non-renewable energy resource	

4.2.9 Know about geothermal energy extraction Understand that geothermal energy is an example of a renewable energy resource	• Rock power: geothermal power simulations - modelling geothermal power sources – to show they are not renewable
Module 3: Metallic mineral deposits	
4.3.1 Show an understanding of concentration factors to produce economic deposits from low crustal abundances of metallic minerals Know about mineral reserves	
4.3.2 Understand the concentration of magnetite by gravity-settling in igneous intrusions	
4.3.3 Understand how hydrothermal mineral veins of cassiterite, galena and sphalerite are formed in association with igneous intrusions	• Interactive hydrothermal mineralisation - 'The rock with the hole' hydrothermal mineralisation
4.3.4 Understand how residual deposits of bauxite are formed	
4.3.5 Understand the secondary enrichment of chalcopyrite in copper deposits	
4.3.6 Understand how deposits of uranium ore are formed in sandstones	
4.3.7 Understand the formation of placer deposits of cassiterite, gold and diamonds in rivers and beaches	• Riches in the river: investigating how valuable ores may become concentrated on river beds
4.3.8 Know how geophysical exploration techniques are used to find metals	• Exploring with physics: measuring the electrical resistance of the ground to find buried objects
4.3.9 Know how geochemical exploration methods are used to find metals	
4.3.10 Know the environmental consequences of opencast and underground metal mining operations Understand that metal mining is an example of unsustainable resource exploitation	
4.3.11 Understand the application of geochemistry to environmental problems	
Module 4: Engineering geology	
4.4.1 Know the characteristics of suitable materials for building and construction Understand the environmental implications of their exploitation	
4.4.2 Understand the geological factors affecting the construction of dams and reservoirs Know ground improvement methods which can be used to prevent leakage from reservoirs Appreciate the environmental consequences of dam and reservoir construction	• Dam burst danger : modelling the collapse of a natural dam in the mountains – and the disaster that might follow.
4.4.3 Understand the geological factors that cause landslips and slumping hazards	• Sandcastles and slopes: what makes sandcastles and slopes collapse?
4.4.4 Understand the geological factors affecting the construction of road cuttings, embankments and tunnels through both hard rock and unconsolidated material Know ground improvement methods that can be used to stabilise rocks and prevent flooding of tunnels	
4.4.5 Understand the geological factors affecting	• Why do coastlines change shape? -

the construction of coastal defences Know methods that can be used to prevent coastal erosion and flooding	Investigating wave erosion, transportation and deposition on a coastline
4.4.6 Understand the geological factors affecting the disposal of waste in landfill sites and appreciate the environmental consequences of landfill waste disposal Understand the technological, environmental and safety problems of underground storage of nuclear waste	• Groundwater – from rain to spring: water from the ground: demonstrating how water flows through the ground – and how it can be used and polluted
A2 Unit F795: *Evolution of Life, Earth and Climate*	
Module 1: Formation of fossils	
5.1.1 Understand the different types of preservation of hard skeletal tissues	• How could I become fossilised? Thinking through fossilisation in the context of me or you
5.1.2 Understand exceptional preservation of fossils	• Curious creatures – using fossil and modern evidence to work out the lifestyles of extinct animals
5.1.3 Know about trace fossils and understand their use in interpreting palaeoenvironments	• The meeting of the dinosaurs – 100 million years ago: the evidence given by dinosaur footprints • A dinosaur in the yard - was *Iguanodon* strolling in the sun, or fleeing in fear? • Trail-making: making your own "fossil" animal trails
5.1.4 Understand the use of fossil assemblages in interpreting palaeoenvironments	• What was it like to be there? – bringing a fossil to life: a series of questions to bring fossils, and the environments in which they lived, to life • Dinosaur death - did it die or was it killed? Was this a Cretaceous crime scene? - using rock and fossil forensic evidence to find out
Module 2: Morphology of fossils and adaptation of organisms to live in different environments	
5.2.1 Know the morphology of trilobites and understand the adaptations for different environments	
5.2.2 Know the morphology of tabulate, rugose and scleractinian corals; understand that fossil corals may indicate a tropical, marine, reef environment	
5.2.3 Know the morphology of brachiopods	
5.2.4 Know the morphological differences between regular and irregular echinoids that reflect their respective modes of life	
5.2.5 Know the morphology of bivalves and understand how their adaptations for different environments	
5.2.6 Recognise minor fossil groups and the environments in which they live	
5.2.7 Know about the main microfossil groups and understand their use in stratigraphy	
Module 3: Fossil evidence of the evolution of organisms and mass extinctions	
5.3.1 Know the meaning of evolution	• Sorting out the evolution of evolution headlines - lay out your own timeline of how the theory of evolution developed

5.3.2 Know the morphology of graptoloids (graptolites) and the morphological changes that show the evolution of graptolites in the Lower Palaeozoic	
5.3.3 Know the morphology of nautiloids and ammonoids and the morphological changes and evolution of nautiloids and ammonoids in the Palaeozoic and Mesozoic	
5.3.4 Know about the evolution of amphibians from fish	
5.3.5 Know about the evolution of dinosaurs	
5.3.6 Know about the major mass extinction events	
Module 4: Dating methods, correlation methods and interpretation of geological maps	
5.4.1 Know about radiometric dating	
5.4.2 Know about relative dating	• Laying down the principles: sequencing the events that form rocks through applying stratigraphic principles
5.4.3. Use dating evidence to interpret geological maps	
5.4.4 Know and understand the geological column	
5.4.5 Know how rocks can be correlated	
5.4.6 Know the main appearances and extinctions of key fossil groups and their use as zone fossils	• A time-line in your own backyard: hang pictures of the important events in the history of life on a string time-line
Module 5: Changing climate	
5.5.1 Know that climate has changed over geological time	
5.5.2 Know that there have been major changes in sea level over geological time	
5.5.3 Know about the evidence for palaeoclimatic changes	