Course ID 027148

Integrated Subsurface Description

EART 20021

Credit rating 10
ECTS credits 5

Unit coordinator: Jonathan Redfern

Full year

School of Earth and Environmental Sciences
Undergraduate

Level 2

FHEQ level ' Middle part of Bachelors'

Course unit overview
This unit will introduce students to the full range geological types of oil and gas reservoirs in the sub-surface (shallow marine, deep marine, fluvial, glacial and carbonate) and show how a geological understanding of these rock types can improve predictive models for the production and development of sub-surface oil and gas reservoirs, for which data is commonly limited, This unit will provide an understanding of how outcrop analogues can be used to inform these models, as well as sub-surface data sets. Both depositional and post depositional processes will be considered.

Aims
The aim of this unit is to provide a thorough grounding in how integrated outcrop and subsurface data collection and analysis can improve models for oil and gas reservoirs and aid production and development.

Assessment methods
Assignement 1a Report (individual) 25% 1500 words, ILOs tested = 1, 3Assignment 1b Class Test 25% Computer Based, ILOs tested = 4Assignment 2 Exam 50% 1.5 hours, ILOs tested = 1, 2, 4, 5

Course ID 005884

Global Biogeochemical Cycles

EART 20092

Credit rating 10
ECTS credits 5

Unit coordinator: James Allan

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
This course introduces the rationale for considering the fluxes and interactions of the main elements and nutrients in the earth system in a holistic, 'top down' and interdependent manner. It includes the necessary descriptions of its major compartments: the atmosphere, biosphere, hydrosphere, the cryosphere and the lithosphere; and introduces key concepts of reservoirs, fluxes, equilibrium and turnover times. The main cycles are considered, including the carbon, water, sulphur, nitrogen and phosphorous cycles and their couplings and feedbacks are discussed. There relevance within the earth system will be covered, with a particular emphasis on issues such as climate change, eutrophication and air quality. Human impacts on the key natural cycles will be discussed in the context of global and regional environmental change, which will include what efforts are being employed to mitigate or remediate these effects.

Aims
To provide an overview of the cycling of key chemicals through the earth system focussing on carbon, nitrogen, sulphur, phosphorous and water and their roles within the atmosphere, hydrosphere, cryosphere and lithosphere.
To introduce the reservoir model, concepts such as turnover time and equilibrium, and develop quantitative approaches to assessing budgets and fluxes in global natural cycles.
To give an understanding the role of couplings and feedbacks within the earth system and how this makes different aspects interdependent.
To identify and quantify anthropogenic perturbations to these aspects of the earth system and understand what effects these may have.

Assessment methods

Other	20%
Written exam	60%
Set exercise	20%

Report (individual) (20%)Online test (20%)Exam (60%)

Course ID 005885

Global Tectonics

EART 20101

Credit rating 10

ECTS credits 5

Unit coordinator: Julian Mecklenburgh

Semester 1

School of Earth and Environmental Sciences

Undergraduate ***Level 5***

FHEQ level ' Middle part of Bachelors'

Course unit overview

Global tectonics will provide an understanding of plate tectonic processes that underpin the interpretation of the geological record.

Aims

To examine Plate Tectonic processes at an intermediate level, building upon the grounding provided by the EART1011 Planet Earth module. To examine the development of orogenic belts and sedimentary basins in a plate-tectonics context.

Assessment methods

Online test 1, one hour (4%)Online test 2, one hour (6%)Online test 3, one hour (10%)Exam, 1.5 hours (80%)

Course ID 005886

Palaeobiology

EART 20112

Credit rating 10

ECTS credits 5

Unit coordinator: Russell Garwood

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 5***

FHEQ level ' Middle part of Bachelors'

Course unit overview

Life first appeared on earth more than 3000-million years ago, and since this time has undergone many changes, driven by evolution. This course will explore the evolution of life in deep time, from its origins, through major evolutionary transitions, to the ecosystems we have today. It will: explore the approaches employed in the study of past life; the uses of both invertebrates and vertebrate fossils in the broader context of earth and environmental sciences; and highlight the applications of palaeontology in other fields. Key topics include: evolution and the tree of life, biostratigraphy, palaeoecology, fossils as indicators of the environment, extinction, and the preservation of fossils.

Aims

This course has three primary aims:

-- To provide an overview of major milestones in the history of life, the patterns and processes of evolution, and the structure of the tree of life.

-- To explore the uses, description and classification of both invertebrates and vertebrate fossils through geological time. This will include an introduction to microfossils.

-- To cover topics in palaeoecology such as fossils as indicators of environment, and the development of ecosystems.

Assessment methods

Other	25%
Written exam	50%
Practical skills assessment	25%

Written Exam, 2 hours (50%) Poster, 650-1000 words (25%) Practical Test, 1 hour(25%)

Course ID 005888

Sediment transport processes and depositional environments

EART 20121

Credit rating 10
ECTS credits 5

Unit coordinator: Merren Jones

Semester 1

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
Deciphering the language of sediments and the stratigraphic record is one of the great enterprises of the Earth Sciences. This course is designed to develop students' practical ability to describe and make process-based interpretations of sedimentary rocks. The course builds from one week to the next, and the concepts discussed increase in scale, beginning with the study of a particle within a flow, and concluding with large scale controls on basin fills. Emphasis is placed on problem solving and thinking quantitatively, and physical experimentation plays a central role in the course to both visualise processes (e.g., the formation of individual bedforms and structures) and to explore the physics behind sediment transport and deposition. During the practical classes students work collaboratively in research teams to develop skills in defining a hypothesis and planning and executing experiments to test those hypotheses.

Aims
The aim of this course is to learn to 'read' features you observe in the stratigraphic record. A more complicated way of saying this is, this course unit aims to develop the skills needed to describe and interpret the stratigraphic record in both space and time, emphasising the processes of sediment transport and deposition, and the interpretation of clastic depositional environments.

Assessment methods

Other	50%
Written exam	50%

Exam, 2 hours (50%)Test, 2 hours (50%)Test (quiz) formative (0%)

Course ID 005889

Igneous Petrology

EART 20131

Credit rating 10

ECTS credits 5

Unit coordinator: Margaret Hartley

Semester 1

School of Earth and Environmental Sciences

Undergraduate ***Level 5***

FHEQ level ' Middle part of Bachelors'

Course unit overview

The course investigates the variety of igneous rock types observed on Earth, and the processes that form them. It covers magma generation in the Earth, differentiation processes, and the links between magma compositions and tectonic setting, It explains how to use analytical, graphical and theoretical techniques to understand and model a variety of igneous processes, and hence interpret the origin of igneous rock samples. This module provides the foundations for interpreting igneous rocks encountered elsewhere in the degree programme, in particular those in the 2-year Easter field course to Glencoe.

Aims

The aim of this course is to explain the diversity of igneous rock types observed on Earth. You will learn the skills needed to recognise the compositions, mineralogies and textures of all the major igneous rock types, and hence to interpret the melting and crystallization processes that occur in igneous and magmatic systems.

Assessment methods

Other	40%
Written exam	60%

Report (individual), up to 8 pages (30%)BB quizzes (2% each = 10% total)Written Exam, 2 hours (60%)

Course ID 005891

Geochemistry

EART 20151

Credit rating 10

ECTS credits 5

Unit coordinator: Greg Holland

Semester 1

School of Earth and Environmental Sciences

Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview

The course illustrates the importance of Geochemistry to global evolution of the Earth. The first half of the module teaches geochemical theory which is used to interpret the laboratory practicals. The second half of the module expands on the theory and discusses geochemistry is a broader planetary scale context. Students will have 10 hrs lectures, and 5 lab based practicals. The practical classes involve lab chemistry experiments and paper-based write-up exercises.

Aims

To outline the origin of the elements and their isotopes, their gross distribution throughout the Earth and the key processes controlling their partitioning with particular focus on fluid geochemistry.

Assessment methods

Other	50%
Written exam	50%

Exam, 1.5 hours (50%)Report (individual) (50%)

Course ID 005892

Environmental Investigative Methods

EART 20162

Credit rating 10
ECTS credits 5

Unit coordinator: Stephen Boult

Semester 1

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
Data and background information will be provided for students to produce several research projects across the range of environmental sciences. The projects are designed to demonstrate the requirements of research, a common process for carrying out research, and to teach the skills needed. Projects will progress from those based on comparison of measurements to comparison of relationships to comparison to models. All projects will teach students how to communicate by construction of logical written argument and are fully supported by videos on Blackboard.

Aims
To prepare students to carry out an independent research project by defining a process to be followed and teaching particular skills using environmental science case studies.

Assessment methods
Test, 1.5 hours (100%)

Course ID 005900

Carbonate and Evaporite Depositional Systems

EART 20222

Credit rating 10
ECTS credits 5

Unit coordinator: Stefan Schroeder

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
A module building on fundamental sedimentology and palaeontology, giving students ample practical experience of looking at the diversity of carbonate and evaporite rocks, as well as understanding their formation, diagenesis and applied aspects. Students will discover these rocks as systems integrating aspects of biology, chemistry and physics, as archives of past climates, and of great economic importance.
Students will learn techniques of rock description and interpretation of processes and environments from their observations. The course covers methods such as facies analysis, logging, correlation tools and sea level analysis to encourage an integrated view of depositional systems. A particular emphasis is placed on applied aspects of carbonate / evaporite depositional systems to highlight possible employment directions.

Aims
This module aims to give students a sound overview of the nature and origin of carbonate and evaporite rocks, depositional processes and environments of deposition as well as the evolution of depositional systems with time. This will prepare students for fieldwork and for basin analysis in year 3, and for more specialist studies. A particular emphasis is placed on applied aspects of carbonate-evaporite depositional systems.

Assessment methods

Written exam	50%
Practical skills assessment	50%

Course ID 005901

Metamorphic Petrology

EART 20232

Credit rating 10

ECTS credits 5

Unit coordinator: Alison Pawley

Semester 2

School of Earth and Environmental Sciences

Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview

In this course students will learn how to identify metamorphic rocks (mineralogy, texture, protolith), how to infer conditions of formation (P,T,X) from mineral parageneses and mineral equilibria, about the metamorphic processes involved, and how metamorphic rocks can be used to help the geologist understand large-scale earth processes (e.g. orogenesis, subduction).

Aims

The aim of the course is to learn how to extract as much information as possible about metamorphic processes from the rocks themselves, on all scales from the microscopic to regional tectonic environments, and to use this information to infer their tectonic settings and aid in the interpretation of their geological histories.

Assessment methods

3 x 30 minute tests, (12% each = 36%)Report (individual) (14%)Exam, 2 hours (50%)

Course ID 005905

Understanding our Metal Resources

EART 20262

Credit rating 10
ECTS credits 5

Unit coordinator: Victoria Coker

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
In order to gain a practical understanding of metal resources students will be first introduced to the technique and skill of reflected light microscopy, essential for identifying phases non-transparent (opaque) in 30 micron thick thin sections, and thus critical for holistic petrography. Many of the world's main metalliferous ores comprise suites of non-transparent oxides and sulphides, and therefore reflected light microscopy is essential for examining these deposits and their mineral processing. This skill will be then used to examine a range of ore textures and examples of mineral deposits. Other aspects of mineral deposit study will be introduced - fluid inclusions and beneficiation, the processing of an ore deposit to separate out the economic components. Four classic types of major mineral deposit will be studied as case studies.

Aims
The aim of this course is to give students practical knowledge and skills used directly in the discovery and exploitation of metal deposits, critical for a career in the mining industry. Students will learn the technique of reflected light microscopy for the study of non-transparent phases and its application in the study of metalliferous ores and their processing as well as obtain an understanding of metalliferous mineral deposits, their characteristics, methods of study and formation.

Assessment methods

Other	25%
Written exam	50%
Practical skills assessment	25%

One hour practical test (25%)Individual report (25%)Final written exam, 2 hours (50%)

Course ID 005907

Atmospheric Physics & Weather

EART 20281

Credit rating 10
ECTS credits 5

Unit coordinator: Jonathan Crosier

Semester 1

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
The module provides an overview of the atmosphere and the atmospheric processes that lead to the weather we experience. We look at the forces that determine air motion (wind), and the behaviour of dry and moist air (clouds and rain). We describe how the atmosphere is observed and measured, and how those measurements are combined with the laws of physics to provide a weather forecast, or on a longer timescale to explore climate change.

Aims
To give an understanding of the physics determining the behaviour of the Earth's atmosphere and its observed weather phenomena.

Assessment methods

Other	20%
Written exam	80%

Coursework assignment (20%)Exam, 1.5 hours (80%)

Course ID 005909

Structural Geology

EART 20292

Credit rating 10

ECTS credits 5

Unit coordinator: Stephen Covey-Crump

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 5***

FHEQ level ' Middle part of Bachelors'

Course unit overview

The lectures provide an overview of the subject, describing the geometry of geological structures and their associated minor structures, together with the key mechanical concepts of stress, strain and microscale rock deformation processes. The last three lectures seek to integrate the preceding eight by describing the interrelationships between these structures in contractional, extensional and strike-slip tectonic settings. Examples are taken from other planetary bodies in addition to Earth. The lectures are densely packed with content so that the overview of the subject is comprehensive - it is intended that the PowerPoint presentations (which include substantial extra comments/further reading in the notes pane to each slide) may be used as a reference source in future studies. As such, this is a road map of the subject - different students will focus on different aspects. Assessment, however, focuses on key material (highlighted within each lecture) that any geologist should be familiar with.

The practicals develop a working understanding of structural analysis, focusing on the use of stereonet techniques to carry out such an analysis. There is a particular (but not exclusive) emphasis on techniques that students might use while undertaking their Independent Mapping Project. The initial focus is upon the use of stereonets for analysing the geometry of folds and faults and for constructing cross sections on dipping planes to illustrate that geometry. Three practicals are devoted to stress and strain analysis to develop the content of the lectures on those subjects. We then establish a deeper understanding of what stereonets can do for us by using them to solve a range of geometrical tasks, including unrotating dipping units and showing how they may be used to establish the kinematics of large scale faults from minor fractures and fabrics found in fault zones.

Aims

The aim of this unit is to outline the principal types of geological structures that are formed when rock sequences are deformed (*e.g.*, folds, faults, fractures and shear zones), and to provide practical training in analysing the geometry of these structures. Along the way, an introduction to the concepts of stress and strain and to the processes by which rocks deform is provided because these are pivotal in developing the subject within the broad field of geomechanics. The unit complements material covered within the 2 year field

courses (EART20300). It provides the necessary grounding in all the structural techniques required for the Independent Mapping Project (EART30000) at the end of the 2 year, while also providing the prerequisites for those planning to pursue further studies in structural processes and geomechanics (engineering geology, petrophysics) within their 3 year.

Assessment methods

Other	50%
Written exam	50%

(1)"Theory" exam [summative] Diagrammatic, short answer questions primarily on lecture content but with aspects that were developed in the practicals (e.g., stress and strain analysis). 2.5 hours (50%)(2)"Practical" exam [summative] map-based exercise with accompanying short answer questions focusing primarily on analysis of the geometry of folds and faults. 2.5 hrs (50%)

Course ID 028733

Reservoir and Production Chemistry

EART 20301

Credit rating 10
ECTS credits 5

Unit coordinator: Roy Wogelius

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
Building on first year modules covering basic geology (rock identification) and a basic knowledge of generation and migration (A-level maths + 1 yr Eng Maths + A level chemistry) this second year module will present the fundamental chemistry of the reaction pathway leading to hydrocarbon generation and will develop an understanding of how the chemical properties of the product phases affect hydrocarbon migration from source to reservoir as well as detail key reactions that occur during extraction such as degassing. Critical inorganic and organic concepts involving hydrocarbon generation include: clay mineral stability, surface catalysis, and kinetics within source and reservoir rocks. The course will conclude with basic flow modelling based on an advanced understanding of system chemistry.

Aims
This course will give the student an advanced understanding of the key chemical processes that control the fundamental pathways to hydrocarbon generation and how these processes also affect fluid migration in the subsurface.
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Assessment methods

Other	40%
Written exam	60%

Report- Assessed practical 1, 5 pages (10%)Report- Assessed practical 2, 5 pages (10%)Report- Assessed practical 3, 5 pages (10%)Test, 1 hour (10%)Exam, 1.5 hours (60%)

Course ID 031063

Urban Geoscience and Contaminated Land Projects

EART 20352

Credit rating 10
ECTS credits 5

Unit coordinator: Colin Hughes

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
Teams of students will work on literature based projects investigating different UK case study cities. Using a wide range of information sources, students will develop a scientific understanding of the regional and local physical geography and geology, in particular the role of local natural resources in the development of the city, including mineral resources, fossil fuels, hydrology and hydrogeology. From the literature and online historical sources they will investigate the underpinning science of industrial processes, products and waste outputs from a city's primary industrial and domestic activities over time, including likely future development. In particular, they will pay attention to impact on surface and subsurface natural environments (air quality, surface and groundwater, soils and sediments, and solid and drift geology) and the wider potential harm to ecosystems and human health. Each individual student will be allocated a specific site within their case study city, and carry out a comprehensive 'Phase 1' baseline desk study to determine the site's physical geography, geology, ecology and land use history to evaluate the likely environmental impact of human activity over time, including potential legacy and current environmental problems; and consider technological approaches to remediation. Throughout the course unit students will be expected to develop and demonstrate an in depth understanding of the science underpinning all aspects of their project work.

Aims
- To build upon individual and team project based working in the first year by studying the past, present and potential future of selected UK cities in the context of natural resourceexploitation, urban development and environmental impact, mitigation and clean-up
- Examine how a city's geology and wider natural environment have influenced itsdevelopment and land use over time, especially since the Industrial Revolution andthroughout the 20th and into the 21st centuries.
- Investigate the underpinning science of how urban development, and city specificindustries, have left legacies of environmental degradation at and below the surfacethroughout brownfield sites, and more widely, across city landscapes.
- Understand how regulatory frameworks and environmental technologies can help in theremediation of legacy environmental degradation, and in the control and mitigation

ofcurrent and future development activities.

- Key topics will include: ‘pollutant sources and sinks’; ‘source pathway receptor model forenvironmental pollution’; water utilities; quarrying; mining and other heavy industries;and industrial and domestic waste disposal.
- Explore the relationship between environmental problems in cities and the widersociological, technological, economic and political factors that influence urbandevelopment
- Develop academic and professional skills, including: literature review, media monitoring,essay and report writing, team working, project management and presentation skills

Assessment methods

Essay (individual) (media journal) (10%)Essay (individual) (project diary) (10%)Essay (individual) (reflective appraisal) (10%)Essay (group) (co-authored team city case study) (30%)Essay (individual) (Phase 1 environmental site assessment) (20%)Oral (group) (final) (20%)See Blackboard for full details of all assessments, including formative ones.

Course ID 038380

Meteorites and Planetary Material

EART 20382

Credit rating 10
ECTS credits 5

Unit coordinator: Raymond Burgess
Unit coordinator: Rhian Jones

Semester 2

School of Earth and Environmental Sciences
Undergraduate ***Level 5***

FHEQ level ' Middle part of Bachelors'

Course unit overview
This unit is an overview of extraterrestrial material, including meteorites and lunar samples. Students will examine the properties of meteorites and lunar samples and learn how to interpret the formation of these samples and the geological processes that they record. The unit builds on petrology skills that students have acquired in Geology classes (Earth Materials, Igneous Petrology) and their understanding of the formation of the Solar System from prior classes in Planetary Science. Since the unit demonstrates the breadth of sample studies it will assist with student choices of third and fourth year research projects.

Aims
The unit aims to introduce students to the diversity of extraterrestrial materials available for study on Earth. Students will investigate the formation conditions and origins of different materials, and the role played by sample studies in interpreting the formation and geological evolution of the solar system. This involves studies of meteorites and lunar samples in hand sample, and using transmitted and reflected light microscopy. Students will also be introduced to peer-reviewed literature of sample studies.

Assessment methods
Report (individual) - Descriptions, 20 pages (70%)Report (individual) - Poster (30%)

Course ID 029811

Subsurface Techniques

EART 20411

Credit rating 10

ECTS credits 5

Unit coordinator: Mads Huuse

Semester 1

School of Earth and Environmental Sciences

Undergraduate ***Level 5***

FHEQ level ' Middle part of Bachelors'

Course unit overview

In this unit students will be introduced to the basic interpretation of seismic and borehole data for subsurface structure and stratigraphy. Lectures will provide an overview of the creation and interpretation of seismic images and practicals will focus on aspects of rock physics fundamentals and hands-on seismic and borehole log interpretation. The unit starts with classroom-based lectures and practical exercises on paper, followed by workstation-based 3D interpretation of oil field seismic data using state-of-the-art workstation techniques. The latter part enables students to create the basic input for use in reservoir modelling.

Aims

The aim of this unit is to familiarise students with key techniques for subsurface interpretation and to enable them to undertake the basic subsurface interpretation required to build a reservoir model using oil field data

Assessment methods

Other	40%
Written exam	60%

Practical Assignment Report (individual), 8 pages (40%) Written exam, 2 hours(60%)

Course ID 029812

Geomechanics for Petroleum Engineers

EART 20422

Credit rating 10
ECTS credits 5

Unit coordinator: Ernest Rutter

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
The theories of stress, infinitesimal strain and elasticity, and the strength and modes of failure of rocks are topics that must be understood by the practising Petroleum Engineer. The aim of this course is to introduce these topics. The practical applications of this subject are (a) to understand stresses around boreholes, borehole failure, in-situ stress measurement, hydraulic fracture and enhanced hydrocarbon recovery, (b) to understand stress states in reservoirs and how they arise, allowing us to minimise reservoir damage and maximise productivity.

Aims
The aim of this course unit is to introduce the theories of stress, infinitesimal strain and elasticity, and the strength and modes of failure of rocks.

Assessment methods
Mid-tem summative test in the same style as the final exam, 1 hour (40%)Final exam in May, 1.75 hours (60%)

Course ID 023000

Formation Evaluation I

EART 20432

Credit rating 10

ECTS credits 5

Unit coordinator: Catherine Hollis

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 5***

FHEQ level ' Middle part of Bachelors'

Course unit overview

Formation Evaluation is the study of the physical properties of rocks and their ability to store and flow hydrocarbon. This unit will introduce the fundamental principles of petrophysics and its importance to resource evaluation in hydrocarbon reservoirs. It focuses on how porosity, permeability and hydrocarbon saturation are measured in rock samples and from geophysical logs.

The unit integrates lectures and class-based practical activities and experiments and a 1 day fieldtrip to the British Geological Survey core store in Keyworth, Nottingham.

Aims

To develop an understanding of the key techniques used for the petrophysical characterisation of reservoir rocks in the subsurface. It will introduce the principles of net-to-gross, porosity, permeability and saturation determination and the controls on their distribution.

Assessment methods

Report (group): core description [2 pages + core sedimentological log] (25%)Practical test (in-class) (25%)Examination, 1.5 hours (50%)

Course ID 025476

Environmental Soil Science - biogeochemistry

EART 20802

Credit rating 10
ECTS credits 5

Unit coordinator: Clare Robinson

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
It is only through an understanding of soil processes that effective strategies can be made to counteract humankinds effects of pollution and disturbance on soils.

Aims
To examine the soil as a functional unit of terrestrial ecosystems and human-made environments.

Assessment methods
Report (individual), one A4 page (15%)Test, 2 hours (15%)Exam, 1.5 hours (70%)

Course ID 024307

Introduction to Drilling and Production Engineering

EART 20901

Credit rating 10
ECTS credits 5

Unit coordinator: Catherine Hollis

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 5

FHEQ level ' Middle part of Bachelors'

Course unit overview
Classroom-based short course taught by an external lecturer, John Galvin, aimed at introducing the fundamentals of drilling engineering.

Aims
The aim of this module is to build a basic understanding of drilling techniques and introduce the fundamentals of well testing and engineering safety during drilling and production.

Assessment methods
In Class Assignment (100%)

Course ID 005915

Presenting Contemporary Geoscience

EART 30030

Credit rating 10
ECTS credits 5

Unit coordinator: Grant Allen

Full year

School of Earth and Environmental Sciences
Undergraduate

Level 6

FHEQ level ' Last part of a Bachelors'

Course unit overview

This course unit will teach and coach the student in the art of effective professional and technical communication through learning about and presenting personally chosen topics of scientific interest across a range of formats (oral, poster and written). This is an important and requisite skill in all walks of modern professional life, where conferences, meetings and workshops are ubiquitous ways of networking across and within a wide range of organisations. The student may be surprised at how often they will need to present their work to peers and lay audiences in most professional careers and this course will give useful practice in this important skill demanded by employers. This is designed to hone the skills and experience gained previously in Earth Science course units (through tutorials, field exercises and other course unit project presentations and essays).

Aims

This unit aims to develop and deliver best practice in scientific (and technical) communication, including individual and group presentation styles to various audiences, succinct written reporting, and poster presentation. The written report and presentation will focus on a scientific topic of interest chosen by the student, either from a recommended list or from a student-led topic idea in negotiation with a project supervisor.
Unit aims are:
1/ To develop skill in distilling a critical understanding and narrative of a contemporary scientific topic of interest.
2/ To develop effective communication skills in written, verbal and poster formats.
The overall coursework will be to prepare a conference-style abstract, a poster and a seminar presentation (10 minutes) to give to staff and peers on a chosen specialist topic in Earth, atmospheric and environmental Sciences.

Assessment methods

Essay (2 A4 pages) - 30%Oral presentation (individual) - 35%Presentation (individual

poster) - 35%

Course ID 005929

Introduction to Geomechanics

EART 30141

Credit rating 10
ECTS credits 5

Unit coordinator: Stephen Covey-Crump

Semester 1

School of Earth and Environmental Sciences
Undergraduate

Level 6

FHEQ level ' Last part of a Bachelors'

Course unit overview
The stress analysis techniques explored in this unit are delivered via a suite of paper-based practical exercises. All necessary mathematics is taught within the unit. After introducing some foundational material on matrix manipulation, we consider what the "state of stress" actually means and use both graphical and matrix manipulation methods to evaluate that state of stress from measurements of normal stress and shear stress on a plane or from measurements of principal stresses. We examine how stress analyses may be carried out in geographical coordinate systems and, as a by-product of this, show how operations commonly done with a stereonet may be done instead by manipulating vectors. We then turn to examine stresses in thrust sheets and develop that approach into slope stability applications. We conclude the first half of the unit by examining the mechanical consequences of fluids within porous rocks.
In the second half of the course we use the techniques learned to date to deduce the stresses required for brittle failure in contractional, extensional and strike-slip tectonic settings, and then use this analysis to constrain the magnitude of horizontal stresses in down-borehole settings. We conclude the unit by looking at stress with depth in the lithosphere, extending our primarily upper crust/brittle regime analyses into deeper lithosphere/plastic deformation regimes.

Aims
The aim of this unit is to provide a practical introduction to graphical and mathematical techniques that are widely used within the geotechnical industries to evaluate states of stress in the sub-surface. The techniques are applied to estimate stresses in structural geology (stresses on faults, strength with depth), engineering geology (slope stability) and down-borehole settings. As such the unit provides a strong foundation for students interested in taking up applied geomechanics at postgraduate level or who are interested in pursuing a career within any parts of the energy, mineral resource and environmental sectors that have an interest in the strength and potential for brittle failure of the rocks that they encounter in their operations.

Assessment methods

Other	50%
Written exam	50%

Test (2.5hr, week 7) (50%)Exam (2.5hr, week 12) (50%)

Course ID 005930

Analytical Techniques

EART 30151

Credit rating 10

ECTS credits 5

Unit coordinator: Roy Wogelius

Semester 1

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

This unit will cover X-ray and vibrational spectroscopy, mass spectrometry, diffraction, tomography, electron beam analysis, and the basics of error analysis. Examples will be drawn from petrology, environmental chemistry, palaeontology, and other areas of the sciences to illustrate key points.

The electron microprobe, X-ray diffractometer, and inductively coupled plasma spectrometer are the three cornerstone instruments of an Earth sciences analytical facility and therefore these three technologies will serve as the basis for the course. Modern research relies on a range of instruments, and therefore once the core concepts are established new and more specialist methods will be introduced. Beginning with a lecture to outline the basic theory of each method the student will then be given a practical exercise to explore the capabilities, limitations, and costs of using each instrument. Discussions during practicals and lectures will include concrete examples of recent research applications.

Aims

The aim of this course is to teach the student the fundamental physical and chemical principles which underpin modern analytical methods in Earth and Environmental Science research. This knowledge is fundamental to a career as a practicing scientist in these fields.

Assessment methods

Other	20%
Written exam	80%

Report-Assessed Practical 1, 5 pages (5%)Report- Assessed Practical 2, 5 pages (5%)Test (10%)1.5 Hour Examination (80%)

Course ID 005933

Mineral Deposits

EART 30172

Credit rating 10

ECTS credits 5

Unit coordinator: David Polya

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

1. Introduction - overview of ore deposit types, genesis and distribution.
2. Professional skills & careers in the metalliferous mining industry

Mineral Resource Evaluation & Ore Deposit Life Cycles

3. Mineral Resource Evaluation
4. Mineral Exploration
5. Exploration methods - remote sensing, lidar & UAV
6. Environmental issues arising from metalliferous mining

Ore Deposit Genesis

7. Controls on Ore Mineral Solubility
8. Case study: Gold geochemistry
9. Controls on Hydrothermal Fluid Flow
10. Case study: Panasqueira W-Sn Ore Deposit, Portugal

Aims

The unit aims to:

[i] introduce the principles of ore formation and in particular the chemical and physical controls on the genesis of hydrothermal ore deposits;

[ii] introduce key elements of the mining cycle - mineral resource demand, mineral exploration, ore grade prediction and environmental & socio-economic legacies of mining; and

[iii] develop key skills and attributes of those seeking employment in the economic geology sector.

Assessment methods

Other	50%
Written exam	50%

1) Formative Assessment Background Knowledge, 2 hours (0%)2) Formative Assessment Team Exercise on Metal Minerals Industry , 10-15 minutes (0%)3) Commodity Review

Team Exercise, 15-20 minutes (25%)4) Practical Exercise, 4 hours (25%)5) Theory Examination, 1.5 hours (50%)

Course ID 005934

Hydrogeology

EART 30182

Credit rating 10

ECTS credits 5

Unit coordinator: David Polya

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 3***

FHEQ level ' Last part of a Bachelors'

Course unit overview

EART30182 (Hydrogeology) outlines the principles of physical and chemical hydrogeology; includes consideration of landfill site design with regard to aquifer protection; and the nature & dispersion of key contaminants in aquifers.

Aims

To introduce the principles of physical and chemical hydrogeology and the description of aquifers; to consider important aspects of groundwater contamination and aquifer protection.

Assessment methods

ASSESSMENT2 hour practical examination inMay (40 % of marks).1.5 hour written examination inMay/June (60 % of marks).All learning outcomes may be assessed by each assessment method but to varying degrees depending upon the assessment method, in particular:(i) the practical examination will focus substantively more on assessing quantitative applications of theory;(ii) the written examination will focus substantively more on assessing understanding of theoryFEEDBACKFeedback on practicals and presentations will be made during practical classes.Feedback on all formal assessment will be made via Blackboard and/or through a centrally arranged class feedback session.

Course ID 005937

Energy Resources

EART 30201

Credit rating 10

ECTS credits 5

Unit coordinator: Jonathan Redfern

Semester 1

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

The module examines the supply of energy to meet global demand. After an introduction to global energy usage and resources, this applied geology course introduces the fundamentals of the main energy sources; oil and gas, coal, nuclear and renewables. The methods used for exploration and exploitation of hydrocarbons, coal and uranium resources are discussed, together with the increasing importance of renewable energy generation and its role in the energy mix.

Aims

The course introduces students to world energy usage and the extraction of resources to meet global demand. We evaluate fossil fuels, nuclear and renewable energy sources.
Oil and gas exploration and production is reviewed; introducing students to the different petroleum types, how hydrocarbons are generated from source rocks and reservoirs, trapping methods and seals. Students are given typical subsurface lithological and geophysical data, and in a series of practical exercises are introduced to methods to evaluate the information and interpret the results.
The course introduces coal petrology and students will be taught how to describe the main macerels, their mode of formation and coal-forming environments. Methods of coal exploration and production are discussed and geological hazards in coal mines assessed.
The course explores the nature and origin of uranium, its geochemistry, mining and processing. The use of uranium in the civil nuclear power industry is discussed.
Solar and other renewable energy is introduced and its role in the energy mix is evaluated.

Assessment methods

Exam, 1.5 hours (50%)Practical Exercise 1 (20%)Practical Exercise 2 (20%)Group Presentation, 10 minutes (10%)

Course ID 027167

Reservoir Engineering and Field Development

EART 30211

Credit rating 10
ECTS credits 5

Unit coordinator: Ian Kane

Semester 1

School of Earth and Environmental Sciences
Undergraduate

Level 6

FHEQ level ' Last part of a Bachelors'

Course unit overview
This applied unit is designed to build core skills related to the analysis, prediction and optimization of field, reservoir, well and plant performance in the context of depletion planning. It provides an improved understanding of the oilfield business environment, project and development economics. The unit provides background and support to the design project in semester 2 (CHEN30232).

Aims
Aims
This module aims to provide students with the skills to:
- interpret subsurface data, plan data acquisition
- predict production
- develop an oilfield
- assess and book reserves
- understand and integrate project and development economics

Assessment methods

Other	25%
Written exam	75%

Course ID 005940

Comparative Planetology

EART 30232

Credit rating 10

ECTS credits 5

Unit coordinator: James Gilmour

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

In this course unit students will learn about the geology of the terrestrial planets and consider what we can learn about the processes of planet formation and evolution. Content varies somewhat from year to year to reflect current areas of exciting research, but in outline will cover these areas.

• The backdrop to the course is a consideration of whether our solar system is typical of solar systems in general, or whether only unusual solar systems are capable of supporting a technological civilization.
• There will be a few classes on the environment of the early solar system where the planets formed. This will include the evidence for the presence of massive stars nearby as our sun was forming, and the processing of material on the first asteroids as they were heated by radioactive decay of short-lived isotopes produced in those stars.
• In discussing the planets, we will start with the Moon. We will find out what sorts of structures impacts produce, and how they are used with the principle of superposition to establish the relative ages of planetary surfaces. We will see how impact cratering has affected the surfaces of other planets and icy moons, and what the cratering record of the moon tells us about the bombardment history of the inner solar system. We will compare Mercury's history with that of the Moon.
• Moving on, we will look at the histories of Mars and Venus, especially the contrasting fates of water , varying styles of volcanic activity, and the reasons their climates have differed from that of the Earth. This will lead to a discussion of the features of the Earth that lead to its being able to support us, and how they arose.
• Finally, we will turn to the icy worlds of the outer solar system, and try to see how geology works in an environments where "rocks" are made of ice and, on Titan, the fluid is a hydrocarbon.

There is an emphasis in the course on developing your own understanding, applying it in new contexts, and supporting your opinions with evidence. In previous years physics and other students successfully followed this class in spite of a clash with another option on Fridays - lectures are recorded and available via blackboard as audio files with accompanying power points. Students are encouraged to read around the subject, following their interests and starting from some recommended papers on the blackboard site.

Aims

To allow students to develop an integrated view of the formation and evolution of our solar system and the rocky and icy bodies within it.

Assessment methods

Other	20%
Written exam	80%

Assessment methodsTake home exam question essay (20%)1.5 hour exam (80%).

Course ID 037639

Environmental Radioactivity and Nuclear Power

EART 30252

Credit rating 10
ECTS credits 5

Unit coordinator: Katherine Morris

Semester 2

School of Earth and Environmental Sciences
Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview
This course explores the theme of environmental radioactivity and nuclear power and is available to students across the School. The approach used in teaching and learning is to familiarise all students with the different types of radioactivity and nuclear fission and fusion. These concepts are then carried through to explore radioactivity in the environment (natural and anthropogenic), radioactivity in modern society (medical and other uses), the nuclear fuel cycle, nuclear power reactors, nuclear weapons, nuclear accidents / terrorism and management of radioactive wastes. Throughout the focus is on the environmental impacts of these processes and a particular theme is to explore the risks posed by nuclear power reactors and their wastes in the context of other risks posed by society.

Aims
The aims of the course are to provide a framework for students to understand:

- Radioactive decay
- Nuclear fission and nuclear fusion
- Radioactivity in the environment and in modern society
- How nuclear reactors work and how fission in reactors is different to fission in weapons
- The risk posed by radioactive materials in the context of other risks
- The nuclear legacy - what it is and how old nuclear facilities are managed and decommissioned
- Radioactive wastes - Low Intermediate and High level wastes.
- Current issues contributing to the socio-political debate about new nuclear power and radioactive waste management.

Assessment methods

Other	30%
Written exam	70%

Exam, 1.5hrs (70%)Report (BSc1500 words / Masters 3000 words) (30%)

Course ID 005946

Volcanology

EART 30282

Credit rating 10

ECTS credits 5

Unit coordinator: Mike Burton

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

The course starts by discussing what controls the distribution of volcanoes on Earth. We then examine the anatomy of volcanoes, and review processes of fractional crystallisation which lead to evolution of magma types, followed by a quantitative examination of magma properties, and the relationship between viscosity, crystal volatile content and volcanic behaviour. This is followed by describing and quantifying different types of volcanic activity, eruptive processes on Earth and also in the solar system, and how to interpret eruptive products and deposits. We then examine volcano surveillance methods, risk and hazard assessment, and the impact of volcanoes on climate and extinction events.

There are ten lectures which explore the principle processes in volcanology, from petrology to fluid dynamics to risk communication. Eight of these lectures are accompanied by a 2 hour practical held as an exercise class, where the whole group goes through questions together, either alone in pairs or group working. Content from both the practicals and the lectures will be assessed, and extra reading will be rewarded in the assessments, of which there are two. Firstly after lecture 5 an essay is set with a two week deadline, this makes up 50% of the course. There is also an end of course exam for a further 50%. After the final lecture there is no exercise class, but an open question and answer session where we can discuss any element of the course, and provide feedback for the essay.

Aims

This course will enable students to explain the principle processes which produce volcanism on Earth, the key role of geochemistry in the rheology of magmas, volatile exsolution and degassing, how gas-magma coupling controls magma ascent and eruption style, volcano monitoring, hazards and risk assessment, and health/climate impacts. The course aims to build on nearly all the courses which students have followed during their degree.

Assessment methods

Written exam	50%
Written assignment (inc essay)	50%

Course ID 005953

Evolution of the Earth's Lithosphere

EART 30332

Credit rating 10
ECTS credits 5

Unit coordinator: Brian O'Driscoll

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 6

FHEQ level ' Last part of a Bachelors'

Course unit overview
Earth's lithosphere is the rigid outer shell of the planet including the crust and the upper part of the mantle. This unit considers fundamental processes that have driven lithospheric evolution through geological time, with a particular emphasis on igneous and metamorphic petrology and the applications of geochemistry to solving problems in this area of study.

Aims
The principal aim of the module is to impart an advanced understanding of some important mechanisms involved in the formation and evolution of the Earth's lithosphere, within the framework of plate tectonics.

Assessment methods

Other	50%
Written exam	50%

Coursework (individual poster presentation, 10 pages) (20%)Coursework (report - individual, 15 pages) (30%)Exam (2 hours) (50%)

Course ID 005955

Hydrogeochemistry

EART 30341

Credit rating 10

ECTS credits 5

Unit coordinator: David Polya

Semester 1

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

EART30341 (Hydrogeochemistry) provides an overview of the major physico-chemical processes involved in water-rock reactions within the Earth's crust, understanding of which has important applications to understanding mineral deposits, oil & gas generation & migration and metamorphic processes ore deposits;

Week 1: Introduction: Importance, applications & basics of hydrogeochemistry (DAP)
Week 2: Groundwater & hydrothermal fluid flow systems (DAP)
Week 3: Controls on the chemistry of natural waters (DAP)
Week 4: Trace gases in groundwaters as a paleaoclimate record (RB)
Week 5: Dating groundwaters: 14C (RB)
Week 6: Stable isotopes in natural waters (RB)
Week 7: Stable isotopic geothermometry (RB)
Week 8: Surface absorption reactions (RAW)
Week 9: Mineral-fluid kinetics (RAW)
Week 10: Mineral-fluid kinetics (RAW

Detailed topics may vary from year-to-year according to staff availability and topical events.

Aims

The unit aims to:

Outline the principles of the major physico-chemical processes involved in water-rock reactions within the Earth's crust.

Assessment methods

[1] Formative Assessment Background Knowledge, 2 hours (0%)[2] Practical Exercise (Wks 1-3), 4 hours (10%)[3] Practical Exercise (Wks 4-6), 4 hours (10%)[4] Practical Exercise (Wks 7-8), 4 hours (10%)[5] Practical Exercise (Wks 9-10), 4 hours (10%)[6] Theory Examination, 1.5 hours (60%)

Course ID 005957

Climate and Energy P607

EART 30362

Credit rating 10

ECTS credits 5

Unit coordinator: Martin Gallagher

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

This course illustrates the importance of understanding a range of processes from the microscale to the planetary scale in the Earth's atmosphere and how these interact with both internal and external forcing agents, natural and anthropogenic, to control the Earth's climate. These processes are placed in context by showing changes in atmospheric composition on geological timescales and how these are related to changes in the Earth's radiative input due to orbital precession and obliquity changes as a result of the Milankovitch cycles, which are still being hotly debated hotly including potential for so-called "climate tipping-points".

Students are introduced to the basic equations of radiative transfer, atmospheric scattering and absorption processes and how these can be used to build a simple model to predict the temperature profile in an atmosphere. Students are then introduced to the basic greenhouse effect equations and predictions. The final part of the course will link place the natural science components into a socio-economic context by summarising those principles are used to understand human population growth and its associated energy use, both past and in the future. Global energy availability is then discussed using top-down estimates in order to understand global energy sources, renewable and non-renewable (fossil fuels). The students will also learn how to calculate the lifetime of these energy sources and debate the energy source mix that will be needed to satisfy predicted future energy needs.

Syllabus:

- Composition of the atmosphere and the atmospheric energy balance. Sun-Earth radiation balance and Milankovitch cycles
- Radiative heat balance in the atmosphere
- Energy flow in the biosphere, atmosphere and ocean
- A simple climate model, a simple aerosol scattering and absorption model. Earth vs Venus climatology
- Climatology of the Earth over Geological time
- Circulation of the oceans and the atmosphere - ENSO
- Evidence for natural and anthropogenic climate change
- The pattern of energy consumption now and in the future
- Future climate change predictions; emissions reductions and their impact on future energy consumption
- Lifetime of fossil fuels. Energy efficiency, COP, Carnot cycle and heat pumps
- Contribution of alternative/renewable energy and nuclear resources for the

future. Renewable energy progress.

Tutorial lectures. The final two lectures will cover problem solving based on past examination questions. Students are encouraged to contact the lecturer after this week to discuss solutions to these problems either by email or by arranging a personal/group tutorial.

Aims

The aim of this course is provide students with the skills to understand, analyse and critique state of the art knowledge relevant to climate science at multiple skill levels from those accessible to the interested layman as represented by "New Scientist" and "Scientific American" articles and at the mathematical level to understand how fundamental processes such as atmospheric radiative transfer and aerosol-cloud interactions at the microscale can have consequences for regional and global climate change. The second part of the course then provides the basic skills to understand past and current man's global energy use and to calculate future uses in context with available energy resources.

The unit aims to:

• educate students about past and present changes in earth's atmospheric composition and the basic biogeochemical and astronomical drivers for those changes

• highlight the basic methods used to provide a picture of past changes in planetary climate, the pros and cons of these different observation methods and how they have been combined and improved

• demonstrate results from cutting edge of satellite remote sensing platforms and how these are transforming knowledge of climate change and aiding testing of new climate models.

• demonstrate using cutting edge in situ aircraft observations fundamental processes at the mcroscopic scale and how these influence the Earth's radiative budget at the regional and global scale.

• explore changes in physical and chemical feedback pathways in different regions of the globe due to aerosols and the contribution from natural and anthropogenic sources.

• to review and make use of basic equations for molecular and aerosol aerosol scattering and absorption and their effects over different surface types and on vertical temperature and radiative profiles within the Earth's atmosphere and how these compare with proifles from other planetary bodies.

• to educate students in man's global energy use and how to calculate top down estimates of natural energy cycles and how man's energy use compares with these

• to educate students in how global population changes with time and what special and economic factors influence these changes and how they factor into estimates of man's future energy use

• to educate students in the available energy sources, both renewable and non-renewable and how these have changed over history and how they must change in future to accommodate man's predicted energy use.

Assessment methods

Written exam	100%

Course ID 005958

Sedimentary Basins and Sequence Stratigraphy

EART 30372

Credit rating 10
ECTS credits 5

Unit coordinator: Mads Huuse
Unit coordinator: Stefan Schroeder
Unit coordinator: Ian Kane

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 3

FHEQ level ' Last part of a Bachelors'

Course unit overview
This module covers the origin and nature of sedimentary basins, and their stratigraphic fill.

Aims
1. To develop a detailed understanding of how sedimentary basins form, the different types of such basins and the expression and characteristics of these sedimentary basins.

2. To understand how the stratigraphic record within sedimentary basins is formed and preserved and how it responds to intrinsic variability of depositional systems and varying tectonic and climatic processes.

3. To understand the seismic-svcale expression of sedimentary basins and their sedimentary fill.

Assessment methods

Other	30%
Written exam	70%

Module assessment:Practical assessments (2 practicals, each practical worth 15% of the module mark; outcomes 1, 4, 5 and 6).

2 hour written examination in June. (70%; outcomes 1-6)

Course ID 023932

Drilling Engineering

EART 30381

Credit rating 10

ECTS credits 5

Unit coordinator: Stefan Schroeder

Semester 1

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

This unit is taught by a series of expert drilling engineers who are actively engaged in drilling. It aims to provide fundamental training in the theory of drilling engineering.

Aims

Aims

The aim of this module is provide advanced training in Drilling Engineering, including:

- Prepare for drilling by through defining the well objectives and calculating pore pressure
- Plan well placement and describe how drilling will proceed
- Calculate the necessary drilling parameters, including mud composition and weight
- Design casing design, cementing
- Plan wellbore surveys
- Describe how to drill safety

The unit gives skills in well planning and well design, and develops problem-solving, oral communication and team work.

Assessment methods

Test (30%)Coursework (70%)

Course ID 023933

Geostatistics and Advanced Reservoir Modelling

EART 30391

Credit rating 10
ECTS credits 5

Unit coordinator: David Hodgetts

Semester 1

School of Earth and Environmental Sciences
Undergraduate

Level 6

FHEQ level ' Last part of a Bachelors'

Course unit overview
Theory:
1. What is a Reservoir Model and why do we need them in the petroleum industry.
2. Markov Chains and Monte-Carlo simulations.
3. Univariate and Multivariate statistics applied to reservoir characterisation.
4. Reservoir modelling algorithms: How they work and where to apply them.

Practical:
Getting started:
1. Introduction to the Petrel Reservoir Modelling package.
2. Structural modelling: modelling faults and horizons

Modelling algorithms by example:
1. Deepwater fan complex: Sequential Indicator Simulations (SIS)
2. Confined fluvial systems: Object Modelling
3. Shoreface settings: Truncated Gaussian Simulations
4. Carbonate reservoirs: SIS, Probability volumes, Discrete Fracture Networks.

Aims
The unit aims to:
[i] Introduce the principles of Stochastic Reservoir Modelling, and the underlying statistics that support this modelling approach.
[ii] Introduce the concepts of uncertainty and risk, and how those concepts apply to reservoir modelling.
[iii] Develop key skills and attributes of those seeking employment in the petroleum geology sector.

Assessment methods
[1] Formative Assessment: Brief on-line multiple choice questions after each practical assignment (10 mins per practical class) (0%)[2] Theory Examination (40%)[3] Theory Examination (60%)

Course ID 005959

Palaeontology- Ecosystems of the Past

EART 30411

Credit rating 10
ECTS credits 5

Unit coordinator: John Nudds

Semester 1

School of Earth and Environmental Sciences
Undergraduate

Level 6

FHEQ level ' Last part of a Bachelors'

Course unit overview
Most major advances in understanding the history of life on Earth in recent years have been through the study of exceptionally well-preserved biotas (Fossil-Lagerstatten). This course introduces students to some of the most important and best known sites around the globe, and by following these in chronological order from the Precambrian up to the Quaternary enables an appreciation of the evolution over time of fossil ecosystems.

Aims
The course unit aims to follow the evolution of the first metazoans of the Ediacaran 'garden', through the 'weird wonders' of the Burgess Shale, through the giant coal-forests of the Carboniferous, to Archaeopteryx, the world's first bird, and on to the feathered dinosaurs, recently discovered in China.

Assessment methods
1) 3,000 word essay (40%)2) 1.5 hour exam (60%)

Course ID 027132

Meteorology

EART 30551

Credit rating 10

ECTS credits 5

Unit coordinator: Luis Garcia-Carreras

Semester 1

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

The module will cover three broad areas and skills, which are necessary for understanding and predicting weather; how to read and interpret weather observations and charts from different sources, what are the physical processes that drive different weather phenomena (especially high-impact weather), and how are environmental predictions, such as weather forecasts, produced. The students will be able to apply this knowledge to real-world cases. The course is delivered through weekly lectures and a forecasting contest which will allow the students to put their skills into practice. Each lecture will end with a discussion of the past week's weather using the latest available observations. These discussions will provide a link between the classroom material and what they experience day to day, while also providing feedback on their forecasting attempts. In addition, the course will be assessed via an assignment done at home in the first weeks, which will introduce the student to different sources of observational data and how to interpret these, and three in-course tests which will provide feedback on the student's understanding of the lectures throughout the course.

Aims

The aim of this module is to provide students with the tools to describe and understand real-world weather phenomena, particularly high-impact weather events relevant to the UK, and how to develop weather forecasts and other environmental predictions while understanding sources of uncertainty in forecasts.

Assessment methods

Three in-class tests (3 x 25%) Assignment (10%) Forecasting Contest (15%)

Course ID 027133

Organic Geochemistry

EART 30641

Credit rating 10

ECTS credits 5

Unit coordinator: Bart Van Dongen

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

This course illustrates the importance that organic matter plays in to the biosphere and geosphere and hence drives the global carbon cycle. Students are introduced to the basic principles of how organic compounds are formed, altered and preserved, will explore the processing of organic matter through the Earth systems and will investigate how specific biomarkers/proxies can be used to obtain valuable information about the (palaeo) environment and/or environmental processes. Students are introduced in to latest developments in organic geochemistry and will develop practical organic geochemical skills.

Aims

The aim of this course is to provide insight into cutting edge organic geochemistry to allow students to develop the skills to reconstruct climate conditions both in space and time using organic geochemical proxies, emphasising the formation, transport and fate of organic compounds and the interpretation of various depositional environments.

Assessment methods

Other	50%
Written exam	50%

2-hour exam (60%)Report (individual), 4 pages maximum (40%)

Course ID 038203

Earth and Environmental Consultancy

EART 30701

Credit rating 10
ECTS credits 5

Unit coordinator: Colin Hughes

Semester 1

School of Earth and Environmental Sciences
Undergraduate

Level 6

FHEQ level ' Last part of a Bachelors'

Course unit overview

The unit commences with establishing the students' fictitious company role play 'early career scientist identities' - based on their academic interests, career aspirations and dissertation/mapping projects. Their project portfolio includes a team-based assessment of the Environmental Impact Assessment documentation for a proposed major shale gas development. The students' individual project portfolios define the range of expertise, structure and business client market of the company. During this formative stage the students will: review the School's applied research activities; identify with a professional governing body; investigate external ('real world') organisations which have relationships with the company (based on organisations with real world links to the School); and access the professional literature to evaluate key themes affecting the applied geology and environmental science industrial sectors. A business scenario which threatens the company suddenly arises and, in role, the students have to quickly learn how to develop a viable business plan, based on market research (a 'Competitive Action Plan'). The market research requires them to collaborate in analysing all the factors which affect their business sector, including all the external organisations involved: clients, competitors, statutory and professional bodies. In role the students are supported by a management consultant (member of academic staff in role) who facilitates the required learning and development. Out of role, there are regular briefings with staff to ensure coherence and progression. There are no exams. Initial formative coursework forms the foundation for subsequent summative individual and group assessed coursework; with students being assessed individually for their contributions to teamwork assessments. The co-authored Competitive Action Plan will consist of a comprehensive analysis of the Earth and environmental science business service sector, including competitor analysis, internal assessment of the students' company's competitiveness, and design of promotional materials. In addition to written materials, the students will, in role, present and defend their proposals to current and prospective investors. In role, they will also need to reapply for their jobs in writing. Finally, the students will write a professional reflective appraisal of their learning and development, reviewing their own and their peers' performance.

Aims

To offer experiential learning which will enable Earth and environmental science students to:

- Better understand the business environment where many Earth and environmental science graduates work - both discipline specific and more widely applicable;
- Evaluate the purpose and process of Environmental Impact Assessment;
- Develop and demonstrate high level professional skills, including creative problem solving and market research based business planning.

These aims are achieved through realistic role play as early career scientists, working for a fictitious Manchester University-based multidisciplinary consultancy specialising in applied geology and environmental impact assessment.

Assessment methods

Report (Project diary) (10%)Essay (Annotated list of organisations) (10%)Essay (Reflective appraisal) (10%)Essay (Individual project portfolio) (10%)Essay (group co-authored business plan) (30%)Essay (In role job re-application letter and online CV) (10%)Oral assessment (Group) (20%)

Course ID 029813

Formation Evaluation II

EART 30772

Credit rating 10

ECTS credits 5

Unit coordinator: Catherine Hollis

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

This Unit advances knowledge of the range of tools and techniques used in Formation Evaluation from Formation Evaluation I. It outlines the theory and methods behind determination of the volume and recovery of hydrocarbons within oil and gas reservoirs, focusing on core and geophysical (wireline) logs. Emphasis is on the geometry of pores in clastic and carbonate reservoirs and their impact on the quantification of porosity and oil in place, as well as formation damage. The role of non-routine logging techniques in reservoir characterisation is also introduced.

Aims

To build on the principles of Formation Evaluation described in Formation Evaluation I (EART20432), such that students are capable of providing a robust geological and petrophysical assessment of reservoir quality and rock physical properties

Assessment methods

Other	30%
Written exam	70%

Two online assessments will be conducted (fixed time period, one attempt only) during weeks 1-10 (each worth 15%)Final examination, 1.5 hours (70%)

Course ID 025478

Problems in Environmental Mineralogy & Chemistry

EART 30812

Credit rating 10
ECTS credits 5

Unit coordinator: Samuel Shaw

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 6

FHEQ level ' Last part of a Bachelors'

Course unit overview
This course introduces the basic concepts required to apply mineralogy and geochemistry to environmental problems. Starting with funamental mineralogy, this part of the course covers the structure and chemistry of minerals including key concepts related to lattice arrangements and bonding within minerals, ionic substitution and the concept of a unit cell. The course then covers the structure of low-temperature phases including clay minerals, oxides, phosphates and carbonates. In addition, concepts related to the fluid-solid interactions, including dissolution/precipitation, surface chemistry and adsorption processes are studied.
Following on from the fundamental concepts the course focuses on mineralogical and geochemical processes in natural processes including weathering and soil formation, marine aquatic system and within the atmosphere, highlighting changes in mineralogy as a function of environmental conditions and processes.
Finally, the course examines the role of minerals in key anthropogenically perturbed systems including but not limited to: radioactive waste disposal, hazardous waste disposal, groundwater production, aerosol particulates and mine tailings.

Aims
The aim of the course to develop an integrated view of mineralogical and geochemical processes applied in understanding natural environmental processes and key contaminated systems.

Assessment methods

Other	40%
Written exam	60%

4-5 page report, due in week 4 (20%)
4-5 page report, due in week 8 (20%)
Exam, 1.5 hrs (60%)

Course ID 005966

Geomicrobiology

EART 30831

Credit rating 10

ECTS credits 5

Unit coordinator: Jonathan Lloyd

Semester 1

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

The course will be delivered by Prof Lloyd, augmented with invited guest lectures as appropriate covering emerging "hot topics" in the area. Initial lectures will focus on the "microbiological basics" to make sure that all of the students on the course have the required foundations, followed by lectures (and group activities) covering fundamental elemental cycles, including an emphasis on the ways that these natural processes can be utilised in diverse areas of science of technology. These will include bioremediation, high value bionanomaterial synthesis and the safe exploitation of the subsurface.

Aims

The aim of this course is to provide insight into the role that microorganisms play or have played in geological processes, covering the molecular-scale mechanisms of global bioprocesses, through to high technology biotechnological applications

Assessment methods

Other	30%
Written exam	70%

Exam, 1.5 hours (70%)Oral (group) presentation on sampling & analysis, 15 minutes (15%)Presentation (poster) on seminal papers from the literature (15%)

Course ID 038920

Advances in Palaeobiology

EART 30882

Credit rating 10

ECTS credits 5

Unit coordinator: Robert Sansom

Semester 2

School of Earth and Environmental Sciences

Undergraduate ***Level 6***

FHEQ level ' Last part of a Bachelors'

Course unit overview

The unit will draw upon the wide range of world experts at the University of Manchester; each week, a different expert will cover topics relating to their own research and cutting edge techniques in palaeobiology. As such, this unit will bring students right up to the state-of-the-art both in terms of understanding of current hot topics and practical skills. The format for each week will be a 1 hour lecture followed by an interactive seminar session (either directed discussion, hands-on practical, or some combination of the two). After the Easter break, students will give an assessed individual presentation on a topic of their choice from the course, in a half-day seminar.

Aims

-To provide insight into cutting edge evolutionary palaeobiology and science-based archaeology through important current controversies and analytical techniques.
-Equip students with the necessary skills and awareness to tackle important evolutionary problems using techniques ranging from biomechanics and phylogenetics to tomography and taxonomy.

Assessment methods

Other	30%
Written exam	70%

Written exam (2 hours) - 70% Assessed individual presentation (10 minutes) - 30%

Course ID 028736

Field Development & Production Engineering II: Economics, HSE, and Surface Facilities Engineering

EART 30902

Credit rating 10
ECTS credits 5

Unit coordinator: Ian Kane

Semester 2

School of Earth and Environmental Sciences
Undergraduate

Level 6

FHEQ level ' Last part of a Bachelors'

Course unit overview
Details to be added shortly

Aims
Details to be added shortly

Assessment methods

Written exam	100%

Course ID 023937

Origin of the Solar System

EART 30962

Credit rating 10

ECTS credits 5

Unit coordinator: Ian Lyon

Semester 2

School of Earth and Environmental Sciences

Undergraduate

Level 6

FHEQ level ' Last part of a Bachelors'

Course unit overview

This course covers nucleosynthesis and the formation of solar systems. The course introduces Big Bang nucleosynthesis of hydrogen and helium and the formation of stars from this primordial material. The basic physics of how stars work and the nuclear reactions and quantum mechanical effects that allow fusion reactions to happen are discussed.
The stellar sites of r (rapid) and s (slow) neutron capture processes by which all of the elements in the periodic table heavier than helium are produced are studied. Explosive nucleosynthesis in novae and supernovae are studied along with mass loss by winds from giant stars as methods of spreading this material back into the interstellar medium.
The course then looks at how material in the form of giant molecular clouds can condense into stars and how planetary systems can be formed from accretion discs around those protostars.

Aims

To understand the solar system's history, its place in the Universe and how the atoms that form the solar system were made.

Assessment methods

Written exam	50%
Written assignment (inc essay)	50%