

## **Advanced Level Geology in the United Kingdom: A New Approach by the Welsh Joint Education Committee**

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### **Abstract**

The Welsh Joint Education Committee (W.J.E.C.) is one of two providers of Advanced Level (AL) geology in the United Kingdom. The Dearing review (1998) of the post-16 curriculum entitled 'Qualifying for Success' suggested a number of fundamental changes to the existing provision. The W.J.E.C.'s new AL geology specification (syllabus) is a response to this review. The specification offers an attractive, relevant science programme for students. It aims to retain and expand the place of geology in the new post-16 structure by attracting a wider cohort of one-year students through the Advanced Subsidiary (AS) course, and demonstrating depth and rigour, whilst retaining interest as students progress onto the A2, and thus complete the AL course.

## **Geologi Peringkat Tinggi di United Kingdom: Satu Pendekatan Baru Oleh Jawatankuasa Gabungan Pendidikan Welsh**

### **Abstrak**

Jawatankuasa Gabungan Pendidikan Welsh (W.J.E.C) merupakan salah satu daripada penyumbang geologi Peringkat Tinggi (AL) di United Kingdom. Ulasan Dearing (1998) untuk 16 jawatan kurikulum bertajuk "Layak untuk Berjaya" mencadangkan beberapa perubahan asas bagi menyumbang kepada program yang sedia ada. Spesifikasi (sukatan) geologi AL baru oleh W.J.E.C. merupakan tindakan terhadap ulasan ini. Spesifikasi ini memberi tawaran istimewa program sains untuk pelajar. Ia bertujuan untuk mengekalkan dan mengembangkan ruang geologi dalam struktur baru lepasan-16 dengan menarik lebih kumpulan pelajar tahun pertama melalui kursus Tambahan Terkini (AS), dan menunjukkan dalam dan had, dan pada masa yang sama mengekalkan minat selari dengan peningkatan pelajar ke A2, dan akhirnya menyiapkan seluruh kursus AL.

## **INTRODUCTION**

The Welsh Joint Education Committee (W.J.E.C.) is based in Cardiff and is an examination board, which sets national examinations in England and Wales. It is one of two providers of Advanced Level (AL) geology in the United Kingdom and the only provider of General Certificate of Secondary Education (G.C.S.E.) geology.

The Dearing review of the post-16 curriculum in the United Kingdom entitled 'Qualifying for Success' suggested changes to the existing provision, with five main characteristics:-

- More breadth, from a norm of AL in three subjects, to five subjects in AS Level in year one and three subjects to A2 in the second year of their study programme.
- No loss of academic rigour.
- Greater flexibility and choice with all subjects having a similar structure (three modules in AS and three in A2).
- Demonstrable progression to be shown from pre-G.C.S.E. to post-degree level.
- Parity of esteem between academic and vocational qualifications.

In designing a new AL geology specification the W.J.E.C.'s aim was to retain and expand the place of geology in the new structure by producing an interesting,

topical course which addressed the aims of 'Qualifying for Success'.

### **Rationale**

Geology is the branch of science concerned with the structure, evolution and dynamics of the Earth and with the exploitation of the mineral and energy resources that it contains. Thus, geology is ideally suited to fulfil the educational purpose of demonstrating the relevance of science to society.

Geology applies physical, chemical and biological principles to the investigation of the Earth, but also involves a distinctive scientific methodology invoking internal and external Earth processes to explain the evolution of the planet through geological time. The application of geology to human activities and needs is widely addressed in the specification, providing for a relevance and the development of a broad range of Key Skills (a range of skills which students completing their pre-university education should have obtained).

### **General Objectives**

The structure of the specification allows for the design of individual courses appropriate to students' programmes of study. The structure permits a broad, coherent coverage of geology whilst retaining a clear view of the subjects

identity. To exemplify the relevance and importance of geology to every day life, technological applications and social, economic and environmental issues permeate the specification.

The Advanced Subsidiary (AS) specification (first year of a two year AL course) is designed to provide a course ideally suited to broaden students learning by complementing a science course or providing a contrasting course within the humanities. The specification will extend a science course by study of the application of scientific principles to the investigation of the Earth and by the use of scientific techniques and skills to develop enquiries. AS Unit GL3 (Geology and the Human Environment) identifies the importance of geology to society and includes enquiry-based investigations and the presentation of written reports, which can enrich a humanities programme.

## AIMS

The overall aims of the specification are to provide:-

- A coherent structure of study areas in geology which is accessible to those from a variety of educational backgrounds.
- A series of largely independent but interrelated course units in geology which may be combined either to complement and broaden AS/AL courses of study in sciences or to contrast with and enrich AS/AL courses in the humanities.
- A suitable course for the study of major scientific issues and themes.
- A course with wide scope for cross curricular work exploiting the strong links between geology and other subjects including environmental education providing many contexts for the development of Key Skills.
- A suitable foundation in geology for students who intend to study the subject at a higher level.
- A stimulating course for students who do not intend to continue the formal study of geology between AS/AL level.

The aims relating specifically to geology are:-

- To foster an understanding of the nature and scope of geology, including consideration of geological processes, geological time and Earth history.
- To encourage an awareness and appreciation of the relevance of geology to social, economic, environmental and philosophical issues.
- To provide an informed base for the critical assessment of the relevance and value of geology to society.
- To be aware of how advances in knowledge, understanding and technology, including information technology and instrumentation are used in geology.
- To develop an understanding of the link between theory and experiment.

The aims relating to skills are:-

- To promote the development of Key Skills; communication (written, oral, numerical, graphical,

cartographic), application of number, information technology, practical problem solving and social skills (working with others, improving own learning and performance).

- To promote the development of geological investigative skills in the field and laboratory.
- To provide opportunities for students to investigate, understand, critically evaluate and communicate geological facts and ideas; hence to develop informal ideas and opinions on a range of geological issues, problems and the responsible use of scientific knowledge and evidence.
- To develop skills needed to develop geology in new and changing situations.

## SPECIFICATION CONTENT

Each component of the specification is divided into Key Ideas that link the specification content together. For example, Unit GL1, Key Idea 1, states: the Earth has a concentrically zoned structure and composition. The specification content, within a Key Idea is contained in column 1 (knowledge with understanding) and column 2 (techniques and skills). Column 3 (possible learning experience) is not part of the content, but exemplifies suitable teaching contexts and approaches for the delivery of the content of columns 1 and 2. Links to opportunities for Key Skills are also listed in the possible learning experiences column.

### AS Content

This consists of three units: Unit GL1 Foundation Geology, Unit GL2 Investigative Geology and Unit GL3 Geology and the Human Environment.

#### Unit GL1 Foundation Geology

This unit is organised into three basic scientific topics.

**Matter:** the global structure of the Earth and the composition of its crust.

**Energy:** the Earth energy sources and the resultant internal and external geological processes.

**Time and Change:** the geological record of change and the relative and absolute dating of geological events.

The unit aims to develop the basic geological knowledge understanding and skills to underpin the other units of the course and also develop the geological skills of observation and interpretation of simple geological problem maps, sections, graphic sedimentary logs, photographs and specimens.

#### Unit GL2 Investigative Geology

Using the material from Unit GL1 this unit assesses an investigative approach to learning. The investigative skills are based on the same criteria as the A2 level geological investigation: planning, implementing, analysing evidence

and drawing conclusions and evaluating evidence and procedures. It also assesses appropriate geological techniques and skills acquired in Unit GL1.

### Unit GL3 Geology and the Human Environment

This unit aims to develop knowledge with understanding of natural geological hazards and those caused by human activity, and the means of predicting, monitoring and controlling them. Secondly, it aims to develop an evaluation of the impact of geology in environmental planning and civil engineering projects. Finally, the skills of analysing and evaluating geological data related to site development and hazard assessment may also be developed.

### A2 Content

This consists of three units: Unit GL4 Interpreting the Geological Record, Unit GL5 Geological Themes (a choice of two from four themes) and Unit GL6 Geological Investigations.

### Unit GL4 Interpreting the Geological Record

This has been divided into four sub-units:-

#### E1 Rock Forming Processes

This sub-unit aims to develop:-

- An extended concept of the rock cycle to deepen knowledge with understanding of igneous, sedimentary and metamorphic rocks.
- Extended skills in identifying and interpreting rocks using their composition, textures and other diagnostic features.

#### E2 Rock Deformation

This sub-unit aims to develop:

- An extended understanding of the physical relationship of the type of stress and the resultant rock structures.
- Skills in the laboratory investigation of rock deformation.
- Skills in recognising and interpreting structural data presented in a variety of forms.

#### E3 The Fossil Record

This sub-unit aims to develop:

- An extended knowledge with understanding of the nature of the fossil record.
- Skills in investigating a succession of life through geological time as evidenced by the fossil record.
- Skills in investigating the role of fossils in stratigraphy.
- Skills of observation and interpretation of fossil characteristics.

#### E4 Geological Map Interpretation

The Foundation Geology Unit GL1 introduces interpretation of subsurface geological structures using geological problem maps. In this sub-unit, investigating outcrop patterns on real geological maps develop map interpretation skills further.

This sub-unit aims to develop:-

- Extended skills in interpreting structural information

contained in geological maps

- Skills in extracting information from geological maps related to a range of geological applications.

### Unit GL5 Geological Themes

The Geological Themes build on the GL1, GL3 and GL4 Units. They demonstrate how interconnections between different areas of geology are important to the study of major geological themes. AL students must cover two of the four themes.

#### Theme 1 Quaternary Geology

This half-unit aims to develop :-

- Knowledge with understanding of the link between geological processes and products and an appreciation of the importance of this link in interpreting the geological record.
- An appreciation of the role of geology in the study of global climatic change.
- An appreciation of the fragmentary geological record of Quaternary environmental and climatic change in the British area.
- Fieldwork skills of investigating and interpreting a modern sedimentary environment.

#### Theme 2 Geology of Natural Resources

This half-unit aims to develop:

- Knowledge with understanding of the geological processes that lead to the formation and/or accumulation of natural resources.
- Knowledge with understanding of the methods of exploration for geological resources.
- Appreciation of the need for control of the extraction of geological raw material to minimise environmental problems.
- Appreciation of the wide range of uses of geological raw materials and their importance to society and industry.
- Skills in interpreting geological data to assess resource potential.
- Skills in investigating rocks and minerals in relation to their resource potential.

#### Theme 3 Geological Evolution of Britain

This half-unit aims to develop:-

- Awareness with understanding of the broad pattern of rock outcrop, and the wide range of igneous, sedimentary, metamorphic and tectonic processes that have created the geology of Britain and adjoining continental shelf regions.
- Knowledge with understanding of the geological evolution of Britain and the evidence that the area of Britain has moved northward, in a global context, through Phanerozoic time.
- An appreciation of the techniques of collecting geological field data and presenting and interpreting them in the forms of maps and sections.
- Skills in interpreting geological maps and field observations in plate tectonic terms.

### Theme 4 Geology of the Lithosphere

This half-unit aims to develop:

- An understanding that the lithosphere consists of the crust and uppermost part of the mantle and is a layer of distinctive mechanical properties.
- Knowledge with understanding of the geological processes underlying the formation and evolution of the lithosphere.
- Knowledge with understanding of the methods of investigating the internal structure and composition of crustal and mantle lithosphere.
- Skills interpreting geological and geophysical data to investigate lithospheric structure and processes in the context of plate tectonics.

### Unit GL6 Geological Investigations

A central aim of the AS and AL specifications is the development of geological investigative skills in the field and laboratory. The teaching programme should include investigations designed to develop these skills and assessment should arise naturally from these investigations. The assessment of students' performance should be made during the normal teaching and learning programme and should be an integral part of the scheme of work associated with the various units of the specification. Assessment should be made against the following four criteria:

- Planning
- Implementing
- Analysing evidence and drawing conclusions
- Evaluating evidence and procedures

The student, in choosing topics to investigate is expected to apply the appropriate skills and ideas that have been acquired in the geology course. The teacher can introduce suitable topics for investigation.

Data collection may involve a single geological skill, such as mapping, or, may involve a range of geological skills that could include any of the following; field mapping, section logging, structural measurements, laboratory testing of rock properties, investigation of rock, mineral or fossil suites, analysis of thin sections of photomicrographs, geological computing, laboratory modelling of geological processes.

The work produced for this unit could form the major part of a portfolio of evidence for a Key Skills qualification.

## ASSESSMENT OBJECTIVES

There are four assessment objectives (AO) within the specification. The assessment objectives will be assessed in the different units. Each AO will be given a specific weighting within each unit.

### AO1 Knowledge with Understanding

Students should be able to:-

- Recognise, recall and show understanding of appropriate geological terminology, conventions and classifications, geological processes, products and

concepts, geological techniques.

- Draw on existing knowledge to show responsible use of geology in society.
- Select, organise and present relevant information clearly and logically, using specialist vocabulary where appropriate.

### AO2 Application of Knowledge and Understanding, Analysis and Evaluation

Students should be able to:-

- Describe, explain and interpret fundamental concepts of geology presenting arguments and ideas clearly and logically using specialist vocabulary.
- Interpret meaning, translate and solve problems involving data as continuous prose, tables, diagrams, graphs, maps, photographs, sections.
- Carry out relevant calculations.
- Assess critically the validity of geological generalisations and hypotheses, recognising that some are of a very tentative nature.

### AO3 Experiment and Investigation

Students should be able to:-

- Devise and plan experimental and investigative activities, selecting appropriate techniques.
- Demonstrate safe and skilful practical techniques in the field and laboratory.
- Observe and measure with appropriate precision geological phenomena in the field and laboratory, and record these methodically.
- Interpret, explain, evaluate and communicate the results by presenting information in any relevant form and from this, recognise patterns, develop classifications, synthesise, evaluate and draw relevant conclusions using geological knowledge and understanding and using appropriate specialist vocabulary.

### AO4 Synthesis of Knowledge, Understanding and Skills

Students should be able to:

- Bring together knowledge and concepts from different areas of geology including investigative skills and apply them in a particular context expressing ideas logically and clearly.
- Use geological skills in contexts, which bring together different strands of the subject.

## SCHEME OF ASSESSMENT

Advanced Subsidiary and Advanced Level qualifications are available for this specification.

### Advanced Subsidiary Assessment

This is a modular scheme that consists of three units. Units GL1 and GL2 are integrated in the specification and assessed at the same time. Unit GL3 is assessed separately. The level of assessment required is that which a student

could be expected to achieve having studied one year of an AL course. This emphasises the progression in learning and attainment between G.C.S.E. and AL.

### Units GL1 and GL2 Foundation Geology and Geological Skills

A two and a half hour paper that will test students knowledge through short answer data-response questions incorporated within an integrated problem-solving paper based on a black and white geological map, photographs, specimens and other data.

### Unit GL3 Geology and the Human Environment

A one and a quarter hour paper with two sections. Section A consists of compulsory short answer data-response questions. In section B, one essay with structured paragraph headings is to be answered from a choice of three.

### Advanced Level Assessment

This is a modular scheme consisting of six units, three AS and three A2.

Part 1 – AS (See above)

Part 2 – A2

### Unit GL4 Interpreting the Geological Record

A two hour paper which has two sections. Section A contains compulsory short answer data-response questions. Section B contains compulsory short answer questions based on a real geological map or other data.

### Unit GL5 Geological Themes

A two and a half-hour synoptic and terminal paper on the two themes chosen (two from four). The Geological

Themes build on the specification content of GL1, GL3 and GL4 Units and can therefore be classed as synoptic. Each theme has two sections. Section A contains compulsory data-response questions and Section B contains a choice of one from three essays. In assessment of the essay, mark band criteria are used.

### Unit GL6 Geological Investigations

Geological coursework is assessed against four criteria, each of which needs to be assessed twice. At least 50% of the assessed coursework is to be based on fieldwork; at least 25% is to be based on laboratory work.

## CONCLUSIONS

This paper summarises the approach of the W.J.E.C. to the assessment of AL geology in the United Kingdom. Centres will start teaching the specification in September 2000. The first examination in AS will be in June 2001 and in AL in June 2002. The W.J.E.C. is the major provider of geology curriculum and assessment in the United Kingdom at pre-University level. Prior to gaining Government approval, a detailed specification along with specimen paper and marking schemes, was submitted.

## REFERENCES

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