

Higher National Unit Specification

General information for centres

Unit title: Environmental Chemistry

Unit code: DP4Y 34

Unit purpose: This is a specialised Unit designed as part of the HN Science Framework and will be core in the HND Environmental Sciences, but is likely to be an optional Unit in other awards. The Unit is designed to provide candidates with the underpinning knowledge of environmental chemistry and a range of applied chemical techniques used in environmental chemistry.

On completion of the Unit the candidate should be able to:

- 1 Describe and explain the principles of environmental chemistry of air, water and land.
- 2 Perform experimental techniques applicable to environmental chemistry.

Credit points and level: 1 HN Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Recommended prior knowledge and skills: Access to this Unit is at the discretion of centres, but it would be a distinct advantage if candidates had prior knowledge of some chemistry. Completion of the Unit Fundamental chemistry: Theory and Practice (DH2K 34) or an equivalent would be advantageous.

Core skills: There may be opportunities to gather evidence towards Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

Assessment: Outcome 1 will be assessed using a case study where candidates will be expected to explain the principles of the environmental chemistry of air, water and land. Outcome 2 will require the completion of two practical exercises which will be assessed using a checklist and a laboratory diary or pro forma. Candidates are also expected to produce 2 laboratory reports detailing the experiments and their findings.

Higher National Unit specification: statement of standards

Unit title: Environmental Chemistry

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe and explain the principles of environmental chemistry of air, water and land

Knowledge and/or skills

- ◆ aquatic chemistry
- ◆ geochemistry
- ◆ soil chemistry
- ◆ atmospheric chemistry
- ◆ pollutants in air, soil and water
- ◆ water treatment

Evidence requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can: produce answers to extended response questions covering the knowledge and skills in this Outcome. The assignment should take the form of a case study given to the candidates prior to the assessment. Candidates will have the opportunity to prepare and research information before being presented with a paper under supervised closed-book conditions. Candidates will not be allowed to take any notes or information into the assessment.

The question paper should test the candidates' knowledge of certain aspects of the chemistry of air, water and land. The support notes outline the range of subjects to be covered and the questions should represent a selection from these topics. This will allow scope for a number of different assessments to be prepared.

The question paper should contain no more than 6 questions, with each question requiring an answer of approximately 150 words.

Assessment guidelines

The range of topics covered in this Outcome are difficult to assess using a traditional closed-book exam. By allowing the candidates to prepare for the assessment in this way, more searching questions can be set. Candidates will also have the opportunity to do their own research when preparing their answers. By having the final answers written under closed-book conditions, it will be certain that the work is the candidates own. The questions should be such that the range of material covered in the Outcome is sampled.

Higher National Unit specification: statement of standards (cont)

Unit title: Environmental Chemistry

The question paper could be worth 60 marks with an equal weighting on all the knowledge and skills. The pass mark will be 60%.

Outcome 2

Perform experimental techniques applicable to environmental chemistry

Knowledge and/or skills

- ◆ follow instructions to perform a range of chemical experiments
- ◆ work in a safe manner regarding current health and safety regulations
- ◆ achieve consistent and accurate results
- ◆ report the results clearly and concisely
- ◆ practical applications of environmental chemistry
- ◆ identify sources of experimental errors and estimate size of errors as appropriate

Evidence requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ carry out qualitative investigations of inorganic substances following instructions
- ◆ obtain consistent and accurate results
- ◆ record experimental observations and measurements correctly
- ◆ report accurately and concisely on methods and observations
- ◆ analyse results correctly and state valid conclusions

A checklist will be used to record the results of the candidate's practical work on at least two occasions. Candidates must also complete a laboratory diary or pro forma. For two of the experiments carried out the candidate must also produce a laboratory report which demonstrates the candidate's ability to plan and evaluate the laboratory exercise.

It is not necessary to cover all evidence requirements on each occasion, but where a requirement is included in the assessment it must be met. Each of the assessed experiments should represent at least 2 hours' practical work. The assessed experiments should relate to the chemistry of two from air, water or land. The assessment should be based on the candidate's ability to carry out accurate experimental work and on their ability to report the work accurately and to discuss the relationship between the results and the environmental chemistry involved. Some suggested practicals and exercises are given in the support notes.

Assessment guidelines

This Unit lends itself to study by a number of practical experiments. Some of these are suggested in the support notes. If analytical work is being assessed, candidates should be judged on the accuracy of their results as well as their ability to produce a laboratory report. It may be possible to integrate some of the practical work with that required for other Units, for example some of the analyses may be suitable for the assessment of Outcome 2 from Fundamental Chemistry: Theory and Practice

Administrative Information

Unit code:	DP4Y 34
Unit title:	Environmental Chemistry
Superclass category:	QA
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History of Changes:

Version	Description of change	Date
02	Outcome 2: Knowledge and/or skills — bullet point 5 amended to ‘practical applications of environmental chemistry’	1/8/06

Source: SQA

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Higher National Unit specification: support notes

Unit title: Environmental Chemistry

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

Outcome 1

- ◆ Environmental chemistry of water:
 - properties of water, sources and uses of water, the hydrologic cycle, aquatic chemistry, alkalinity and acidity, metal ions in water, water hardness, oxidation and reduction reactions in water, complexation and chelation in water, humic substances, water interaction with other phases, aquatic life, bacteria in water, microbial transformations in water
 - pollution in water, nature and types of water pollution to include elemental pollutants, (metals, organically bound metals), inorganic pollutants (ammonia, cyanide)
 - nutrient pollution in water — algal nutrients and eutrophication
 - acidity, alkalinity and salinity of water. Oxygen, oxidants and reductants in water
 - organic pollutants — sewage, soaps, detergents, pesticides, polychlorinated biphenyls
 - radioactivity as a pollutant in the aquatic environment — sources and extent
 - water treatment and water use including municipal water treatment and treatment of water for industrial use, sewage treatment, industrial wastewater treatment, methods for removal of metals, heavy metals. Treatment to remove dissolved organic pollutants, dissolved inorganic pollutants and sludge treatment
 - disinfection of water — chlorination, ozone treatment

- ◆ Environmental chemistry of land:
 - the geosphere, nature of solids to include minerals, evaporates, volcanic sublimates, igneous and sedimentary rock, sediments and clays
 - geochemistry should include weathering — physical and chemical aspects
 - groundwater in the geosphere, water wells
 - soil and Agricultural chemistry — the nature and importance of soil, water, air and particles in soil, inorganic components of soil, organic matter in soil and acid/base and ion exchange reactions in soil
 - macro and micronutrients in soil
 - fertilisers in soil and wastes and pollutants in soil
 - genetic engineering and agriculture — effects on soil

Higher National Unit specification: support notes (cont)

Unit title: Environmental Chemistry

- ◆ Environmental chemistry of atmosphere:
 - importance of the atmosphere and physical characteristics of the atmosphere including atmospheric composition, variation of pressure and density with altitude, stratification of the atmosphere
 - energy and mass transfer in the atmosphere
 - chemical and photochemical reactions in the atmosphere including photochemical processes, ions and radicals in the atmosphere. Chemical and biochemical processes in evolution of the atmosphere
 - reactions of atmospheric oxygen and reactions of atmospheric nitrogen
 - atmospheric carbon dioxide, atmospheric water and atmospheric particles

Outcome 2

- ◆ Possible practicals include:
 - alkalinity of water
 - hardness of water
 - pH measurement
 - suspended solid
 - tar and oil in water
 - water sampling techniques
 - tar and oil in soil
 - pH of soil
 - metal content in soil
 - air sampling techniques
 - flow calibration
 - dust particles in air
 - barometric pressure

Guidance on the delivery and assessment of this Unit

This Unit is likely to be delivered towards the end of the HNC in Applied Sciences. Candidates looking to progress to the HND Environmental Science will have to choose this Unit and may well be joined by those following the HND Chemistry. Other candidates in year 2 of their HNDs may choose to study this as an option. There is a link between this Unit and the Environmental Sampling and Analysis Unit, so the content and context should be delivered with this in mind. The decision to choose a case study type assessment is aimed at encouraging the candidates to develop their communication skills in a scientific topic.

Higher National Unit specification: support notes (cont)

Unit title: Environmental Chemistry

Open learning

While aspects of Outcome 1 could be delivered by distance learning, the practical nature of Outcome 2 would make this more difficult. Attendance for a laboratory programme would be required.

Candidates with additional support needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on the SQA website **www.sqa.org.uk**.

General information for candidates

Unit title: Environmental Chemistry

This is a 1 credit Unit, which you are likely to study as part of the HND Environmental Sciences or as an option within the HNC Applied Sciences and HND Chemistry. There is strong link between this Unit and the 'Environmental Sampling and Analysis' Unit and it may be best that both be taken as options. Before progressing to this Unit it would be advisable to have completed Fundamental Chemistry: Theory and Practice, where you will have learned some basic chemistry and developed your practical skills.

On completion of the Unit you should be able to:

- 1 Describe and explain the principles of the environmental chemistry of air, water and land.
- 2 Perform experimental techniques applicable to environmental chemistry.

The main components of the Unit content are:

Outcome 1

In this Outcome you will cover the environmental chemistry of the atmosphere, water and soil. In the section on the atmosphere you will focus on the physical and chemical properties including the variation of density with altitude. Photochemical reactions will be covered as well as the chemical and biological evolution of the atmosphere.

For aquatic systems you will cover the structure of water and the hydrologic cycle. Chemical properties of water such as pH, salt content, presence of pollutants etc. will also be covered as will water treatment systems. For land based systems, some geochemistry dealing with rocks, minerals including the different types found will be discussed along with the effect of weathering. There will be an introduction to soil chemistry, covering organic and inorganic components, as well as acid/base and ion exchange reactions. In all 3 areas common environmental pollutants will be discussed.

Outcome 2

In Outcome 2 you will carry out a range of laboratory exercises related to environmental chemistry. Some possible example are pH measurements, metal ion content of soil, suspended particles in water, dust levels in air etc. The practicals carried out will be at the discretion of individual centres.

Assessment

Outcome 1 will be assessed using a number of extended response questions. The case study will be issued prior to the assessment, and the answers will be given under closed-book conditions. Candidates are not allowed to take any information into the exam.

Outcome 2 will require the completion of at least two laboratory exercises, a checklist and laboratory diary or pro forma and the submission of two laboratory reports.