



Higher National Unit specification

General information for centres

Unit title: Monitoring and Analytical Methods for Environmental Science

Unit code: F5T6 35

Unit purpose: This Unit is designed to give candidates an applied knowledge of common environmental science sampling and analytical techniques used in monitoring environmental variables, as well as experience in writing correctly formatted scientific reports. This type of knowledge and practical experience is vital for many careers in fields requiring fieldwork and/or laboratory skills. Focusing on analysis of soil, water, air and vegetation, the Unit will start with issues to be aware of in designing sampling regimes, before moving on to look at how sampling is actually carried out, with practice in carrying out some techniques. Different laboratory techniques are then described, again with practical experience in some techniques. Ways of summarising and describing the results from analysis are explored, and the format and content of standard scientific reports are explained. Following through on a specific example where sampling design, sampling itself and analysis has been carried out, a full scientific report is produced.

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

- 1 Describe the importance of environmental variables, and evaluate the appropriate sampling techniques and sampling regime for those variables.
- 2 Evaluate the appropriate analysis techniques for defined environmental variables.
- 3 Collect and analyse samples.
- 4 Produce a scientific report which includes summary statistics and graphs of environmental data, and an evaluation and interpretation of the results.

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

**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 the centre. However a basic grounding in science, an awareness of environmental issues and land use options would be advantageous. This might be evidenced by the possession of the Units *Chemistry and Physics for the Life Sciences* F21J 34, *Pollution and Waste Management: an Introduction* F2EE 34, *Quality and Health and Safety Systems in Science Industries* DF82 34, *Environmental Science* DF1V 04.

Core Skills: There are opportunities to develop the Core Skills of *Communication, Numeracy* and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

General information for centres (cont)

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: Outcomes 1 and 2 could be assessed together by means of a closed-book test comprising a set of both short and extended response questions. Outcome 3 could be assessed by means of a log book of techniques used. Outcome 4 could be assessed by a correctly formatted scientific report which involves candidates using data from samples collected and analysed.

Higher National Unit specification: statement of standards

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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 the importance of environmental variables, and evaluate the appropriate sampling techniques and sampling regime for those variables

Knowledge and/or Skills

- ◆ Environmental variables and environmental media
- ◆ Factors affecting sampling techniques and sampling regime

Evidence Requirements

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

- ◆ for at least eight environmental variables (at least two each in the media of air, water and soil, vegetation), describe why each variable is of relevance in environmental studies
- ◆ for at least three environmental variables (from three different media), evaluate at least three main factors that are important in defining sampling techniques and sampling regime for those variables, and explain how the sampling techniques and regime can take those factors into account

Assessment Guidelines

This Outcome may be assessed by means of a short-answer closed-book test. Alternatively, the assessment may be combined with the assessment for Outcome 2. See Outcome 2 for details.

Higher National Unit specification: statement of standards (cont)

Unit title: Monitoring and Analytical Methods for Environmental Science

Outcome 2

Evaluate the appropriate analysis techniques for defined environmental variables

Knowledge and/or Skills

- ◆ Environmental variables and analysis techniques

Evidence Requirements

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

- ◆ for at least nine environmental variables (at least two each in the media of air, water and soil, vegetation), identify and evaluate an appropriate analysis technique (either *in situ* analysis or laboratory analysis)

Assessment Guidelines

Outcomes 1 and 2 could be assessed by means of an examination consisting of short answer and extended response questions that could be conducted under closed-book conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Monitoring and Analytical Methods for Environmental Science

Outcome 3

Collect and analyse samples

Knowledge and/or Skills

- ◆ Sampling techniques and sampling regime
- ◆ Analysis procedures

Evidence Requirements

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

- ◆ for at least three environmental variables (no more than one from each media of air, water and soil, vegetation), carry out appropriate sampling techniques within an appropriate sampling regime
- ◆ for at least three environmental variables (from three different media), carry out appropriate analysis procedures (either *in situ* or in the laboratory)

Assessment Guidelines

Outcome 3 could be assessed by means of a log book that each candidate could keep. In this they can record the sampling and analysis procedures they have carried out, including a brief methodology description and critique of possible errors. Candidates may be supplied with a pro forma outline to guide them in completing this log book.

Higher National Unit specification: statement of standards (cont)

Unit title: Monitoring and Analytical Methods for Environmental Science

Outcome 4

Produce a scientific report which includes summary statistics and graphs of environmental data, and an evaluation and interpretation of the results

Knowledge and/or Skills

- ◆ Basic data presentation skills
- ◆ Simple statistical analysis skills
- ◆ Data interpretation skills
- ◆ Scientific report writing skills

Evidence Requirements

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

- ◆ produce basic statistical summaries (at least one Table) from one environmental variable dataset collected in the course of this Unit, including means and measurements of error as appropriate
- ◆ produce basic summary graphs (at least one Figure) from the same environmental variable dataset collected in the course of this Unit, including means and measurements of error as appropriate
- ◆ if appropriate to the data collected, perform a simple statistical comparison to compare two subsets of the dataset (eg pH upstream v downstream of pollution event)
- ◆ interpret the statistical summaries, summary graphs, and simple analysis
- ◆ produce a scientific report which describes the background to the study, the sampling and analysis methods, the results, an interpretation of the results, a conclusions section, and references

Assessment Guidelines

Outcome 4 could be assessed by means of a scientific report, based on data arising from a case-study where the candidate designed the sampling regime, carried out the sampling, analysed the samples, summarised the data, and interpreted the results. This report could be about 1,500 words or equivalent.

Administrative Information

Unit code: F5T6 35

Unit title: Monitoring and Analytical Methods for Environmental Science

Superclass category: QA

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History of changes:

Version	Description of change	Date

Source: SQA

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Higher National Unit specification: support notes

Unit title: Monitoring and Analytical Methods for Environmental Science

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

The intended context for this Unit is within the HND Environmental Management and Sustainability Group Award.

Outcome 1. This Outcome could describe the main media types that are sampled in environmental studies such as water (river, tap, pollution spills), solids (soils, sewage sludge, sediments, vegetation, animal tissue), and air (indoor and outdoor). For these media types, there are attributes that are commonly measured, and a range of these could be described, including their relevance in an environmental context. These attributes may include: For water: pH; acidity; BOD; dissolved oxygen; nitrate content; metal ions content; pesticide content; suspended solids; volatile organic compounds; conductivity. For solids: organic contaminants; trace metals; N-availability; pH. For gases: oxides of nitrogen; oxides of sulphur; volatile organic compounds; photochemical oxidants; particulate matter.

Factors to take into account in sampling, and different approaches that may be adopted may be described, but in all cases the sampling regimes should be clearly linked to the aims of any study, and the appropriateness of different techniques used or discussed should be made clear. Factors to be aware of in sampling include identification of what to sample (eg by determining critical paths of critical groups), timing of samples, direct v indirect sampling; sampling pattern (eg random, grid, stratified); sampling protocols for water, air, soil; sampling protocols at different times after event (eg pollution spill), for different media (varies with, eg water flow, windspeed etc).

Outcome 2. This Outcome could describe the different analysis techniques available for a range of attributes and media. The link between the aims of a study, the media sampled, the samples taken and the analysis technique used should be made clear. Where possible, analysis techniques could be linked to the environmental variables examples used in Outcome 1. Analysis techniques to cover may include: use of basic laboratory meters such as pH, conductivity, BOD, dissolved oxygen; solvent extraction for analysis; gas or liquid chromatography; spectrophotometry; infrared spectrometry.

Outcome 3. Candidates should demonstrate an ability to correctly carry out some of the sampling and analysis techniques described in Outcomes 1 and 2. This may consist of designing a sampling regime in class, going out to a field site and collecting samples, and then analysing those samples in the laboratory (or with field instrumentation if appropriate — *in situ*). This process may be carried out for different media such as air, water, soil or vegetation samples, and more than one attribute may be measured from one set of samples (for example, pH, BOD and nitrate content may be measured from a single set of water samples).

Higher National Unit specification: support notes (cont)

Unit title: Monitoring and Analytical Methods for Environmental Science

Outcome 4. This Outcome could bring together elements from preceding Outcomes, by using data from samples that the candidates themselves have collected and analysed. The data could then be summarised in appropriate fashion, including producing means and some measure of dispersion (such as standard deviations, standard error, 95 % confidence intervals). Data should then be displayed in an appropriate graphical format, for example to show changes over time, or to display means (plus error bars) of different samples together. Simple statistical analysis may be carried out, as appropriate, such as t-tests or linear regression. The results then need to be interpreted in view of the aims of the study and the methodology adopted. The whole study may then be presented by means of a standard scientific report, with sections as follows: Introduction, Aims, Methods, Results, Discussion, Conclusions and References.

Guidance on the delivery and assessment of this Unit

Ideally this Unit should be delivered using a variety of methods and media, including lectures, seminars, fieldwork and laboratory exercises. Site visits would be required for fieldwork, but will also be useful in illustrating concepts and underlining the importance of site-specific issues. The structure adopted may be to take each of the three media (air, water, soil) in turn, and go through the environmental variables, sampling and analysis applicable to the media/variables. Alternatively, the structure could be based around environmental variables, sampling and analysis overall, with examples from the three media used at each stage.

The assessment for Outcomes 1 and 2 could be a closed-book class test with a combination of short answer and extended response questions.

Outcome 3 could be assessed by means of a log book that each candidate could keep. In this they can record the sampling and analysis procedures they have carried out, including a brief methodology description and critique of possible errors. Candidates may be supplied with a pro forma outline to guide them in completing this log book.

Outcome 4 could be assessed by means of a scientific report, about 1,500 words long, based on samples that the students themselves gathered. In this case, the students should have been involved in designing the sampling regime, carrying out the analysis in the laboratory, and then summarising the results via descriptive statistics and graphs.

Opportunities for developing Core Skills

There are opportunities to develop the Core Skills of *Communication*, *Numeracy* and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components. The *Numeracy* Core Skill may be developed in Outcome 4 in the course of data summary and analysis. The *Communication* Core Skill may be developed through compiling reports and test questions, whilst *Problem Solving* may be developed all Outcomes, and in working in groups to perform any group work.

Open learning

This Unit would be partly suitable for delivery on an open (distance) learning basis. The practical aspects of laboratory analysis would, however, require specialist support, and it is recommended that candidates would require organised laboratory sessions to complete the necessary work.

Higher National Unit specification: support notes (cont)

Unit title: Monitoring and Analytical Methods for Environmental Science

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website

www.sqa.org.uk/assessmentarrangements

General information for candidates

Unit title: Monitoring and Analytical Methods for Environmental Science

The ability to carry out environmental monitoring methods is required in many careers, and this Unit aims to provide you with knowledge of a range of common sampling regimes and analysis techniques, including practical experience in carrying out some of them.

On completion of the Unit you should be able to:

- ◆ describe the importance of environmental variables, and evaluate the appropriate sampling techniques and sampling regime for those variables
- ◆ for defined environmental variables, evaluate the appropriate analysis techniques for those variables
- ◆ collect and analyse samples
- ◆ produce a scientific report which includes summary statistics and graphs of environmental data, and an evaluation and interpretation of the results

Environmental media types that will be covered will include water, air and solids (eg soils and vegetation). Sampling regimes will give you knowledge of how to effectively sample from specific media for specific attributes, whilst the analysis techniques will show the relevance of different techniques for different purposes and in different situations. This Unit then goes on to show you how to correctly summarise environmental data, and how to interpret that data in a scientific report format.

You may be assessed by means of an examination consisting of short answer and extended response questions, a log book that can record the sampling and analysis procedures carried out, and by means of a scientific report, based on data arising from a case-study where you design the sampling regime, carry out the sampling, analyse the samples, summarise the data, and interpret the results.

There are opportunities to develop the Core Skills of *Communication*, *Numeracy* and *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.