Unit 5: Informatics for Environmental and Sustainability Industries

Unit code: A/602/6495

QCF Level 3: BTEC National

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to enable learners to develop a knowledge of the types of organisations and the terminology used in the environmental sustainability industry. They will also gain an understanding of informatics when it is applied to environmental sustainability. Learners will develop skills in data collection, storage and analysis.

Unit introduction

Informatics is the scientific study of information, information processing and the use of information for particular scientific applications. Informatics in its broadest sense covers information theory (identifying patterns and trends using mathematics), information science (collection, classification, manipulation, storage, retrieval and dissemination of information) and computer science (the study of the electronic storage, processing and communication of information).

Environmental informatics is the science of information applied to environmental science. As such, it provides the information processing and communication infrastructure to the interdisciplinary field of environmental sciences aiming at data, information and knowledge integration, the application of computational intelligence to environmental data as well as the identification of environmental impacts of information technology.

With regard to the environment, climate change and sustainability, controversy has been generated in the media by the interpretation of different sources of data. Along with this there have been massive advances in science and technology and over the past few decades unprecedented amounts of data have been generated. In the context of the environment and sustainability, it is therefore very important for learners to have good knowledge of the relevant terminology to enable them to identify and distinguish verifiable sources of information. This expansion of information in terms of the environment, climate change and sustainability has resulted in the need for more and more sophisticated databases to store, organise and index the data, and for specialised tools to view and analyse it.

Learners will study the aims and methods of informatics, data storage and the applications of informatics in environmental sustainability. They will also learn about the processes of data collection, warehousing and analysis.

Learning outcomes

On completion of this unit a learner should:

1 Know the types of organisation engaged in environmental sustainability

2 Understand how informatics is used in an environmental and sustainable context

3 Be able to collect scientific data from relevant environmental and sustainable sources

4 Be able to store and analyse scientific data in an environmental and sustainable context.

Unit content

1 Know the types of organisation engaged in environmental sustainability

Terminology in informatics: symbols, representations, formulae, glossary of terms, units of measurement, abbreviations

Types of organisation and committees: eg EU, UK governmental, non-governmental organisations, local authorities, energy industries, manufacturers, the Carbon Trust

2 Understand how informatics is used in an environmental and sustainable context

Aims: to understand how systems work; modelling systems; increasing understanding of basic scientific processes

Methods: representation; storage; organisation; manipulation; distribution and maintenance of data

Sources of data: relevant journals, magazines, libraries, organisation information sources

Applications: hypothesising; predicting; modelling; developing predictive methods to model function

3 Be able to collect scientific data from relevant environmental and sustainable sources

Computational science: computer procedures; process of data interpretation and analysis; use of specialised tools to view and analyse data

Data collection: new approaches to data collection; quality standards for new data sets eg human genome project; using search engines, role of the internet

4 Be able to store and analyse scientific data in an environmental and sustainable context

Data warehousing/databases: data capture; file formats; typical records within files; ease of access to stored data; design of data formats and databases

Data analysis: use of software techniques for finding patterns and regularities in data sets; comparison of data from different sources; queries for finding specific information in databases

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 describe the differences between the main types of organisations engaged in providing environmental sustainability data [IE1]		
P2 explain the methods used in informatics [IE1]		
P3 explain how informatics is used in environmental sustainability [IE1]	**M1** discuss a selected application of informatics in environmental sustainability, including methods used to maintain and manipulate data	**D1** discuss the need to be able to extract specific, relevant data
P4 collect relevant data from environmental and sustainable sources [SM3]	**M2** run queries to obtain specified information from a database	
P5 build an environmental and sustainable database to store scientific data [CT1, 5]		
P6 perform an analysis of the data collected, reporting patterns and regularities in data sets. [IE4]	**M3** explain patterns and regularities in data sets.	**D2** evaluate effectiveness of own database, recommending improvements.

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

This unit can be delivered in conjunction with any of the mathematical units, eg *Unit 11: Using Mathematical Tools in Science*, *Unit 12: Using Statistics for Science* or *Unit 13: Mathematical Calculations for Science* or with any of the practical units in order to contextualise the learning and generate meaningful data in an environmental and sustainable context.

For learning outcome 1, learners could be provided with a list of terms, symbols, formulae, abbreviations and units used in environmental sustainability and asked to confirm or find out the meaning of each. There is a large number of organisations and committees providing information and data in the field of environmental sustainability. Learners could use the internet to gather information about the main types and build up a classification.

Learning outcome 2 lends itself to discussion on the use of and need for informatics in environmental sustainability, especially in terms of climate change and the use of energy/global emissions, and in terms of issues such as recycling and waste management in the UK and the EU. A case study approach could be used that includes different sources of data. Learners would benefit from guided support in exploring the methods used in informatics. There is a wealth of information on the internet. Learners need to understand how databases are used and gain some awareness of the vast amount of information that must be manipulated.

For learning outcome 3, learners should be introduced to methods of data collection and the quality standards associated with them. This session should include the use of internet search engines. Learners will need to collect experimental data for use in learning outcome 4.

For learning outcome 4, the development of appropriate computer skills, especially in the correct use of software, should be encouraged whenever possible. Analysis of experimentally-derived data should also be attempted. A case study approach could be used to unify a number of themes and contextualise the learning. The use of computer teaching programs and CD ROMs would enable learners to do some independent study.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and assessment
Introduction and overview of the unit and how it relates to other units in the programme of study.
Formal session to introduce and reinforce terminology used in environmental sustainability.
Learner activity – researching types of organisations and committees engaged in environmental sustainability.
Assignment 1: Types of Organisations, Committees and Data (P1) Tutor introduces the assignment brief.
Formal sessions on aims, methods and sources of data.
Demonstrations on sources of data and their applications, and informatics websites.
Learner activities – researching sources of data and use of methods in informatics.

Topic and suggested assignments/activities and assessment
Assignment 2: Applications of Informatics in Environmental Sustainability (P2, P3, M1, D1)
Tutor introduces the assignment brief.
Formal session on data collection.
Demonstrations on data collection and the processes involved.
Formative learner activities on data collection.
Assignment 3: Data Collection (P4, P5, M2)
Tutor introduces the assignment brief.
Demonstration on setting up a database.
Formal session on data storage and analysis.
Assignment 4: Environmental Sustainability Database (P6, M3, D2)
Tutor introduces the assignment brief.
Review of unit and assignment programme.

Assessment

Evidence could be provided using experimentally-derived secondary sources of data in case studies, verifiable media sources of data and interpretation exercises. Literature searches and reviews would also be appropriate.

For P1, learners need to know the differences between the main types of organisations engaged in providing environmental sustainability data, eg organisations and committees set up by the UK Government, non-government organisations, university departments, environmental journals, commercial organisations etc. Evidence could be in the form of learners giving seminars/presentations, supported by an assessor's observation record to confirm learners' achievement.

For P2 and P3, learners need to explain the methods and applications of informatics, including the range of sources available. Learners should give reasons and/or evidence to support their explanation. This may be part of a report or instructional booklet/leaflet.

For P4, learners need to collect data themselves from environmental and sustainable sources. The data collected can also be used for P5 and P6, although this isn't essential.

For P5, learners need to build their own environmental and sustainable database using Microsoft Access or similar software. They must consider the aim of the database when designing and formatting fields, and they must populate it with relevant data. Evidence could be presented in a report.

For P6, learners need to perform an analysis of the data collected and report main patterns and regularities in the data sets. This can be combined with other units in order to perform meaningful analyses. Evidence could be presented in a report.

For M1, learners need to choose an environmental sustainability application of informatics and discuss the methods used to maintain and manipulate information. Learners may like to relate this criterion to their area of interest. Evidence could be presented in a booklet or leaflet.

For M2, learners need to interrogate the database to answer specific questions. The questions can be set by the tutor or the learner. Ideally, learners should consider the type of questions that the database needs to answer when designing the database. Evidence could be presented in a report.

For M3, learners need to take their analysis from P6 and explain how patterns and regularities exist. Evidence could be presented as a log and report.

For D1, learners can draw on group debate to discuss the need of many environmental sustainability-based organisations to manipulate large databases to answer specific questions. Evidence could be presented in a booklet or leaflet.

For D2, learners need to evaluate their own database, using reflective skills and experience of researching other databases to suggest improvements for the future. Evidence could be presented as a log and report.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1	Types of Organisations, Committees and Data	You are a careers adviser going to a careers event to promote courses in environmental sustainability.	Presentation. Observation record.
P2, P3, M1, D1	Applications of Informatics in Environmental Sustainability	You are a new lecturer who needs to purchase some materials for your learners.	Booklet/leaflet.
P4, P5, M2	Data Collection	As an environmental science technician you have to record the process of how you collect data.	Report.
P6, M3, D2	Environmental Sustainability Database	You are a recycling consultant who has won a contract to set up a database to store and analyse a specific data set on local authorities.	Log. Report.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Environmental Sustainability sector suite. This unit has particular links with the following units in the BTEC Environmental Sustainability suite:

Level 2	Level 3
Using Mathematical Tools for Science	Mathematical Calculations for Science
	Using Statistics in Science

Essential resources

Learners need access to appropriate computer facilities, software, tutorial support and library resources. The use of computer teaching programs and CD ROM simulations of experiments should be encouraged.

Employer engagement and vocational contexts

The government has set up a number of organisations such as the Carbon Trust, and there are a large number of consultant companies engaged in energy conservation and environmental sustainability. Commercial industrial oil companies are also seeking new ways of reducing fossil fuel usage and university departments are exploring different forms of renewable energies etc.

Input from technicians and scientists working in a range of environmental science and situations would help to make the unit vocationally relevant. Work placements may help put informatics into a environmental sustainability and scientific context. The Science, Technology, Engineering and Mathematics (STEM) Network has developed resources for anyone interested in science. Visit www.stemnet.org.uk for details.

It may also be interesting for learners to see the European Bioinformatics Institute website, www.ebi.ac.uk, to see the types of jobs that exist in this area. The website for jobs in research, science, academic and related professions, www.jobs.ac.uk, advertises positions related to various areas of informatics.

Indicative reading for learners

Textbooks

Gibas C and Jambeck P – *Developing Bioinformatics Computer Skills* (O'Reilly, 2001) ISBN 9781565926646

Jagota A K – *Data Analysis and Classification for Bioinformatics* (Bioinformatics By the Bay, 2000) ISBN 9780970029706

Radford T – *Frontiers: Science and Technology: Book 3* (Atlantic Books, 2003) ISBN 97818435401 75

Websites

Carbon Trust	www.carbontrust.co.uk
Centres for environmental informatics	www.lec.lancs.ac.uk/cei www.sunderland.ac.uk/faculties/apsc/centres/cei
Department for Business, Innovation and Skills	www.bis.gov.uk
Department for Environment, Food and Rural Affairs (Defra)	www.defra.gov.uk
Local Government: Environmental sustainability and climate change	www.idea.gov.uk/idk/core/page.do?pageId=80829
Gas and electricity regulator	www.ofgem.gov.uk

Journal

Journal of Environmental Informatics

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	identifying questions to answer regarding the sources, methods and applications of informatics in environmental and sustainability industries analysing data from the data set, finding patterns and regularities
Creative thinkers	designing and building a database to store data, trying out alternatives when necessary and following through ideas
Self-managers	organising time and resources when collecting data and planning databases.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	supporting conclusions drawn from analysis of data
Creative thinkers	asking questions to extend their thinking, exploring a particular application of informatics related to their area of interest
Reflective learners	inviting feedback on database design, evaluating own work and recommending improvements for the future
Team workers	providing feedback to peers.

Functional skills – Level 2

Skill	When learners are ...
ICT – using ICT	
Plan solutions to complex tasks by analysing the necessary stages	producing an environmental sustainability database
ICT – finding and selecting information	
Use appropriate search techniques to locate and select relevant information	searching databases using software to find trends in data sets
Select information from a variety of sources to meet requirements of a complex task	searching databases using software to find trends in data sets
ICT – developing, presenting and communicating information	
Enter, develop and refine information using appropriate software to meet requirements of a complex task	using ICT to enter and format information when producing a booklet/pamphlet/report
Use appropriate software to meet the requirements of a complex data-handling task	collecting data setting up databases
Combine and present information in ways that are fit for purpose and audience	using ICT to enter and format information when producing a booklet/pamphlet/report
Evaluate the selection, use and effectiveness of ICT tools and facilities used to present information	using ICT to enter and format information when producing a booklet/pamphlet/report
Mathematics – representing	
Identify the situation or problems and identify the mathematical methods needed to solve them	using mathematical methods to find patterns in data sets using mathematical methods to analyse data
Choose from a range of mathematics to find solutions	using mathematical methods to find patterns in data sets using mathematical methods to analyse data
Mathematics – analysing	
Apply a range of mathematics to find solutions	using mathematical methods to find patterns in data sets using mathematical methods to analyse data
Use appropriate checking procedures and evaluate their effectiveness at each stage	running queries to obtain specified information
Mathematics – interpreting	
Draw conclusions and provide mathematical justifications	using justifications to explain patterns and regularities in data sets

Skill	When learners are ...
English – Speaking, Listening and Communication	
Make a range of contributions to discussions in a range of contexts, including those that are unfamiliar, and make effective presentations	discussing the needs and uses of informatics, including in terms of moral, social and ethical issues involved
English – Reading	
Select, read, understand and compare texts and use them to gather information, ideas, arguments and opinions	reading and digesting information from textbooks and computer teaching programs
English – Writing	
Write a range of texts, including extended written documents, communicating information, ideas and opinions, effectively and persuasively	producing a booklet/report on different methods used in informatics.