Unit 9: Informatics for Science

Unit code: J/502/5548

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 and understanding of informatics, the process of data collection and to develop skills in data storage and analysis.

Unit introduction

Informatics is the scientific study of information, information processing and the use of information for particular scientific applications. The massive advances in science and technology over the past few decades have generated an unprecedented amount of data. This expansion of information 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. They will also learn about the processes of data collection, warehousing and analysis.

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). Informatics can refer to a particular discipline, such as medical informatics or bioinformatics.

Learning outcomes

On completion of this unit a learner should:

1 Know how informatics is used in science

2 Be able to collect scientific data

3 Be able to store and analyse scientific data.

Unit content

1 Know how informatics is used in science

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: from biological, chemical, physical science sources, eg amino acid sequences, protein structures, physical and chemical scientific constants, journals, magazines, libraries

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

2 Be able to collect scientific data

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

3 Be able to store and analyse scientific data

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; 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 identify sources of informatics [IE]	**M1** explain a particular application of informatics in science	**D1** discuss the need to be able to extract specific, relevant data
P2 describe the methods used in informatics [IE]		
P3 describe how informatics is used in science [IE]		
P4 describe the process of data collection		
P5 collect data from scientific data sites [SM]	**M2** run queries to obtain specified information from a database	
P6 build a scientific database to store scientific data [CT]	**M3** explain patterns and regularities in data sets.	**D2** evaluate own database and recommend improvements.
P7 perform an analysis of the data, finding patterns and regularities in data sets. [IE]		

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 6: Using Mathematical Tools for Science*, *Unit 7: Mathematical Calculations for Science* or *Unit 8: Statistics for Science* or with any of the practical units in order to contextualise the learning and generate meaningful data.

Learning outcome 1 lends itself to some discussion on the use of and need for informatics in science, especially in terms of moral, social and ethical issues, eg curing diseases or producing sufficient food to feed the world. Learners would benefit from closely 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.

In learning outcome 2, learners should be introduced to methods of data collection and the quality standards associated with this. This session should include the use of internet search engines. Learners will need to collect experimental data for use in learning outcome 3.

For learning outcome 3, 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 to unit including hardware and software available.
Learning outcome 1 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.
Assignment 1 – Applications of Scientific Informatics (P1, P2, P3, M1, D1)
Learning outcome 2 Formal session on data collection.
Demonstrations on data collection and the processes involved.
Formative learner activities on data collection.
Assignment 2 – Data Collection (P4, P5, M2)
Learning outcome 3 Demonstration on setting up a database.
Formal session on data storage and analysis.
Assignment 3 – Scientific Database (P6, P7, M3, D2)
Review of unit and assignment programme.

Assessment

To enable learners to generate the required evidence, the unit should be adapted to suit the resources within a centre and the endorsed title being followed by the learner. Evidence could be provided by use of experimentally-derived data in case studies and interpretation exercises. Literature searches and reviews would also be appropriate.

All the pass criteria must be met in order for a learner to achieve this unit.

For P1, P2 and P3, learners must demonstrate their knowledge of the need for and uses of informatics, including the range of sources available. This may be part of a written report or instructional leaflet.

For P4 and P5, learners must show their knowledge of the data collection process before attempting to collect data themselves. The data collected can also be used for P6 and P7, although this isn't essential.

For P6 and P7, learners must build their own 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. This can be combined with other units in order to perform meaningful analyses.

For a merit grade, all the pass grade criteria and all the merit grade criteria must be met.

For M1, learners need to choose a particular application of informatics and should go into detail to explain the methods used to maintain and manipulate information. Learners may like to relate this criteria to their area of interest.

For M2, learners must 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.

For M3, learners need to take their analysis from P7 and explain how patterns and regularities exist.

For a distinction grade, all the pass, merit and distinction grade criteria must be met.

For D1, learners can draw on group discussions to explain the need of many science-based organisations to manipulate large databases to answer specific science-based questions. This may be through case studies, as learners must give examples relevant to the endorsed title they are following.

For D2, learners need to evaluate their own database, using reflective skills and experience of researching other databases to suggest improvements for the future.

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, P2, P3, M1, D1	Applications of Scientific Informatics	A new science teacher is purchasing some teaching materials for his/her learners.	Booklet/pamphlet.
P4, P5, M2	Data Collection	A science technician has been asked to record the process of how he/she collects data.	Report.
P6, P7, M3, D2	Scientific Database	A science consultant has won a contract to set up a database to store and analyse a specific data set.	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 in Applied Science sector suite. This unit has particular links with other units shown below in the BTEC Applied Science suite of qualifications:

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

Essential resources

Learners will 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

Ideally, input from technicians and scientists working in a range of laboratory situations would help to make the unit vocationally relevant. Work placements may help put informatics into a scientific context. The network for science, technology, engineering and maths (STEM) have developed resources for anyone interested in science. Visit **www.stemnet.org.uk** for details.

It may also be interesting to use websites such as the European Bioinformatics Institute **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

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	[IE1] identifying questions to answer regarding the sources, methods and applications of informatics in science [IE4] analysing data from the data set, finding patterns and regularities
Creative thinkers	[CT1,5] designing and building a database to store scientific data, trying out alternatives when necessary and following through ideas
Self-managers	[SM3] organising time and resources when collecting data and planning database.

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	[IE6] supporting conclusions drawn from analysis of data
Creative thinkers	[CT2] asking questions to extend their thinking, exploring a particular application of informatics related to their area of interest
Reflective learners	[RL4,5] inviting feedback on database design, evaluating own work and recommending improvements for the future
Team workers	[TW6] providing feedback to peers.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	searching databases for, eg amino acid sequences of particular genes or physical and chemical constants using software to find trends in data sets
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	using ICT to enter and format information when producing a booklet/pamphlet/report
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	
Evaluate the selection and use of ICT tools and facilities used to present information	
Mathematics	
Identify the situation or problem and the mathematical methods needed to tackle it	using mathematical methods to find patterns in data sets using mathematical methods to analyse data
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	running queries to obtain specified information
Draw conclusions and provide mathematical justifications	using justifications to explain patterns and regularities in data sets
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	discussing the needs and uses of informatics, including in terms of moral, social and ethical issues involved
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reading and digesting information from textbooks and computer teaching programs
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing a booklet/report on different methods used in informatics.