

# Unit 16: Understanding Aquatic Ecosystems

**Unit code:** Y/600/9218

**QCF Level 3:** BTEC National

**Credit value:** 10

**Guided learning hours:** 60

## ● Aim and purpose

This unit aims to introduce learners to aquatic ecosystems skills and understanding and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

## ● Unit introduction

Aquatic ecosystems are widely recognised as pressurised and threatened and in need of management and protection. How they are managed is very much at the forefront of scientists' minds as the demands on sport fishing, fisheries and marine fishing waters increases. A key role of scientists, ecologists and industry workers is managing these vital resources.

In this unit, learners will develop an understanding of the key ideas and principles in this area so that they can enter the industry and help support a wide variety of organisations trying to maintain inland aquatic and marine systems and native species, develop sustainable ecosystems and manage the impact of human activity.

There are a large number of opportunities for practical field work within this unit which can give learners a real insight into the wide variety of ecosystems that exist in this area. A number of common surveying techniques are covered in detail as well as the biology of these habitats. Learners may also have the chance to work along side a marine biologist, surveying team or fisheries worker to gain experience of how ecosystems are surveyed and managed. The unit can be very practically based and provides a good opportunity for learners to complete a work placement within the marine ecology or fisheries industries.

The skills developed in this unit can be applied to other land -based sectors as many surveying and management techniques are quite similar. The unit also covers the biology of living things in these habitats and basic biological principles.

## ● Learning outcomes

**On completion of this unit a learner should:**

- 1 Understand basic ecological principles
- 2 Know the fundamental dynamics of freshwater ecosystems
- 3 Understand the fundamental dynamics of marine ecosystems
- 4 Be able to survey aquatic populations and environments.

# Unit content

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## 1 Understand basic ecological principles

*Ecological principles:* nutrient cycles eg nitrogen, carbon, phosphorus, oxygen; food chains; food webs; pyramids of number and biomass; energy movement in the food chain (waste, respiration, decay); predator/prey relationships eg cycling; effects of biotic and abiotic factors on productivity within an ecosystem eg competition, substrate type.

## 2 Know the fundamental dynamics of freshwater ecosystems

*Freshwater ecosystems:* identification of freshwater aquatic plants, invertebrates and fish species and their preferred requirements and habitats; physical characteristics for a habitat including temperature, dissolved oxygen, pH, nutrient levels, pollution, suspended solids and light levels.

## 3 Understand the fundamental dynamics of marine ecosystems

*Marine ecosystems:* identification of marine plants, invertebrates and fish species and their preferred requirements and habitats; zonation in marine habitats; biotic and abiotic reasons for organism zonation; adaptations of flora and fauna to marine and estuarine conditions; physical characteristics for a habitat including temperature, dissolved oxygen, pH, nutrient levels, pollution, suspended solids, salinity, wave action and light levels.

## 4 Be able to survey aquatic populations and environments

*Methods used to survey aquatic populations and environments:* methods used to sample water and survey physical features of water bodies; methods used to measure basic water chemistry eg dissolved oxygen, pH, suspended solids; methods used to survey aquatic plants, micro-organisms, invertebrates and fish; methods used to analyse collected data from aquatic environments; use of biotic indices, physical and chemical analysis to identify the status of aquatic ecosystems; health and safety; current legislation; animal and plant welfare

## 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.

<b>Assessment and grading criteria</b>		
<b>To achieve a pass grade the evidence must show that the learner is able to:</b>	<b>To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:</b>	<b>To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:</b>
<b>P1</b> explain how the essential nutrients cycle through a given aquatic ecosystem [IE]	<b>M1</b> describe current threats to marine nutrient cycling.	<b>D1</b> evaluate the impact of an organism on the nutrient levels in a habitat
<b>P2</b> explain how energy flows through a given aquatic ecosystem		
<b>P3</b> discuss predator/prey relationships in a given aquatic ecosystem		
<b>P4</b> describe the physical characteristics of a given aquatic ecosystem	<b>M2</b> use equipment to measure and record physical characteristics of a site safely and correctly	
<b>P5</b> identify and describe the flora and fauna of a given aquatic ecosystem		
<b>P6</b> explain zonation of the marine environment	<b>M3</b> discuss the factors that affect shoreline zonation of organisms	<b>D2</b> compare different methods of surveying aquatic ecosystems.
<b>P7</b> assess the physical characteristics of a given marine ecosystem [RL]		
<b>P8</b> analyse the flora and fauna of a given marine ecosystem		
<b>P9</b> plan a survey for a given aquatic ecosystem	<b>M4</b> evaluate the surveying methods used for a given aquatic ecosystem.	
<b>P10</b> carry out a survey for a given aquatic ecosystem [TW, SM, EP]		
<b>P11</b> analyse survey results		
<b>P12</b> report on the condition of a given aquatic ecosystem.		

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

<b>Key</b>	IE – independent enquirers CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators
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# **Essential guidance for tutors**

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## **Delivery**

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to work experience placements.

Unless the centre is located near a freshwater or marine habitat, much of the unit delivery will involve site visits, guest speakers and work placements. However, aspects can be delivered using a wide range of techniques including lectures, discussions, seminar presentations, supervised aquatic biology practical sessions and research using the internet and/or library resources. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors are made aware of the requirements of this unit before any work-related activities are undertaken so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to use fish capture methods and they should ask for observation records and/or witness statements to be provided as evidence of this. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Guest speakers would be useful in providing background information on legal requirements and health and safety considerations when surveying an aquatic ecosystem. It may also be possible for surveys to be carried out with other local organisations who might provide equipment, support and a site to survey at little or no cost.

Whichever delivery methods are used, it is essential that tutors stress the importance of animal welfare, sound environmental management and the need to manage the resource using legal methods. Health and safety issues relating to working in and around water must be stressed and reinforced regularly, and risk assessments must be undertaken before any practical activities.

Learning outcome 1 is likely to be delivered through formal lectures, discussions, practicals, presentations and independent learner research. Learners will become aware of a range of ecological principles in the context of the aquatic environments covered in other learning outcomes. Visiting expert speakers could add to the relevance of the subject for learners. For example, a sport fishery manager or Environment Agency fisheries or ecological appraisal officer could talk about their work, the situations they face and the methods they use.

Learning outcome 2 covers freshwater ecosystems such as streams, rivers and lakes and the identification of a range of species found in these environments. It would be expected that formal lectures, discussions, supervised practicals and site visits would form part of the delivery. Visiting expert speakers could add to the relevance of the subject for learners. Health and safety issues must be addressed before learners visit any freshwater habitats. Suitable training and guidance must be given before learners attempt to measure physical site characteristics. Adequate personal protective equipment (PPE) must be provided and used following the production of suitable risk assessments.

Learning outcome 3 considers the species typically found in marine and estuarine ecosystems. Delivery techniques should be varied and can be linked to delivery of learning outcome 2. It would be expected that formal lectures, discussions, supervised marine and estuarine site visits and practicals would form part of the delivery. Visiting expert speakers could add to the relevance of the subject for learners. For example, a marine biologist or conservationist could talk about their work and the methods they use. Again health and safety is paramount and the same considerations apply as for learning outcome 2.

Learning outcome 4 addresses the methods commonly used to survey the physical, chemical and biological characteristics of aquatic ecosystems. Delivery techniques can be linked to delivery of learning outcomes 2 and 3, but learners should plan, survey and report back on a specified aquatic habitat. It would be expected

that formal lectures, demonstrations, practicals and site visits would form part of the delivery. Alternatively, learning outcomes 2, 3 and 4 may be covered on a work placement at a company, charity or other organisation.

## 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 gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview to the unit.
<b>Assignment 1: Ecological Principles</b> (P1, P2, P3, M1, D1) Introduction assignment. Research and formal lectures on biological principles.
<b>Assignment 2: Freshwater Aquatic Ecosystems</b> (P4, P5, M2) Introduction assignment. Guided site visits, lectures, research, supervised practical work, work placement.
<b>Assignment 3: Marine Aquatic Ecosystems</b> (P6, P7, P8, M3) Introduction assignment. Guided site visits, lectures, research, supervised practical work, work placement.
<b>Assignment 4: Estimating Plant or Animal Populations</b> (P9, P10, P11, P12, M4, D2) Introduction to the assignment. Work placements, guest speakers, site visits, demonstrations, supervised practical, internet research, library research, demonstrations and lectures.
Unit review.

## Assessment

For P1, learners must explain how nutrients are cycled through an aquatic ecosystem. Evidence can be in the form of an information booklet, presentation, PowerPoint, series of annotated diagrams or seminar.

P2 involves looking at energy flow in an aquatic ecosystem and evidence can be presented in a similar manner as for P1.

For P3, learners should discuss predator-prey relationships, for example involving mammals, birds, fish and invertebrates. Evidence can be in the form of a set of detailed notes, a presentation, leaflet, poster, or observed role play.

P4 requires learners to describe physical characteristics of a freshwater aquatic ecosystem, such as area, depth profiles, flow regimes, geology and morphology. Evidence can come from notes, presentations and observations of practical work with supporting witness statements or photographic evidence of results.

P5 involves the identification and description of the flora and fauna of a freshwater system. Learners could produce a presentation, booklet, annotated poster, classification key, guide for fisheries owners or a web page.

P6 requires learners to have studied plant and animal zonation in a marine environment. Evidence could take the form of a series of diagrams, field study notes and photographs or an annotated series of photographs/diagrams showing the zonation at each level.

P7 and P8 can be assessed in a similar way as for P4 and P5 but must focus on the marine environment.

For P9, learners must show that they can plan a survey for an aquatic ecosystem correctly. This can be assessed by the tutor, a work placement supervisor or guest speaker. Evidence can be provided from a range of activities listed in the delivery section. Witness statements, a presentation, production of a surveying sheet that can be used by others or a report on how to survey a specific location can form the basis of the evidence.

For P10, learners must be able to carry out the survey they prepared for P9. Evidence can be provided from a range of activities listed in the delivery section. A work diary, annotated photographic diary, witness statements or observation records form the basis of the evidence. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

P11 requires learners to analyse results, perhaps those produced for P10, and should involve analysis of graphs to best show data from the survey, production of statistics on the species found and comparison of data from surveys of similar sites.

Evidence for P12 can be a report on the site used in P9, P10 and P11. The report should describe the status of the ecosystem surveyed and address any identified issues. Evidence could also be in the form of a presentation or report to the land owner or government agency.

M1 requires learners to describe current threats to nutrient cycling. Evidence could be in the form of an internet research project with supporting notes, a presentation, leaflet, poster or climate change/marine conservation campaign web page. M3 can also be assessed in a similar way.

M2 involves setting up and using equipment to survey an aquatic ecosystem. Evidence can be in the form of witness statements, observation records, learner diary, an annotated photographic diary or even a film/documentary about the site.

For M4, learners must evaluate the different surveying techniques that are used in aquatic ecosystems. If possible, evidence could be in the form of a site visit with notes where learners have observed these techniques in the field, and research notes.

For D1, learners should evaluate the impact of an organism on the nutrient levels in a habitat, for example, the effect of carp in a lake or pond. This could be assessed along with P6 during site visits. Evidence can also be in the form of notes, a presentation, PowerPoint presentation or newspaper/journal article.

D2 requires learners to compare different surveying methods which can be applied in aquatic and marine environments. Learners should build on information gathered during P9 and M4 to discuss the effectiveness of these methods of surveying, their respective advantages and disadvantages and discuss the reliability of the results gained from each method.

## **Programme of suggested assignments**

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance only 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
	Ecological Principles	You have recently been employed by a local charity that maintains a number of aquatic ecosystem-related reserves as a tour guide. Your first task is to prepare an introductory presentation on aquatic ecology for a volunteer group.	Presentation, notes, research.
P4, P5, M2	Freshwater Aquatic Ecosystems	A primary school will be visiting your reserve and wants to do some simple sampling. Prepare a guide sheet and classification key for their visit.	Producing a key, guide sheets, notes, observation records.
P6, P7, P8, M3	Marine Aquatic Ecosystems	You have been asked to visit another reserve which is part of the same organisation. You have been asked to complete a diary, take photographs and write notes on how the marine reserve is managed compared to your local freshwater reserve.	Diary, notes, presentation, report.
P9, P10, P11, P12, M4, D2	Estimating Plant or Animal Populations	You have been asked to run an event at the reserve. Scientists from around the country will be visiting to look at data that you have collected and discuss the importance of the reserve. You must plan and carry out a survey as well as presenting your findings.	Presentation, notes, data, booklet, graphs.

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

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Introduction to Aquatic Ecology	Understanding Water Quality
	Understanding Water Pollution Control and Management

## Essential resources

Learners will need access to a range of aquatic ecosystems. This should include access to marine (for example, rocky shore) and estuarine ecosystems; aquariums could be used to augment learning. Access to a running freshwater ecosystem is also required so that, for example, a kick sample for aquatic invertebrate sampling can be taken.

For fieldwork, data may be recorded on waterproof notepads. Other equipment required will include invertebrate sampling nets, sample bottles, basic water test equipment, an oxygen meter, equipment for identifying plants, invertebrates and fish and suitable identification keys.

An appropriate first aid kit should be carried and appropriate PPE, such as waterproof clothing and boots, should be used. Lifejackets and throw ropes will also be needed for working in and around water following a suitable risk assessment.

Tutors delivering this unit must be experienced in the assessment of water quality and aquatic environments.

## Employer engagement and vocational contexts

Learners would benefit from having access to a working environment. Often this can be achieved by creating links with local businesses or charitable organisations that may even benefit from taking on learners. Local authorities can be a useful source of information as can business education alliances. Charitable organisations can often provide guest speakers to give lectures as well as demonstrations.

## Indicative reading for learners

### Textbooks

Barnes R and Mann K – *Fundamentals of Aquatic Ecology*, 2nd Edition (Blackwell Science, 1991)  
ISBN 0632029838

Croft P – *Key to the Major Groups of British Freshwater Invertebrate Animals* (Field Studies Council, 1986)  
ISBN 1851531815

Gibson R, Hextall B and Rogers A – *Photographic Guide to Sea and Shore Life of Britain and North-west Europe* (Oxford University Press, 2001) ISBN 0198507097

Jeffries M and Mills D – *Freshwater Ecology: Principles and Applications* (John Wiley and Sons, 1996)  
ISBN 0471946958

Miller P and Nicholls J – *Handguide to the Fishes of Britain and Europe* (HarperCollins Publishers, 1980)  
ISBN 0002197510

Olsen L-H, Pedersen B and Sunesen J – *Small Freshwater Creatures* (Oxford University Press, 2001)  
ISBN 0198507984

Templeton R – *Freshwater Fisheries Management*, 2nd Edition (Blackwell Science, 1995) ISBN 085238209X

### Journals

*Journal of Applied Ecology* (Blackwell Science)

*Journal of Fisheries Ecology and Management* (Blackwell Science)

*Journal of Marine Ecology* (Blackwell Science)

### Websites

[www.ceh.ac.uk](http://www.ceh.ac.uk)

Centre for Ecology and Hydrology

[www.cefas.co.uk](http://www.cefas.co.uk)

Centre for Environment Fisheries & Aquaculture Science

[www.defra.gov.uk](http://www.defra.gov.uk)

Department for Environment, Food and Rural Affairs

[www.environment-agency.gov.uk](http://www.environment-agency.gov.uk)

Environment Agency

[www.fishbase.org](http://www.fishbase.org)

FishBase

[www.hse.gov.uk](http://www.hse.gov.uk)

Health and Safety Executive

[www.lantra.co.uk](http://www.lantra.co.uk)

Sector Skills Council for Environment and Land-based Industries

## Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

<b>Skill</b>	<b>When learners are ...</b>
<b>Independent enquirers</b>	carrying out internet and library research
<b>Reflective learners</b>	assessing own work and improving their skills
<b>Team workers</b>	completing surveying activities
<b>Self-managers</b>	completing tasks on time, meeting targets for assessments
<b>Effective participants</b>	completing group surveys.

Although PLTS opportunities 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.

<b>Skill</b>	<b>When learners are ...</b>
<b>Independent enquirers</b>	carrying out research
<b>Creative thinkers</b>	applying techniques studied to the working environment
<b>Reflective learners</b>	suggesting improvements to techniques and sites
<b>Team workers</b>	practising techniques
<b>Self-managers</b>	producing written work on time
<b>Effective participants</b>	participating in team activities.

## ● Functional Skills – Level 2

Skill	When learners are ...
<b>ICT – Use ICT systems</b>	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	carrying out various research activities
<b>ICT – Find and select information</b>	
Select and use a variety of sources of information independently for a complex task	carrying out research
<b>ICT – Develop, present and communicate information</b>	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> <li>• text and tables</li> <li>• images</li> <li>• numbers</li> <li>• records</li> </ul>	analysing data
Bring together information to suit content and purpose	analysing data
Present information in ways that are fit for purpose and audience	analysing data
<b>Mathematics</b>	
Select and apply a range of skills to find solutions	interpreting data
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	analysing data
Draw conclusions and provide mathematical justifications	analysing data
<b>English</b>	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	producing presentations, video, blogs, group presentations.
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reading information as part of internet and library research
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	completing reports, diaries and other assessments.