Unit 8: Understanding Marine Aquarium Systems

Unit code: Y/601/2099

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to introduce learners to the marine aquaria skills and knowledge 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

The welfare of animals is now more important than it has been. Fish and invertebrates are not exempt from animal welfare legislation. This unit looks at all aspects of marine life and systems in order to provide specialist knowledge for learners. It aims to provide learners with knowledge and practical skills required to maintain an environment for marine fish, aquatic invertebrates and plants kept in captivity and to identify and recommend species which can be housed together.

Learners will explore the requirements of fish, aquatic invertebrates and plants kept in marine aquaria, and what must be done in order to maintain a healthy environment for them. They will cover concepts of mixed fish displays and themed displays. Learners will explore the sources of fish, aquatic invertebrates and plants and the concept of sustainable resources.

Learners will research the equipment and materials used in the aquatics industry, providing knowledge about the components used in single and multi-tank systems and examines the animal health and welfare legislation relevant to those working in the aquatics industry.

Learning outcomes

On completion of this unit a learner should:

1 Know the requirements of aquatic organisms kept in marine aquaria

2 Understand the suitability of species to be kept in marine aquaria

3 Understand the principles of life support equipment used in marine aquaria

4 Understand the major current legislation relating to the aquatics industry

5 Be able to set up, maintain and evaluate marine aquaria.

Unit content

1 Know the requirements of aquatic organisms kept in marine aquaria

Water quality factors: temperature, oxygen, ammonia, nitrite, nitrate, phosphate, carbon dioxide, salinity, flow rates, stocking density,

Nutrition: types of foods – dry and wet, commercial and natural foodstuffs, presentation of food, frequency of feeding, specialist feeders

Marine species: Invertebrates: corals – soft and hard; coelenterates, echinoderms, cnidaria, annelid, crustacea; fish

Health: absence of pathogens; health and disease status

Environmental enrichment: to stimulate reproduction; requirements for normal behaviour, growth, health, reproduction and propagation

2 Understand the suitability of species to be kept in marine aquaria

Characteristics of organisms kept in aquaria: Compatibility, shoaling species, free swimming, benthic, carnivore, omnivore, and herbivore

Aquarium types: themed aquaria and the species kept in them; community tanks and suitable organisms; touch pools, kriesels

Sources of aquarium stock; wild caught, sustainable sources, captive bred;

Health and safety: risk assessment; animal welfare issues; relevant current legislation and codes of practice

3 Understand the principles of life support equipment used in marine aquaria

Types of aquaria; materials used to make aquaria, eg glass, acrylic;

Light: lighting components; light intensities and emission spectra;

Salt: salt mixes and manufacture and natural sea water

Air: air pumps, blowers and compressors

Filtration: individual and centralised filtration systems: internal and external filters, power filters – air driven and pump driven and wet/dry filters, trickle towers, protein skimmers, fluidised sand beds, UV sterilisation, modular systems, carbon filters, algae scrubbers, biological, chemical and mechanical; calcium reactors

Heating: heating systems – heater/thermostats, heat exchangers, chilling systems – refrigeration units;

Substrate: real and artificial substrates and decoration;

Specialist equipment: redox monitors and controllers, ozonisers, carbon dioxide dosing systems, wave machines

Health and safety: risk assessment; use of personal protective equipment (PPE)

4 Understand the major current legislation relating to the aquatics industry

Health and welfare legislation: Animal welfare act, Zoo licence act, Pet shop act, and codes of practice relating to collecting, transportation, keeping and display of aquatic organisms;

Rare and endangered species (Convention on International Trade in Endangered Species [CITES]); dangerous species; relevant current human health and safety legislation and codes of practice, eg Health and safety at Work Act 1974, Sale of Goods Act 1979; risk assessment; keeping of stock and systems record keeping; use of display labels

5 Be able to set up, maintain and evaluate marine aquaria

Skills and techniques: required to produce a viable aquarium effectively eg where to place heater and thermostat, filter, lighting equipment, tank décor and selection of inhabitants.

Water testing: how to test, what to test, frequency of testing and interpretation of results.

Recording evidence: eg diary, logbook, portfolio, video, audio, observation record, witness testimony, feedback sheets

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 water parameters required for given marine organisms [IE, SM]		
P2 describe the factors which can influence a given marine organisms behaviour [IE, SM]		
P3 discuss nutritional requirements for commonly kept marine species [IE, SM]		**D1** discuss the effects of delivery of foodstuffs on marine organisms health status
P4 explain the characteristics required of marine organisms for use in a mixed species aquarium [IE, EP, SM]	**M1** describe methods of propagating soft corals	
P5 evaluate sustainable collecting of marine organisms [IE, EP, SM]	**M2** discuss the effects of collecting wild caught aquatic organisms on the environment	
P6 explain the functions of the life support equipment required for a marine aquarium [CT, IE, SM, EP]		
P7 evaluate different salt mixes available for marine systems. [CT, IE, SM, EP]		
P8 discuss the use of ozone in life support systems [CT, IE, SM, EP]		**D2** evaluate the use of ozone in marine aquaria.
P9 analyse light requirements for a given marine aquarium [IE, RL,EP]	**M3** evaluate solid state lighting on a marine aquarium.	

P10	explain how health and safety requirement are satisfied for a given marine aquarium [IE, SM,EP]		
P11	discuss the impact of the Zoo Licence Act on public aquaria [IE, SM,EP]		
P12	produce a husbandry advice sheets for given marine organisms [IE, SM,EP]		
P13	select and set up equipment and aquatic animal and plant species for marine aquaria [TW, SM]		
P14	monitor and maintain marine aquaria for a given period [TW, SM]		
P15	evaluate aquatic species health and welfare and equipment in relation to the aquaria maintained. [IE, RL,EP]		

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.

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

Essential guidance for tutors

Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to different marine aquaria and retail outlets to look at different life support systems and will have links to industrial experience placements. It can be delivered either as a stand alone unit or in conjunction with Aquarium systems 1 – freshwater systems

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised practicals, research using internet and library resources and the use of personal and industrial experience would all be suitable. Delivery should stimulate, motivate, educate and inspire 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 were made aware of the requirements of this unit prior to any work-related activities so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to establish and maintain aquaria and to produce display labels and information sheets, and they should be encouraged to ask for observation records and 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.

Whichever delivery methods are used, it is essential that tutors stress the importance of animal welfare, sound environment 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 regularly reinforced, and risk assessments must be undertaken prior to practical activities.

Tutors should consider integrating the delivery, private study and assessment of this unit with any other relevant units and assessment instruments learners may be taking as part of their programme of study.

All learning outcomes are directly linked. They cover the knowledge required for the successful keeping of aquatic organisms. They are likely to be delivered by formal lectures, discussion, site visits, practical sessions, independent learner research and by guest speakers from the retail aquatics trade, public aquaria and government agencies. Learners will become aware that aquatic organisms require different conditions and have different triggers for breeding. Zoo licence inspectors would be able to talk about the inspection process and the benefits of legislation. Speakers from public aquaria could explain, for example, the concepts of environmental enrichment and the effects of zoo licence inspections on their livestock and facilities. Speakers from the retail trade would be able to explain how the animal welfare legislation has affected them. Health and safety issues and risk assessments must be carried out for all activities.

Learning outcome 3 covers the equipment commonly used in domestic, retail and public aquaria. It is likely to be delivered by formal lecture, discussion, site visits to retail outlets and public aquaria, practical sessions, independent research by learners and by guest speakers. Visits to public aquaria and importers/wholesalers will enhance the learning experience and help learners to observe the specialist equipment and materials used in the industry.

Learning outcome 5 is purely practical based and could be incorporated into delivery of outcomes 1 – 4.

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 to module.
Water quality factors.
Nutrition.
Marine species.
Health and Environmental enrichment and propagation.
Assignment 1: Water Quality Factors and their Effects on Marine Organisms (P1, P2, P7, P14, P15)
Introduction by tutor.
Self directed time/research for assignment and assignment writing.
Practical time for assessment.
Assignment 2: Food Requirements and Feeding of Marine Fish and Invertebrates (P3, D1)
Introduction by tutor.
Self directed time/research for assignment and assignment writing.
Characteristics of organisms.
Aquarium types.
Assignment 3: The Reef Aquarium (P4, P6, P9, P10, P13, M3)
Introduction by tutor.
Self directed time/research for assignment and assignment writing.
Sources of Aquarium stock.
Assignment 4: Sourcing of Livestock (P5, P12, M1, M2)
Introduction by tutor.
Self directed time/research for assignment and assignment writing.
Health and Safety.
Types of Aquaria.
Light and Air.
Filtration.
Assignment 5: Ozone (P8, D2)
Introduction by tutor.
Self directed time/research for assignment and assignment writing.
Heating.
Substrates and specialist equipment.
Health and welfare legislation.
Assignment 6: Legislation (P11, P12)
Introduction by tutor.
Self directed time/research for assignment and assignment writing.

Topic and suggested assignments/activities and/assessment
Rare and Endangered species and dangerous species.
Record keeping.
Practical work: Producing a viable aquarium.
Practical work: water testing.
Practical work: Recording logbook/diary.
Unit review.

Assessment

For P1 learners are required to describe the water parameters for a given marine organisms. This can be in the form of a table and should cover the parameters indicated in the unit content. This could be used as part of the assessment of P14. Where possible the species should be the same for all learners.

For P2 learners are required to discuss the factors which affect behaviour of marine organisms. It should include feeding strategies as well as environmental parameters This could be in the form of a group discussion, group presentation or a written exercise.

P3 looks at the nutritional requirements for commonly kept marine species. Again assessment could be in the form of a written exercise, group discussion, or practical assessment. This could be part of the assessment for P1.

P4 requires the learner to list the characteristics required in marine species for use in a mixed species aquarium. Evidence could be in the form of a written exercise, group discussion or presentation and could be part of the assessment for P5 and P13.

P5 requires the learner to evaluate sustainable collecting of marine organisms. This could be part of the assessment for P4 and P13. Evidence could in the form of a written exercise of as a group presentation.

For P6 the learner is required to explain the functions of life support equipment. This must include all the essential equipment required for a marine aquarium. Evidence could be in the form of a pictorial presentation or as a written exercise and can be part of the assessment for P8 and P9.

P7 requires the learners to evaluate different salt mixes available for marine systems. Evidence for this could be in the form of a practical exercise, group discussion or written exercise.

P8 requires the learner to discuss the use of ozone in life support systems. It can be part of the assessment of P6 and P10.

P9 looks at the light requirements for a given marine aquarium. Light spectrum, photoperiod and light intensity should be discussed, as well as equipment to provide this. Evidence could be in the form of a written exercise or group presentations and could be part of the exercise for P6.

P10 looks at how health and safety requirements are satisfied for a given marine aquarium. This could be part of the assessment for P6 and P8.

P11 looks at the Zoo licence Act and its impact on public aquaria. This could be assessed as a written exercise or a presentation. Evidence could also be acquired from a suitable work placement.

P12 requires the learner to produce husbandry advice sheets for given marine species. As a minimum, a fish, a coral and another marine invertebrate should be covered.

P13 requires the learner to select and set up a marine aquarium. Evidence for this could be acquired during the delivery of learning outcome 2. This is a practical exercise and should be assessed during a group or individual activity

Like wise P14 requires learners to monitor, and maintain a marine aquarium over time. The evidence for this could be in the form of a logbook or observation over a period of time. Assessment should begin after learning outcome 1 has been delivered

P15 requires learner to judge how effective a species is being maintained in an aquarium. Evidence for this could be in the form of a group discussion, and be based on observations of the aquatic species for a period of time. Evidence could be based on a visit to an aquarium or retail outlet.

M1 requires the learners to describe methods of propagating soft corals. Evidence for this could be in the form of a written assignment, a presentation or as a practical exercise.

M2 requires the learner to discuss the effects of collecting wild caught aquatic organisms on the environment. The learner should explain the effects of the different methods of capture and their impact on the marine environment. Evidence for this could be in the form of a written assignment, a presentation or a group discussion.

M3 requires the learner to evaluate solid state lighting. Evidence should include efficiency, light intensity, power requirements of the different systems. Evidence for this could be in the form of a written assignment, a presentation or a group discussion.

D1 requires the learner discuss the effects of delivery of food stuffs on marine organisms health status. It should include discussion on frequency of feeding, vitamin deficiencies, and essential amino acids. Use of live foods – in particular Artemia sp. nauplii and the need to feed them with essential amino acids. Evidence could be in the form of a written assignment or a group discussion or oral presentation.

D2 requires learners to discuss the use of ozone in marine aquaria. It should cover what ozone is, how it works and the health and safety implications for the user Evidence could be in the form of a written assignment or a group discussion or oral presentation.

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 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,P7, P14, P15	Water Quality Factors and their Effects on Marine Organisms	People who maintain aquatic organisms have to be able to maintain the environment the creatures live in. This assignment is designed to develop the skills and experience required. Produce a logbook for maintaining a given marine aquarium. You must explain what you are testing for, why you are testing and the organisms if the parameters are incorrect. You need to include the test results for the parameters for at least a month of maintenance. Judge how effective you program of maintenance has been with regard to the health and welfare of the organisms.	Written and practical.

Criteria covered	Assignment Title	Scenario	Assessment Method
P3, D1	Food Requirements and Feeding of Marine Fish and Invertebrates	After water quality, nutrition is key to successful husbandry of marine fish. Recent developments in nutrition have shown frequency of feeding is very important and can affect water quality. This assignment is designed to develop knowledge and experience in this area. You are required to produce a comprehensive nutritional diet for a given marine aquarium. Evaluate the effect of delivering the diet twice a day with delivering the same daily quantity over more than four feeding sessions. You should be comparing water quality and animal behaviour.	Written and practical.
P4,P6,P9, P10, P13, M3	The Reef Aquarium	A reef aquarium can be one of the most interesting aquariums. The intra- and inter-species interactions are very complex. This assignment is designed to help the learner develop an understanding of commonly available species behaviour and characteristics. Plan and set up a marine aquarium, explaining your selection of aquatic organisms -in terms of their requirements and behaviour; and the essential equipment required – explaining the importance of each. You should explain how health and safety requirements are met.	Written and practical.
P5, P12, M1, M2	Sourcing of Livestock	The breeding of marine creatures is still fairly rare; most of the marines are wild caught. The impact of collecting can be significant. This assignment requires the learner to look at how marine creature are collected, and to help them develop an understanding of the precarious nature of habitats. You are required to produce a report on the state of the trade in marine fish and invertebrate. You should explain: how marine creatures are collected, what impact this has on the reef, how and which species are captive bred, and how to propagate soft corals.	Written or oral presentation.
P8, D2	Ozone	Ozone is often used in marine aquaria to improve the effectiveness of protein skimming. However it is a very noxious gas. This assignment is designed to make the learners aware of the threats to marine aquarists from ozone. You are required to investigate the use of ozone in the marine aquarium. You are expected to explain its benefits to the marine system, its effect on human health and judge how valuable it is.	Written or oral Presentation.

Criteria covered	Assignment Title	Scenario	Assessment Method
P11, P12	Legislation	There have been some effective legislation passed on animal welfare in recent years. This assignment looks at current legislation. It is designed to enable the learner to recognise the benefits to the industry of legislation. The animal welfare act requires husbandry sheets to be given by retail outlets each time a creature is sold. You are required to produce husbandry advice sheets for a marine fish, a marine invertebrate and a soft coral. The Zoo Licence Act has had an impact on our Zoos and Aquaria. You are required to explain how the act has benefited the Public Aquaria in Britain.	Written or oral presentation.

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 Fish Health and Welfare
Introduction to Caring for Ornamental Aquatics	Understanding Fish Biology and Behaviour

Essential resources

Learners will require access to a laboratory, a workshop, public display aquaria, retail/wholesale premises and to a range of stocked aquaria on which they can work, ideally on an individual basis.

Learners will also require appropriate personal protective equipment (PPE) for use in a laboratory, a full range of aquarium and water testing equipment, a computer with appropriate software and access to a library and resource centre.

Tutors delivering this unit should be competent and experienced in the aquatics industry.

Employer engagement and vocational contexts

Learners would benefit from visits to retail outlets, trade fairs eg GLEE and public aquariums. Industrial work placements should be used to gain valuable experience and can provide practical experiences for the learners. Employers should be encouraged where possible to help support the theory of the unit with practical applications. Guest speakers from industry could provide experience and specialist knowledge.

Indicative reading for learners

Textbooks

Anthony Calfo and Christine Williams – *Book of Coral Propagation. Vol 1 Edition 2* (Reading Trees, 2007) ISBN 0980236507

Robert M. Fenner – *The Conscientious Marine Aquarist: A Commonsense Handbook for Successful Saltwater Hobbyists* (Microcosm/T.F.H. Professional, 2008) ISBN 1890087998

Svein A Fossa and A J Nilsen – *The Modern Reef Aquarium: V1 The foundation for successful setting up and maintaining a coral reef aquarium* (Birgit Schemettkamp Verlag, 2003) ISBN 392881929 1

Bob Goemans and Lance Ichinotsubo – *The Marine Fish Health and Feeding Handbook Illustrated edition*(Microcosm, 2008) ISBN 1890087955

Haywood M and Wells S – *The Manual of Marine Invertebrates* (Salamander Books Ltd, 1996) ISBN 086101474X

Hemdal J – *Advanced Marine Aquarium Techniques* (TFH Publications US, 2006) ISBN 0793805651

Frank H Hoff and Terry W Snell – *Plankton Culture Manual, 6th Edition* (Florida Aqua Farms Inc, 2007) ISBN 0966296044

Moe M – *The Marine Aquarium Handbook: Beginner to Breeder, 3rd Edition* (Microcosm, 2009) ISBN 9780982026212

Spotte S – *Marine Aquarium Keeping: The Science, Animals and Art, 2nd Edition* (John Wiley and Sons, 1993) ISBN 047159489X

Journals

Freshwater and Marine Aquarium Magazine

Marine World Magazine

Ultra Marine Magazine

Websites

www.aquariumcouncil.org	Marine Aquarium Council
www.cefas.co.uk	The centre for Environment, Fisheries and Aquaculture Science (CEFAS)
www.defra.gov.uk	Department of Environment, Food and Rural affairs
www.famamagazine.com/FAMA	Freshwater and Marine Aquarium Magazine
www.fishdoc.co.uk	Fish Health
www.hse.gov.uk	Health and Safety Executive
www.lantra.co.uk	Lantra Sector Skills Council
www.marineworldmagazine.com	Marine World Magazine
www.ornamentalfish.org	Ornamental Aquatic Trade Association
www.practicalfishkeeping.co.uk	Practical Fish Keeping magazine
www.tropicalfishcentre.co.uk	Tropical Fish Centre
www.tsoshop.co.uk	The Stationary Office (TSO)
www.ultramarinemagazine.co.uk	Ultra Marine Magazine

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:

Skill	When learners are ...
Independent enquirers	Researching assignment information from internet and literature
Creative thinkers	Designing systems Planning aquarium layouts
Reflective learners	Applying knowledge from other modules and across learning outcomes
Team workers	Working with others to produce presentations or group discussions
Self-managers	Meeting deadlines
Effective participators	Working with others to produce presentations or group discussions.

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.

Skill	When learners are ...
Independent enquirers	Researching assignment information from internet and literature
Creative thinkers	Designing systems Planning aquarium layouts
Reflective learners	Applying knowledge from other modules and across learning outcomes
Team workers	Working with others to produce presentations or group discussions
Self-managers	Meeting deadlines
Effective participators	Working with others to produce presentations or group discussions.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	researching assignment information producing evidence
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	researching assignment information
Manage information storage to enable efficient retrieval	note taking from formal sessions
Follow and understand the need for safety and security practices	maintenance work water testing
Troubleshoot	maintenance work water testing
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching assignment information from internet and literature
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	researching assignment information from internet and literature
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	water testing and recording water testing producing evidence
Bring together information to suit content and purpose	written assignments designing systems
Present information in ways that are fit for purpose and audience	written assignments producing presentations or group discussions
Evaluate the selection and use of ICT tools and facilities used to present information	producing evidence
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	producing presentations or group discussions researching assignment information from internet and literature
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	water testing and recording

Skill	When learners are ...
Identify the situation or problem and the mathematical methods needed to tackle it	stocking density calculations
Select and apply a range of skills to find solutions	planning aquarium layouts
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	producing presentations or group discussions
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching assignment information from internet and literature
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	written assignments.