Unit 7: Understanding Freshwater Aquarium Systems

Unit code: Y/601/0272

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to introduce learners to skills and understanding relating to freshwater aquarium system 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

Animals welfare is now more important than it has been. Fish are not exempt from animal welfare morality, ethical considerations and legislation. This unit looks at all aspects of freshwater fish and the associated systems in order to develop learners' specialist knowledge. It aims to give learners the knowledge and practical skills required to maintain an environment for freshwater fish, aquatic invertebrates and plants kept in captivity and to identify and recommend species which can be housed together.

Learners will practise and develop practical skills in freshwater aquatic husbandry. They will research the requirements of fish, aquatic invertebrates and plants kept in freshwater aquaria, and what must be carried out in order to maintain a healthy environment for them. Learners will cover the concepts of mixed fish and themed displays. They will explore the sources of fish, aquatic invertebrates and plants and the concept of sustainable resources.

Learners will explore the equipment and materials used in the aquatics industry, including the components used in single and multi-tank systems. They will examine the animal health and welfare legislation relevant to working in the aquatics industry.

Learning outcomes

On completion of this unit a learner should:

1 Know the requirements of freshwater aquatic organisms

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

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

4 Understand the major current legislation relating to the aquatics industry

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

Unit content

1 Know the requirements of freshwater aquatic organisms

Water quality factors: brackish water, soft water, hard water, 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 eg wood-eaters (*Panaque* sp) filter feeders – eg *Polyodon* sp

Freshwater species: invertebrates eg crabs, shrimps; amphibians eg salamanders, newts, frogs; fish – brackish water, soft water and hard water specialists

Health: causes of ill-health eg stress, pathogens; health and disease status

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

2 Understand the suitability of species to be kept in freshwater 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

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

Animal welfare issues: stock suitability for given systems; relevant current legislation and codes of practice

Health and safety: risk assessment eg for venomous species; relevant current legislation and codes of practice

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

Types of aquaria; materials used to make aquaria e.*g. glass, acrylic*

Light: lighting components; light intensities and emission spectra

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, fluidised sand beds, UV sterilisation, modular systems, carbon filters, algae scrubbers, biological, chemical and mechanical

Heating and cooling: heating systems – heater/thermostats, heat exchangers, cooling systems

Substrate: real and artificial substrates and decoration

Specialist equipment: automatic water changing systems; carbon dioxide dosing systems

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: eg Animal Welfare Acts, Zoo Licence Act, Pet Shop Act, Wildlife & Countryside Act, Import of Live Fish Act; 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 freshwater aquaria

Skills and techniques: required to produce a viable aquarium effectively eg location of 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 data: eg. record sheets, observation records, centralised centre records

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 water parameters required for given aquatic species [IE , SM]		
P2 describe factors which can influence a given aquatic species behaviour [EP ,SM]		
P3 describe environmental changes required to stimulate sexual reproduction for a given aquatic species [IE, EP, SM]		
P4 explain the characteristics required of aquatic organisms for use in a mixed species aquarium [IE, EP, SM]		
P5 categorise given species of aquatic organisms for their suitability in a multi species aquarium [CT, IE, SM, EP]		
P6 evaluate sustainable collecting of aquatic organisms [IE ,TW, EP]	**M1** discuss the effects, both positive and where appropriate negative, of the trade in wild caught aquatic organisms on the environment	
P7 explain the functions of the life support equipment required for a freshwater aquarium [IE, SM ,EP]		

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:**
P8 compare centralised filtration systems with individual filtration systems. [CT, IE, RL, EP]	**M2** design a centralised filtration system for a retail outlet.	
P9 explain the light requirements for a planted aquarium [CT, IE, RL, EP]		
P10 explain how the Animal Welfare Acts affect the aquatics industry [IE, RL,EP]		**D1** explain why the Animal Welfare Act was passed and what it is intended to do.
P11 discuss the impact of the Zoo Licence Act on public aquaria [IE, RL,EP]		
P12 produce a husbandry advice sheet for given aquatic organisms [IE, SM]		
P13 select and set up equipment and aquatic animal and plant species for freshwater aquaria [TW]		
P14 monitor and maintain freshwater aquaria for a given period [TW, SM]		
P15 evaluate aquatic species health and welfare and equipment in relation to the aquaria maintained. [IE, EP, CT, RL, SM]		

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 suitable collections and will links to work experience placements.

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 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 establish and maintain aquaria and to produce display labels and information sheets, and they should 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 environmental management and the need to manage the resource using ethical and 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.

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 in this unit are directly linked and cover the knowledge required for the successful keeping of aquatic organisms. Delivery is likely to be through formal lectures, discussion, site visits, practical sessions, independent learner research and 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 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 both retail sections and public aquaria. It is likely to be delivered using formal lectures, discussion, site visits to retail outlets and public aquaria, practical sessions, independent research by learners and 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 practically-based and should be incorporated into the delivery of learning outcomes 1,2,3 and 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.
Freshwater species.
Health and environmental enrichment.
Assignment 1: Water Quality Factors and their Effects on Aquatic Organisms (P1, P2, P14, P15)
Introduction by tutor.
Self-directed time/research for assignment and assignment writing.
Practical time for assessment.
Assignment 2: Breeding Aquatic Organisms (P3)
Introduction by tutor.
Self -directed time/research for assignment and assignment writing.
Characteristics of organisms.
Aquarium types.
Assignment 3: The Mixed Aquarium (P4, P5, P7, P13)
Introduction by tutor.
Self-directed time/research for assignment and assignment writing.
Sources of aquarium stock.
Assignment 4: Sustainability (P6, M1)
Introduction by tutor.
Self-directed time/research for assignment and assignment writing.
Health and safety.
Types of aquaria.
Light and air.
Assignment 5: Light and the Planted Aquarium (P9)
Introduction by tutor.
Self-directed time/research for assignment and assignment writing.
Filtration.
Assignment 6: Filtration (P8, M2)
Introduction by tutor.
Self-directed time/research for assignment and assignment writing.
Heating.
Substrates and specialist equipment.
Health and welfare legislation.
Assignment 7: Legislation (P10, P11, D1)
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.
Human health and safety.
Record keeping.
Assignment 8: Husbandry Sheets (P12) Introduction by tutor.
Self-directed time/research for assignment and assignment writing.
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 species. Evidence 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 forP14. Where possible the species should be the same for all learners.

For P2, learners are required to discuss the factors which affect the behaviour of aquatic organisms. Evidence could be in the form of a group discussion, group presentation or a written exercise.

P3 looks at the environmental stimuli required to encourage aquatic organisms to breed. It should include day length and temperature and water changes. Again Evidence could be in the form of a written exercise, group discussion, or practical assessment.

P4 requires learners to list the characteristics required in aquatic species in order for them to be compatible. 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 learners to categorise the species of aquatic organisms in a mixed community into areas they inhabit, areas they feed in and roles/functions they provide in the aquarium. This could be part of the assessment for P4 and P13. Evidence could be in the form of a written exercise or a group presentation.

For P6, learners are required to look at sustainable collection methods for aquatic organisms. Evidence could be in the form of a presentation or a written exercise.

For P7, learners are required to explain the functions of life support equipment in a freshwater aquarium. This must include all the essential equipment required for a freshwater aquarium. Evidence could be in the form of a pictorial presentation or a written exercise.

P8 requires learners to compare central filtration systems with individual filtration systems in terms of benefits to the species maintained, maintenance time, costs and disease control.

P9 looks at the light requirements for a planted tank. Light spectrum, photoperiod and light intensity should be discussed. Evidence could be in the form of a written exercise or group presentations.

P10 and P11 look at specific legislation and its impact on industry. They could be assessed independently or jointly as a written exercise or a presentation. Learners must demonstrate an understanding of the responsibilities of staff in relation to animal welfare in the aquatics industry. Evidence could also be acquired from a suitable work placement.

P12 requires learners to produce husbandry advice sheets for given aquatic species. As a minimum, a fish, an invertebrate and an amphibian should be covered.

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

Likewise, P14 requires learners to monitor, and maintain, a freshwater aquarium over time. Evidence 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 learners to judge how effectively a species is being maintained in an aquarium. Evidence could be in the form of a group discussion, and be based on observations of the aquatic species over a period of time. Evidence could be based on a visit to an aquarium or retail outlet.

M1 requires learners to discuss the effects of the wild-caught trade in aquatic organisms. Learners should demonstrate understanding of the potential socio-economic benefits to a region of this trade and its potential environmental and sociological impacts and disbenefits. Evidence could be in the form of a written assignment or in a presentation.

M2 requires learners to design a centralised filtration system. Learners should explain the functions and importance of all the equipment used. Evidence for this could be in the form of a written assignment or a fully annotated poster.

D1 requires learners to become familiar with the history of animal welfare legislation and what the Animal Welfare Act is trying to achieve. 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, P14, P15	Water quality factors and their effects on aquatic 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 aquarium. You must explain what you are testing, why you are testing and the effects on 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 your programme 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	Breeding aquatic organisms	It is every fish keepers dream to be able to breed their favourite species. This assignment is designed to give learners knowledge of the triggers which stimulate breeding behaviour. Produce a guide to spawning a Corydoras catfish, a Koi carp; and explain how photoperiod may effect reproduction in temperate species.	Written and practical.
P4, P5, P7, P13	The mixed aquarium	A mixed aquarium is very peaceful and relaxing, and is often found in stressful places like dentist's waiting room. This assignment looks at what can be mixed together successfully. Plan and set up a mixed aquarium, explaining your selection of aquatic organisms -in terms of their requirements; and the essential equipment required – in terms of its function.	Written and practical.
P6, M1	Sustainability	Large numbers of aquatic organisms are wild caught. This removal of animals from the wild has implications. This assignment looks at the effects of removal from the wild and how the effects can be minimised. Discuss the effects of the trade in wild caught aquatic organisms and judge whether the methods are acceptable. Consider project Piaba and other attempts at sustainability and discuss the effectiveness of the projects.	Written or oral presentation.
P8, M2	Filtration	Retail outlets and public aquaria have large numbers of tanks. The filtration systems they use can vary greatly. This assignment is designed to give learners knowledge of both central and stand- alone systems and the benefits and drawbacks of each system. Design a centralised filtration system for a retail outlet, explain the functions of each piece of equipment in the system and explain the advantages and disadvantages of a centralised system as compared to individually filtered tanks.	Written or oral presentation.
P9	Light and the planted aquarium	Plants have a very specific light requirement in order to grow. They can provide a stunning effect in an aquarium. This assignment is designed to develop knowledge of the effects of light and lighting on plants. You are required to give a 15 min presentation on the effects of different lighting on a planted aquarium.	Written or oral presentation.

Criteria covered	Assignment title	Scenario	Assessment method
P10, P11, D1	Legislation	There have been several important pieces of legislation passed in recent years. This assignment looks at key pieces and the impact on the aquatics industry.	Written or presentation.
P12	Husbandry sheets	Most people when they purchase new fish do so on a whim. Retail outlets are required to give a guidance sheet to t purchasers. This assignment aims to give learners experience of writing guidance sheets. You are required to produce husbandry advice sheets for a goldfish, an axolotl and an amano shrimp.	Written.

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 Caring for Ornamental Aquatics	Understanding Aquatic Plant Biology and Husbandry
Introduction to Fish Health	Understanding Marine Aquarium Systems
Introduction to Fish Biology	Understanding Aquatic Ecosystems

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 and public aquaria Work placements should be used to gain valuable experience and can provide practical experiences for learners. Employers should be encouraged, where possible, to help support the theory of the unit with practical applications

Indicative reading for learners

Textbooks

Andrews C, Carrington N and Exell A – *The Manual of Fish Health* (Salamander Books, 1996) ISBN 0861013689

Baensch H and Riehl R – *Aquarium Atlas* (Mergus Verlag, 2004) ISBN 3882440589

Bailey M and Burgess P – *Tropical Fishlopaedia: A Complete Guide to Fish Care* (Howell Books, 2000) ISBN 1582451664

Hawkins A – *Aquarium Systems* (Academic Press, 1981) ISBN 0123333806

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

Nelson J – *Fishes of the World, 4th Edition* (John Wiley and Sons, 2006) ISBN 0471250317

Magazines

Aquatic Trader

Freshwater and Marine Aquarium

Practical Fish Keeping

Today's Aquarist

Websites

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	Sector Skills Council for the Environment and Land-based Industries
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)

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 evidence for their assignments
Creative thinkers	planning assignment work
Reflective learners	applying knowledge across learning outcomes and from linked units
Team workers	working together to achieve goals
Self-managers	meeting deadlines for assignments carrying out maintenance schedules
Effective participators	participating in 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 using the internet and relevant literature
Creative thinkers	designing systems planning aquarium layouts
Reflective learners	applying knowledge from other units and across learning outcomes
Team workers	working with others to produce presentations or group discussions
Self-managers	meeting deadlines
Effective participators	passing on personal experience and knowledge in group activities.

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	researching for their assignments note taking from formal sessions
Follow and understand the need for safety and security practices	carrying out maintenance work on aquaria
Troubleshoot	carrying out maintenance work on aquaria
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching for their assignments producing evidence
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	researching for assignments
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	producing evidence
Bring together information to suit content and purpose	researching for their assignments
Present information in ways that are fit for purpose and audience	producing evidence
Evaluate the selection and use of ICT tools and facilities used to present information	researching for their assignments
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	researching for their assignments producing evidence
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	carrying out maintenance work carrying out water testing

Skill	When learners are ...
Identify the situation or problem and the mathematical methods needed to tackle it	calculating stocking density calculating flow rate
Select and apply a range of skills to find solutions	carrying out maintenance work on aquaria
Use appropriate checking procedures and evaluate their effectiveness at each stage	carrying out water testing and recording
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	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching for their assignments
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing written assignments.