Unit 6: Understanding Aquatic Plant Biology and Husbandry

Unit code: Y/600/9221

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to introduce learners to aquatic plant biology and husbandry 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 on to further/higher education.

Unit introduction

Aquatic plants come in many different shapes and colours and have many different requirements. This unit looks at those differences and gives learners the knowledge and practical skills required to use aquatic plants successfully, either in the gardening or aquascaping sectors.

Learners will develop their knowledge of the range and biology of aquatic plants commonly sold in the aquatics industry, and the methods and systems used to propagate and grow aquatic plants. They will cover the causes, symptoms, treatment and prevention of aquatic plant diseases and pests. Learners will also cover the causes and symptoms of ill health in plants and carry out appropriate methods of treating and preventing aquatic plant diseases and pests.

Learners will explore the range of markets for ornamental aquatic plants, together with the methods of packaging and managing retail systems. They will understand the advantages and disadvantages of a range of packaging methods and appreciate how the retail systems used to hold and sell plants are managed.

Throughout the unit, the emphasis should be on safe working. Learners will understand safe systems of work and be familiar with accepted practices and behaviours.

Learning outcomes

On completion of this unit a learner should:

1 Understand the biology of aquatic plants common in the aquatics industry

2 Be able to grow and propagate commonly kept aquatic plant species

3 Understand common aquatic plant diseases and pests

4 Understand the ornamental aquatic plant market.

Unit content

1 Understand the biology of aquatic plants common in the aquatics industry

Aquatic plants: identification of common ornamental plant species, eg *Elodea Densa*, *Cabomba*, *Hygrophylia Polysperma*, *Anubias Barterii*; structure, function and adaptations of aquatic plants

Classification: binomial system; by habitat, eg emergent, marginal, floating, submerged

Environmental requirements: nutritional, physical, mineral requirements, eg iron, nitrogen, phosphorus, potassium, trace elements

Photosynthesis: light requirements, carbon dioxide requirements, limiting factors; light phase, dark phase, compensation point

2 Be able to grow and propagate commonly kept aquatic plant species

Aquarium and pond systems: substrates, heating, lighting; photoperiod and spectrum, CO2 diffusers, filtration, fertiliser; safety equipment, eg circuit breakers, PPE

Aquascaping: features of plants used in aquascaping, eg height, shade tolerance, marginal and emergent species, colour, growth rate; habitat and maintenance requirements

Reproductive strategies: sexual, asexual

Methods of propagation: cuttings, budding, corms, bulbs, cultivars

Seeds: collection, storage and germination

Health and safety: risk assessments, RIDDOR, codes of conduct, relevant current legislation

3 Understand common aquatic plant diseases and pests

Aquatic plant diseases: mineral deficiencies, temperature, incorrect illumination, lack of CO2, incorrect depth, incorrect humidity; fungal; symptoms; treatments

Pests: snails, china mark moths, leaf miners, aphids; prophylactic measures and treatments; suitable pest control measures (chemical and biological)

Health and safety: operator health, safety and welfare; relevant current legislation; risk assessment

4 Understand the ornamental aquatic plant market

Aquarium market: types of plants, eg marginal, emergent, floating, submerged; sources of plants eg imported, cultivated; non-aquatic plants; uses of plants, eg 'plant-only' aquariums, decorative, refugia; customer requirements; introduction of contaminants, eg biological, pesticides

Pond market: types of plant, eg marginal, emergent, floating, submerged; sources of plants, eg cultivated, imported; seasonality; customer requirements; uses of plants; plant contaminants, eg biological, pesticides

Point of sale: presentation of aquarium and pond plants; packaging; seasonality; prolonging shelf life of plants; maintenance requirements; factors affecting pricing; pricing

Environmental issues: release of non-native plants and potential effects; identification of problematical species; use of pesticides; pest plants in aquaria and ponds; safe disposal of non-native plants, eg composting, incineration

Legislation: relevant current legislation and codes of practice, eg relating to importation, culture, sale, release to the wild

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 explain the process of photosynthesis in the aquatic environment [IE, SM]		
P2 examine the structure of a given species of aquatic plant [IE, SM]		
P3 discuss how given species of aquatic plants are adapted to the aquatic environment [IE, CT, SM]	**M1** explain how plants can be classified using the binomial system and habitat preference	
P4 design a system to maintain a given selection of aquatic plant species [CT, SM, RL, IE]	M2 design an aquascaped aquarium for a given selection of aquatic plant species	
P5 carry out aquatic plant growth and maintenance for a given aquatic plant collection [TW,RL]		
P6 report on how a holding system meets the needs of given aquatic plant species [IE, CT, SM]		**D1** report on how an aquarium system meets health and safety requirements
P7 produce a guide on how to create cultivars of given aquatic plant species [IE, CT, RL, SM]		
P8 examine a selection of aquatic plant species for signs of ill health [CT, SM, EP, RL]	**M3** suggest the causes of ill health in a selection of aquatic plant species	
P9 explain the nutrient requirements of aquatic plants [IE, CT, RL SM]		

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:**
P10 discuss methods to control common pests of aquatic plants [IE, CT, EP, SM]		**D2** discuss the effects of the use of pesticides on aquatic plants for both aquarium and pond situations
P11 describe the aquarium plant market in the UK [IE, CT, SM]	**M4** explain the challenges aquatic plants create for retailers.	
P12 describe the pond aquatic plant market in the UK [IE, CT, SM]		**D3** explain the problems caused by biological contaminants introduced to aquatic plants.
P13 describe the potential effects of the introduction of non-native ornamental plant species to the wild.		

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

Learners will benefit from visits to aquatic retail and specialist outlets and from specialist guest speakers. Learners will toned to carry out several practical activities to demonstrate their knowledge.

Tutors delivering this unit have opportunities to use a wide a range of teaching and learning techniques. Lectures, discussions, seminar presentations, site visits, supervised propagation and husbandry, system installation and management practicals, research using the internet and/or library resources and the use of personal and/or industrial experience would all be suitable. 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 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 propagate plants or install and manage a range of plant-life support systems, and they should ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Health and safety issues must be stressed and reinforced regularly. Risk assessments must be undertaken before any practical activities.

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

Learning outcome 1 is likely to be delivered using formal lectures, practicals, site visits, discussion and independent learner research. Visits to a range of aquatic plant nurseries, wholesalers and retailers would add to the relevance of the subject for learners.

Learning outcome 2 may be delivered using formal lectures, discussions, practicals and independent learner research. Actual propagation, systems installation and management practicals would assist learners in achieving the necessary outcomes. Adequate personal protective equipment (PPE) must be provided and used following the production of suitable risk assessments. Visits to aquatic plant nurseries, wholesalers and retailers would add relevance to the subject for learners.

Learning outcome 3 covers the prevention and control of aquatic plant disease and pests, and may be linked to the delivery of learning outcomes 1 and 2.

Learning outcome 4 addresses the marketing and retailing of ornamental aquatic plants. Delivery may include formal lectures, discussions, practicals and independent learner research. Visits to a range of retail units would assist learners in achieving the necessary outcomes.

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.
Photosynthesis.
Biology of aquatic plants.
Assignment 1: Photosynthesis and Plant Structure (P1, P2)
Introduction by tutor.
Self- directed time/research for assignment and assignment writing.
Assignment 2: Classification of Aquatic Plants (P3, M1)
Introduction by tutor.
Practical activity for Assignment 2.
Equipment requirements for aquatic plants.
Cultivation of aquatics.
Reproduction in aquatic plants.
Aquascaping.
Assignment 3: Aquascaping (P4, P5, P6, M2, D1, D2)
Introduction by tutor.
Self-directed time/research for assignment and writing of assignment.
Maintenance of planted tank 30 min per week approx.
Assignment 4: Cultivation of Plants (P7)
Introduction by tutor.
Self- directed time/research for assignment.
Plant diseases – mineral deficiencies.
Plant pests.
Health and safety.
Assignment 5: Plant Health (P8, P9, M3)
Introduction by tutor.
Practical assessment on plant health.
Assignment 6: Pests and Pest Treatments (P10, D3)
Introduction by tutor.
Self -directed study/research for assignment.
Aquarium plant market.
Pond plant market.
Assignment 7: Aquatic Plant Markets (P11, P12, P13, M4)
Introduction by tutor.
Visit to retail outlets.
Self-directed study/research into markets, assignment writing.
Unit review.

Assessment

For P1, learners are expected to identify all the requirements for photosynthesis. Evidence could be in the form of a poster or a written exercise.

For P2, learners are required to identify all the structures of a plant including tissue types. This can be linked with P3 and include the structure and tissues that are specific to aquatic plants. Evidence could be in the form of a poster, presentation or written work.

P3 requires learners to discuss how a specific aquatic plant is adapted to the aquatic environment. Tutors should identify the plant, or agree it through discussion with learners. Where possible, to ensure assessment is fair, the complexity of the plant's structure should be the same for each learner. Evidence could be in the form of a fully annotated poster or written exercise and be part of the activity for P2.

P4 requires learners to design a life-support system for a selection of aquatic plants. Tutors should identify the aquatic plants or agree them through discussion with learners. Where possible, to ensure assessment is fair, the complexity of the plants' environmental requirements should be the same for all learners. Evidence could be in the form of a presentation, poster or written exercise and could be part of the exercise for P6.

P5 requires learners to maintain and grow aquatic plants. This can be in a pond or aquarium situation. Tutors should identify the aquatic plant collection or agree them through discussion with learners. Where possible, to ensure assessment is fair, the collection's size and complexity should be the same for all learners. This could be assessed during practical activities or at a work placement.

P6 requires learners to report on how an aquarium system satisfies the requirements of aquatic plants. Tutors should identify the aquatic plants or agree them through discussion with learners. Where possible, to ensure assessment is fair, the complexity of the plants' environmental requirements should be the same for all learners. Evidence for this could be included in the exercise for P4 with learners explaining the requirements of aquatic plants and how their system provides for these needs.

For P7, learners need to produce a guide for the production of cultivars. Tutors should identify the aquatic plant or agree it in discussion with learners. Where possible, the size and complexity of the task should be the same for each learner to ensure assessment is fair. The plant species may be the same as that used to provide evidence for other grading criteria.

For P8, learners are required to examine a variety of aquatic plants for signs of ill health. As a minimum, learners are required to examine at least four different ornamental aquatic plants. Tutors should identify the plants to be examined. Where possible, to ensure assessment is fair, the complexity of the plants' health status should be the same for all learners. Tutors can choose plants that are healthy as part of the assessment process but they must include at least two that are not. Learners are required to identify the health status of at least four plants correctly during the assessment. This could be assessed directly by the tutor during practical activities. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

For P9, learners are required to explain the minerals required by aquatic plants. This must include the macronutrients and trace elements required by plants. Evidence could be in the form of a presentation or written exercise.

P10 requires learners to discuss methods used to control common pests of aquatic plants. Learners should cover both biological and chemical controls. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), or an annotated poster or leaflet.

P11 requires learners to explain the aquarium market. Learners should cover customer requirements, seasonality, availability and the use of non-aquatic plants. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector) or a written exercise.

P12 requires learners to explain the pond market. Evidence could be included in the exercise for P11 and could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector) or a written exercise.

For P13, learners are required to describe the potential effects of introducing non-native ornamental plant species to the wild, citing examples of already-escaped species in the UK. Learners should demonstrate an understanding of the need for the correct disposal of non-native plant species through, for example, correct composting or incineration. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector) or a written exercise.

For M1, learners are required to look at the classification of plants by habitat and the Linnaean binomial system. Learners should include all habitat types described in the unit content. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector) or a written exercise.

M2 requires learners to design an aquascaped aquarium. Tutors should identify the aquatic plants or agree them through discussion with learners. Where possible, to ensure assessment is fair, the selection of plants should be the same for all learners. This could be assessed directly by the tutor during practical activities or as a written exercise. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

M3 requires learners to suggest causes of ill health in a selection of aquatic plants. As a minimum, learners are required to examine at least four different ornamental aquatic plants. Tutors should identify the plants to be examined. Where possible, to ensure assessment is fair, the complexity of the plants' health status should be the same for all learners. Learners are required to identify the causes of poor health status of at least four plants correctly during the assessment. This could be assessed directly by the tutor during practical activities and linked to P8. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

M4 requires learners to explain the challenges aquatic plants create for retailers. Learners should look at both the aquarium and pond market. Evidence could be included in the exercise for P11 and take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector) or a written exercise.

For D1, learners are required to report on how an aquarium system meets health and safety requirements. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), or a written exercise, and should include risk assessments.

D2 requires learners to discuss the effects of the pesticides used on aquatic plants, for both aquarium and pond situations. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector) or a written exercise.

D3 requires learners to explain the problems biological contaminants cause when introduced to aquatic plants. Both pond plants and aquarium plants should be covered. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector) or a written exercise.

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
P1, P2	Photosynthesis and Plant Structure	Photosynthesis is the most important process in nature. Without it there would be very little life. This assignment is designed to help learners understand this process and the structure of aquatic plants Produce a poster showing all the structures and tissues of a typical aquatic plant. Explain the functions of the various tissues. Explain the light and dark phases of photosynthesis and the requirements of photosynthesis and the factors that limit it.	Poster and written evidence.
P3, M1	Classification of Aquatic Plants	Aquatic plants can be classified by both their shape and habitat. This assignment has been designed to help learners develop a good working knowledge of plant classification. Look at an aquatic habitat and identify the plants living in it. Classify them according to habitat and scientific names. Explain how they have adapted to their habitat.	Practical supplemented with written evidence.
P4, P5, P6, M2,D1, D2	Aquascaping	Plants are very important in an aquarium. They can enhance the effect and give fish places of refuge. This assignment looks at the equipment needed to keep plants successfully and how plants can be arranged successfully in an aquarium Plan an aquarium for a selection of aquatic plants. Explain the equipment required and the function of each piece. Include in your plan a layout for the plants and explain why each plant is placed where it is. Explain how the system meets the requirements of the plants and how health and safety requirements are met. A planted tank is a garden in miniature and, like all gardens, needs maintenance. This assignment is designed to develop your skills Maintain a given planted aquarium over a period of weeks. You should feed plants, remove unwanted growth and dead or decaying plant material	Poster and written evidence or practical evidence and written evidence.
P7	Cultivation of Plants	Though sexual reproduction can produce new plants, it is a slow process. This exercise is designed to look at how plants can be produced more quickly using asexual reproduction methods Produce a 'How to' guide for the production of cultivars of either a pond lily or an aquatic iris	Poster or leaflet.

Criteria covered	Assignment title	Scenario	Assessment method
P8,P9, M3	Plant Health	This practical assignment is designed to develop knowledge of plant ill health Examine a collection of either pond or aquarium plants for signs of ill health. Explain the signs and discuss the possible causes – include mineral deficiencies	Practical and written evidence.
P10, D3	Pests and Pest Treatments	Many of the plants used in aquatic displays are grown either abroad or in open ponds. They are likely to have animals living on them. This exercise helps learners to become aware of these creatures, how to deal with them, and the possible ramifications of the treatments Discuss the pest species that can be found on aquatic plants both those which may affect the plants and those which may affect aquatic animals, how these pests can be treated and the effects these treatments may have on the environment. This should be done for both aquarium and pond plants	Practical or written evidence or discussion.
P11, P12, P13, M4	Aquatic Plant Markets	The pond plant market is very different to the aquarium plant market. This assignment is designed to help learners expand their knowledge of these markets Explain the aquarium plant market in terms of customer requirements and expectations, and explain how the retailer meets these requirements. Explain the pond plant market in terms of customer requirements, plant requirements and seasonality. Consider the potential effects of the release of non-native plant species to the wild, citing examples of escaped ornamental species and the issues they have created.	Written evidence.

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 Freshwater Aquarium Systems
	Understanding Marine Aquarium Systems

Essential resources

Learners should have access to a laboratory, a workshop and a range of ornamental aquatic plant facilities, such as aquariums, pools and propagation systems. Equipment required will include normal safety equipment used in these facilities, a range of water-quality test kits, and materials and equipment needed for the construction of aquatic plant propagation and life support systems. Learners should also have access to a wide range of tropical and coldwater ornamental aquatic plants. Learners would benefit from visits to suitable retail outlets and visits from specialist guest speakers.

Employer engagement and vocational contexts

Learners would benefit from visits to retail outlets for both aquarium and pond plants.

Indicative reading for learners

Textbooks

Edwards M – *Plants for Water Gardens* (Demsey Parr, 1999) ISBN 1840843381

Hiscock P – *Encyclopedia of Aquarium Plants* (Interpet Publishing, 2003) ISBN 1903098467

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

Stevensen D and Scheurmann I – *Aquarium Plants Manual: A Complete Pet Owner's Manual* (Barron's Educational Series, 1993) ISBN 0812016874

Swindells P – *Pond Plants and Cultivation* (Interpet Publishing, 2001) ISBN 1903098335

Journals

Aquascaping World magazine

The Aquatic Gardener: Journal of the Aquatic Gardeners' Association

Websites

www.aquascapingworld.com www.thetropicaltank.co.uk	Aquarium Plants
www.ceh.ac.uk	Centre for Ecology and Hydrology
www.cornwallwildlifetrust.org.uk	The Wildlife Trusts Cornwall
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.hse.gov.uk	Health and Safety Executive
www.ornamentalfish.org	Ornamental Aquatic Trade Association
www.practicalfishkeeping.co.uk	Practical Fishkeeping
www.rhs.org.uk	Royal Horticultural Society

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 assignments
Creative thinkers	planning assignment work planning aquascaping
Reflective learners	applying knowledge across learning outcomes and from linked units
Teamworkers	working together to achieve goals
Self-managers	meeting deadlines for assignments carrying out maintenance schedules
Effective participators	carrying out maintenance schedules 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
Creative thinkers	designing systems planning aquarium layouts planning pond layouts
Reflective learners	applying knowledge from other units and across learning outcomes
Teamworkers	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 for assignments producing assignment evidence
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	researching for assignments
Manage information storage to enable efficient retrieval	researching for assignments note-taking from formal sessions
Follow and understand the need for safety and security practices	carrying out practical activities
Troubleshoot	carrying maintenance work
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching for assignments
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	researching for assignment.
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	
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	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	