



# MCAST

Malta College of Arts, Science & Technology

MQF Level 4

AG4-02-19

**MCAST Advanced Diploma in Fish Management**

**Course Specification**

## **Course Description**

This course offers the learner a wide perspective in different aspects of fish management and will provide learners with a broad knowledge and aptitude related to the fish husbandry sector and industry. Learners will be given the required knowledge, skills and competences in both farmed and ornamental fish husbandry industries. This programme of studies also exposes learners to key concepts related to wild stock fisheries management.

The programme will give an opportunity to learners to gain experience while learning new skills. Learners are constantly encouraged to relate theory to practice at all stages through assignments, projects, practical work and work placements. Scheduled fish husbandry duties form an integral part of the curriculum

## **Programme Learning Outcomes**

At the end of the programme the learner will be able to:

- 1. Understand a number of scientific and technical aspects in the fish husbandry area.*
- 2. Understand the anatomy, physiology, behaviour and health of fish.*
- 3. Undertake work-related experience in the land-based sector (Aquaculture).*
- 4. Develop business ideas and carry out investigative projects in the land-based sector (Aquaculture).*

## **Entry Requirements**

MCAST Diploma in Fish Husbandry

or

MCAST Diploma in Animal Care

or

MCAST Diploma in Horticulture

or

MCAST Diploma in Applied Science

or

4 SEC/O-Level/SSC&P (Level 3) passes Preferred: Biology, Chemistry, Mathematics and English Language

## Current Approved Programme Structure

<b>Unit Title</b>	<b>ECVET/ECTS</b>
Global Aquaculture , Fisheries and Trade	6
Fish biology and Behaviour	6
Fish Health and Welfare	6
Basic Chemistry	6
Farming of Sea bream, Sea Bass & Meagre	6
Health and Safety and First Aid	6
Communication Skills for Employment	6
Entrepreneurship & Business Management	6
Farming of Tuna and Amberjack	6
An introduction to Fisheries Studies	6
Understanding Fisheries Management	6
Marine Ornamental Aquaria	6
Aquascaping and Ornamental Invertebrates	6
Navigation	6
Introduction to Oceanography	6
Freshwater Ornamental Aquaria	6
English	6
Work Related Experience in the Environmental Sustainability Sector	6
Entrepreneurship	6
Information Technology	6
<b>Total ECVET/ECTS</b>	<b>120</b>

## Global Aquaculture, Fisheries and Trade

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

The unit is designed for centre based delivery for learners planning to enter the fish management sector (aquaculture or fisheries) or progress to higher education.

Outcome 1 will develop the learner's understanding of the production and supply of fish and fish products from capture based fisheries and aquaculture traded globally, and factors influencing consumer demand.

The challenges facing fishery management will be revealed, providing a global context that will help learners to better understand the management of the Maltese and Mediterranean fishery. The concept of sustainability and 'sustainable yield' will be introduced and exemplified through a range of case studies illustrating sustainable and unsustainable fisheries and aquaculture enterprises, satisfying Outcome 2.

Learners will develop an understanding of the principles and evolution of aquaculture as an alternative and potentially more sustainable aquatic food supply, capable of resolving the global 'protein deficit' looming in the 21<sup>st</sup> Century. The range of aquaculture practices within temperate and tropical regions, utilising freshwater and marine environments, will be revealed, from extensive through to intensive systems, exploring the factors influencing their development.

On completion of the unit, learners will have grasped that the full scope of aquaculture includes the culture of plants, crustaceans, shellfish and fin fish. The pros and cons of 'low input' extensive aquaculture systems will be highlighted and compared to the intensive monoculture of high value carnivorous species reliant on aquaculture technology and dietary protein derived from finite marine fish stocks, satisfying Outcome 3. An awareness of the socio-economic importance of aquaculture to rural communities will be developed, acknowledging the potential detrimental impacts and the preventive and remedial measures that can safeguard the natural environment.

Outcome 4 requires learners to devise and conduct a consumer survey to investigate the nature of demand for aquatic food and consumer resistance towards unfamiliar products. The difficulty suppliers can have in gaining consumer acceptance of new aquatic food products in order to successfully diversify will be demonstrated, and marketing solutions considered.

## Learning Outcomes

**On completion of this unit the learner will be able to**

1. *Categorise global fishery and aquaculture production and trade, with reference to the main fish producing countries and the species that they provide and/or produce.*
2. *Identify the main drivers for change in modern aquaculture/fisheries systems globally, and the need to consider greater intensification.*
3. *Describe the development of aquaculture systems, from extensive to intensive regimes, with reference to sustainability and socioeconomic benefits.*
4. *Conduct a consumer survey to establish those factors influencing attitudes towards aquatic food products.*

## Fish Biology and Behaviour

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This unit is designed for centre based delivery, preparing learners for entry to the aquaculture, fisheries, or ornamental sector at an operative level, or progression to higher education.

Fish populations need to be managed effectively in order to satisfy a range of aims, whether found in capture based fisheries, fish farms or aquaria. Fish propagation and growth, whilst achieving high standards of animal welfare and safeguarding the environment, are applicable to all industry sectors. Equipped with an underpinning knowledge of fish biology, learners will appreciate how environmental conditions can influence fish behaviour and the importance of minimising fish stress in order to sustain fish health and productivity. By heightening their animal welfare and environmental awareness, learners will develop the necessary legal, moral and ethical responsibility to ensure that fish under their care are provided the correct conditions to thrive and exhibit normal behaviour.

Initially, learners will familiarise themselves with internal and external fish anatomy, relating the normal anatomical features of healthy fish to important physiological processes. Subsequently, an understanding of normal and abnormal fish behaviour will be developed through making observations and with reference to physiological processes which can influence behaviour and indicate the condition of their environment. Finally, the interrelationships between fish and their environment will be explored more comprehensively with reference to their feeding behaviour, nutritional requirements and metabolism.

Although Teleost fin fish of commercial significance to either aquaculture, fish capture or the ornamentals sector in the Mediterranean region provide the short list, the unit does allow learners the freedom to study specific fish species of personal interest in more depth.

## Learning Outcomes

**On completion of this unit the learner will be able to**

1. *Describe the external and internal anatomy of specific fish species with reference to the visual signs of poor health.*
2. *Explain the functions of the major organs of specific fish species with reference to their physiological role.*
3. *Describe the normal and abnormal behaviour of specific fish species with reference to their tolerance limits.*
4. *Describe the feeding behaviour for specific fish species with reference to their metabolism.*

## Fish Health and Welfare

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This unit is designed to suit centre-based delivery and learners seeking to enter the fish management sector (aquaculture, fisheries or ornamentals) or planning to progress to higher education. It aims to introduce the skills and knowledge that relate to fish health and welfare and fish husbandry within a range of fish holding facilities.

Maintaining fish health is fundamental to keeping fish in captivity, whether they are being farmed, or held and traded within the ornamental sector. As similar fish welfare considerations apply, regardless of sector, it is important that learners understand how health problems can arise, aware of the limitations of conventional chemical treatments which are becoming increasingly ineffective and restricted, shifting the emphasis towards disease prevention.

Learners will investigate a range of pathogens that can cause disease, from viruses and bacteria, to parasites and fungi, to satisfy Outcomes 1 and 2. This will include studying the aetiology and possible symptoms of a disease outbreak, and developing their knowledge of preventative measures and, for when prevention has failed, disease treatments. Based on an understanding of the pathogens requirements, learners will relate various techniques available to prevent and treat disease to 'standard operating procedures' found in the fish management industry. Ultimately, this should reduce the risk of local disease outbreaks escalating to become pandemics, to the benefit of the industry globally.

To satisfy Outcome 3, learners will investigate health problems that have environmental and nutritional causes, learning how to identify symptoms and differentiate them from pathogenic diseases. Reference will be made to mitigation through good fish husbandry, including optimising the rearing environment and feed management. An exploration of the relevant EU legislation and codes of practice relating to fish welfare and fish health management at national level completes Outcome 4.

## Learning Outcomes

**On completion of this unit the learner will be able to**

- 1. Explain the management of viral and bacterial fish diseases with reference to their causes and symptoms.*
- 2. Explain the management of parasitic and fungal fish diseases with reference to their causes and symptoms.*
- 3. Describe the management of nutritional, environmental and genetic fish health problems with reference to their causes and symptoms.*
- 4. Explain the legislative control of fish health management in the EU, with reference to relevant codes of practice and the implications to fish husbandry practices.*

## Basic Chemistry

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

The aim for this unit is to provide students with the basic principles of chemistry such that it underpins their understanding of the biological molecules within plant and animal tissues and how they interact with inert and active molecules within their environment. Although theoretical, the unit is complemented by a significant amount of practical work to allow students to investigate chemical pathways, interactions and laws, and to develop key laboratory skills that can be transferred to other scientific disciplines. Skills such as writing and interpreting chemical formulae, equations and calculations will be developed as well as quantitative and qualitative investigations of chemical principles.

The unit begins with an examination of the periodic table and the physical properties of elements that have led to its structure. This leads into the study of chemical bonding with the focus on the three strongest types of bonds (covalent, ionic and metallic) before broadening out to cover alternative bond types.

The unit then turns its attention to exploring the biologically important molecules and their properties in detail, including water, carbohydrates, structural and functional proteins, lipids.

### Learning Outcomes

**On completion of this unit the learner will be able to**

1. *Describe atomic structure, properties of identified elements and principles of bonding.*
2. *Describe and apply the principles of equilibrium.*
3. *Discuss the chemistry of biologically important molecules.*
4. *Demonstrate competence in a range of skills necessary in the study of chemistry.*

## Farming of Sea bream, Sea Bass & Meagre

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This unit is designed for centre-based delivery to suit those aiming to enter the fish management sector (aquaculture, fisheries or ornamentals), or planning to progress to higher education. It introduces learners to the knowledge and skills that relate to the farming of Sea bream, Sea bass and Meagre, and includes on farm practical skills development.

Outcome 1 introduces the farming of Sea bream and Sea bass, the established backbone of Mediterranean aquaculture, more recently complemented by Meagre production, as the industry diversifies. Following an initial overview of the evolution of Mediterranean farming methods, learners will study intensive ‘closed’ production cycles for current and emerging farmed species from ova production through to harvest.

Learners will discover how the main farmed species are propagated, including the management of brood-stock, ova production, incubation and early rearing up to a typical transfer target weights of 2-4 grams. By developing an overarching understanding of hatchery phase operations, Outcome 2 will be satisfied.

An understanding of fish husbandry requirements during hatchery and on-growing phases will be developed through a combination of study and periods of on farm practical experience. Learners will select equipment and technology needed to ensure a high quality rearing environment, optimal feed intake, and minimal fish stress during grading and harvesting operations to satisfy Outcome 3. Concurrently, through completing a period of work experience on an on-growing site, learners will demonstrate defined practical fish husbandry competences to satisfy Outcome 4.

Towards the end of the unit the learners familiarity with farm site selection criteria and factors determining the fish holding capacity, economic viability and environmental impact of on-growing will have grown. Consideration of the governance and regulatory framework for Mediterranean aquaculture, and its impact on and the development of farming practices for Sea bream, Sea bass and Meagre, and the growth of the sector, will lead to the completion of Outcome 5, concluding the unit.

## Learning Outcomes

**On completion of this unit the learner will be able to**

- 1. Describe the production cycle of farmed Sea bream, Sea bass and Meagre including the hatchery, nursery and on-growing phases.*
- 2. Explain the hatchery, nursery and on-growing phases including the husbandry requirements, for Sea bream, Sea bass and Meagre.*
- 3. Select the equipment and technology required for fish production operations during hatchery and on-growing phases for Sea bream, Sea bass and Meagre.*
- 4. Conduct routine fish husbandry on-growing operations for Sea bream, Sea bass or Meagre, conforming to standard operating procedures.*
- 5. Outline the principles of aquaculture governance and licensing with reference to the criteria applied to ensure responsible farm site selection in the Mediterranean region.*

## Health and Safety and First Aid

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

The Health and Safety element of this course is knowledge, skill and competency based unit which will allow learners to recognise, practice and display the necessary skills for competent analytical analysis of Health and Safety within an Agribusiness workplace setting.

Learners will develop a understanding of the hazards and risks which can face a worker in dealing with everyday issues while working in an Agribusiness setting including working with animals and machinery. They will be able to apply Health and Safety Legislation for controls in ‘so far as is reasonably practicable’ or employ best practise.

This unit is relevant to all employees and the skills developed can be demonstrated in an Agribusiness setting. The Candidate will become familiar with the Risk Assessment core principles and practice, and the desirable actions and Controls needed to allow a ‘suitable and sufficient’ Assessment is carried out. The unit will allow the candidate to develop a good understanding of the role of Health and Safety Legislation and the need to meet its requirements within an Agribusiness workplace.

Learners will have become competent in the execution of a Risk Assessment and will have a clear understanding of the Legal requirements needed to comply in completing and recording within an Agribusiness setting. By meeting all criteria in this unit, learners will also obtain a first aid certificate, making them certified first aiders.

### Learning Outcomes

**On completion of this unit the learner will be able to**

- 1. Understand common Health and Safety terminology and the information of the Health and Safety Legislation.*
- 2. Identify common Health and Safety hazards within a farm setting.*
- 3. Develop the skill in Assessing Risks to control and minimise Health and Safety risks.*
- 4. Use first aid procedures to respond to emergency situations.*

## Communication Skills for Employment

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This is a skills based unit and will equip learners with necessary requirements in relation to communication skills for employment. The skills will prepare learners for employment in their appropriate job/work experience/placement employment sector.

The unit is made up of five key areas:

- Effective communication (including verbal and written - public speaking, making a presentation, writing work placement letters, report writing)
- Interview skills (Learners will develop skills to plan a successful interview (Fish Management sector)).
- Determine own responsibilities and performance (Learner will have the opportunity to assess and develop an understanding of own responsibilities and performance in, or when entering the workplace.
- Workplace Dynamics (Learner will develop leadership skills and teamwork skills, customer service and work ethics).

The unit is relevant for learners wishing to enter employment and will prepare them with key skills for their employment and allow them to develop own strategies in relation to own personal and professional development. It will further, develop their skills when engaging in work based positions (leadership roles, individual work and teamwork, etc). The learners will develop employability skills.

### Learning Outcomes

**On completion of this unit the learner will be able to**

1. *Develop interpersonal and transferable skills in relation to effective communication in a working environment.*
2. *Demonstrate effective Interview skills required for employment.*
3. *Determine own responsibilities and performance at the work place.*
4. *Explain workplace dynamics.*

## Entrepreneurship & Business Management

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

Although their stories vary, all entrepreneurial firms start with one or more entrepreneurs, the recognition of an opportunity and a plan for how to shape the opportunity into a viable business. Entrepreneurs are the backbone of most economy especially considering that more than 90% of businesses are either micro or small or medium enterprises. Governments all across the world try to improve the business climate to facilitate the entrepreneurship spirit and the ability of these individuals to transform their ideas into viable businesses as these in turn generate income for the country and employment for the population.

This is the essence of the unit. During delivery of this unit Learners will develop an understanding of the process of generating ideas, which is the initial step for the creation of a business venture but more than that will also understand how to assess the potential of different ideas generated. This will be further developed through the knowledge and skills required to carry out the proper feasibility analysis to determine the actual potential of an idea being developed.

Throughout the Unit Learners will be provided with an opportunity to learn how to develop a business plan based on a selected idea and will have the possibility of building their own business plan. This will also introduce the learner to analytical skills required to ascertain the future needs of a business and based on all this information build a presentation for different audiences.

Part of this unit is skills based and will allow learners to demonstrate they have the necessary skills analyse ideas generated and develop appropriate business plans.

Learners will also be introduced to different form of business financing including new and emerging ones. Throughout this section, the various costs and benefits will be analysed and learners will be able to develop an ability to ascertain which method of funding is most appropriate for a business enterprise.

## Learning Outcomes

**On completion of this unit the student will be able to**

1. *Distinguish the characteristics that make up successful entrepreneurs and the common myths surrounding it and identify ways of generating new ideas.*
2. *Construct a basic feasibility analysis to evaluate new business opportunities.*
3. *Construct a basic business plan to present to potential investors.*
4. *Identify sources of finance for new entrepreneurs.*

## Farming of Tuna and Amberjack

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This unit is designed to suit centre-based delivery and will help to prepare learners planning to enter the fish management sector (aquaculture, fisheries or ornamentals) or progress to higher education. It aims to introduce learners to the knowledge underpinning the farming of Tuna and Amberjack in the Mediterranean region, and provides insights to progress with the development and commercialisation of ‘controlled’ propagation, essential to the future of the sector. Within Unit assessments learners are provided a degree of choice, and can focus on either Tuna or Amberjack production.

As a scene setter, Learning Outcome 1 introduces learners to Tuna farming, a relatively new and profitable addition to Mediterranean aquaculture. The enterprise’s dependency on the capture of adult wild fish in seine nets, which are transferred to cages and towed by tug boats to the on-growing sites for ‘fattening’, is highlighted. Learners will become aware of the unsustainable nature of current production regimes, necessitating the development of closed cycle production. The risks of a down turn due to wild stock scarcity will be discussed, incentivising diversification and development of Amberjack production. Learners will explore the recent Amberjack research and development that is bringing commercial ‘closed cycle’ production of this promising new farmed species closer, in some depth, satisfying Outcome 2.

Learners will be made aware of the live feed production trials underway in an attempt to improve the survival rate of Tuna larvae during the critical first 10 days of rearing. Outcome 3 is satisfied by learners establishing, maintaining and monitoring a demonstration scale live feeds unit for algae, rotifers and *Artemia* (brine shrimp) *nauplii*, gaining some of the basic skills and disciplines that would be required in a Tuna or Amberjack hatchery.

Outcome 4 requires learners to demonstrate an understanding of fish husbandry requirements during the on-growing phase, developed through a combination of centre based study and visits to farms and research facilities. Finally, through the completion of Outcome 5, Learners will gain an appreciation of factors influencing the selection and development of farm sites, including the criteria for economically viable fish production and the need to mitigate environmental impact. The influence of site

conditions and production regimes on the selection and operation of aquaculture technology will be considered.

## Learning Outcomes

On completion of this unit the learner will be able to

1. *Describe tuna and amberjack production regimes, with reference to the need for improved long-term sustainability.*
2. *Explain the development of hatchery techniques and technologies for farmed Tuna and Amberjack with reference to current research and development.*
3. *Conduct live feed culture operations according to established conventions in marine finfish hatcheries.*
4. *Describe the fish husbandry and site maintenance requirements during the on-growing phase for tuna and amberjack with reference to the Maltese industry.*
5. *Describe the influence of site specific factors on the selection of equipment and technology that is suitable for on-growing Tuna and Amberjack*

## An Introduction to Fisheries Studies

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This unit is designed for centre-based delivery to meet the needs of learners looking to enter the fish capture sector, or progress to higher education. The knowledge gained relating to the principles of fisheries biology that underpin the assessment and management of wild fish populations will provide a platform for understanding fisheries management.

Outcome 1 introduces learners to the central purpose of fisheries science, determining the fishing effort required for sustainable yields. A distinction will be drawn between MSY (Maximum Sustainable Yield) and MEY (Maximum Economic Yield) in the context of the history of a typical fishery as it moves from the 'prospective' stage, to being developed and ultimately over exploited. The methods of conserving fish stocks through controlling and limiting fishing effort will be discussed in general practical terms.

The standard methods of measuring individual finfish, shellfish and crustaceans will be revealed in Outcome 2, and consolidated through practical activities. The aging of fin fish from scale and otolith reading will be demonstrated and practiced by learners, and the information used to establish the age structure of a given fish population.

Once competent in the measurement of fish lengths and aging fish by scale or otolith reading, the processes and challenges of fish population assessment can be considered more fully by learners, as required by Outcome 3. Sampling strategies will be introduced, with the emphasis on ensuring 'representative samples', overcoming the influence of random sampling error and sampling bias that can undermine the supply of reliable management information, to the detriment of fishery science and capture fisheries.

Parallel to their knowledge development, learners will develop practical skills in the standardised measurement of fish length, shell fish and crustacean dimensions, and the aging of fish through scale reading, using the data to determine fish population structures. The results of a qualitative analysis of fish stomach contents can be correlated to fish age, determining changes in feeding behaviour over time. Learners will collect record and analyse fish data, learning how appropriate sample sizes and sampling regimes are established, thereby satisfying Outcome 4.

## Learning Outcomes

On completion of this unit the learner will be able to

1. *Explain how fish stocks can be managed to provide a sustainable yield whilst being protected from over exploitation.*
2. *Describe the standardised methods of measuring individual finfish, shellfish and crustaceans with reference to data extrapolation.*
3. *Describe fish population assessment methodologies with reference to sampling regimes and fish catch data.*
4. *Assess a fish population through applied field work and data analysis, informed by supplementary information.*

## Understanding Fisheries Management

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This unit is designed for centre-based delivery to meet the needs of learners looking to enter the fish capture sector, or progress to higher education. The understanding of a range of commercial fishing and fishery management practices is consolidated through the examination of a local fishery operation.

Outcome 1 introduces learners to the wide range of fishing methods and gear deployed to capture commercially significant species within industrial, semi industrial and artisanal fisheries important to Malta and the Mediterranean region. The different gear types for finfish, shellfish and crustaceans are considered, developing the learner's appreciation of the rationale for selecting particular methods and gear configurations to suit the environmental conditions and target species.

With some knowledge of fishing previously established, Outcome 2 provides learners the opportunity to relate commonly deployed fishing methods to fishery management practices, in particular the control of fishing effort and the use of different fishing gear to influence species and size selectivity helping to redress the frequent high 'bycatch' discard rates which concern environmentalists, the public and industry. The imposition of marine reserves and management zones is considered with reference to the Maltese Fisheries Management Zone (FMZ) recently established. Outcome 3 exposes learners to the equipment and technology used to prepare and store fish post capture, ensuring fish products of the highest quality reach market and satisfy consumer needs. The Maltese fish supply licensing and distribution system is studied in some detail to illustrate fish supply regulation from a predominantly artisanal fishery.

Learners can study and experience the operation of a specific fishery of interest to them, to satisfy Outcome 4, learning how the fishing gear is prepared, operated and maintained, fouling and snagging avoided, and the 'catch per unit effort' optimised. The safety regulations governing commercial fishing will be integrated and emphasised throughout, and some basic commercial fishing skills gained through completing Outcome 5.

## Learning Outcomes

On completion of this unit the learner will be able to

1. *Describe how finfish, shellfish and crustaceans are captured and the range of fishing methods and gear used.*
2. *Explain the fishery management practices applied locally and regionally across a range of fisheries.*
3. *Describe the fish supply process from capture to market and the measures taken to safeguard product quality.*
4. *Explain fishery operations for a given fishery, with reference to the preparation, handling and maintenance of fishing equipment.*
5. *Participate in commercial fishing operations complying with standard operating procedures and health and safety requirements.*

## Marine Ornamental Aquaria

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This unit is designed for centre-based delivery to meet the needs of learners looking to enter the ornamental sector, or progress to higher education. Skills relating to marine aquarium systems and an understanding of how to provide the environmental conditions required by commonly held flora and fauna will be developed.

Outcome 1 is introductory, introducing the marine flora and fauna of commercial interest. Learners will research the habitat requirements and optimal conditions for fish and aquatic invertebrates commonly kept in marine aquaria, and the operating procedures that maintain a healthy aquatic environment.

The sources of fish and aquatic invertebrates for the ornamental trade will be revealed and sustainability issues facing the ornamental sector, considered. They will progress to the establishment of mixed fish populations and themed displays subsequently, satisfying Outcome 2.

Outcome 3 encourages learners to explore the technology, equipment and materials used in the aquatics industry, including the components of single and multi-tank systems used by hobbyists and the ornamental trade.

Outcome 4 develops the learner's knowledge of the animal health and welfare legislation with which the ornamental sector must comply, exemplified through case studies. The welfare of animals is taken seriously by society, and fish are subject to the same moral, ethical and legal considerations as other animals when kept in captivity.

Through practical demonstration, instruction and practise, marine aquatic husbandry skills will be nurtured and consolidated. Learners will be equipped to establish and maintain an aquarium environment for selected compatible species of marine fish, and aquatic invertebrates, thereby satisfying Outcome 5 and completing the Unit.

### Learning Outcomes

**On completion of this unit the learner will be able to**

1. Describe the habitat and environmental requirements of marine aquatic organisms, with reference to fish and invertebrates.

2. *Describe the marine species that are suitable for keeping in a range of marine aquaria configurations with reference to their compatibility.*
3. *Explain environmental control principles with reference to the function of the equipment used in marine aquaria to support aquatic life.*
4. *Explain the implications of the major legislation governing the aquatics industry with reference to its impact on operating procedures.*
5. *Establish a marine aquarium community and maintain suitable environmental conditions informed by routine monitoring.*

## Aquascaping and Ornamental Invertebrates

Unit level (MQF): 4

Credits: 6

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### Unit Description

This unit is designed for centre-based delivery to meet the needs of learners looking to enter the ornamental sector, or progress to higher education. The Unit has two distinct strands, the specialist art of ‘aquascape’ creation, and the biology and husbandry of ornamental invertebrates.

Outcome 1 introduces learners to ‘aquascaping’, developing an appreciation of a number of popular distinct styles, including the garden-like Dutch style and the Japanese-inspired nature style. The craft skills to create an arrangement of aquatic plants, rocks, stones and driftwood to compose attractive aquascapes, will be developed. Although the primary aim is to create an aesthetically pleasing underwater landscape, the technical aspects of aquatic plant maintenance will be considered. To ensure the success and continuity of an aquascape, learners must balance many factors in a closed system aquarium, including; filtration, maintaining carbon dioxide to support photosynthesis, substrate and fertilization, lighting, and algae control. Learners will be required to design, develop and maintain their own aquarium aquascape, gaining real hands on experience and skills to satisfy Outcome 2.

Working with captive species of invertebrates in the retail or public aquarium sectors, demands a thorough knowledge of the general biology of the invertebrates kept and maintained. As the species commonly held belong to a diverse and varied range of classes, many have unique and specialised features that can influence their husbandry and care.

Outcome 3 develops the learners’ knowledge of the range of invertebrate species kept for ornamental purposes, initially building an understanding of the classification system and evolutionary history of the taxa ‘in scope’. Learners will be familiarised with the general internal and external anatomy of the key taxa, so that the more unusual biological features of some organisms can be understood. They can then reflect on how extraordinary features may determine or influence animal care and husbandry, linking their biological knowledge to practical workplace implications.

A practical working knowledge of invertebrate reproductive strategies and requirements will be developed as captive breeding programmes are becoming increasingly important in the conservation of many aquatic animals. In addition, selective breeding is used to develop new strains for the ornamental trade,

successfully. Real 'hands on' experience, working with a range of captive ornamental invertebrates over an extended period will consolidate learners' knowledge and understanding, developing key husbandry skills and satisfying Outcome 4.

## **Learning Outcomes**

**On completion of this unit the learner will be able to**

- 1. Describe how aquascapes are designed, created and maintained with reference to current influential trends.*
- 2. Design, construct, and maintain an aquascape, conforming to approved plans.*
- 3. Explain the biology of ornamental aquatic invertebrates, with reference to the husbandry implications and emerging breeding practices.*
- 4. Feed and maintain a selection of ornamental invertebrates, maintaining optimal environmental conditions.*

## Navigation

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

**A comprehensive introduction to Navigation and Boat handling in short trip sea passages for inexperienced individuals in non-tidal waters.**

The course will equip individuals with enough knowledge to be able to plan short trip sea passages, understand the vessel they are on, communicate with authorities, behave in a competent manner as a crewmember onboard and navigate local and familiar waters by day. The learner will also acquire a good grounding in weather monitoring and be able to exert a judgement on the state of the weather during a trip.

The course also includes nautical language and words, rope handling, safety procedures, collision regulations, compass and electrical navigational aids, chart work, weather, passage planning and pilotage, buoyage systems.

In addition the course will introduce the learner to navigational lights so as to provide a basic knowledge should the voyage overlap into night time.

NB In the course of this unit, students will also learn how to handle a boat. At the end of this unit students will be competent to undertake the Nautical License exam held by Transport Malta. It is advisable that learners do so in order to be in possession of the correct license as required by Transport Malta under Maltese Law and thereby enable them to apply a practical use of this unit to its fullest extent.

### Learning Outcomes

**On completion of this unit the learner will be able to**

1. *Demonstrate Seamanship.*
2. *Demonstrate Navigational Competence.*
3. *Interpret and Apply Rules and Regulations.*
4. *Apply and Interpret Weather forecasts and Patterns.*

## Introduction to Oceanography

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This unit is designed for centre-based delivery to meet the needs of learners looking to enter the fish management sector (aquaculture, fisheries or ornamentals), or progress to higher education. The knowledge gained in Oceanography is complemented by the skills developed in the identification of marine life and the analysis of water characteristics.

The biodiversity, productivity and spoliation of marine ecosystems, is explored fully, supporting the development of emergent thinking in Fisheries Management. Conventional, single species stock management approaches which have led to the overexploitation of fish stocks are being questioned, and calls for a more ecologically sound holistic 'multi-species' approach to fishery management are growing. Therefore, the central thrust of the unit - understanding the ecology of the marine environment, provides a basis for better management of marine resources in the future, locally, and globally.

Outcome 1 introduces important water characteristics in the context of the hydrological cycle, including the freshwater phase, before the emphasis shifts towards a full exploration of the marine environment. This is exemplified by studying the nature of the freshwater and marine resource in Malta and the Mediterranean region. Initially, learners will develop their knowledge of how water characteristics can change during waters' journey through the hydrological cycle due to natural and human influences. The physical and chemical properties of water are explored through class based activity and practical field work, as required by Outcome 2, and the key parameters measured. This can be integrated with water quality monitoring in fish holding facilities, re-enforcing the dynamic nature of the biotic influences on water and potential impact on captive and natural fish stocks.

In Outcome 3, learners will develop a basic knowledge of physical oceanography, emphasising the physical forces that drive water movement and exchange between oceans, including wind generated currents and waves, water density differentials and tidal action. This knowledge underpins the development of learners full understanding of how key requirements to the growth of marine life, including oxygen and nutrients, are transported, boosting the productivity of the oceans.

Outcomes 4 and 5 are a major component of delivery, providing learners the opportunity to develop a detailed knowledge of Mediterranean flora, fauna and ecology, including the identification of typical members of the main taxa through qualitative surveys of a range of marine habitats. Once the holistic and cyclical nature of marine food webs and trophic systems are understood, consideration of current environmental issues, including spoliation, overfishing and the impact of invasive exotic species, can follow. The unit will conclude on a positive note, with an evaluation of marine conservation plans in place and under development for the Mediterranean region.

## Learning Outcomes

**On completion of this unit the learner will be able to**

- 1. Describe the typical variations in the physical and chemical characteristics of water at different stages of the hydrological cycle.*
- 2. Measure the physical and chemical characteristics of water in the field using basic chemical tests and monitoring equipment.*
- 3. Describe the physical zones of the marine environment and the forces driving water circulation in the oceans.*
- 4. Explain the ecology and biodiversity of the Mediterranean marine environment with reference to factors determining productivity.*
- 5. Identify Mediterranean marine flora and fauna using simple identification keys and through conducting qualitative surveys.*

## Freshwater Ornamental Aquaria

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This unit is designed for centre-based delivery to meet the needs of learners looking to enter the ornamental sector, or progress to higher education. Skills relating to freshwater the establishment and maintenance of freshwater aquarium systems will be developed.

Outcome 1 introduces to the learner to freshwater flora and fauna of commercial interest. Learners will research the habitat requirements and optimal conditions for fish, aquatic invertebrates and plants commonly kept in freshwater aquaria, and the operating procedures required, ensuring a healthy aquatic environment.

The sources of fish, aquatic invertebrates and plants for the ornamental trade will be revealed and sustainability issues facing the ornamental sector considered. Learners will progress to the establishment of mixed fish populations and themed displays subsequently, satisfying Outcome 2.

Outcome 3 encourages the exploration of the technology, equipment and materials used in the aquatics industry, including the components of single and multi-tank systems deployed by hobbyists and the ornamental trade.

Outcome 4 develops the learner's knowledge of the animal health and welfare legislation with jurisdiction over the ornamental sector, exemplified through case studies. Learners will be made aware that the welfare of animals is taken seriously by society, and that the moral, ethical and legal considerations applied to terrestrial animals, also apply to fish when kept in captivity.

Through practical demonstration, instruction and practise, freshwater aquatic husbandry skills will be nurtured and consolidated. Learners will be equipped to establish and maintain an aquarium environment for compatible species of freshwater fish, aquatic invertebrates and plants, thereby satisfying Outcome 5.

### Learning Outcomes

**On completion of this unit the learner will be able to**

1. *Describe the habitat and environmental requirements of freshwater aquatic organisms with reference to their tolerance limits and optimal conditions.*

2. *Evaluate the suitability of aquatic flora and fauna to be kept in freshwater aquaria with reference to their compatibility.*
3. *Explain environmental control principles with reference to the function of the equipment used in freshwater aquaria to support aquatic life.*
4. *Explain the implications of the major legislation governing the aquatics industry with reference to codes of practice.*
5. *Establish freshwater aquaria environments and their inhabitants, monitoring the aquatic environment to ensure that suitable conditions are maintained.*

## Work-related Experience in the Environmental Sustainability Sector

**Unit level (MQF):** 4

**Credits:** 6

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### Unit Description

This is a skills based unit that will allow learners to demonstrate that they have the necessary skills to be able to understand the importance of sustainable approaches on the workplace, and to be able to plan, undertake and review work-based experience in the environmental sustainability sector. Students will familiarise themselves with important aspects of sustainable approaches, such as their importance, impacts, the opportunities they provide and several popular techniques currently implemented.

The Unit is relevant to learners wishing to further develop their knowledge and understanding of a sustainable approach to businesses, and the ways with which they can access the various career opportunities this stream offers. On completion of the Unit, learners will have grasped the three step process to preparing for sustainable based work-related experience: prepare, undertake and review. They will obtain insight into what steps are required in the application process, what skills are required in an interview, and how they can prepare to start work. Furthermore, learners will gain knowledge of various methods with which they can keep track of their progress, as well as methods of how they can review their performance for self-improvement. Learners will also be able to implement a Personal Development Plan for their work-related experience.

Learners will carry out independent research and study to obtain important inductive insight into work-based experience in the environmental sustainability sector.

### Learning Outcomes

**On completion of this unit the learner will be able to**

- 1. Describe the importance of applying a sustainable approach in the workplace.*
- 2. Prepare for a sustainable work-related experience in the environmental sustainability sector.*
- 3. Undertake a work-related experience in the environmental sustainability sector.*
- 4. Review a work-related experience in the environmental sustainability sector.*