

Unit 22: Understanding Ornamental Fish and Aquatic Invertebrate Biology

Unit code:	K/600/9241
QCF Level 3:	BTEC National
Credit value:	10
Guided learning hours:	60

● Aim and purpose

This unit aims to introduce learners to ornamental fish and aquatic invertebrate biology understanding and how this 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

Working with captive species of fish and invertebrates, such as in the retail or public aquarium industry, demands a thorough knowledge of the general biology of the animals that are maintained. Additionally, the species kept are diverse and varied and many animals have unique and specialised features that often impact on their husbandry and care.

This unit develops the learners' knowledge of the range of aquatic species kept for ornamental purposes. This should build on their understanding of the basic classification of animals in order to appreciate their position in the animal kingdom and relationship to other species.

The general internal and external anatomical features should be investigated, so that the more unusual biological features of some organisms can be more fully understood. Learners should then consider how these extraordinary features might alter the care the animal needs in relation to normal husbandry procedures. In doing so, knowledge of the biology is directly linked to practical implications in the workplace. Learners should have the opportunity to apply this knowledge practically.

Increasingly, captive breeding programmes are becoming important in the conservation of aquatic animals. On the other hand, selective breeding is used to develop new ornamental strains. For both these applications, it is useful to have a good understanding of the principles of genetics. Again, the practical application of this knowledge is important and can be demonstrated in an through the produce a basic genetic cross diagram. The learner should also consider the legal and ethical implications for some genetic manipulation.

Learning outcomes

On completion of this unit a learner should:

- 1 Understand the biological features of ornamental bony fish
- 2 Understand the biological features of aquatic invertebrates
- 3 Understand the biological features of elasmobranchs
- 4 Understand principles of genetics and how these are applied to fish culture.

Unit content

1 Understand the biological features of ornamental bony fish

Classification: the Linnaean classification system; the development of fish groups; the concept of taxa eg kingdom, class, order, family, genus, species; binomial system of scientific nomenclature

Internal and external anatomical features; structure, location and function of major internal and external features eg major internal organs, fins, sensory systems

Structure and function of unique biological features of taxa eg 'lung' of lungfish, labyrinth organs of anabantids; the impact of these features on husbandry; life cycles; reproductive strategies

2 Understand the biological features of aquatic invertebrates

Classification: the taxonomy and development of invertebrates commonly kept in captivity

Internal and external anatomical features: structure, location and function of major internal and external features eg exoskeleton, mouth parts, gonads, intestine

Structure and function of unique biological features of taxa: eg zooxanthellae in cnidarians; the impact these features have on the invertebrates' husbandry; life cycles; reproductive strategies

3 Understand the biological features of elasmobranchs

Classification: the taxonomy and development of chondrichthyes

Internal and external anatomical features: structure, location and function of major internal and external features eg major internal organs, fins, sensory systems

Structure and function of unique biological features of taxa eg Leydig's organ, epigonal organ, spiral valve, heterocercal tail; impact of their biology on husbandry requirements eg nutrition, environment; life cycles; reproductive strategies

4 Understand principles of genetics and how these are applied to fish culture

Common genetic terms eg heredity; locus; haploidy; diploidy; genetic variation; genotype; phenotype; alleles, heterozygy, homozygy

Genetic crossing: genetic and environmental sex determination; hermaphroditism (synchronous and asynchronous); genetic manipulation eg triploidy, gynogenesis

Genetic manipulation: use of genetic selection in developing desirable characteristics eg shape, colour; undesirable effects of genetic selection eg deformities; environmental and fish welfare issues; relevant current legislation and codes of practice

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 structure of major internal and anatomical features of selected bony fish	M1 explain in detail the structure and function of internal or external anatomical features unique to selected species from different bony fish groups	D1 explain how the unique biology of selected aquatic species affects their husbandry
P2 explain the function of major external and anatomical features of selected bony fish		
P3 apply the Linnaean system of classification to classify a selected range of fish to genus [CT]		
P4 explain the structure of the major internal and anatomical features of selected species from different aquatic invertebrate groups	M2 explain in detail the structure and function of internal or external anatomical features unique to selected species from different aquatic invertebrate groups	
P5 explain the function of the major external and anatomical features of selected species from different aquatic invertebrate groups [IE]		
P6 apply the Linnaean system of classification to classify a selected range of aquatic invertebrates to genus		
P7 explain the structure of the major internal and anatomical features of selected species from different elasmobranch groups	M3 explain in detail the structure and function of internal or external features unique to selected species from different elasmobranch groups	

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 explain the function of the major external and anatomical features of selected species from different elasmobranch groups		
P9 apply the Linnaean system of classification to classify a selected range of elasmobranchs to genus [SM, EP, RL]		
P10 explain the meaning of selected, common genetic terms and expressions. [SM]	M4 produce a genetic cross diagram for developing a desirable characteristic in a selected bony fish species.	D2 review the use of genetic manipulation in fish culture.

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 CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators
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Essential guidance for tutors

Delivery

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, supervised site visits, 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. The impact of the unique biology of aquatic animals on their care should be relevant to every work placement in the aquatics or public aquarium industries. 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 breed bony fish to produce desirable characteristics and they should ask for observation records or witness statements to be provided as evidence of this. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Visiting expert speakers could add to the relevance of the subject for learners. For example, an aquarium manager or aquarist could talk about their work and the methods they use.

Whichever delivery methods are used, it is essential that tutors stress the importance of animal welfare and careful environmental and safe practice when working with aquatic systems.

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. This is particularly important when working with some of the specialist species (for example corals and lionfish) that may be toxic or potentially dangerous, or with aquatic systems especially those incorporating electrical equipment.

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 outcomes 1, 2 and 3 cover parallel topics. Initial coverage of the classification of aquatic species is likely to be delivered through formal lectures but, once the foundations are laid, knowledge could be expanded, deepened or integrated into practical areas through guided study and discussion with learners. Learners could classify and identify the features of species kept at home or seen during visits to public aquariums, retailers or wholesalers. Visiting speakers could be invited to talk about the husbandry of particular species and how this relates to their biology.

Learning outcome 4 looks at the principles of genetics. Delivery techniques should be varied and, again, can build on any experience learners have of, for example, particular fish breeding programmes. Visiting speakers could give be useful in delivery of this topic. Experts on the breeding of koi, for example, could provide a great deal of directly relevant information on applying genetic principles to producing koi varieties.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

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

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

Topic and suggested assignments/activities and/assessment
Introduction and overview of the unit.
Assignment 1: Bony Fish Biology and Husbandry (P1, P2, P3, M1, D1)
Introduction to assignment.
Classification of fish, including agnathans and chondrichthyes.
Internal and external features of bony fish, unusual features of selected bony fish and potential impact of these features on their care.
Assignment 2: Aquatic Invertebrate Biology and Husbandry (P4, P5, P6, M2, D1)
Introduction to assignment.
Classification of aquatic invertebrates commonly maintained in captivity.
Internal and external features of invertebrates, unusual features of selected aquatic invertebrates and potential impact on their care.
Assignment 3: Elasmobranch Biology and Husbandry (P7, P8, P9, M3, D1) Introduction to assignment.
Internal and external features of elasmobranchs, unusual features of selected elasmobranchs and potential impact on their care.
Assignment 4: The Principles of Genetics (P10, M4, D2)
Introduction to assignment.
Genetic terminology, genetic crosses, use of genetics in fish culture, legal implications.
Individual support.
Personal study.
Practice: care of aquatic collections, husbandry regimes, maintenance of displays and associated equipment/life support systems.
All forms of assessment.
Unit review.

Assessment

For P1, P2, P4, P5, P7 and P8, learners must provide information on the structure function of the major internal and external anatomical features of selected aquatic animals. Tutors should identify the species or agree them through discussion with learners. Where possible, to ensure assessment is fair, the complexity of the task should be the same for all learners. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster, a project or a series of laboratory reports.

Alternatively, this could be assessed directly by the tutor during practical activities (such as dissection and visits). If this format is used then suitable evidence from guided activities would be observation records completed by learners and tutor and accompanied by appropriate work logs or other relevant learner notes. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

For P3, P6, and P9, learners are required to provide information on the classification of selected aquatic species. Most texts on the diversity of aquatic animals will provide information on their taxonomy and learners should be encouraged to develop the full classification, although it will only be assessed to genus level. There are also many web-based sites where full classification is given. Learners may choose and investigate species which are of particular interest to them

For P10, learners are expected to demonstrate their understanding of basic genetic terminology. This could

be assessed via a time constrained test or oral questions. Where possible, to ensure assessment is fair the complexity of the task should be the same for all learners.

For M1, M2, and M3, learners must provide information on the structure function of major internal or external anatomical features unique to selected species from different aquatic animal groups, such as those features identified in the content. Tutors should identify the species or agree them through discussion with learners. Where possible, to ensure assessment is fair, the complexity of the task should be the same for all learners. This may be the same species used to provide evidence for other grading criteria. It is expected that learners will provide evidence for at least three species of bony fish, invertebrates and elasmobranch. Evidence could be in the same form as for P1, P2, P4, P5, P7 and P8.

For M4, learners must produce a genetic cross diagram for developing a desirable characteristic in a selected bony fish species. Tutors should identify the desirable characteristic or agree it through discussion with learners. Where possible, to ensure assessment is fair, the size and complexity of the task should be the same for all learners. This may be the same species as that used to provide evidence for other grading criteria. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a project.

For D1, learners must evaluate how the unique biology of selected aquatic species affects their husbandry. For example, learners could include in their evidence how the venous system of fish affects the intramuscular administration and pharmacokinetics of drugs or why lungfish and anabantids must have access to the water surface. If learners wish to investigate invertebrate groups they could look at the use of lighting to provide photosynthesis for the zooxanthellae of cnidarians. For elasmobranchs, the Ampullae of Lorenzini might affect the use of electrical equipment in the aquarium. Tutors should identify the species or agree them through discussion with learners. Where possible, to ensure assessment is fair, the complexity of the task should be the same for all learners. This may be the same species as those used to provide evidence for other grading criteria. It is expected that learners will provide evidence for at least three bony fish, three invertebrate or three elasmobranch species. Evidence could be in the same form as for P1 and linked to other grading criteria, for example M1.

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, P3 M1, D1	Bony fish biology and husbandry	Describe the usual and unusual biological features seen amongst bony fish and determine how this might affect their care.	Written evidence.
P4, P5, P6, M2, D1	Aquatic invertebrate biology and husbandry	Describe the usual and unusual biological features seen amongst aquatic invertebrates and determine how this might affect their care.	Written evidence.
P7, P8, P9, M3, D1	Elasmobranch biology and husbandry	Describe the usual and unusual biological features seen amongst elasmobranchs and determine how this might affect their care.	Written evidence.
P10, M4, D2	The principles of genetics	Demonstrate an understanding of genetic terminology, use this knowledge to produce a genetic cross diagram and outline the legal and ethical considerations.	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 Caring for Ornamental Aquatics	Understanding Fish Biology and Behaviour
Introduction to Fish Biology	Understanding Fish Health and Welfare
	Understanding Freshwater Aquarium Systems
	Understanding Marine Aquarium Systems
	Understanding Cyprinid Fish Farming
	Understanding Aquatics Management

Essential resources

Learners will need access to appropriate facilities where aquatic animals are kept. This might include the centre's fish house, a retail or wholesale premises or public aquarium. Access to a well-equipped laboratory will also be required for the examination of fish and invertebrate specimens.

Employer engagement and vocational contexts

Centres are encouraged to create and develop links with local retail or wholesale establishments and public aquariums. This could be via guest lectures or visits to see how the husbandry requirements of aquatic animals are met. Guest lecturers from public aquariums would be particularly useful in imparting their experience of current conservation programmes, the latest legislation and codes of practice in relation breeding/genetic programmes and public perceptions of genetic manipulation.

Indicative reading for learners

Textbooks

Andrews C, Excell A and Carrington N – *The Interpet Manual of Fish Health, 2nd Edition* (Interpet Publishing, 2002) ISBN 1842860674

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

Bond C – *The Biology of Fishes, 2nd Edition* (Thompson Learning, 1996) ISBN 0030703425

Bone Q, Marshall N and Blaxter J – *Biology of Fishes, 2nd Edition* (Taylor and Francis, 1995) ISBN 0748744983

Carrier J – *Biology of Sharks and Their Relatives* (Taylor and Francis, 2004) ISBN 084931514X

Haywood M – *The Interpet Manual of Marine Invertebrates* (Interpet Publishing, 1999) ISBN 1902389611

Moe M – *The Marine Aquarium Handbook: Beginner to Breeder* (Green Turtle Publications, 1992) ISBN 0939960079

Purdom C – *Genetics and Fish Breeding* (Kluwer Academic Publishers, 1992) ISBN 0412330407

Scott M – *Aquarium Sharks and Rays* (TFH Publications, 2001) ISBN 1890087572

Smartt J and Bundell J – *Goldfish Breeding and Genetics* (TFH Publications, 1997) ISBN 0793800900

Tave D – *Genetics for Fish Hatchery Managers, 2nd Edition* (Kluwer Academic Publishers, 1993) ISBN 0442004176

Tave D – *Selective Breeding Programmes for Medium-sized Fish Farms* (Food and Agriculture Organization of the UN, 1995) ISBN 925103740X

Magazines

Freshwater and Marine Aquarium magazine

Practical Fishkeeping magazine

Websites

www.defra.gov.uk

Department for Environment, Food and Rural Affairs

www.famamagazine.com

Freshwater and Marine Aquarium

www.hsegov.uk

Health and Safety Executive

www.lantra.co.uk

Sector Skills Council for the Environmental and Land-based Industries

www.ofish.org

Ornamental Fish International

www.ornamentalfish.org

Ornamental Fish

www.practicalfishkeeping.co.uk

Practical Fishkeeping

www.zipcodezoo.com

Zip Code Zoo

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 the unique features of aquatic animals
Creative thinkers	producing a genetic cross diagram
Reflective learners	considering how biological features impact on husbandry
Self-managers	revising and learning genetic terminology
Effective participators	giving their opinions on the ethical consideration of genetic manipulation.

● 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	
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	finding the classification of aquatic species using a variety of web sources
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> • text and tables • images • numbers • records 	producing written documents for Assignments 1-4
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	

Skill	When learners are ...
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	explaining how knowledge of the principles of genetic selection can be applied in the culture of ornamental bony fish
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reading articles explaining and evaluating the use of genetic selection and manipulation
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing written evidence for Assignments 1-3.