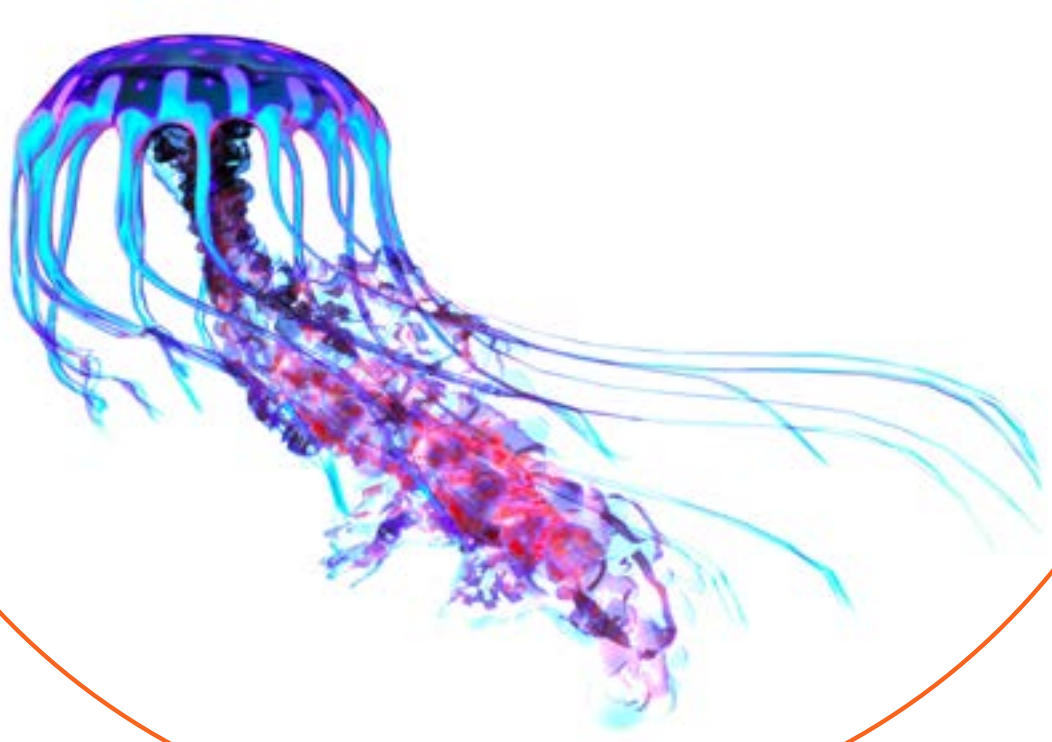
Cambridge Assessment International Education

Syllabus

Cambridge O Level

Marine Science 5180

Use this syllabus for exams in 2023.
Exams are available in the June series.
Exams are also available in the November series in Mauritius only.



Version 3

Please check the syllabus page at **www.cambridgeinternational.org/olevel** to see if this syllabus is available in your administrative zone.

Cambridge Pathway

Changes to the syllabus for 2023

The latest syllabus is version 3, published October 2022.

Exams are available in the June series.
Exams are also available in the November series in Mauritius only.

Previous changes to version 2, published May 2021

Information about availability on page 7 has been updated. There are no other changes to this syllabus.

You are strongly advised to read the whole syllabus before planning your teaching programme.

Any textbooks endorsed to support the syllabus for examination from 2018 are still suitable for use with this syllabus.

Contents

1. Introduction

1.1 Why choose Cambridge International?

Cambridge International prepares school students for life, helping them develop an informed curiosity and a lasting passion for learning. We are part of the University of Cambridge.

Our Cambridge Pathway gives students a clear path for educational success from age 5 to 19. Schools can shape the curriculum around how they want students to learn – with a wide range of subjects and flexible ways to offer them. It helps students discover new abilities and a wider world, and gives them the skills they need for life, so they can achieve at school, university and work.

Our programmes and qualifications set the global standard for international education. They are created by subject experts, rooted in academic rigour and reflect the latest educational research. They provide a strong platform for students to progress from one stage to the next, and are well supported by teaching and learning resources.

Every year, nearly a million Cambridge learners from 10 000 schools in 160 countries prepare for their future with the Cambridge Pathway.

Cambridge learners

Our mission is to provide educational benefit through provision of international programmes and qualifications for school education and to be the world leader in this field. Together with schools, we develop Cambridge learners who are:

- **confident** in working with information and ideas – their own and those of others
- **responsible** for themselves, responsive to and respectful of others
- **reflective** as learners, developing their ability to learn
- **innovative** and equipped for new and future challenges
- **engaged** intellectually and socially, ready to make a difference.

Recognition

Our expertise in curriculum, teaching and learning, and assessment is the basis for the recognition of our programmes and qualifications around the world.

Cambridge O Level is internationally recognised by schools, universities and employers as equivalent in demand to Cambridge IGCSE™ (International General Certificate of Secondary Education). There are over 600 000 entries a year in over 50 countries. Learn more at **www.cambridgeinternational.org/recognition**

Cambridge Assessment International Education is an education organisation and politically neutral. The contents of this syllabus, examination papers and associated materials do not endorse any political view. We endeavour to treat all aspects of the exam process neutrally.

Support for teachers

A wide range of materials and resources is available to support teachers and learners in Cambridge schools. Resources suit a variety of teaching methods in different international contexts. Through subject discussion forums and training, teachers can access the expert advice they need for teaching our qualifications. More details can be found in Section 2 of this syllabus and at **www.cambridgeinternational.org/teachers**

Support for exams officers

Exams officers can trust in reliable, efficient administration of exams entries and excellent personal support from our customer services. Learn more at **www.cambridgeinternational.org/eoguide**

Quality management

Cambridge International is committed to providing exceptional quality. In line with this commitment, our quality management system for the provision of international qualifications and education programmes for students aged 5 to 19 is independently certified as meeting the internationally recognised standard, ISO 9001:2015. Learn more at **www.cambridgeinternational.org/ISO9001**

1.2 Why choose Cambridge O Level?

Cambridge O Level is typically for 14 to 16 year olds and is an internationally recognised qualification. It has been designed especially for an international market and is sensitive to the needs of different countries. Cambridge O Level is designed for learners whose first language may not be English, and this is acknowledged throughout the examination process.

Our aim is to balance knowledge, understanding and skills in our programmes and qualifications to enable students to become effective learners and to provide a solid foundation for their continuing educational journey.

Through our professional development courses and our support materials for Cambridge O Levels, we provide the tools to enable teachers to prepare students to the best of their ability and work with us in the pursuit of excellence in education.

Cambridge O Levels are considered to be an excellent preparation for Cambridge International AS & A Levels, the Cambridge AICE (Advanced International Certificate of Education) Diploma, Cambridge Pre-U, and other education programmes, such as the US Advanced Placement program and the International Baccalaureate Diploma programme. Learn more about Cambridge O Levels at **www.cambridgeinternational.org/olevel**

Guided learning hours

Cambridge O Level syllabuses are designed on the assumption that learners have about 130 guided learning hours per subject over the duration of the course, but this is for guidance only. The number of hours required to gain the qualification may vary according to local curricular practice and the students' prior experience of the subject.

1.3 Why choose Cambridge O Level Marine Science?

International O Levels are established qualifications that keep pace with educational developments and trends. The International O Level curriculum places emphasis on broad and balanced study across a wide range of subject areas. The curriculum is structured so that students attain both practical skills and theoretical knowledge.

Cambridge O Level Marine Science is recognised by universities and employers throughout the world as proof of knowledge and understanding. Successful Cambridge O Level Marine Science candidates gain lifelong skills, including:

- an awareness of the intricate and delicate nature of the marine environment and its ecosystem
- knowledge of the practices and extent of the fishing industry within a world context and the need for sustainable development
- the development of relevant attitudes, such as a concern for accuracy and precision, objectivity, integrity, enquiry, initiative and inventiveness
- further interest in, and care for, the environment
- a better understanding of the influence and limitations placed on scientific study by society, economy, technology, ethics, the community and the environment.

Candidates may also study for a Cambridge O Level in a number of other science subjects including Chemistry and Physics. In addition to Cambridge O Levels, Cambridge International also offers Cambridge IGCSE and International A and AS Levels for further study in both Marine Science and other science subjects. See **www.cambridgeinternational.org** for a full list of the qualifications you can take.

Prior learning

We recommend that candidates who are beginning this course should have previously studied a science curriculum such as that of the Cambridge Secondary 1 Science or equivalent national educational frameworks. Candidates should also have adequate mathematical skills for the content contained in this syllabus.

Progression

O Level Certificates are general qualifications that enable candidates to progress either directly to employment, or to proceed to further qualifications.

Candidates who are awarded grades A* to C in O Level Marine Science are well prepared to follow courses leading to AS & A Level Marine Science, or the equivalent.

1.4 How can I find out more?

If you are already a Cambridge school

You can make entries for this qualification through your usual channels. If you have any questions, please contact us at **info@cambridgeinternational.org**

If you are not yet a Cambridge school

Learn about the benefits of becoming a Cambridge school at **www.cambridgeinternational.org/join**

Email us at **info@cambridgeinternational.org** to find out how your organisation can register to become a Cambridge school.

2. Teacher support

2.1 Support materials

You can go to our public website at **www.cambridgeinternational.org/olevel** to download current and future syllabuses together with specimen papers or past question papers, examiner reports and grade threshold tables from one series.

For teachers at registered Cambridge schools a range of additional support materials for specific syllabuses is available online from the School Support Hub. Go to **www.cambridgeinternational.org/support** (username and password required). If you do not have access, speak to the School Support coordinator at your school.

2.2 Training

We offer a range of support activities for teachers to ensure they have the relevant knowledge and skills to deliver our qualifications. See **www.cambridgeinternational.org/events** for further information.

3. Assessment at a glance

All candidates enter for three papers – Papers 1, 2 and 3.

Paper 1	**1 hour 30 minutes**
Candidates answer all questions. The questions require a mix of short or longer structured answers. 80 marks	
Paper 2	**1 hour 30 minutes**
Paper 2 has two sections. Candidates answer both sections which will include data handling. Section A consists of structured questions. Candidates answer all questions. Section B consists of questions requiring extended answers. Candidates answer all questions. 60 marks	
Paper 3	**1 hour 30 minutes**
Paper 3 will assess candidates' knowledge and understanding as well as the skills gained from undertaking core practicals. 60 marks	

Availability

Exams are available in the June series.
Exams are also available in the November series in Mauritius only.

This syllabus is not available to private candidates.

All Cambridge schools are allocated to one of six administrative zones. Each zone has a specific timetable. This syllabus is not available in all administrative zones. To find out about availability check the syllabus page at **www.cambridgeinternational.org/5180**

Detailed timetables are available from **www.cambridgeinternational.org/timetables**

Combining this with other syllabuses

Candidates can combine this syllabus in an examination series with any other Cambridge International syllabus, except:

- syllabuses with the same title at the same level.

Please note that Cambridge O Level, Cambridge IGCSE and Cambridge IGCSE (9–1) syllabuses are at the same level.

4. Syllabus aims and assessment objectives

4.1 Syllabus aims

1. To provide a worthwhile educational experience for all candidates, through well-designed studies of Marine Science, whether or not they go on to study a related subject beyond this level.
2. To enable candidates to acquire sufficient understanding and knowledge to:
   - develop an awareness of the practices and extent of the fishing industry within a world context and the need for sustainable development
   - appreciate the extent and variety of the exploitation of marine resources
   - be aware of the contribution of science to the modernisation and advancement of the fisheries industry
   - recognise the importance of marine resources as a major source of nutrition
   - recognise the importance of marine resources as a major contributor to national economies
   - appreciate the inter-dependence and integrated nature of Marine Science, the fishing industry and other industries such as tourism
   - appreciate the intricate and delicate nature of the marine environment and its ecosystems
   - acquire a sense of respect and responsibility for the environmental and conservational issues associated with the marine environment and the fishing industry.
3. To stimulate candidates, to create and sustain their interest in Marine Science, and to enhance their understanding of its relevance to society.
4. To develop abilities and skills that are relevant to the study and practice of Marine Science.
5. To assist the development of:
   - objectivity
   - integrity
   - initiative
   - the skills of scientific inquiry.
6. To promote an awareness:
   - that the study and practice of science is subject to social, economic, technological, ethical and cultural influences and limitations
   - that science transcends national boundaries and that the language of science, correctly and rigorously applied, is universal.
7. To be suitably prepared for studies beyond O Level in subjects relating to the marine environment, in further education.

In this syllabus, the learning outcomes of each theme are followed by a table summarising the content of the theme.

4.2 Assessment objectives

These assessment objectives describe the knowledge, skills and abilities that candidates are expected to demonstrate at the end of the course. They generally reflect those aspects of the aims that will be assessed.

AO A: Knowledge with understanding

Candidates should be able to demonstrate knowledge and understanding in relation to:

- the marine environment
- systematics and biodiversity
- anatomy and physiology of some marine organisms
- the distribution and abundance of marine organisms
- fisheries resources
- fishing gear technology
- seafood technology
- fisheries economics and marketing
- fisheries management.

The curriculum content defines the factual knowledge that candidates may be required to recall and explain. Questions testing these objectives will often begin with one of the following words: *define*, *state*, *name*, *describe*, *explain (using your knowledge and understanding)* or *outline*. (See the glossary of terms at the back of this booklet.)

AO B: Handling information and application of knowledge and understanding

Candidates should be able to use oral, written, symbolic, graphical and numerical forms of presentation to:

- handle information presented
- present data in different forms and interpret data
- present reasoned explanation for phenomena, patterns and relationships
- manipulate numerical and other data
- apply their knowledge and understanding of the learning outcomes.

Some aspects of this assessment objective cannot be precisely specified in the curriculum content because questions testing such skills may be based on information and contexts that are unfamiliar to the candidate. In answering such questions, candidates are required to use principles and concepts that are within the syllabus and apply them in a logical, reasoned or deductive manner. Questions testing these objectives may begin with one of the following words: *discuss*, *predict*, *suggest*, *explain*, *calculate* or *determine*.

AO C: Practical skills and investigations

Candidates should be able to:

- draw and label specimens, make measurements and understand the concept of scale; make relevant comparisons of biological material
- record results and interpret experimental observations and data
- describe experimental methods
- extract, classify and present experimental data in appropriate forms including tables, graphs and diagrams to enable reasoned conclusions to be made
- design, plan and evaluate investigations to test hypotheses and consider limitations and improvements to their designs.

Practical work is an essential part of the course. It is expected that practical activities will underpin each of the syllabus themes and candidates are expected to carry out all the core practicals included in the syllabus. Candidates' experience of practical activities and the skills gained will be assessed by means of a practical assessment paper.

4.3 Weighting for assessment objectives

The approximate weightings allocated to each of the assessment objectives in the scheme of assessment are summarised in the table below.

Assessment objective	Weighting (%)
A Knowledge with understanding	40
B Handling information and application of knowledge and understanding	30
C Practical skills and investigations	30

The relationship between the assessment objectives and the scheme of assessment is set out in the table below. The values given are for guidance only and have a tolerance of ±2%.

Assessment objective	Paper 1 (%)	Paper 2 (%)	Paper 3 (%)
A Knowledge with understanding	25	15	–
B Handling information and application of knowledge and understanding	15	15	–
C Practical skills and investigations	–	–	30

4.4 Scheme of assessment

Paper	Type of Paper	Duration	Assessment objectives	Marks	Weighting (%)
1	Short, structured questions	1 hour 30 minutes	AO A and AO B	80	40
2	Data handling and longer written questions	1 hour 30 minutes	AO A and AO B	60	30
3	Practical assessment paper	1 hour 30 minutes	AO C	60	30

In all examinations, where question papers include data, candidates will be expected to use units that are consistent with the units supplied and should not attempt conversion to other systems of units unless this is a requirement of the question.

Paper 1 consists of short, structured questions based on the syllabus subject content. All questions are compulsory.

Paper 2 consists of two sections: Section A and Section B. Section A consists of data handling and data interpretation questions, and Section B contains questions requiring extended answers. All questions are compulsory.

Paper 3 consists of a practical assessment paper.

This paper tests candidates' experience of core practicals and includes questions designed to test each of the following categories:

- making and recording accurate observations
- performing experiments and interpreting the results
- designing and evaluating experiments.

All questions are compulsory.

5. Syllabus content

This syllabus gives you the flexibility to design a course that will interest, challenge and engage your learners. Where appropriate you are responsible for selecting resources and examples to support your learners' study. These should be appropriate for the learners' age, cultural background and learning context as well as complying with your school policies and local legal requirements.

Theme 1: The marine environment

Aims

Candidates will gain a knowledge and understanding of the structure of the Earth; the marine environment and ecosystems; features of shores and coral atolls; the chemical and physical properties of sea water; climatic properties and global warming.

Learning outcomes

Candidates should be able to:

(a) describe the structure of the Earth as core, mantle and crust

(b) outline plate tectonic theory

(c) understand the formation of tsunamis

(d) appreciate the extent and depths of the oceans

(e) outline the geomorphology of the marine environment as continental shelf, continental slope, abyssal plain, submarine ridge, ocean trench, volcanic island, coral reef and atoll

(f) describe the main features of a sandy shore, rocky shore and a muddy shore

(g) describe the features of estuaries and mangrove forests

(h) outline the Darwin-Dana-Daly theory of atoll formation

(i) understand the chemical properties of sea water including inorganic solutes, salinity, dissolved oxygen, pH

(j) describe the processes of diffusion and osmosis

(k) understand the physical properties of sea water including density, pressure, light penetration, temperature, tides and wave action, currents and upwellings

(l) describe the features of wet and dry monsoons

(m) outline the features of El Niño

(n) discuss the causes and effects of global warming

(o) apply the knowledge and understanding gained in this section in new contexts

Core practical work to include investigating chemical and physical properties of sea water including density, salinity (by evaporation), light penetration, temperature, tidal amplitude; measurement of current speed and direction using a timed float and compass; measurement of the volume of an irregular object by the displacement method; demonstration of 'sinking sea water' to show difference in densities between fresh water and sea water; construction and use of a simple hydrometer; investigating sediment particle size distribution by sedimentation; determination of the slope of a beach; determination of the moisture content of sand from different areas of a beach.

Content of Theme 1	
1. Introduction to Marine Science 1.1 Structure of the Earth 1.2 Plate tectonics 1.3 Tsunamis 1.4 Extent and depths of the oceans **2. Geomorphology of the marine environment** 2.1 Continental shelf 2.2 Continental slope 2.3 Abyssal plain 2.4 Submarine ridge 2.5 Ocean trench 2.6 Volcanic island 2.7 Coral reef 2.8 Atoll **3. The sea shore** 3.1 Sandy shore 3.2 Rocky shore 3.3 Muddy shore **4. Coastal features** 4.1 Estuaries 4.2 Mangroves	**5. Atoll formation** 5.1 The Darwin-Dana-Daly theory **6. Chemical properties of sea water** 6.1 Inorganic solutes 6.2 Salinity 6.3 Dissolved oxygen 6.4 pH 6.5 Diffusion and osmosis **7. Physical properties of sea water** 7.1 Density 7.2 Pressure 7.3 Light penetration 7.4 Temperature 7.5 Tides and wave action 7.6 Currents and upwellings **8. Climatic features** 8.1 Monsoons 8.2 El Niño 8.3 Global warming

Theme 2: Systematics and biodiversity

Aims

Candidates will gain a knowledge and understanding of the principles of classification, including the five kingdom system, biodiversity and the characteristic external features of a range of representative marine organisms.

Learning outcomes

Candidates should be able to:

(a) understand that species are classified into groups according to shared features
(b) describe the principles of classification based on kingdom, phylum, class, order, genus and species
(c) describe the features of the five kingdoms (prokaryotes, protoctists, fungi, plants and animals)
(d) understand the principle of dichotomous keys for identification
(e) explain the meaning of the term *biodiversity*
(f) compare the biodiversity of two contrasting habitats, e.g. coral reef and sandy shore
(g) identify and describe the characteristic external features of each of the following groups:
    viruses and bacteria
    algae (microalgae, green algae, red algae and brown algae)
    flowering plants (seagrasses)
    cnidaria (jellyfish, sea anemones and coral polyps)
    annelids (polychaetes)
    molluscs (gastropods, bivalves and cephalopods)
    arthropods (shrimps, crabs and lobsters)
    echinoderms (sea cucumbers, starfish and sea urchins)
    chordates (bony fish, cartilaginous fish, reptiles, birds and mammals)
(h) apply the knowledge and understanding gained in this section in new contexts

Core practical work to include a simple comparison of species diversity in two different habitats; examination of specimens, making accurate drawings and making comparisons of external features.

Content of Theme 2	
1. Introduction to classification 1.1 Classification based on shared features 1.2 Principles of classification 1.3 The five kingdom system of classification 1.4 Dichotomous keys **2. Biodiversity** 2.1 Biodiversity of two habitats	**3. Representative marine organisms** 3.1 Viruses and bacteria 3.2 Algae 3.3 Seagrasses 3.4 Cnidaria 3.5 Annelids 3.6 Molluscs 3.7 Arthropods 3.8 Echinoderms 3.9 Chordates

Theme 3: Anatomy and physiology

Aims

Candidates will gain a knowledge and understanding of the structure and functions of external features, internal features, reproduction and life cycles of a range of representative marine organisms.

Learning outcomes

Candidates should be able to:

(a) describe the external features and their functions of a coral polyp (body, tentacles, oral disc, mouth, corallite)

(b) describe the internal features and their functions of a coral polyp (zooxanthellae, stinging cells, stomach cavity, mesenteries)

(c) describe the life cycle, reproduction and growth of corals (sexual and asexual reproduction)

(d) describe the external features and their functions of a sea cucumber (mouth, anus, tube feet)

(e) describe the life cycle, reproduction and growth of a sea cucumber (eggs, sperm, external fertilisation planktonic larvae)

(f) describe the external features and their functions of a decapod crustacean (carapace, abdomen, walking legs, eyes, antennae)

(g) describe the life cycle, reproduction and growth of a decapod crustacean (eggs, sperm, external fertilisation, planktonic larvae, moulting)

(h) describe the external features and their functions of a bony fish (mouth, nares, eyes, scales, lateral line, operculum, paired fins, median fins)

(i) describe the internal features and their functions of a bony fish (bony skeleton, gills, heart, swim bladder, gonads, gut)

(j) describe the life cycle, reproduction and growth of a bony fish (eggs, sperm, fertilisation, larvae)

(k) apply the knowledge and understanding gained in this section in new contexts

Core practical work to include dissection of a bony fish. Candidates should also be able to make accurate drawings of specimens, to make measurements, and understand the concept of scale in relation to their drawings.

Core practical work to include making comparisons between the visible external features of two contrasting specimens.

Content of Theme 3	
1. Corals 1.1 External features and functions 1.2 Internal features and functions 1.3 Reproduction and growth **2. Sea cucumber** 2.1 External features and functions 2.2 Reproduction and growth	**3. Decapod crustacean** 3.1 External features and functions 3.2 Reproduction and growth **4. Bony fish** 4.1 External features and functions 4.2 Internal features and functions 4.3 Reproduction and growth

Theme 4: Distribution and abundance

Aims

Candidates will gain a knowledge and understanding of the principles of ecology, including energy flow, food chains and food webs in the marine environment; the ways in which marine organisms are adapted to various abiotic and biotic factors.

Learning outcomes

Candidates should be able to:

(a) explain the meaning of the following terms: *ecology*, *habitat*, *ecosystem*, *primary producer*, *population*, *community*, *herbivore*, *carnivore*, *predator*, *prey*, *trophic level*

(b) outline the process of photosynthesis

(c) understand the importance of primary producers in marine ecosystems

(d) understand the flow of energy in marine food chains and food webs

(e) explain why energy is lost between trophic levels

(f) understand that food chains can be represented as pyramids of numbers and pyramids of biomass

(g) explain the importance of inorganic nutrients (nitrates and phosphates) for the growth of primary producers in marine ecosystems

(h) recall the role of upwellings in replenishing nutrients

(i) outline the role of decomposers in nutrient recycling

(j) identify common marine habitats and their characteristics (rocky shores, sandy shores, mangroves, shallow lagoon, coral reefs, open ocean, deep benthic)

(k) give examples of the ways in which marine organisms respond to the following abiotic factors: temperature, light, oxygen, salinity, wave action, current

(l) give examples of the structural and behavioural adaptations of marine organisms in relation to the following biotic factors: predator, prey, competition, symbiosis, shoaling

(m) apply the knowledge and understanding gained in this section in new contexts

Core practical work to include investigating the effect of light intensity on the rate of photosynthesis of an aquatic plant; construction of pyramids of numbers and fresh biomass, using simple techniques for collection of organisms; collection of plankton and identification of phytoplankton and zooplankton (limited to distinguishing between phytoplankton and zooplankton); comparisons between specimens from contrasting habitats, to understand how fish are adapted to their environment; field work including the use of a quadrat, transects and random sampling to investigate the distribution of organisms in a marine littoral habitat; investigating substrate selection using a marine invertebrate, measurement of the thickness of mollusc shells related to particle size of the substrate.

Content of Theme 4	
1. Introduction to marine ecology 1.1 Ecology 1.2 Habitat 1.3 Ecosystem 1.4 Primary producers 1.5 Population 1.6 Community 1.7 Herbivore 1.8 Carnivore 1.9 Predator 1.10 Prey 1.11 Trophic level **2. Energy flow in an ecosystem** 2.1 Photosynthesis 2.2 Primary producers 2.3 Flow of energy in food chains 2.4 Energy loss 2.5 Ecological pyramids **3. Inorganic nutrients** 3.1 Nitrates and phosphates 3.2 Upwellings 3.3 Decomposers	**4. Marine habitats** 4.1 Rocky shores 4.2 Sandy shores 4.3 Mangroves 4.4 Shallow lagoons 4.5 Coral reefs 4.6 Open ocean 4.7 Deep benthic **5. Responses of marine organisms to abiotic factors** 5.1 Temperature 5.2 Light 5.3 Oxygen 5.4 Salinity 5.5 Wave action 5.6 Currents **6. Adaptations of marine organisms in relation to biotic factors** 6.1 Predator 6.2 Prey 6.3 Competition 6.4 Symbiosis 6.5 Shoaling

Theme 5: Fisheries resources

Aims

Candidates will gain a knowledge and understanding of the main international and national fisheries and their exploitation; factors affecting fisheries resources; aquaculture and its social and environmental impacts.

Learning outcomes

Candidates should be able to:

(a) outline the main international fisheries resources (Indian Ocean, Atlantic Ocean, Pacific Ocean, and Mediterranean Sea) and their level of exploitation

(b) identify the main factors (production, demand and exploitation) affecting international fisheries resources

(c) analyse the main in-shore (close to land, in water up to about 30 m in depth), near-shore (deep lagoons, near reefs and within and around atolls) and off-shore (open seas and oceans) national fisheries resources and their level of exploitation

(d) describe how fishing grounds and seasons affect the availability of fisheries resources

(e) explain the meaning of the term *aquaculture*

(f) distinguish between intensive and extensive aquaculture operations

(g) identify the international fisheries resources produced from aquaculture, including fish and invertebrates

(h) describe the social aspects and environmental impact of aquaculture

(i) apply the knowledge and understanding gained in this section in new contexts

Core practical work to include visits to an aquaculture operation and a fish market; construction and analysis of a questionnaire.

Content of Theme 5

1. Fisheries resources
- 1.1 International fisheries resources
- 1.2 Factors affecting international fisheries resources

2. The national fishing industry
- 2.1 In-shore species
- 2.2 Off-shore species
- 2.3 Pelagic fisheries
- 2.4 Demersal fisheries

3. Factors affecting production
- 3.1 Fishing grounds
- 3.2 Seasons

4. Aquaculture
- 4.1 Intensive operations
- 4.2 Extensive operations
- 4.3 Fish and invertebrates
- 4.4 Social aspects
- 4.5 Environmental impact

Theme 6: Fishing and fishing gear technology

Aims

Candidates will gain a knowledge and understanding of the features of harbours and boatyards, boat building materials and fishing boats; navigational aids and seamanship; major fishing methods and their environmental impacts; the principle of a fish aggregating device.

Learning outcomes

Candidates should be able to:

(a) compare the features of traditional and modern harbours and boatyards

(b) describe three types of boat building materials and their properties (wood, aluminium and fibreglass)

(c) describe the features of a typical fishing boat

(d) outline the principle of a marine diesel engine (limited to the functioning of a 4-stroke diesel engine)

(e) describe the uses of the following navigational aids: compass, radar, echo sounder, Global Positioning System (GPS), chart, buoys

(f) explain what is meant by the term *seamanship*

(g) describe each of the following methods of fishing and their environmental impacts: beam trawl, otter trawl, long-line, drift nets (gill nets), purse seine, pelagic trawling, pelagic long-lines, pole-and-line fishing (including bait fishing), basket traps, cast nets

(h) explain the principle of a fish aggregating device (FAD)

(i) apply the knowledge and understanding gained in this section in new contexts

Core practical work to include investigations of buoyancy and streamlining.

Where possible, core practical work to include observation of local fishing methods; visits to a harbour and a boatyard.

Content of Theme 6	
1. Aids to fishing 1.1 Harbours 1.2 Boatyards 1.3 Boat building materials 1.4 Fishing boats 1.5 Marine diesel engine 1.6 Navigational aids 1.7 Seamanship	**2. Fishing gear and methods** 2.1 Beam trawl 2.2 Otter trawl 2.3 Long-line 2.4 Drift nets (gill nets) 2.5 Purse seine 2.6 Pelagic trawling 2.7 Pelagic long-lines 2.8 Pole-and-line 2.9 Basket traps 2.10 Cast nets 2.11 Fish aggregating devices

Theme 7: Seafood technology

Aims

Candidates will gain a knowledge and understanding of the properties of a range of biological molecules and their importance in a balanced diet; fish as a source of food, spoilage and methods of fish processing; genetic engineering and its economic and environmental impacts.

Learning outcomes

Candidates should be able to:

(a) recall the functions of some important biological molecules, including carbohydrates, lipids, proteins and nucleic acids

(b) understand that carbohydrates include simple sugars (monosaccharides and disaccharides) and polysaccharides (starch and glycogen)

(c) understand the general properties of lipids as fats and oils

(d) understand that proteins are polymers of amino acids

(e) understand that DNA and RNA are polynucleotides consisting of many mononucleotide monomers

(f) recall the essential components of a balanced diet, including water, carbohydrates, proteins, lipids, vitamins, mineral salts and dietary fibre

(g) explain the importance of fish as a source of food

(h) outline the social and economic importance of fish as a source of food

(i) explain what is meant by the term *spoilage*

(j) explain what is meant by the terms rigor mortis, autolysis, rancidity and putrefaction

(k) describe how freshly caught fish should be handled to minimise spoilage

(l) describe methods of fish processing and preservation, including chilling, freezing, irradiation and canning

(m) explain what is meant by the term *genetic engineering*

(n) outline the process by which a growth-promoting gene can be transferred to trout

(o) discuss the economic and environmental implications of the development of genetically engineered fish

(p) apply the knowledge and understanding gained in this section in new contexts

Core practical work to include biochemical tests for reducing sugars, non-reducing sugars, starch and proteins, using Benedict's reagent (or Fehling's), iodine solution and biuret reagent as appropriate.

Content of Theme 7	
1. Biological molecules 1.1 Carbohydrates 1.2 Lipids 1.3 Proteins 1.4 Nucleic acids **2. Diet** 2.1 Components of a balanced diet 2.2 Fish as food 2.3 Social and economic importance **3. Fish spoilage** 3.1 Rigor mortis 3.2 Autolysis 3.3 Rancidity 3.4 Putrefaction 3.5 Fresh fish handling	**4. Processing and preservation** 4.1 Chilling 4.2 Freezing 4.3 Irradiation 4.4 Canning **5. Genetic engineering** 5.1 Application 5.2 Implications

Theme 8: Fisheries economics and marketing

Aims

Candidates will gain a knowledge and understanding of the principles of economics applied to fisheries; ecotourism and its advantages and environmental impacts; seafood production, markets and international trade.

Learning outcomes

Candidates should be able to:

(a) explain the meaning of the following terms used in economics: *scarcity*, *unlimited wants*, *choice*, *opportunity cost*, *producers* (in the context of goods and services), *consumers* (in the context of using goods and services) and *regulators*

(b) outline the types of economic resources (natural, human, capital)

(c) discuss the relationship between the fisheries industry and the tourism industry

(d) explain the meaning of the term *marine ecotourism*

(e) state the aims of marine ecotourism

(f) discuss the potential advantages of marine ecotourism

(g) discuss the environmental impacts of marine ecotourism

(h) compare public and private ownership of fisheries

(i) outline the economic factors that affect aquaculture operations

(j) describe national and international seafood production and consumption patterns

(k) outline the factors that affect the price of seafood products (demand, supply, equilibrium, shortages, surpluses, pricing policy)

(l) identify what a market is, how markets are developed and the international markets for seafood products

(m) explain the meaning of the term *barter*

(n) outline how national and international trade occurs and the factors that influence trade (distances, labour supply, capital, exploitation, economic growth, contract sales)

(o) explain what is meant by the term *exclusive economic zone* (EEZ)

(p) apply the knowledge and understanding gained in this section in new contexts

Where possible, core practical work to include a visit to a fish market and processing plant; investigation of seafood products and their export destinations.

Content of Theme 8	
1. Introduction to economics 1.1 Economics in everyday life 1.2 Economic resources 1.3 Fisheries and tourism **2. Ecotourism** 2.1 Aims 2.2 Advantages 2.3 Environmental impacts	**3. Fisheries and marketing** 3.1 Public and private ownership 3.2 Aquaculture 3.3 Seafood production and consumption 3.4 Determination of market prices 3.5 Markets 3.6 Barter 3.7 National and international trade 3.8 The exclusive economic zone (EEZ)

Theme 9: Fisheries management

Aims

Candidates will gain a knowledge and understanding of national and international management of fisheries and sustainability; human impacts on marine ecosystems and conservation; regulation of fisheries and the aims of organisations involved in fisheries management and conservation.

Learning outcomes

Candidates should be able to:

(a) state the aims of management in the fisheries industry (continued employment, increased earnings, protection of fisheries resources)

(b) identify the regional, national and international organisations involved in fisheries management

(c) understand how fish stocks can be harvested sustainably

(d) explain the meaning of the following terms used in fisheries management: *maximum sustainable yield*, *catch per unit effort*

(e) describe fisheries projects to determine maximum sustainable yields (tag-release-recapture, gut content analysis, age and growth, fecundity, abundance and yield prediction)

(f) discuss the human impacts on the marine ecosystem (pollution by litter, oil, sewage, pesticides and heavy metals)

(g) identify the pollution control measures for litter, sewage and oil

(h) explain the meaning of the term *conservation*

(i) describe the conservation measures used for endangered species (turtles, sea cucumbers, giant clams and rare shells)

(j) understand the environmental impact of coral mining on fisheries

(k) describe the benefits of artificial reefs

(l) describe how fisheries practices are regulated and enforced (quotas, licences, boat restrictions, gear restrictions, closed seasons, closed areas and surveillance)

(m) outline the aims of organisations involved in fisheries management and conservation (Convention on International Trade in Endangered Species, Marine Stewardship Council)

(n) understand what is meant by the term *Marine Protected Area*

(o) apply the knowledge and understanding gained in this section in new contexts

Core practical work to include dissection of fish and examination of gut contents; examination of scales using a microscope; measurements of length and mass of a sample of fish or mollusc shells and analysis of data using graphical skills; estimation of fecundity of a mature female fish; estimation of growth rates from scale rings.

Content of Theme 9	
1. Management and aims of management 1.1 Aims 1.2 Regional management 1.3 National management 1.4 International collaboration **2. Fisheries data** 2.1 Maximum sustainable yield 2.2 Catch per unit effort 2.3 Tag-release-recapture 2.4 Gut content analysis 2.5 Age and growth 2.6 Fecundity 2.7 Abundance and yield prediction **3. Human impacts** 3.1 Litter 3.2 Oil 3.3 Sewage 3.4 Pesticides 3.5 Heavy metals	**4. Conservation** 4.1 Turtles 4.2 Sea cucumbers 4.3 Giant clams 4.4 Rare shells 4.5 Coral mining 4.6 Artificial reefs **5. Regulation of fisheries practices** 5.1 Quotas 5.2 Licences 5.3 Boat restrictions 5.4 Gear restrictions 5.5 Closed seasons 5.6 Closed areas 5.7 Surveillance **6. Fisheries conservation** 6.1 Convention on International Trade in Endangered Species (CITES) 6.2 Marine Stewardship Council (MSC) 6.3 Marine Protected Areas

6. Apendix

6.1 Symbols, units and definitions of physical quantities

Candidates should be able to state the symbols for the following physical quantities and, where indicated, state the units in which they are measured.

Quantity	*Symbol*	*Unit*
length	*l, h*	km, m, cm, mm
area	*A*	m^2, cm^2
volume	*V*	m^3, dm^3, cm^3
weight	*W*	N
mass	*m, M*	kg, g, mg
density	*d*, ρ	kg/m^3, g/cm^3
time	*t*	h, min, s
speed	*u, v*	km/h, m/s, cm/s
temperature	*t*	°C
concentration	ρ_i	g/dm^3

6.2 Mathematical requirements

Calculators may be used in all parts of the assessment.

Candidates should be able to:

- add, subtract, multiply and divide
- understand and use *means, decimals, fractions, percentages, ratios* and *reciprocals*
- recognise and use standard notation
- use direct and inverse proportion
- use positive whole number indices
- draw charts and graphs from given data
- interpret charts and graphs
- select suitable scales and axes for graphs
- make approximate evaluations of numerical expressions
- recognise and use the relationship between length, surface area and volume and their units on metric scales
- use usual mathematical instruments (ruler, compasses, protractor, set square)
- solve equations of the form $x = yz$ for any one term when the other two are known
- recognise and use points of the compass (N, S, E, W)
- recognise and use latitude and longitude on a map (degrees and minutes)

6.3 Glossary of terms used in science papers

It is hoped that the glossary (which is relevant only to science subjects) will prove helpful to candidates as a guide (i.e. it is neither exhaustive nor definitive). The glossary has been deliberately kept brief not only with respect to the number of terms included but also to the descriptions of their meanings. Candidates should appreciate that the meaning of a term must depend, in part, on its context.

1. *Define* (the term(s) ...) is intended literally, only a formal statement or equivalent paraphrase being required.
2. *What do you understand by/What is meant by* (the term (s) ...) normally implies that a definition should be given, together with some relevant comment on the significance or context of the term(s) concerned, especially where two or more terms are included in the question. The amount of supplementary comment intended should be interpreted in the light of the indicated mark value.
3. *State* implies a concise answer with little or no supporting argument (e.g. a numerical answer that can readily be obtained 'by inspection').
4. *List* requires a number of points, generally each of one word, with no elaboration. Where a given number of points is specified this should not be exceeded.
5. *Explain* may imply reasoning or some reference to theory, depending on the context.
6. *Describe* requires the candidate to state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena.

   In other contexts, *describe* should be interpreted more generally (i.e. the candidate has greater discretion about the nature and the organisation of the material to be included in the answer). *Describe* and *explain* may be coupled, as may *state* and *explain*.
7. *Discuss* requires the candidate to give a critical account of the points involved in the topic.

8. *Outline* implies brevity (i.e. restricting the answer to giving essentials).
9. *Predict* implies that the candidate is not expected to produce the required answer by recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answers extracted in an earlier part of the question.

   Predict also implies a concise answer with no supporting statement required.
10. *Deduce* is used in a similar way to *predict* except that some supporting statement is required (e.g. reference to a law, principle, or the necessary reasoning is to be included in the answer).
11. *Suggest* is used in two main contexts (i.e. either to imply that there is no unique answer (e.g. in chemistry, two or more substances may satisfy the given conditions describing an 'unknown'), or to imply that candidates are expected to apply their general knowledge to a 'novel' situation, one that may be formally 'not in the syllabus').
12. *Find* is a general term that may variously be interpreted as *calculate, measure, determine*, etc.
13. *Calculate* is used when a numerical answer is required. In general, working should be shown, especially where two or more steps are involved.
14. *Measure* implies that the quantity concerned can be directly obtained from a suitable measuring instrument (e.g. length using a rule, or mass using a balance).
15. *Determine* often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula (e.g. resistance, the formula of an ionic compound).
16. *Estimate* implies a reasoned order of magnitude statement or calculation of the quantity concerned, making such simplifying assumptions as may be necessary about points of principle and about the values of quantities not otherwise included in the question.
17. *Sketch*, when applied to graph work, implies that the shape and/or position of the curve need only be qualitatively correct, **but** candidates should be aware that, depending on the context, some quantitative aspects may be looked for (e.g. passing through the origin, having an intercept).

    In diagrams, *sketch* implies that simple, freehand drawing is acceptable; nevertheless, care should be taken over proportions and the clear exposition of important details.

7. Other information

Equality and inclusion

We have taken great care in the preparation of this syllabus and assessment materials to avoid bias of any kind. In our effort to comply with the UK Equality Act (2010), we have taken all reasonable steps to avoid direct and indirect discrimination.

The standard assessment arrangements may present barriers for candidates with impairments. Where a candidate is eligible, we may be able to make arrangements to enable that candidate to access assessments and receive recognition of their attainment. We do not agree access arrangements if they give candidates an unfair advantage over others or if they compromise the standards being assessed.

Candidates who are unable to access the assessment of any component may be eligible to receive an award based on the parts of the assessment they have taken.

Information on access arrangements is in the *Cambridge Handbook* at
www.cambridgeinternational.org/eoguide

Language

This syllabus and the associated assessment materials are available in English only.

Making entries

Exams officers are responsible for submitting entries to Cambridge International. We encourage them to work closely with you to make sure they enter the right number of candidates for the right combination of syllabus components. Entry option codes and instructions for submitting entries are in the *Cambridge Guide to Making Entries*. Your exams officer has a copy of this guide.

Exam administration

To keep our exams secure, we produce question papers for different areas of the world, known as 'administrative zones'. We allocate all Cambridge schools to one administrative zone determined by their location. Each zone has a specific timetable. Some of our syllabuses offer candidates different assessment options. An entry option code is used to identify the components the candidate will take relevant to the administrative zone and the available assessment options.

Retakes

Candidates can retake the whole qualification as many times as they want to. This is a linear qualification so candidates cannot re-sit individual components.

Grading and reporting

Cambridge O Level results are shown by one of the grades A*, A, B, C, D or E, indicating the standard achieved, A* being the highest and E the lowest. 'Ungraded' indicates that the candidate's performance fell short of the standard required for grade E. 'Ungraded' will be reported on the statement of results but not on the certificate. The letters Q (pending) and X (no result) may also appear on the statement of results but not on the certificate.

How students and teachers can use the grades

Assessment at Cambridge O Level has two purposes:

- to measure learning and achievement

  The assessment:

  – confirms achievement and performance in relation to the knowledge, understanding and skills specified in the syllabus, to the levels described in the grade descriptions.
- to show likely future success

  The outcomes:

  – help predict which students are well prepared for a particular course or career and/or which students are more likely to be successful

  – help students choose the most suitable course or career.

Cambridge Assessment International Education
The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom
Tel: +44 (0)1223 553554 Fax: +44 (0)1223 553558
Email: info@cambridgeinternational.org www.cambridgeinternational.org