Cambridge Assessment International Education

Interactive

Learner Guide

Cambridge International AS & A Level

Marine Science 9693

For examination from 2022

Version 2

Cambridge Pathway

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About this guide

This guide explains what you need to know about your Cambridge International AS & A Level Marine Science 9693 course and examinations.

This guide will help you to:

- understand what skills you should develop by taking this Cambridge International AS & A Level course
- understand how you will be assessed
- understand what we are looking for in the answers you write
- plan your revision programme
- revise, by providing revision tips and an interactive revision checklist (Section 5).

Following a Cambridge International AS & A Level programme will help you to develop abilities that universities value highly, including a deep understanding of your subject; higher order thinking skills (analysis, critical thinking, problem solving); presenting ordered and coherent arguments; and independent learning and research.

Studying Cambridge International AS & A Level Marine Science will help you to develop a set of transferable skills, including the ability to work with mathematical information; think logically and independently; consider accuracy; model situations mathematically; analyse results and reflect on findings.

Section 1: Syllabus content - what you need to know

This section gives you an outline of the syllabus content for this course.

There are five topics in the AS Level course, and a further four additional topics for the full A Level qualification.

AS Level topics	Content included
1. Water	1.1 Particle theory and bonding 1.2 Solubility in water 1.3 Density and pressure
2. Earth processes	2.1 Tectonic processes 2.2 Weathering, erosion and sedimentation 2.3 Tides and ocean currents
3. Interactions in marine ecosystems	3.1 Interactions 3.2 Feeding relationships 3.3 Nutrient cycles
4. Classification and biodiversity	4.1 The classification of marine organisms 4.2 Key groups of marine organisms 4.3 Biodiversity 4.4 Populations and sampling techniques
5. Examples of marine ecosystems	5.1 The open ocean 5.2 The tropical coral reef 5.3 The rocky shore 5.4 The sandy shore 5.5 The mangrove forest

AS Level candidates also study practical skills

A Level topics	Content included
6. Physiology of marine organisms	6.1 General cell structure 6.2 Movement of substances 6.3 Gas exchange 6.4 Osmoregulation
7. Energy	7.1 Photosynthesis 7.2 Chemosynthesis 7.3 Respiration
8. Fisheries for the future	8.1 Life cycles 8.2 Sustainable fisheries 8.3 Marine aquaculture
9. Human impacts on marine ecosystems	9.1 Ecological impacts of human activities 9.2 Global warming and its impact 9.3 Ocean acidification 9.4 Conservation of marine ecosystems

A Level candidates also study practical skills.

Make sure you always check the latest syllabus, which is available from our public website.

Prior knowledge

There is no prior knowledge assumed for this course, however we recommend that learners starting this course should have completed a course in Cambridge O Level or Cambridge IGCSE™ Biology or Marine Science, or the equivalent.

Key concepts

Key concepts are essential ideas that help you to develop a deep understanding of your subject and make links between different aspects of the course. The key concepts for Cambridge International AS & A Level Marine Science are:

Observation and experiment
The scientific process of observation and enquiry, experimentation and fieldwork are fundamental to marine science.

The science of water
Water is the key component of the oceans and an understanding of water at a molecular level underpins concepts such as salinity, pressure, density and the availability of key gases and nutrients, which in turn affect the distribution and abundance of living organisms.

Forming and shaping the ocean floor and coastlines
Dynamic interactions between the lithosphere, atmosphere and hydrosphere lead to the development of diverse marine habitats, which are subject to ongoing changes.

Organisms in their environment
The marine biome is the largest biome on the planet and contains many diverse habitats, within which organisms interact with the biotic and abiotic environment. The morphology, physiology and behaviour of organisms are adapted to niches within these habitats. By understanding this diversity, students will have a greater appreciation of the marine environment and the need for its conservation.

Human influences in local and global contexts
Human activities may have a local and global impact. The exploitation of marine resources and the disposal of waste in and around our oceans must be managed if our use of the oceans is to be sustainable for future generations.

Section 2: How you will be assessed

Cambridge International AS Marine Science makes up the first half of the Cambridge International AS & A Level course in Marine Science.

About the examinations

There are two papers you must take to obtain an AS Level Marine Science qualification, and a further two additional papers to obtain a full A Level in Marine Science.

- Paper 1: AS Level Theory
- Paper 2: AS Level Data-handling and investigative skills
- Paper 3: A Level Theory
- Paper 4: A Level Data-handling and investigative skills

About the papers

The table gives you further information about the examination papers:

Component	Time and marks	Questions	Percentage of total mark
Paper 1 AS Level Theory	1 hour 45 minutes 75 marks	Structured and free-response questions on AS Level syllabus content. Section A: Structured questions (45 marks) Section B: Free-response questions (30 marks)	50% of the AS Level 25% of the A Level
Paper 2 AS Level Data-handling and investigative skills	1 hour 45 minutes 75 marks	Structured questions based around AS Level syllabus content testing data-handling and investigative skills.	50% of the AS Level 25% of the A Level
Paper 3 A Level Theory	1 hour 45 minutes 75 marks	Structured and free-response questions based on the A Level syllabus content, but knowledge of the AS Level syllabus content may be required. Section A: Structured questions (45 marks) Section B: Free-response questions (30 marks)	25% of the A Level
Paper 4 A Level Data-handling and investigative skills	1 hour 45 minutes 75 marks	Structured questions based around A Level syllabus content testing data-handling and investigative skills. Knowledge of the AS Level syllabus content may also be required.	25% of the A Level

Section 3: What skills will be assessed?

The examiners take account of the following skills areas (**assessment objectives**) in the examinations:

Assessment objectives (AO)	What does the AO mean?
AO1 Knowledge and understanding	You should be able to demonstrate knowledge and understanding of: • scientific phenomena, facts, definitions, concepts and theories • scientific vocabulary, terminology and conventions (including symbols, quantities and units) • scientific and technological applications, with their social, economic, ethical and environmental implications.
AO2 Handling and applying information	You should be able to apply knowledge in familiar and unfamiliar contexts in words or using other forms of presentation (e.g. drawings, symbols, graphical and numerical) to: • locate, select, organise and communicate relevant information from a variety of sources • manipulate numerical, graphical and other data • analyse and interpret observations and data to identify patterns, report trends and reach conclusions • give reasoned explanations for phenomena, patterns and relationships.
AO3 Experimental skills and investigations	You should be able, in familiar and unfamiliar contexts to: • make estimates, predictions and propose hypotheses from given scenarios, information or data • describe how to ethically and safely use techniques, apparatus and materials in an investigative context • plan experiments and investigations • present and display data and observations in suitable formats • evaluate given experimental methods and the quality of data, and suggest possible improvements.

It is important that you know the different weightings (%) of the assessment objectives, as this affects how the examiner will assess your work.

The approximate weightings allocated to each of the assessment objectives (AOs) are summarised below.

Assessment objectives as a percentage of each qualification

Assessment objective	Weighting in AS Level %	Weighting in A Level %
AO1 Knowledge and understanding	45	40
AO2 Handling and applying information	40	45
AO3 Experimental skills and investigations	15	15
Total	100	100

Assessment objectives are expressed as a percentage of each qualification.

Assessment objectives as a percentage of each component

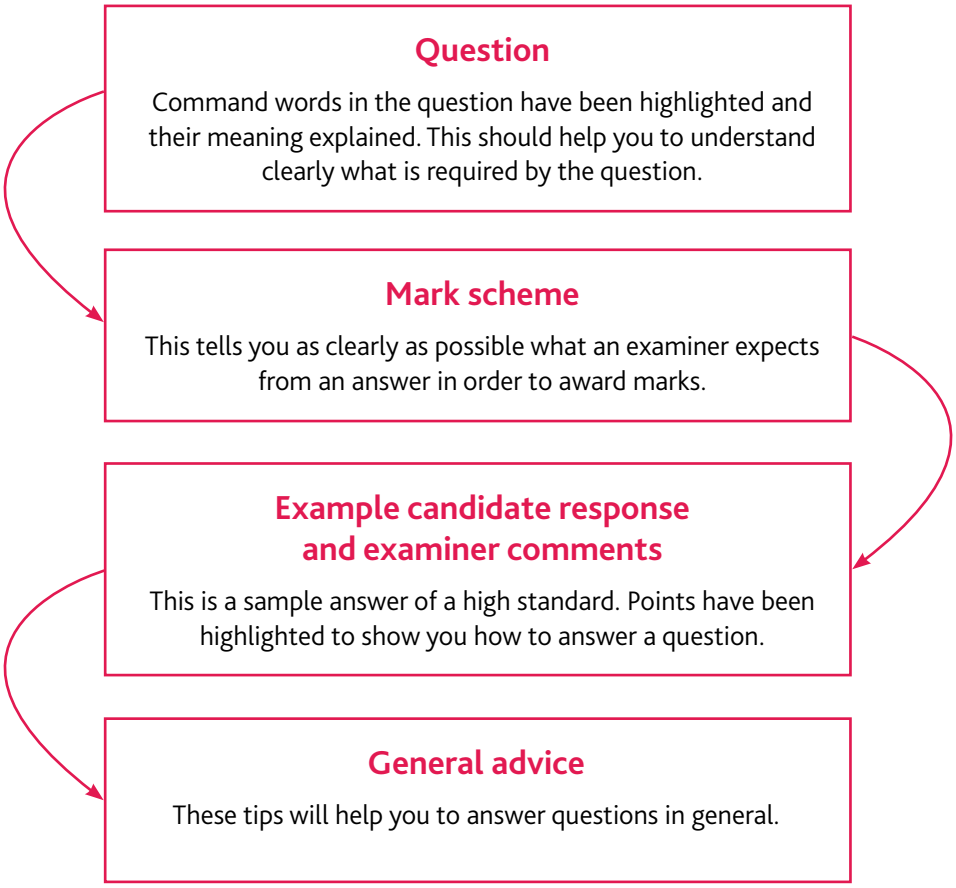
Assessment objective	Weighting in components %			
	Paper 1	Paper 2	Paper 3	Paper 4
AO1 Knowledge and understanding	67	20	53	20
AO2 Handling and applying information	33	47	47	47
AO3 Experimental skills and investigations	–	33	–	33
Total	100	100	100	100

Section 4: Example candidate response

This section takes you through an example question and candidate response. It will help you to see how to identify the command words within questions and to understand what is required in your response. Understanding the questions will help you to know what you need to do with your knowledge. For example, you might need to state something, calculate something, find something or show something.

All information and advice in this section is specific to the example question and response being demonstrated. It should give you an idea of how your responses might be viewed by an examiner but it is not a list of what to do in all questions. In your own examination, you will need to pay careful attention to what each question is asking you to do.

This section is sructured as follows:



Question

1 Scientists surveyed the distribution of species on a coral reef in Indonesia.

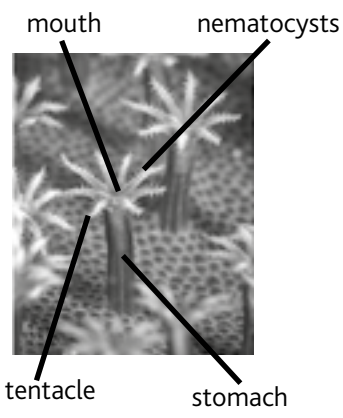
(a) Fig. 1.1 shows some coral polyps on the reef.

Fig. 1.1

Add these labels to Fig. 1.1 to indicate the location of the following structures in a polyp.

nematocysts mouth stomach tentacle [4]

Mark scheme

Question	Answer	Mark	Guidance
1 (a)	correct placement of labels as follows: mouth labelled in centre of tentacles; stomach labelled on body of polyp; nematocysts labelled on tentacle(s); one or any number of tentacles labelled;	**4**	

Now let's look at the example candidate response to the question and the examiner comments.

Example candidate response

1 Scientists surveyed the distribution of species on a coral reef in Indonesia.

(a) Fig. 1.1 shows some coral polyps on the reef.

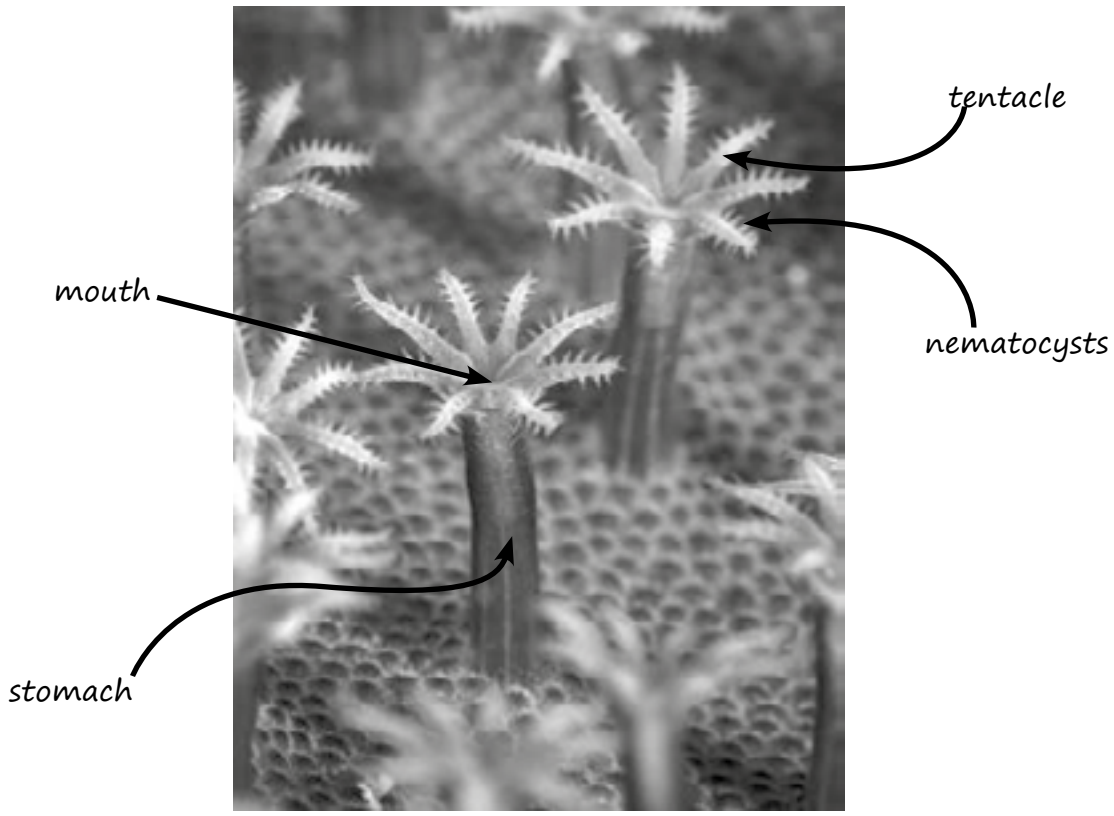


Fig. 1.1

Add these labels to Fig. 1.1 to indicate the location of the following structures in a polyp.

nematocysts mouth stomach tentacle [4]

Examiner comment

The candidate has correctly labelled the position of all four structures. However, they have used arrow heads rather than just a label line and lines have not been drawn with a ruler. The label line must touch the structure, so only three marks would be awarded.

Question

(b) Fig. 1.2 shows a granulated sea star, *Choriaster granulatus*, on the reef.

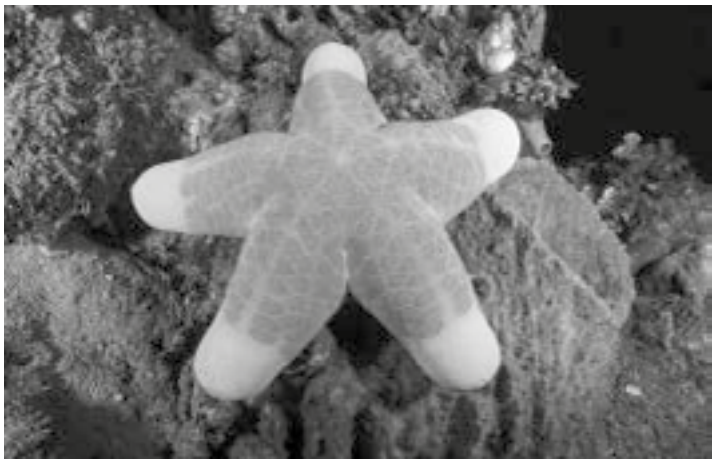


Fig. 1.2

(ii) Make a large drawing of the sea star shown in Fig. 1.2. Only show the markings on one of the arms.

Do **not** label your drawing.

Use a sharp pencil.

Mark scheme

Question	Answer	Mark	Guidance
1 (b)(ii)	quality of outline (thin and continuous); suitable size (at least 70mm × 70 mm); in proportion (arms longer than they are wide); detail (at least white area on ends of arms demarked);	**4**	**AVP**

Example candidate response

(b) Fig. 1.2 shows a granulated sea star, *Choriaster granulatus*, on the reef.

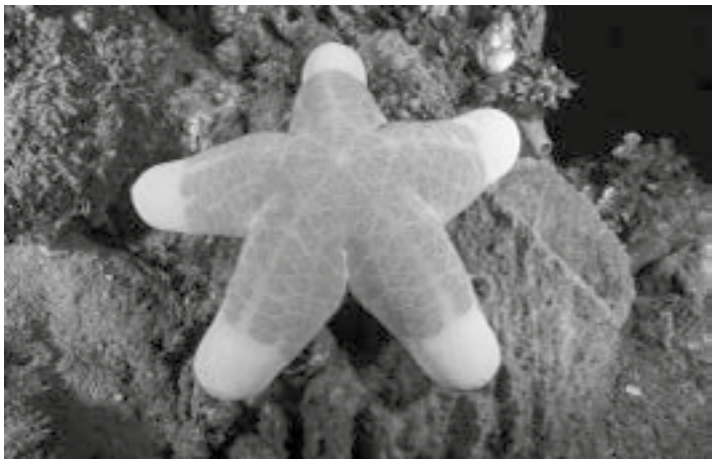


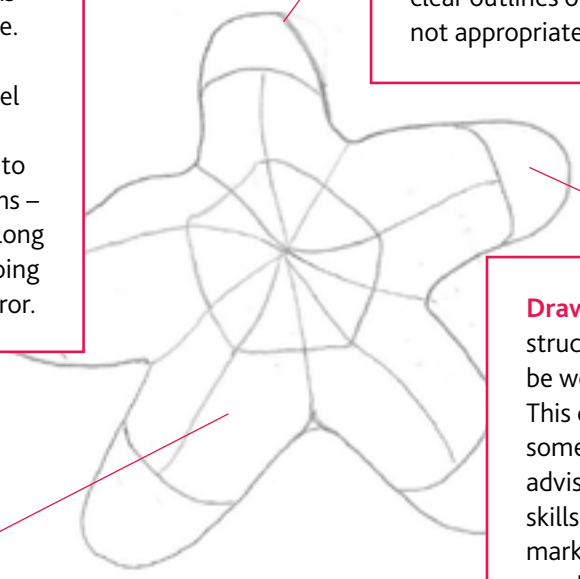
Fig. 1.2

(ii) Make a large drawing of the sea star shown in Fig. 1.2. Only show the markings on one of the arms.

Do **not** label your drawing.

Detail – it can be difficult to judge how much detail to include, candidates are not expected to recreate all minor details such as the intricate pattern shown here. Whilst not perfectly accurate, this drawing has a sufficient level of correct detail, so the mark is awarded. They were only asked to add the detail on one of the arms – this would not be penalised so long as the detail was correct, but doing this does give more room for error.

Quality of outline – this should be thin and continuous. There are one or two tiny gaps, and the right hand side of the top arm is unclear, so the mark would not be awarded. Note that there is no attempt at shading in areas of different tone - drawings should be clear outlines only (sketch like diagrams are not appropriate).



Drawing in proportion – the structures in the drawing should be well proportioned and to scale. This can be difficult to achieve for some specimens so candidates are advised to practice their drawing skills as part of their revision. The mark has been awarded for each arm being longer than its width (which is perfect). This can be seen by eye, but there is a ruler available during on-screen marking where this can be checked.

Suitable size – the drawing should usually be large enough to fill at least two-thirds of the available space, so this mark would be awarded.

[4]

Question

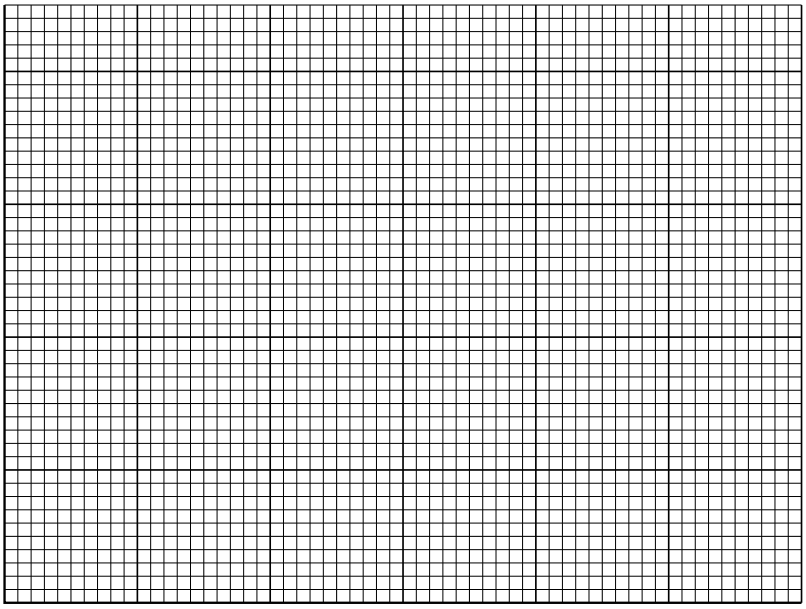
2 Table 2.1 shows how temperature affects the density of pure water.

Table 2.1

temperature of water / °C	density / kg m^{-3}
4	1000
10	999
20	998
30	996
40	992
50	988

(a) (i) Plot a line graph of the data in Table 2.1. Use a ruler to join the points with straight lines.

Use a sharp pencil.



[4]

Mark scheme

Question	Answer	Mark	Guidance
2 (a)(i)	suitable scale for *x* and *y* axes; correct labels for each axis including units; correct plots ± 1 mm; plots joined with straight lines;	**4**	plots must cover at least half of grid **R** extrapolation beyond plots

Question

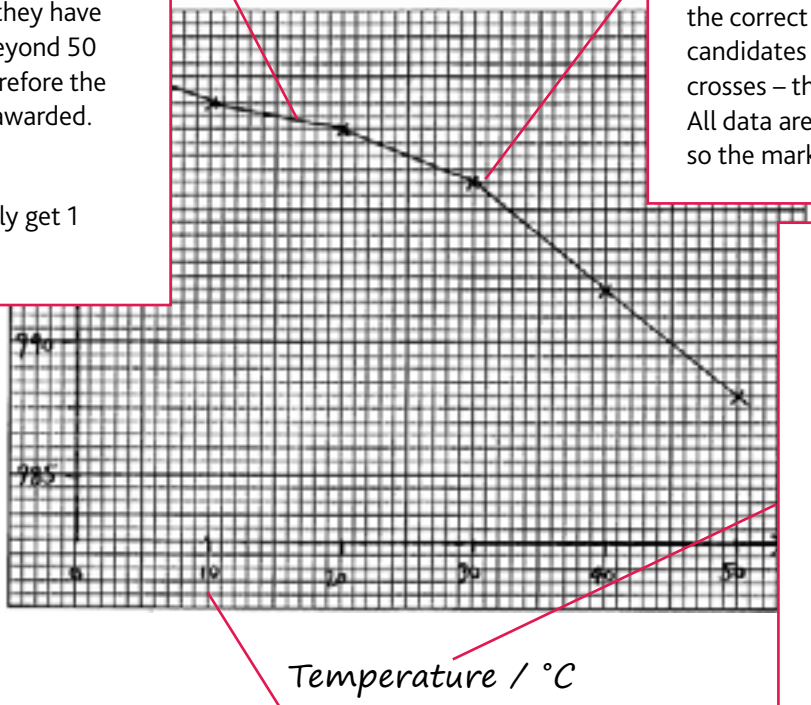
2 Table 2.1 shows how temperature affects the density of pure water.

Table 2.1

temperature of water / °C	density / kg m^{-3}
4	1000
10	999
20	998
30	996
40	992
50	988

oh of the data in Table 2.1. Use a ruler to j

encil.



Data points connected – this should be done with a ruler. A common mistake is for candidates to draw an additional line to the origin that is not included in the data provided. Candidates should be careful not to extend the lines beyond the plots. Although the candidate has neatly joined the plots correctly, they have extended the line beyond 50 (extrapolation). Therefore the mark has not been awarded.

The graph would only get 1 mark out of 4.

Correct plots – ideally plots should be made with a sharp HB pencil so that they are clear and can be corrected if necessary. Plots must be within 1mm of the correct position. Sometimes candidates use large scribbled crosses – these are not acceptable. All data are correctly plotted here so the mark would be awarded.

Correct labels and units for each axis – correct labels and units must be placed against each axis. Candidates must use the headings from the columns in the table of data – in this case 'temperature of water' / °C for the x axis and density / kg m^{-3} for the y axis. The mark has therefore not been awarded.

Suitable scales for axes – the scale chosen should ensure that the plotted graph covers at least half of the grid provided. The scales must be even across the range of values. The scale does not need to start at 0 if appropriate.

Although the plotted graph covers more than half the grid, the candidate has not included a line break at the start of the y axis or an initial value of 982.5, so this mark cannot be awarded.

Usually the x axis should be used for the independent variable, and the y axis for the dependent variable. In this case density depends on temperature, so the axes have been plotted the correct way round. An exception to this rule is when the independent variable is depth, which should always be plotted on the y axis.

Question

(ii) Describe a laboratory experiment that you could use to safely test the following hypothesis.

Light intensity increases the rate of photosynthesis in seagrass.

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Mark scheme

Question	Answer	Mark	Guidance
4 (a)(ii)	*any five from:* seagrass carefully removed / containd in suitable vessel; (independent variable) description of variation of light intensity; suggested suitable range; (dependent variable) measurement of evoluation of oxygen; suitable method described for recording oxygen evolution; description of rate calculation; any **two,** standardised / control, variables, e.g. temperature of water / amount of seagrass used ; idea of repeating results; calculation of mean from repeats; credit reference to trying to remove heating effect, e.g. using Perspex screen; credit reference to ensuring CO_2 is not a limiting factor; credit safety consideration, e.g. burn from lamp / electrical kit and water;	**5**	**A** changing distance / voltage of lamp **A** use of meters or measuring volume

Example candidate response

(ii) Describe a laboratory experiment that you could use to safely test the following hypothesis.

Light intensity increases the rate of photosynthesis in seagrass.

The rate of photosynthesis can be found by measuring the amount of oxygen produced by the seagrass over time. A sample of seagrass can be placed in a large beaker beneath an inverted funnel in seawater. A lamp can be shone onto the seagrass so that it photosynthesises. The funnel is connected to a gas syringe that will collect the oxygen as it is produced to measure its volume. A timer can be used to time how much oxygen is produced in one hour. The rate of oxygen produced can then be determined in cm^3 per hour. The light intensity can be varied by changing the distance between the lamp and the beaker containing the seagrass. This could be done at 10cm intervals from 10 to 50 cm. The procedure should be repeated three times at each distance and a mean rate calculated for each distance. A graph could then be plotted to show the relationship between light intensity and rate of photosynthesis. In order to gain reliable results some variables will need to be controlled, such as the same temperature of the water in the beaker and the same mass of seagrass used.

[5]

Examiner Comment

This is a comprehensive answer that would gain full marks. Candidates are advised to first identify the different variables that will be manipulated or controlled to include:

- The variable to be investigated (the independent variable), in this case light intensity. There should be mention of the range of values to be used;
- The variable to be measured in the results (the dependent variable), in this case the volume of oxygen produced;
- The variables to be kept constant (control variables that would avoid the production of unreliable results). This could involve a number of factors and candidates are usually expected to suggest at least two.

There is a clear description of the apparatus and method that will be used to carry out the investigation. Note that the candidate correctly describes using seawater, not just water.

Candidates should ensure equipment needed to measure these variables is described.

Ideally, this response could describe further how some variables would be controlled, e.g. the temperature of the water by eliminating the heating effect of the lamp, and/or by ensuring carbon dioxide does not become a limiting factor.

The candidate also refers to repeating the procedure and calculating a mean. This part of the response would be improved if there was reference to ignoring any anomalous results when calculating this.

It is not necessary to describe the plotting of graphs or other ways of displaying results, but this response would benefit from some reference to performing the procedure safely, e.g. ensuring water does not come into contact with electrical equipment or avoiding burns from the lamp.

Clearly labelled diagrams are acceptable if they help clarify a candidate's response. Bullet points are also acceptable.

Mark schemes for this type of question usually contain a number of marking points so candidates do not have to include every detail to gain full marks.

General advice

It is always a good idea to read the question carefully, noticing the command words and key instructions (in this case 'State', 'Find' and 'Calculate'). You may want to underline them to help you think what they mean. Many candidates jump straight into writing their working only to realise too late that they've used the wrong method. Read the question first and pause to think about what you need to find before you start doing any working – this will help you to choose an efficient method so you don't waste time in the examination. Don't forget that your working is part of your solution and you can gain method marks even if you don't get as far as a correct answer. In the example question, there are several FT (follow through) marks as well. This means that if you can go on to use your values correctly, even if they are wrong, you can still get subsequent method marks.

When answering a question based on a graph, such as the example question, it is often helpful to add to the graph any values you find, or information from the question. This will help you to think about what methods you can use to answer the question. If the question doesn't provide a graph or diagram, it is often useful for you to sketch your own.

Using correct notation in your working will help you to think clearly as well as making it easier for someone else to understand what you have done.

Make sure you are clear if you need to differentiate or integrate. It is surprisingly common for learners to get confused when a question requires both methods.

If you have had a good attempt at a question and still not managed to finish it, it is best to move on to another question and come back to it later. This will help you to make good use of the time you have available.

Allow a few minutes at the end of the examination to check your work. This will help you to spot errors in your arithmetic that could lose you marks.

Section 5: Revision

This advice will help you revise and prepare for the examinations. It is divided into general advice and specific advice for each of the papers.

Use the tick boxes ☐ to keep a record of what you have done, what you plan to do or what you understand.

General advice

Before the examination

- ☐ Find out when the examinations are and plan your revision so you have enough time for each topic. A revision timetable will help you.
- ☐ Find out how long each paper is and how many questions you have to answer.
- ☐ Know the meaning of the command words used in questions and how to apply them to the information given. Highlight the command words in past papers and check what they mean.
- ☐ Make revision notes; try different styles of notes. Discover what works best for you.
- ☐ Work for short periods then have a break. Revise small sections of the syllabus at a time.
- ☐ Build your confidence by practising questions on each of the topics.
- ☐ Make sure you practise lots of past examination questions so that you are familiar with the format of the examination papers. You could time yourself when doing a paper so that you know how quickly you need to work in the real examination.
- ☐ Papers from older versions of the syllabus will still be useful as most of the old content is still included, but the length of the papers will be different and there is a lot of new content that they won't be testing.
- ☐ Look at mark schemes to help you to understand how the marks are awarded for each question.
- ☐ Make sure you are familiar with the mathematical notation that you need for this syllabus. Your teacher will be able to advise you on what is expected.
- ☐ Check which formulae are in the formula booklet available in the examination, and which ones you need to learn.

During the examination

- ☐ Read the instructions carefully and answer **all** the questions.
- ☐ Check the number of marks for each question or part question. This helps you to judge how long you should be spend on the response. You don't want to spend too long on some questions and then run out of time at the end.
- ☐ Do not leave out questions or parts of questions. Remember, no answer means no mark.
- ☐ You do not have to answer the questions in the order they are printed in the answer booklet. You may be able to do a later question more easily then come back to an earlier one for another try.
- ☐ Read each question very carefully. Misreading a question can cost you marks:
  - Identify the command words – you could underline or highlight them.
  - Identify the technical terms and perhaps underline or highlight them too.
  - Try to put the question into your own words to understand what it is really asking.
- ☐ Read all parts of a question before starting your answer. Think carefully about what is needed for each part. You will not need to repeat material.
- ☐ Look very carefully at the information you are given.
  - For graphs, read the title, key, axes, etc. to find out exactly what they show.
  - For photographs, look carefully at the whole image.

- [ ] **Answer the question.** This is very important!
  - Use your knowledge and understanding.
  - Do not everything you know about a topic. Only use the information you need to answer the question.
- [ ] Make sure that you have answered everything that a question asks. Sometimes one sentence asks two things, e.g. 'Show that … and hence find …'. It is easy to concentrate on the first request and forget about the second one.
- [ ] Always show your working. Marks are usually awarded for using correct steps in the method even if you make a mistake somewhere.
- [ ] Don't cross out any working until you have replaced it by trying again. Even if you know it's not correct you may still be able to get method marks. If you have made two or more attempts, make sure you cross out all except the one you want marked.
- [ ] Use mathematical terms in your answers when possible.
- [ ] Annotated diagrams and graphs can help you, and can be used to support your answer. Use them whenever possible but do not repeat the information in words.
- [ ] Make sure all your numbers are clear, for example make sure your '1' doesn't look like a '7'.
- [ ] If you need to change a word or a number, or even a sign (+ to – for example), it is better to cross out your work and rewrite it. Don't try to write over the top of your previous work as it will be difficult to read and you may not get the marks.
- [ ] Don't write your answers in two columns in the examination. It is difficult for the examiners to read and follow your working.

Advice for all papers

- [ ] Do not waste time and space re-writing what is asked in the question.

  For example, if asked to 'explain why the population of damsel fish decreased after lionfish had been introduced', there is no need to start your answer with 'the population of damsel fish decreased after lionfish had been introduced because…', full sentences are not essential.
- [ ] When dealing with quantities, make sure you avoid the term 'amount' and use the appropriate scientific term, such as the mass or the volume.
- [ ] Try to use shorter sentences wherever possible – longer sentences can become confused and lose their meaning.
- [ ] Check that your answer makes sense and is not contradictory – an incorrect statement will negate a correct one
- [ ] Make sure you are aware of the 'list' rule. If you are asked for one answer, you should only write one. If you write multiple answers the wrong ones will negate the correct ones. For example if you are asked for two answers, and you write more than two, the first being correct, the second wrong and the third correct, you would only receive one mark.
- [ ] If provided with tables of results to comment on, look carefully at the column and row headings and at any units – make sure you use these correctly when giving your answer.

  The same advice applies to graphs and charts – look carefully at any axes and units.

  Some graphs display more than one set of data with scales and units on y axes on either side. These are potentially the most confusing and so highlighting on your question paper which lines or bars apply to each side can be helpful.
- [ ] If asked to extract information from tables, graphs or charts, it can be helpful to place a ruler on the page to help you follow a particular pattern, trend or value.
- [ ] If asked to 'use' a graph or chart to help answer a question, you are expected to extract information from it to support your answer.

  At a basic level this may just involve quoting information or figures you have read from the graph. However at a more advanced level you would be expected to process the information somehow.

  For example, if you have read from a graph that a value decreases from 500 to 100, simply stating that there was a 400 decrease shows simple processing of the data. Better still, stating that it is an 80% decrease is a stronger answer. Candidates are strongly recommended to get into the habit of processing data to ensure they gain maximum marks.

- ☐ If asked to make a comparison in a question, remember this can include things in common as well as differences.
- ☐ If you run out of space for an answer, do not try to cram words into the answer space in tiny writing, as this might not be legible to the examiner. Instead you can request and continue on additional sheets of paper or use blank spaces on the/another page. It is helpful to write for the examiner where the rest of the answer is located e.g. 'continued on extra paper / continued on page 7'. Ensure the question number for the rest of the answer is clearly indicated e.g. 1 (a) (iii).

Advice for Paper 1 and Paper 3

For the structured questions in section A, most of the good advice is covered above, but the following additional points may be useful.

- ☐ Always try to provide an answer to every question. If questions ever have a multiple choice selection then always fill in an answer, even if it has to be a guess. If you do have to guess, first try to narrow down which are the most likely options. Similarly, if questions require you to fill in a table or add in missing words, always try to fill them in with an answer., provide a considered guess.
- ☐ Always think carefully about what might be the correct scientific term from the syllabus for a short answer question. For example 'aerobic respiration' may be better than just 'respiration'.
- ☐ Some biological terms have very similar spelling, so take care to make sure you write clearly and spell terms accurately e.g. El Niño is very similar to La Niña in both spelling and meaning.

In section B of papers 1 and 3 you are expected to write longer answers.

- ☐ Try to write in full sentences if you can but this is not essential. If time is short bullet points may be a more efficient way of answering, but avoid abbreviations unless they are given in the syllabus (e.g. ENSO).
- ☐ You can use labelled annotated diagrams as part of your answer.
- ☐ For the longest questions it may be worth writing a short plan first to help you include all the necessary detail.

  For example, if asked to discuss the factors that will affect the distribution of organisms on a rocky shore, a simple spider diagram of factors may be useful.

  If asked for an answer that requires sequential information, such as bioaccumulation of antifouling paint along food chains, a simple flow diagram of stages may help in order to keep them in a logical sequence.

  Don't cross these plans out as you may even pick up marks from these if you fail to include a point later on.
- ☐ Often there are paired marks within a mark scheme. For instance, in the rocky shore example, there may be a mark for suggesting the length of time exposed to the air and then another mark for linking this to the risk of desiccation.
- ☐ Ensure you stick to the question and do not waste time on content that is not relevant.

Advice for Paper 2 and Paper 4

In Paper 2 and Paper 4 you will need to demonstrate your experimental, investigative and data-handling skills, so must be able to do the following:

- ☐ Be able to make a prediction, formulate a hypothesis, or comment on those given in questions.
- ☐ Identify the variables involved in investigations including the dependent variable, independent variable and those key variables to be standardised.
- ☐ Be able to describe or comment on a practical method, including the range of values and number of replicates used.
- ☐ Decide how measurements should be recorded, including the creation of results tables, and suggest how data may be used to reach a conclusion.
- ☐ Assess risks, describe precautions and consider the ethical treatment of organisms.
- ☐ Present numerical data, values or observations in a suitable table of results.
- ☐ Use descriptive column headings including any required units (no units in the body of the table).
- ☐ Make drawings large and unshaded and use fine, clear, unbroken lines, showing clear outlines of structures (always draw in pencil).
- ☐ Use ruler-drawn label lines to identify structures on diagrams, without an arrowhead.
- ☐ Display data as a line graph (continuous data), bar chart (discontinuous or categorical) or histogram (frequency data).

- ☐ Use a scale where both axes cover most or all of the grid available and allow the graph to be read easily to half a square.
- ☐ Ensure axes are labelled to match the relevant table headings, including any units.
- ☐ Ensure all graph points are plotted accurately using a sharp pencil, as a small cross or a small dot in a circle, with the intersection of the cross or centre of the dot exactly on the required point.
- ☐ Ensure the plotted points of a graph are connected with a clear, sharp and unbroken line, either as a line of best fit, a smooth curve or with ruled straight lines joining the points.
- ☐ Use no extrapolation of graph lines unless this can be assumed from the data – lines should only pass through the origin if a data point is present there.
- ☐ Ensure all bars on a bar chart or histogram are plotted accurately, with clear, unbroken lines that are drawn with a sharp pencil and ruler.
- ☐ Use keys and labels on graphs where appropriate.
- ☐ Criticise and evaluate experimental procedure, including any impact on the conclusions that may be drawn.
- ☐ Be able to draw a sketch graph to show the expected relationship between two variables. Ensure that the independent variable is on the x axis (unless it is depth) and the dependent variable is on the y axis. Scales should not be added to the axes.
- ☐ Identify and comment on anomalies and sources of error, assessing their impact on the conclusions that may be drawn.
- ☐ Within familiar contexts, suggest possible explanations for anomalous readings
- ☐ Suggest improvements to a procedure that will increase the accuracy of the observations or measurements.
- ☐ Describe clearly, in words or diagrams, improvements to the procedure or modifications to extend the investigation.
- ☐ Apply a suitable statistical test and when appropriate, refer back to a null hypothesis.

Revision checklists

The tables below can be used as a revision checklist: **It doesn't contain all the detailed knowledge you need to know, just an overview**. For more detail see the syllabus and talk to your teacher.

The table headings are explained below:

Topic	You should be able to	R	A	G	Comments
These are the units of study that you will be learning about.	The content of this column explains what you need to be able to do and the content of the syllabus you need to cover before the examinations.	You can use the tick boxes to show when you have revised an item and how confident you feel about it. R = RED means you are really unsure and lack confidence; you might want to focus your revision here and possibly talk to your teacher for help A = AMBER means you are reasonably confident but need some extra practice G = GREEN means you are very confident. As your revision progresses, you can concentrate on the RED and AMBER items in order to turn them into GREEN items. You might find it helpful to highlight each topic in red, orange or green to help you prioritise.			You can use this column to: • add more information about the details for each point • add formulae or notes • include a reference to a useful resource • highlight areas of difficulty or things that you need to talk to your teacher about or look up in a textbook.

Note: please check the syllabus content to make sure you have covered all the topics.

Paper 1

1.1 Features of travel and tourism industry

Topic	You should be able to	R	A	G	Comments
1. Water	Use kinetic particle theory to explain changes in state	☐	☐	☐	
	Describe the structure of the atom	☐	☐	☐	
	Know seawater is a mixture and identify the main salts dissolved in it	☐	☐	☐	
	Describe ionic and covalent bonding and identify specific examples of each	☐	☐	☐	
	Explain how hydrogen bonding affects the properties of water	☐	☐	☐	
	Understand the factors affecting the solubility of solutes and gases in water	☐	☐	☐	
	Understand the pH scale and know methods for testing the pH of water	☐	☐	☐	
	Understand the relationships between temperature, pressure, salinity and density of water	☐	☐	☐	
2. Earth processes	Describe the structure of the Earth and the theory of plate tectonics	☐	☐	☐	
	Apply the theory of plate tectonics to explain tectonic processes and the features they produce	☐	☐	☐	
	Describe the conditions at hydrothermal vents including how they contribute to the formation of chimneys	☐	☐	☐	
	Describe the main processes involved in weathering, erosion and sedimentation	☐	☐	☐	
	Understand and explain how weathering, erosion and sedimentation affect the morphology of shores, estuaries and deltas	☐	☐	☐	
	Define and state examples of the littoral zone	☐	☐	☐	
	Explain how tides are produced including the factors affecting tidal range	☐	☐	☐	
	Interpret tide tables and graphs	☐	☐	☐	

You should be able to	Ways to practise skills	R	A	G	Comments
	Explain the factors affecting the production of ocean currents, upwellings and the ocean conveyor belt	☐	☐	☐	
	Discuss the causes and effects of El Niño and La Niña events during the ENSO cycle in the Pacific Ocean	☐	☐	☐	
3. Interactions in marine ecosystems	Explain, represent and interpret feeding relationships in an ecosystem, including as food chains and food webs	☐	☐	☐	
	Understand photosynthesis and chemosynthesis and how the glucose produced may be used	☐	☐	☐	
	Know how to investigate the affect of light intensity on the rate of photosynthesis	☐	☐	☐	
	Define productivity and explain the potential impact it has on food chains.	☐	☐	☐	
	Calculate and explain the energy losses along food chains, and draw, describe and interpret pyramids of energy, numbers and biomass	☐	☐	☐	
	Understand the term nutrient to include examples of gases, ions and organic molecules	☐	☐	☐	
	State the chemical composition and structure of carbohydrates, lipids and proteins	☐	☐	☐	
	Know the roles of essential nutrients in living organisms	☐	☐	☐	
	Understand how reservoirs of dissolved nutrients may be replenished or depleted	☐	☐	☐	
	Describe and understand the carbon cycle	☐	☐	☐	
4. Classification and biodiversity	Describe the classification of species into the taxonomic hierarchy and use the binomial system of species nomenclature	☐	☐	☐	
	Construct and use simple dichotomous keys, and make observations and drawings from structures or specimens	☐	☐	☐	
	Understand the nature of phytoplankton and zooplankton	☐	☐	☐	
	State the main features of key groups of marine organisms, and understand their ecological and economic importance.	☐	☐	☐	
	Explain key ecosystem terms using marine examples	☐	☐	☐	

You should be able to	Ways to practise skills	R	A	G	Comments
	Understand and apply sampling techniques, including application of the statistical tests listed in the specification	☐	☐	☐	
5. Examples of marine ecosystems	Identify the world's oceans and the zones within them, and understand the importance of their interaction with the atmosphere	☐	☐	☐	
	Describe the conditions required for tropical coral reef and describe and compare the four types	☐	☐	☐	
	Describe the structure of a typical coral polyp, the two types of coral (hard and soft), and explain how they obtain their nutrition	☐	☐	☐	
	Discuss the importance of coral reefs and discuss the causes and effects of reef erosion	☐	☐	☐	
	Describe the main features of rocky shores, sandy shores and mangrove forests	☐	☐	☐	
	Explain the effects of biotic and abiotic factors on the organisms living on rocky shores, sandy shores and in mangrove forests, and the adaptations of organisms living there.	☐	☐	☐	
	Discuss the importance of mangrove forests from both an ecological and human perspective.	☐	☐	☐	

Paper 3 and Paper 4

You should be able to	Ways to practise skills	R	A	G	Comments
6. Physiology of marine organisms	Recognise cell structures and outline their functions	☐	☐	☐	
	Be able to draw cells or specimens from images	☐	☐	☐	
	Describe and explain the processes of diffusion, facilitated diffusion, osmosis and active transport	☐	☐	☐	
	Understand how water potential affects transport processes	☐	☐	☐	
	Know how to investigate diffusion and osmosis using plant tissue and non-living materials, including surface area to volume ratio calculations	☐	☐	☐	
	Understand the need for gas exchange and describe the ways it can be achieved	☐	☐	☐	
	Relate the method of gas exchange to the size and structure of an organism	☐	☐	☐	

You should be able to	Ways to practise skills	R	A	G	Comments
	Explain the need for osmoregulation, and the different strategies that marine organisms use to achieve it	☐	☐	☐	
7. Energy	Understand the process of photosynthesis, including the availability and absorption of light of different wavelengths	☐	☐	☐	
	Understand the light dependent and light independent reactions in photosynthesis, and know the structures inside the chloroplast that perform them	☐	☐	☐	
	Understand limiting factors, including investigating the effect of changing wavelength of light on the rate of photosynthesis	☐	☐	☐	
	Describe chemosynthesis and understand how it supports food chains at hydrothermal vents	☐	☐	☐	
	Describe and understand aerobic respiration, and know why anaerobic respiration may occur	☐	☐	☐	
8. Fisheries for the future	Describe the differences between complex and simple life cycles	☐	☐	☐	
	Outline the importance of different stages in the life cycle of organisms	☐	☐	☐	
	Explain the need for the sustainable exploitation of fisheries	☐	☐	☐	
	Discuss the impact of modern fishing technology, and know how to assess how best to exploit fisheries	☐	☐	☐	
	Discuss the advantages and disadvantages of the principal tools used to ensure that fisheries are exploited on a sustainable basis	☐	☐	☐	
	Discuss the impacts of restricted / unrestricted fishing, and the advantages / disadvantages of rehabilitation strategies	☐	☐	☐	
	Describe intensive and extensive aquaculture techniques, including the requirements for long-term success	☐	☐	☐	
	Discuss the principal impacts of aquaculture	☐	☐	☐	
9. Human impacts on marine ecosystems	Explain the impacts of human activities on marine water quality, habitats, organisms and food webs	☐	☐	☐	
	Discuss the impacts of plastics and microplastics on the marine ecosystems, and strategies to limit their release	☐	☐	☐	

You should be able to	Ways to practise skills	R	A	G	Comments
	Describe how the natural greenhouse effect creates the Earth's ambient temperature and explain how the enhanced greenhouse effect leads to global warming	☐	☐	☐	
	Discuss and evaluate the evidence for and against the hypothesis that human activity significantly contributes to global warming	☐	☐	☐	
	Describe the possible impacts of global warming on the marine environment	☐	☐	☐	
	Explain the relationships between atmospheric carbon dioxide, dissolved carbon dioxide and acidity in the ocean	☐	☐	☐	
	Describe the impact of ocean acidification on hard corals and shelled organisms, and be able to investigate the effect of pH on the loss of mass of empty mollusc shells	☐	☐	☐	
	Understand the need for conservation in terms of maintaining or enhancing biodiversity	☐	☐	☐	
	Discuss strategies for conserving marine species, including from the threat of invasive species	☐	☐	☐	
	Understand the importance of international cooperation and legislation, including the role of the International Union for Conservation of Nature (IUCN), and the difficulties involved.	☐	☐	☐	

Section 6: Useful websites

The websites listed below are useful resources to help you study for your Cambridge International AS & A Level Marine Science.

Coasts and Reefs
www.coastsandreefs.net/bio/coasts.php

Coral Reef Alliance
https://coral.org/

Fishwatch – US Seafood Facts
www.fishwatch.gov/

Food and Agriculture Organisation of the United States (FAO)
www.fao.org/fishery/factsheets/en

Marine Conservation Society
www.mcsuk.org/goodfishguide/search
www.mcsuk.org/downloads/fisheries/Farmed_Fish.pdf

Monterey Bay Aquarium Seafood Watch
www.seafoodwatch.org/ocean-issues

National Geographic Video
https://video.nationalgeographic.com/

National Oceanic and Atmospheric Administration (NOAA)
www.noaa.gov/education
http://oceanexplorer.noaa.gov/edu/learning/5_chemosynthesis/activities/hydrothermal.html
www.montereyinstitute.org/noaa/lesson10.html

Reef
www.reef.org/

Smithsonian Ocean Portal
https://ocean.si.edu/

Cambridge Assessment International Education
The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom
t: +44 1223 553554
e: info@cambridgeinternational.org www.cambridgeinternational.org