

# Applicable standards

## National Curriculum for England Key Stage 4

KS4 Biology and Combined Science	Lessons					
	1	2	3	4	5	6
<b>Element of the curriculum</b>						
<b>Biology</b>						
• AQA GCSE Biology 4.4.1 - photosynthesis as the key process for food production and therefore biomass for life.	✓	✓				
• AQA GCSE Biology 4.4.1 - the process of photosynthesis.	✓	✓				
• AQA GCSE Biology 4.4.1 - factors affecting the rate of photosynthesis.	✓	✓				
• AQA GCSE Biology 4.7.1.1 - levels of organisation within an ecosystem.	✓		✓	✓	✓	
• AQA GCSE Biology 4.7.1.1 - some abiotic and biotic factors which affect communities; the importance of interactions between organisms in a community.	✓		✓	✓		
• AQA GCSE Biology 4.7.1.2 - how materials cycle through abiotic components of ecosystems.	✓		✓			
• AQA GCSE Biology 4.7.1.3 - how materials cycle through biotic components of ecosystems.	✓		✓			
• AQA GCSE Biology 4.7.2.3 - the role of microorganisms (decomposers) in the cycling of materials through an ecosystem.	✓		✓	✓		✓
• AQA GCSE Biology 4.7.1 - organisms are interdependent and are adapted to their environment the importance of biodiversity.	✓		✓	✓		✓
• AQA GCSE Biology 4.7.2 - methods of identifying species and measuring distribution, frequency and abundance of species within a habitat.			✓	✓		✓
• AQA GCSE Biology 4.7.3 - positive and negative human interactions with ecosystems.	✓		✓	✓		✓
<b>Chemistry</b>						
• AQA GCSE Chemistry 4.8.3.3 - the chemistry of acids; reactions with some metals and carbonates.	✓	✓	✓			
• AQA GCSE Chemistry 4.4.2.4 - pH as a measure of hydrogen ion concentration and its numerical scale.	✓	✓	✓			✓
• AQA GCSE Chemistry 4.4.1.1 - reduction and oxidation in terms of loss or gain of oxygen.	✓	✓	✓			✓
<b>Working Scientifically</b>						
• AQA GCSE Biology/Chemistry WS1 - development of scientific thinking.	✓	✓	✓	✓	✓	✓
• AQA GCSE Biology/Chemistry WS2 - experimental skills and strategies.		✓			✓	✓
• AQA GCSE Biology/Chemistry WS3 - analysis and evaluation.		✓	✓	✓	✓	✓
• AQA GCSE Biology/Chemistry WS4 - vocabulary, units, symbols and nomenclature	✓	✓	✓	✓	✓	✓

# SCHEME OF WORK

## Lesson 1: What is ocean acidification?

### Overview

An introduction to the issue of ocean acidification, this lesson uses a combination of video, theory and practical demonstrations to develop students' understanding of the 'other carbon problem'.

### Learning outcomes

- Recall that the release of CO<sub>2</sub> by burning fossil fuels increases the level of atmospheric CO<sub>2</sub>
- Understand the process of ocean acidification and that the oceans act as a 'carbon sink' for atmospheric CO<sub>2</sub>
- Investigate the impact of increased levels of atmospheric CO<sub>2</sub> on ocean chemistry

### Resources



#### Slideshow 1:

Ocean acidification process



#### Student Sheet 1a:

Ocean acidification in a cup

#### Student Sheet 1b:

Do you like your oceans still or sparkling?

#### Student Sheet 1c:

Reflect and connect



#### Subject Update:

Learn more: Ocean acidification process

## Lesson 2: Data analysis: Chemistry

### Overview

One of the most used data sets to show the trend in ocean acidification over the past 20 years is from the Hawaii Ocean Time-series. Students will use real data from a series of research 'cruises' to analyse the information and identify trends. There are options to use ICT to examine the data set, as well as using print outs of graphs and data tables.

### Learning outcomes

- Present data using appropriate methods and carry out and represent mathematical analysis
- Interpret data, including identifying patterns and trends and use data to make inferences and draw conclusions
- Evaluate data critically, showing awareness of potential sources of random variations and systematic errors

### Resources



#### Slideshow 2:

Using Excel to create graphs



#### Student Sheet 2a:

Ocean acidification data and question sheet

#### Student Sheet 2b:

Ocean pH graph

#### Student Sheet 2c:

Ocean carbon dioxide graph

#### Student Sheet 2d:

Ocean acidification graph and question sheet

#### Student Sheet 2e:

Ocean acidification Excel and question sheet



#### Data Set:

Ocean acidification spreadsheet (students)

#### Data Set:

Ocean acidification spreadsheet (teachers)



#### Subject Update:

Learn more: Hawaii Ocean Time-series

# SCHEME OF WORK

## Lesson 3: Research in action

### Overview

The Arctic Ocean is known as a 'sentinel system'. This is because ocean acidification is happening more rapidly in these cold waters. Students will learn about the research that is currently being undertaken in this remote region.

### Learning outcomes

- Learn how scientists work in extreme environments and develop knowledge of science careers
- Link the survey techniques used by students to the environmental and biological survey techniques used by the Catlin Arctic Survey scientists
- Understand how to investigate the relationship between the health of organisms within an ecosystem and environmental factors such as pH

### Resources



**Student Sheet 3a:**  
Scientist tweet sheet

**Student Sheet 3b:**  
Blog post

**Student Sheet 3c:**  
Storyboard template

**Student Sheet 3e:**  
Ocean acidification Excel and question sheet



**Diagram:**  
Sea surface temperature

**Diagram:**  
Changing sea surface pH



**Video:**  
Channel 4 News reports from the Arctic



**Gallery:**  
Ice Base science

**Gallery:**  
Water sampling

**Gallery:**  
Trawling for copepods

**Gallery:**  
Making an ice hole

## Lesson 4: Data analysis: biology

### Overview

The Catlin Arctic Survey scientists wanted to see what impact increased ocean acidification might have on a type of zooplankton, copepods. To do this, they trawled for copepods through a hole in the ice and placed them in experimental batches. These experimental batches were exposed to different levels of pH simulating both current and predicted scenarios. After seven days, the batches were examined to see how many of the copepods had survived in each scenario and analyse the impact that future acidification might have on zooplankton, the foundation of the Arctic food web.

### Learning outcomes

- Present data using appropriate methods and carry out and represent mathematical analysis
- Interpret data, including identifying patterns and trends and use data to make inferences and draw conclusions
- Evaluate data critically, showing awareness of potential sources of random variations and systemic errors

### Resources



**Slideshow 4:**  
Using Excel for calculations



**Student Sheet 4a:**  
Copepod survival adult data sheet

**Student Sheet 4b:**  
Copepod survival Nauplii data sheet

**Student Sheet 4c:**  
Copepod survival data

**Student Sheet 4d:**  
Copepod survival Excel and question sheet



**Data Set:**  
Copepod survival data spreadsheet (students)

**Data Set:**  
Copepod survival data spreadsheet (teachers)

# SCHEME OF WORK

## Lesson 5: From ice to paper

### Overview

Scientists work to increase our understanding, so it is important for the Catlin Ice Base research team to share their findings with a wider audience. They did this in three ways. First, they wrote a scientific paper, recording their research, data and analysis. Second, the university published a press release to share the findings more widely outside the science community. They also collaborated with Encounter Edu to make this educational resource. This lesson examines the process and difficulties of sharing science with different audiences.

### Learning outcomes

- Understand that scientists need to share their findings
- Know about and evaluate the different ways of sharing scientific research
- Compare the style and language of scientific papers with press releases

### Resources



**Slideshow 5:**  
Sharing research



**Student Sheet 5a:**  
Published paper summary

**Student Sheet 5b:**  
Press release

## Lesson 6: Conference in a classroom

### Overview

Scientists often share their results at conferences. They do this in a number of ways, one of which is by presenting a poster. At conferences, researchers will stand next to their posters displaying their research and answer questions relating to their work. In this lesson, students will turn the classroom into a mini-conference venue and display their research into ocean acidification.

### Learning outcomes

- Understand how field research teams communicate results
- Be able to explain the main issue and science of ocean acidification
- Discuss research topics with peers

### Resources



**Student Sheet 6a:**  
Research poster template



**Subject Update:**  
Learn more: Ocean acidification process