

Applicable standards

National Curriculum for England Key Stage 4

KS4 Science	Lessons						
	1	2	3	4	5	6	7
Element of the curriculum							
AQA Trilogy							
• 4.7.1.1 Within a community each species depends on other species.	✓						
• 4.7.2.1 Feeding relationships within a community can be represented by food chains.	✓						
• 4.7.2.2 The carbon cycle returns carbon from organisms to the atmosphere as carbon dioxide to be used by plants in photosynthesis.	✓						
• 4.7.3.2 Pollution can occur in water, from sewage, fertiliser or toxic chemicals and on land, from landfill and from toxic chemicals such as pesticides and herbicides, which may be washed from land into water. Pollution kills plants and animals which can reduce biodiversity.		✓	✓				
• AT6 Application of appropriate sampling techniques to investigate.				✓			
• WS 3.1 Present observations and other data using appropriate methods.					✓		
• WS 3.3 Carry out and represent mathematical and statistical analysis.					✓		
• WS 3.5 Interpret observations and other data.						✓	
• WS 3.6 Present reasoned explanations including relating data to hypotheses.						✓	
• WS1.4 Evaluate associated personal, social, economic and environmental implications.							✓
• WS1.6 Recognise the importance of peer review of results and of communicating results to a range of audiences.							✓
• WS 3.8 Communicate the scientific rationale for findings and reasoned conclusions through written and electronic reports and presentations.							✓
AQA Synergy							
• 4.4.1.2 Explain the importance of the carbon cycle to living organisms.	✓						
• 4.4.2.2 Describe the importance of interdependence and competition in a community.	✓						
• 4.4.2.6 Describe negative human interactions within ecosystems and explain their impact on biodiversity.		✓	✓				
• AT6 Application of appropriate sampling techniques to investigate.				✓			
• WS 3.1 Present observations and other data using appropriate methods.					✓		
• WS 3.3 Carry out and represent mathematical and statistical analysis.					✓		
• WS 3.5 Interpret observations and other data.						✓	
• WS 3.6 Present reasoned explanations including relating data to hypotheses.						✓	
• WS1.4 Evaluate associated personal, social, economic and environmental implications.							✓
• WS1.6 Recognise the importance of peer review of results and of communicating results to a range of audiences.							✓

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Element of the curriculum	Lessons						
	1	2	3	4	5	6	7
OCR 21st Century							
• B3.3.5 Explain the importance of interdependence in a community.	✓						
• B3.3.7 Explain the importance of the carbon cycle to living organisms.	✓						
• B6.3.1 Describe negative human interactions within ecosystems and explain their impact on biodiversity.		✓	✓				
• PAG B2 Application of appropriate sampling techniques to investigate.				✓			
• IaS2.3 When displaying data graphically: a) select an appropriate graphical form, b) use appropriate axes and scales, c) plot data points correctly, d) draw an appropriate line of best fit, e) indicate uncertainty (e.g. range bars).					✓		
• IaS2.4 When analysing data: b) use statistics (range and mean), c) obtain values from a line on a graph.					✓		
• IaS2.7a Use data to make or justify a conclusion.						✓	
• IaS2.7b Explain the extent to which data increase or decrease confidence in a prediction or hypothesis.						✓	
• aS4.9 Suggest reasons why different decisions on the same issue might be appropriate in view of differences in personal, social, or economic context.							✓
• IaS4.10 Explain why scientists should communicate their work to a range of audiences.							✓
OCR Gateway							
• B4.1c Explain the importance of the carbon cycle to living organisms.	✓						
• B4.1f Describe the importance of interdependence in a community.	✓						
• B6.1b Describe negative human interactions within ecosystems and explain their impact on biodiversity to include threats from hunting.		✓	✓				
• B6.1a Explain how to carry out a field investigation into distribution and abundance and how to determine numbers in a given area.				✓			
• WS1.3a Present observations and other data using appropriate methods.					✓		
• WS1.3c Carry out and represent mathematical and statistical analysis.					✓		
• WS1.3e Interpret observations and other data.						✓	
• WS1.3f Present reasoned explanations.						✓	
• WS1.1f Evaluate associated personal, social, economic and environmental implications.							✓
• WS1.1i Recognise the importance of peer review of results and of communicating results to a range of audiences.							✓

Applicable standards

National Curriculum for England Key Stage 4

KS4 Science (continued)	Lessons						
	1	2	3	4	5	6	7
Element of the curriculum							
Edexcel							
• B9.3 Describe the importance of interdependence in a community.	✓						
• B9.4 Describe how the survival of some organisms is dependent on other species.	✓						
• B9.12 Explain the importance of the carbon cycle including the processes involved.	✓						
• B9.8 Explain the positive and negative human interactions within ecosystems and their impacts on biodiversity.		✓	✓				
• WS2e Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative.				✓			
• WS3a Present observations and other data using appropriate methods.					✓		
• WS3b Translate data from one form to another.					✓		
• WS3c Carry out and represent mathematical and statistical analysis.					✓		
• WS3e Interpret observations and other data.						✓	
• WS3f Present reasoned explanations including relating data to hypotheses.						✓	
• WS1c Evaluate associated personal, social, economic and environmental implications.							✓
• WS1f Recognise the importance of peer review of results and of communicating results to a range of audiences.							✓

SCHEME OF WORK

Lesson 1: Why should we care about zooplankton?

Overview

In this lesson, students learn the importance of zooplankton as primary consumers in the community and as part of the marine biological pump in the global carbon cycle. These zooplankton account for a staggering percentage of the Earth's biomass, and yet because they are microscopic and in the ocean, we hardly give them much thought.

Learning outcomes

- Say what zooplankton are (Foundation)
- Define and use a variety of ecological terms correctly to describe zooplankton (Developing)
- Draw food chains and pyramids of numbers with zooplankton (Developing)
- Explain the importance of zooplankton in a community (Competent)
- Explain the importance of zooplankton in the marine carbon cycle (Expert)

Resources



Slideshow 1:
Why should we care about zooplankton?



Student Sheet 1a:
The importance of zooplankton



Answer Sheet 1a:
Mark Scheme for Student Sheet 1a



Video Lesson 1:
Teacher Guidance

Video Lesson 1:
Student Sheet Video

Video Lesson 1:
Student Sheet Video reflection

Video:
Investigating the impact of microplastics



Subject Update:
Learn more: Copepods

Subject Update:
Learn more: Marine carbon cycle

Lesson 2 How can humans affect the marine environment?

Overview

The ocean is worth \$49.7 trillion to the global economy and its beauty is priceless. People, every day, all over the world, use the ocean for a whole variety of purposes: but what impact does this human activity have on the ocean, the organisms that live there and on us?

Learning outcomes

- Give examples of human impacts (Foundation)
- Use the words 'overfishing' 'dose' and 'persistent' correctly (Developing)
- Describe what happens in a trophic cascade and apply this knowledge (Developing)
- Describe the process of bioaccumulation (Competent)
- Explain why it is difficult to predict the impact of population change (Expert)

Resources



Slideshow 2:
How can humans affect the marine environment?



Student Sheet 2a:
Scientist tweet sheet

Student Sheet 2b:
Blog post

Student Sheet 2c:
Storyboard template



Answer Sheet 2b

Answer Sheet 2c



Gallery:
Water sampling



Subject Update:
Learn more: Trophic cascades

SCHEME OF WORK

Lesson 3: What are microplastics and where do they come from?

Overview

In this lesson, students develop their understanding of how human actions can have a negative impact on the marine environment. The context of this lesson is investigating the amount of microplastics that students use every day in personal hygiene products.

Learning outcomes

- Define microplastics (Foundation)
- Give sources of microplastics (Foundation)
- Define and use the term 'microplastic' correctly (Developing)
- Describe how to use sampling techniques (Competent)
- Apply sampling techniques (Competent)
- Switch between multiples of units (Expert)
- Use standard form (Expert)

Resources



Slideshow 3:

What are microplastics and where do they come from?



Activity Overview 3:

How much microplastic



Student Sheet 3a:

How much microplastic

Student Sheet 3b:

Microplastics summary worksheet

Student Sheet 3c:

Hunting microplastic home learning



Subject Update:

Learn more: Marine plastics

Subject Update:

Learn more: Marine plastics facts and figures

Lesson 4: Do zooplankton and microplastics occur together?

Overview

In this lesson students learn how to apply sampling techniques, using real field data collected by Dr Lewis's team. The context of this lesson is the voyage the team took to the Gulf of Maine to investigate if zooplankton and microplastics co-occur.

Learning outcomes

- Describe how to collect data at sea (Foundation)
- Define and use the key words correctly (Developing)
- Apply sampling techniques (Competent)
- Use standard form (Expert)
- Evaluate sampling techniques (Expert)

Resources



Slideshow 4:

Do zooplankton and microplastics occur together?



Student Sheet 4a:

Do zooplankton and microplastics occur together

Student Sheet 4a:

Do zooplankton and microplastics occur together higher



Answer Sheet 4a and 4b



Video:

Science under sail

SCHEME OF WORK

Lesson 5: Do zooplankton eat microplastics? (Experiment set-up)

Overview

This lesson develops students' skills in data handling and presentation. Having learnt about microplastics and zooplankton separately, the next two lessons see students test the hypothesis that zooplankton eat microplastics. In this first lesson, students set up a classroom practical to collect primary data. They then process the secondary data collected by Dr Ceri Lewis and her team.

Learning outcomes

- Calculate differences and plot points on a graph accurately (Foundation)
- Calculate averages, choose appropriate graphs to draw, and draw your own scales on axes (Developing)
- Handle anomalies, draw lines of best fit, and range bars (Competent)
- Find linear equations (Expert)
- Calculate standard deviation (Advanced)

Resources



Slideshow 5:
Do zooplankton eat microplastics? Part 1



Activity Overview 5:
Do zooplankton eat microplastics



Student Sheet 5a:
Do zooplankton eat microplastics practical

Student Sheet 5b:
Do zooplankton eat microplastics data analysis



Answer Sheet 5b



Video:
Science in the lab

Lesson 6: Do zooplankton eat microplastics? (Conclusion)

Overview

In this lesson, students return to their experiments from Lesson 5, and observe the gut contents of the brine shrimp, applying model conclusions to what they can see. Students develop their ability to write scientific conclusions using the secondary data from the research team. The lesson ends with students considering the implications of microplastics being consumed by zooplankton on a wide scale.

Learning outcomes

- Say what results show (Foundation)
- Describe patterns in results (Developing)
- Describe how results support hypotheses (Developing)
- Explain your conclusion with science (Competent)
- Explain conclusions' wider impacts (Competent)
- Support conclusions with numerical values (Expert)
- Describe the limitations of conclusions (Expert)

Resources



Slideshow 6:
Do zooplankton eat microplastics? Part 2



Activity Overview 5:
Do zooplankton eat microplastics



Student Sheet 5a:
Do zooplankton eat microplastics practical

Student Sheet 6a:
Model conclusions

Student Sheet 6b:
Do zooplankton eat microplastics conclusions



Answer Sheet 6b



Video:
Investigating the impact of microplastics

SCHEME OF WORK

Lesson 7: How can you make sure your discoveries have an impact?

Overview

Having made their discovery that microplastics affect zooplankton feeding and that this could have devastating environmental consequences, the question is, what changes do they want to see, and who should make them?

Learning outcomes

- Give some ways scientific discoveries can have an impact (Foundation)
- Produce and implement a small-scale impact plan that reaches 1-2 people (Developing)
- Produce and implement an impact plan that reaches 2-50 people (Competent)
- Produce and implement a large-scale impact plan that reaches 50 or more people (Expert)

Resources

**Slideshow 7:**

How can you make sure your discoveries have an impact?

**Student Sheet 7a:**

Reducing the impacts of microplastics

Student Sheet 7b:

Communications ideas

Student Sheet 7c:

Impact plan

Student Sheet 7d:

SMART targets

**Video:**

Science and society