

Applicable standards

Next Generation Science Standards (NGSS)

Grade 5-8 Science Element of the curriculum	Lessons					
	1	2	3	4	5	6
Earth's Systems						
5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	✓					
Human Impacts						
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.		✓				✓
MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's system	✓					
Weather and Climate						
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	✓					✓
Matter and Energy in Organisms and Ecosystems						
5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.			✓			
MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.				✓		
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.			✓			
MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.			✓			
Interdependent Relationships in Ecosystems						
MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.			✓			
Structure and Properties of Matter						
5-PS1-3. Make observations and measurements to identify materials based on their properties.					✓	
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.					✓	

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Science and Engineering Practices	Lessons					
	1	2	3	4	5	6
Element of the curriculum						
• Asking questions				✓	✓	
• Developing and using models			✓			
• Planning and carrying out investigations		✓		✓	✓	
• Analyzing and interpreting data	✓	✓		✓	✓	✓
• Using mathematics		✓		✓	✓	
• Constructing explanations	✓			✓		✓
• Engaging in argument from evidence	✓					✓
• Obtaining, evaluating and communicating information						✓

SCHEME OF WORK

Lesson 1: Are humans causing ocean acidification?

Overview

A practical lesson where students work scientifically and develop their literacy skills by writing a conclusion using the 'Point Evidence Explain' technique from English. The context of the lesson is the work of Dr Helen Findlay who is investigating ocean acidification: 'the other carbon problem'. This introduction to the carbon cycle and ocean acidification builds on students' prior knowledge of climate change and increased atmospheric carbon dioxide.

Learning outcomes

- Understand the wider context and learning outcomes
- Describe patterns
- Use the 'Point Evidence Explain' technique
- Explain the difference between correlation and cause
- Demonstrate and reflect on learning

Resources

-  **Slideshow 1:**
Are humans causing ocean acidification?
-  **Activity Overview 1:**
Are humans causing ocean acidification?
-  **Student Sheet 1a:**
Investigating the causes of ocean acidification
- Student Sheet 1b:**
Practical instructions
-  **Answer Sheet 1**

Lesson 2: How does ocean acidification affect organisms?

Overview

Students work scientifically by writing a method to test a hypothesis and then practise this in an exam setting. The context of the lesson is Dr Ceri Lewis' work into the impact of ocean acidification on copepods, a type of zooplankton with calcium carbonate shells. The lesson builds on students' prior knowledge of the environmental impact of anthropogenic CO₂ production.

Learning outcomes

- Understand the wider context and learning outcomes
- Identify variables for a hypothesis
- Write a logical step-by-step method
- Describe how to control common hazards
- Demonstrate learning

Resources

-  **Slideshow 2:**
How does ocean acidification affect organisms?
-  **Activity Overview 2:**
Investigating how ocean acidification affects organisms
-  **Student Sheet 2a:**
Investigating how ocean acidification affects organisms
- Student Sheet 2b:**
Ballast tank diagram
-  **Answer Sheet 2:**
Mark scheme for exam style questions

Lesson 3: How does ocean acidification affect communities?

Overview

Students work scientifically by developing and using a model (a food web) to formulate hypotheses. The context of the lesson is Dr Ceri Lewis' investigation into how ocean acidification might affect plankton at low trophic levels and the cascade effects at higher levels. The lesson builds on students' prior knowledge of interdependence.

Learning outcomes

- Understand the wider context and learning outcomes
- Formulate a hypothesis
- Construct a model
- Use a model
- Demonstrate and reflect on learning

Resources

-  **Slideshow 3:**
How does ocean acidification affect communities?
-  **Student Sheet 3a:**
Arctic food webs
- Student Sheet 3b:**
Arctic organisms

SCHEME OF WORK

Lesson 4: How can we investigate photosynthesis in the Arctic safely?

Overview

Students work scientifically by assessing the risks of working in a lab and the more extreme environment of the Arctic. The context of the lesson is Dr Victoria Hill's work into how algal growth is affected by the changing photoperiod in the Arctic.

Learning outcomes

- Identify hazards
- Describe how to control common hazards
- Define the terms 'risk', 'hazard' and 'precaution'
- Complete a risk assessment

Resources



Slideshow 4:

How can we investigate photosynthesis in the Arctic safely?



Activity Overview 4:

How can we investigate photosynthesis in the Arctic safely?



Student Sheet 4a:

How can we investigate photosynthesis in the Arctic safely?

Student Sheet 4b:

Hazards of working in the Arctic



Answer Sheet 4

Lesson 5: Ocean detectives

Overview

Students work scientifically by using analytical techniques in a systematic way to identify mixed up samples of ocean water. The context of the lesson is a mix up in a lab which students have to use their skills to solve.

Learning outcomes

- Understand the wider context and learning outcomes
- Work systematically
- Demonstrate and reflect on learning

Resources



Slideshow 5:

Ocean detectives



Activity Overview 5:

Ocean detectives



Student Sheet 5a:

Ocean detectives



Video:

Arctic field lab

Lesson 6: Can ice melting in the Arctic really cause sea level rise?

Overview

Students work scientifically using models to explain the impacts of Arctic ice melting. Scientist Dr Helen Findlay puts this lesson into context, sharing her experiences studying polar ice.

Learning outcomes

- Understand the wider context and learning outcomes
- Describe how the Arctic is changing
- Compare the impact of different types of ice melting
- Use a model to explain (advanced)
- Demonstrate and reflect on learning

Resources



Slideshow 6:

Can ice melting in the Arctic really cause sea level rise?



Activity Overview 6:

Sea level rise



Student Sheet 6a:

Is all ice equal?

Student Sheet 6b:

Storyboard



Video:

Sea ice 1979 - 2012