Encounter Edu

Frozen Oceans

X-Curric | Ages 7 - 11

Teacher Book

AXA OCEAN EDUCATION

Contents

Welcome to the Frozen Oceans Teacher Book

OCEAN EDUCATION

The oceans are Earth's defining feature. Covering over two-thirds of the planet's surface, they support more than 90% of all life, yet there's still so much left to
discover about them.

AXA XL have been mapping and measuring the oceans since 2009 with the renowned Catlin Arctic Survey, XL Catlin Seaview Survey and the XL Catlin Deep Ocean Survey. Now we're sharing our discoveries with children, teachers and parents, so that we all learn how important they are to our everyday lives.

This booklet focuses on our frozen oceans. The activities are supported online with 360° virtual tours, videos and photography and you can even join a live-link to scientists and explorers in the Arctic.

We hope the activities inspire you. And we'd love to hear how you get on with your own journeys of discovery.

Chip Cunliffe
Director of Sustainable Development
AXA XL

How to use this resource

About Frozen Oceans 7-11

Frozen Oceans provides primary/elementary school teachers with a comprehensive activity-based approach to introduce young people to the wonders and adventure of the Arctic. This resource is based on the Catlin Arctic Survey expeditions, which explored the high Arctic from 2009 to 2011.

Oceans Education programme

This resource is just one of the ways that the AXA XL Ocean Education program is supporting teachers and students to learn about the marine environment. Further resources and opportunities are listed here to give classes further opportunities to explore the wonder and importance of the oceans.

ICT requirements

This unit of work has been designed for classrooms with access to a computer with an interactive whiteboard. Videos and other media on the Media Zone are accessible using a desktop, laptop or tablet. To access 360° media in full virtual reality, students will need access to a virtual reality viewer and compatible smart phone. See encounteredu.com/partners/axa-ocean-education for more information.

Health and safety

All activities should be supervised by a responsible adult. The safety of young people is the responsibility of the supervising adult.

The next generation of explorers

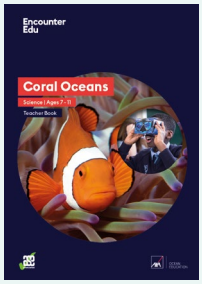
In an article in Newsweek, February 2013, Pen Hadow, polar explorer and the driving force behind the Catlin Arctic Surveys ends the interview with a note of caution.

"The Arctic Ocean is like a defenseless princess who needs chaperones – a new generation of explorers – to represent her interests abroad as she arrives on the global scene. Everyone is looking to see what they can get out of her – nobody else there is coming from her perspective. That's the job of those coming up behind me. Before it's too late. These activities aim to light the fire for a new generation of explorers and scientists".

Units in the AXA XL Ocean Education programme

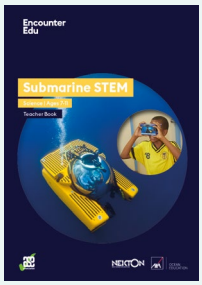
Coral Oceans

Science 7-11
Science 11-14
Science 14-16
Geography 14-16



Submarine STEM

Science 7-11
Science 11-14

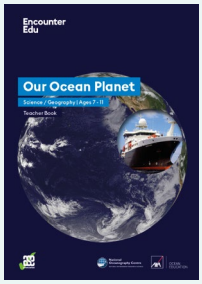


Frozen Oceans

X-Curric 7-11
Science 11-14
Science 14-16
Geography 11-14
Geography 14-16

Our Ocean Planet

Science/ Geography 7-11



About the Catlin Arctic Survey

The Catlin Arctic Survey was a series of expeditions between 2009 and 2011 to explore and investigate how the Arctic is changing, with the concept of explorers working with scientists at the heart of the surveys.

2009 Survey

The first Catlin Arctic Survey sought to answer an important environmental question, 'How long will the Arctic Ocean's sea ice cover remain a year-round surface feature of our planet?'.

Across hundreds of kilometres explorers took thousands of measurements of sea ice thickness. This data was collected and analysed by research partners in the Polar Ocean Physics Group at the University of Cambridge.

Highly experienced polar explorer, and Catlin Arctic Survey founder, Pen Hadow led the expedition. He was accompanied by Ann Daniels, also a renowned polar explorer, and Martin Hartley, the UK's foremost expedition and adventure-travel photographer.

The findings from this survey, together with decades of existing measurements, led the Cambridge scientists to suggest there is a significant probability that, by around 2020, only 20% of the Arctic Ocean basin will have sea ice cover in the summer.

2010 Survey

In 2010, an Ice Base, run by scientific and operations staff, joined the three-person explorer team, creating a two-pronged research effort into the effects of carbon dioxide on the Arctic Ocean.

When carbon dioxide dissolves in sea water it forms a weak acid. The rate at which atmospheric carbon dioxide is increasing is overwhelming the oceans' ability to accommodate these changes, leading to ocean acidification. And because cold water absorbs carbon dioxide more effectively than warm water, the Arctic Ocean is a beacon for how these changes could affect the world's oceans.

The three-person explorer team braved harsh Arctic winter to spring conditions to collect vital water samples and measure sea ice thickness. After a day of hauling 120kg sleds in temperatures as low as -38° C (-36° F), they manually drilled through ice up to five meters thick and kept water samples in a special fridge box to prevent them from freezing.

Their epic trek culminated in a 'Hole at the Pole', a hole drilled through the ice at the North Pole for final water samples.

2011 Survey

The 2011 expedition between February and May involved a team of scientists and other staff travelling to an Ice Base off the western coast of Ellef Ringnes Island in the territory of Nunavut, Canada (78°45' N, 103°30' W). A four strong explorer team also carried out a two part journey across the ice, gathering data as they went.

The expedition involved a range of scientific research, which included:

- Sea ice depth from transects.
- Background temperature and climate readings.
- pH levels (the acidity of the water).
- CDOM levels (refers to the color of the water which is altered by presence of organic material).
- Zooplankton counts (including copepods).

Air temperatures never rose above -15° C for the duration of the expedition, and got as low as -48° C at some points during the scientists' extended stay on the ice.

360° Virtual Reality

The XL Catlin Oceans Education team have returned to the Arctic each year since 2014, exploring and communicating from the area around the UK Arctic Research Station at Ny Alesund, on the Svalbard archipelago. With developments in 360° photography and film making, they have captured the area in stunning images and immersive videos.

The team have taken 360° cameras on the back of skidoos up to glacier research sites, and abseiling 45 meters down into the middle of a glacier. A series of 360° photos have been created to give a tour of the science 'village' of Ny Alesund, the world's most northerly permanent settlement.

Jamie Buchanan-Dunlop, Director of AXA XL's education partner, Encounter Edu (Formerly Digital Explorer), explains, "We want to create educational opportunities where students are learning from the frontiers of knowledge and the world. Making a journey to the Arctic is outside of the reach of most school trips and I don't think I've ever heard of students exploring inside an Arctic glacier! Virtual reality makes it easy for students to encounter these places and meet the scientists and others working there from the comfort of the classroom. It's a chance to change how young people learn from and engage with their world, while allowing educators to deliver the core curriculum."

These Arctic virtual tours can be accessed in the classroom via Google Street View goo.gl/LdU9cv or via the Google Street View app and using Google Education's Expeditions app google.co.uk/edu/expeditions.

Highlights of this 360° virtual reality content and further guidance on its use can also be found at encounter-edu.com/partners/axa-ocean-education.

Applicable standards
The national curriculum in England

KS1 - KS2 Science

Element of the curriculum	Lessons 1	2	3	4	5
KS1					
• Identify and name a variety of common animals that are carnivores, herbivores and omnivores	✓				
• Describe how animals obtain their food from plants and other animals, using the idea of a simple food chain	✓				
• Describe basic needs of animals and the importance of exercise		✓			
• Describe the importance for humans to eat the right amounts of different types of food			✓		
• Describe the simple physical properties and uses of a variety of everyday materials				✓	
• Identify that most living things live in habitats to which they are suited				✓	
KS2					
• Describe how animals obtain their food from plants and other animals, using the idea of a simple food chain	✓				
• Recognise the impact of exercise and lifestyle on body function		✓			
• Describe the importance for humans to eat the right amounts of different types of food			✓		
• Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials				✓	
• Identify how animals are adapted to suit their environment in different ways				✓	
• Impact of changing environments					✓
• Changes of state					✓
Working Scientifically					
• Observing over time		✓		✓	✓
• Pattern seeking					✓
• Identifying, classifying and grouping				✓	
• Comparative and fair testing (controlled investigations)				✓	
• Researching using secondary source	✓		✓		
• Presenting data	✓			✓	

Applicable standards
The national curriculum in England

KS1 - KS2 Geography

Element of the curriculum	Lessons 1	2	3	4	5
• Develop contextual knowledge of globally significant marine places					✓
• Physical geography: describe and understand key aspects of polar biomes					✓

Literacy & Numeracy

Element of the curriculum	Lessons 1	2	3	4	5
• Write a narrative using a creative writing storyboard		✓			
• Compare calories and weights to develop numeracy and mathematical reasoning			✓		

Applicable standards

Next Generation Science Standards (NGSS)

Grades 2-5 Science

Element of the curriculum	Lessons 1	2	3	4	5
K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.				✓	
2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.				✓	
2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.				✓	
2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.	✓				
2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.					✓
2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.					✓
3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.				✓	
3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.				✓	
3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.		✓		✓	
3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.					✓
4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.		✓	✓	✓	
4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.		✓			

Grades 2-5 Science (continued)

Element of the curriculum	Lessons 1	2	3	4	5
5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	✓				
5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.	✓				
5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	✓				
5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.					✓

Science and Engineering Practices

Element of the curriculum	Lessons 1	2	3	4	5
• 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	✓		✓	✓	✓

Lesson 1: What organisms live in the Arctic?

Overview

Students develop their understanding of simple food chains or webs and scientific vocabulary through making an Arctic life mobile.

They will also be introduced to the work of marine scientist, Dr Ceri Lewis, who has worked in the Arctic investigating the impact of environmental change on this fragile ecosystem.

Learning outcomes

- Name five Arctic organisms
- Use scientific vocabulary correctly
- Draw simple food chains
- Draw a food chain with the correct arrows
- Construct a food web

Resources

Slideshow 1:
What organisms live in the Arctic?

Activity Overview 1:
Arctic life mobiles

Student Sheet 1a:
Researching Arctic organisms

Student Sheet 1b:
Arctic organism cards

Student Sheet 1c:
Arctic life mobiles

Thinglink:
What animals live in the Arctic?

Gallery:
What creatures live in the Arctic?

Lesson 2: How do you train like an Arctic explorer?

Overview

In this lesson students simulate the training of Arctic explorers to learn how lifestyles can affect physical and mental health.

The lesson is introduced by Ann Daniels, a record-breaking polar explorer as the first woman in history, along with expedition teammate Caroline Hamilton, to reach the North and South Poles as part of all women teams.

Learning outcomes

- Describe conditions in the Arctic
- Describe some of the challenges of surviving in the Arctic
- Explain why physical training is needed for Arctic explorers
- Explain why mental training is needed for Arctic explorers

Resources

Slideshow 2:
How do you train like an Arctic explorer?

Activity Overview 2a:
Tyre dragging relay

Activity Overview 2b:
Sleeping bag relay

Student Sheet 2a:
Training storyboard

Video:
Training for the Arctic in Devon

Video:
How do you sleep in the Arctic?

Subject Update:
What fitness training do Arctic explorers need?

Lesson 3: How do you eat like an Arctic explorer?

Overview

Students learn about diet and the importance of a balanced diet through the experiences of polar explorers. Using creativity and scientific research skills, students will create a menu suitable for an Arctic expedition.

The lesson is introduced by Fran Orio, a specialist polar cook, who can make amazing meals in the most extreme circumstances.

Learning outcomes

- Link calories to the energy in food
- Use scientific vocabulary correctly
- Describe the role of carbohydrate, fat and protein in the body
- Describe the conditions in the Arctic
- Describe some of the difficulties of surviving in the Arctic
- Design a diet for a polar explorer
- Explain the differences between your diet and a polar explorer's diet

Resources

Slideshow 3:
How do you eat like an Arctic explorer?

Activity Overview 3:
Make your own pemmican

Student Sheet 3a:
Researching food

Student Sheet 3b:
Polar menu

Video:
How many calories does a polar explorer need a day?

Video:
What are the challenges of cooking in an Arctic Ice Base?

Subject Update:
What do polar explorers eat?

Lesson 4: How do humans and animals keep warm in the Arctic?

Overview

In this lesson students investigate the insulating properties of materials and consider how the adaptations of Arctic organisms help develop these.

The context of the lesson is helping to develop new clothing for Tyler Fish, one of the Catlin Arctic Survey explorers.

Learning outcomes

- Describe the conditions in the Arctic
- Make a prediction
- Investigate the insulating properties of three different materials
- Demonstrate learning by producing a poster with a graph and conclusion

Resources

Slideshow 4:
How do humans and animals keep warm in the Arctic?

Activity Overview 4a:
Investigating insulating materials

Student Sheet 4a:
Investigating insulating materials

Student Sheet 4b:
Scientific poster template

Student Sheet 4c:
Scientific poster template (Advanced)

Subject Update:
What equipment and clothing do polar explorers need?

Lesson 5: How is the Arctic changing?

Overview

In this lesson students learn about the impacts of ice in the Arctic melting by watching a series of demonstrations.

The context of the lesson is the work of Dr Helen Findlay who was investigating the effect of environmental change on the Arctic ecosystem.

Learning outcomes

- Describe the conditions in the Arctic
- Describe how the Arctic is changing
- Explain the cause and possible outcome of one problem facing the Arctic

Resources

Slideshow 5:
How is the Arctic changing?

Activity Overview 5a:
The albedo effect

Activity Overview 5b:
Sea level rise

Activity Overview 5c:
Ocean circulation

Student Sheet 5a:
Sentence card sort

Student Sheet 5b:
Storyboard

Video:
What trends are there in sea ice coverage?

Subject Update:
What are ice caps and how are they formed?

Subject Update:
Why is the Arctic melting and why is that a problem?

Subject Update:
How does ocean circulation affect the climate of the UK?

Teacher guidance

The Teacher Guidance for each lesson uses a set of icons as seen below to provide visual clues to support teachers:

Lesson activities

Explain
teacher exposition using slides or script to support

Demonstration / watch
students watch a demonstration or video

Student activity
activity for students to complete individually such as questions on a Student Sheet

Pair activity
activity for students to complete in pairs

Group work
activity for students to complete in groups

Whole class discussion
teacher conducts a whole class discussion on a topic or as a plenary review

Home learning
home learning exercise for after school or alternatively, a lesson extension

Teacher ideas and guidance

Assessment and feedback
guidance to get the most from AfL (Assessment for Learning)

Guidance
further information on how to run an activity or learning step

Idea
optional idea to extend or differentiate an activity or learning step

Information
background or further information to guide an activity or explanation

Technical
specific ICT or practical hints and tips

Health and safety
health and safety information on a specific activity

What organisms live in the Arctic?

Age 7-11

60 minutes

Curriculum links

- Carnivores, herbivores and omnivores.
- Simple food chains.
- Predators and prey.
- Enquiry by research and presenting data.

Lesson overview

Students develop their understanding of simple food chains or webs and scientific vocabulary through making an Arctic life mobile. They will also be introduced to the work of marine scientist, Dr Ceri Lewis, who has worked in the Arctic investigating the impact of environmental change on this fragile ecosystem.

Resources

Slideshow 1:
What organisms live in the Arctic?

Activity Overview 1a:
Arctic life mobiles

Student Sheet 1a:
Researching Arctic organisms

Student Sheet 1b:
Arctic organism cards

Student Sheet 1c:
Arctic life mobiles

Thinglink:
What animals live in the Arctic?

Gallery:
What creatures live in the Arctic?

Lesson steps	Learning outcomes
1. Brief from Dr Ceri Lewis (10 mins) Use the slides to set the context and share the learning outcomes.	• Understand the wider context and learning outcomes
2. Researching Arctic organisms (15 mins) Students research the organisms living in the Arctic using the interactive Thinglink tool.	• Name five Arctic organisms • Use key words correctly
3. Food chains (10 mins) Students learn to show feeding relationships with food chains and webs from the slides.	• Draw simple food chains or webs
4. Arctic mobiles (20 mins) Students demonstrate their learning by building food chain or food web mobiles of the Arctic community.	• Demonstrate learning.
5. Self reflection (5 mins) Using slides, students consider how alternative 'teachers' may have delivered the lesson.	• Reflect on learning

TEACHER GUIDANCE 1 (page 1 of 2)
WHAT ORGANISMS LIVE IN THE ARCTIC?

Step	Guidance	Resources
1 10 mins	The purpose of Step 1 is to share the learning outcomes, set the context and engage students with the learning. · Ask students to write the lesson title from the top left of Slide 2, as well as the date and key question into their books. They can then try to guess the missing words from the key question, which in this case are "organisms" and "rely". · Read the outcomes on Slide 3 with the students and ask them to put their hands up to show what they can already do. · Show students the location of the Arctic on Slide 4 and read the topic brief from Dr Ceri Lewis on Slide 5 to put the lesson into context. Challenge students who you think are over or underestimating their current learning by asking targeted questions. This is a good opportunity for students to take the lead and practise reading aloud.	**Slideshow 1:** Slides 1-5
2 15 mins	In step 2, students research organisms that live in the Arctic. · Hand out Student Sheet 1a. Show the class the Thinglink on the board. As you roll over the red dots, boxes pop out with more information. · Demonstrate picking out the key information from the pop-outs to help complete their worksheet. · Students can use the Thinglink to conduct their research. · Take feedback from the class and check for misconceptions. To support lower ability students, ask them to work in pairs. Ask several students targeted questions. For example, 'name me three predators' and 'how do you know algae are producers?' To challenge higher ability students, ask them to justify some difficult classifications, for example 'why are ringed seals predators and prey?' and 'why aren't copepods predators?'	**Slideshow 1:** Slides 6-7 **Student Sheet 1a:** Researching Arctic Organisms **Thinglink:** What animals live in the Arctic?

TEACHER GUIDANCE 1 (page 2 of 2)
WHAT ORGANISMS LIVE IN THE ARCTIC?

Step	Guidance	Resources
3 10 mins	The purpose of Step 3 is for students to learn how to construct food chains. · Use Slides 8 to 10 to explain how to construct food webs. · Many students erroneously think that the arrows show the action of the predator. One of the best ways for them to remember the correct direction of the arrows is that food goes into their mouths. · Using Slide 11, recap the learning outcomes and ask students to draw a food chain. · Students use Slide 12 to assess themselves. At this point, note any students who have drawn their food chain incorrectly. Correct any misconceptions and ask them spot questions at some point during the next task.	**Slideshow 1:** Slides 8-12
4 20 mins	The purpose of Step 4 is for students in groups to demonstrate their learning by building a mobile. · Hand out Student Sheets 1b and 1c one between two. Use Activity Overview 1a to guide you through the preparation, set up and running of this practical activity. · Ask students to peer assess each-others' mobiles. · Ask students to read out the comments they have made on another groups work: this will highlight if they have understood the success criteria. Poor comments like 'good try' should be replaced using the success criteria and you may have to model this. · For home learning, students could draw out the food chains and these can then be peer assessed again at the start of another lesson. · At this point you can ask students who has made an improvement to show that using feedback drives learning.	**Slideshow 1:** Slide 13 **Activity Overview 1a:** Arctic life mobiles **Student Sheet 1b:** Arctic organism cards **Student Sheet 1c:** Arctic life mobiles
5 5 mins	In Step 5, students reflect on their learning · Ask students to raise their hands to show what outcomes on Slide 14 they are confident they can do. · Challenge students by asking selected individuals what evidence they have that tells them they can meet an outcome. · Ask students to complete the reflection questions on Slide 15. Take feedback from the class. · This activity helps students re-contextualise their learning, by linking it to other areas.	**Slideshow 1:** Slides 14-15

Arctic life mobiles

Age 7+
(adult supervision)

20 minutes

Details

Each group needs:

- Student Sheet 1b
- Student Sheet 1c
- 20cm x 30cm (A4) piece of corrugated cardboard
- 3 x 20cm dowelling or twigs or wooden skewers (point removed)
- 2m of string, wool or fishing line
- Glue
- Scissors
- Sticky tape
- Colouring crayons

Safety and Guidance

Precautions

Great care should be taken when using scissors and dowels. You may wish to run this activity in small groups with closer adult supervision.

Overview

In this activity, students demonstrate their learning about Arctic organisms by constructing a mobile to show either a food chain, or for more advanced students, a food web.

Running the Activity

1. Hand out copies of Student Sheets 1b and 1c.
2. Outline the aims to students.
3. Read through the success criteria, the practical instructions, and the health and safety instructions with students.
4. Give students 15-20 minutes to make their mobiles.
5. Tour the groups as they are working to ask students questions to display their learning - examples are given below.
6. Ask groups to peer assess one another's mobiles.

Example questions

To assess learning at a competent level, ask:

"Which way should the arrows be pointing in the food chain?" or
"Which way does the energy flow in the food chain?"

To assess learning at an advanced level, ask:

"What would happen to the polar bears if the seals died?" or
"What would happen to the polar bears if the walrus died?"

Answers

Advanced students should recognise that the loss of seals could cause the loss of polar bears because the polar bears eat seals. However, the loss of walruses would have a far lesser effect, because, as this food web shows polar bears do not eat walruses.

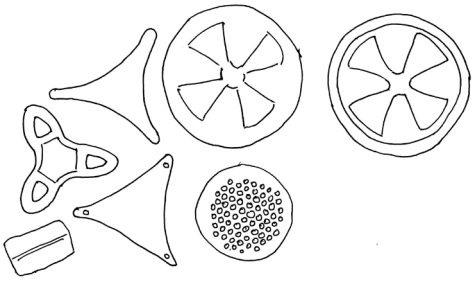
Exceptional students may realise that the loss of walruses could affect the number of clams, which would have a knock on effect all through the food web.

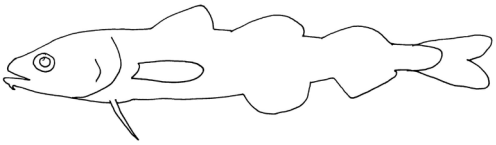
Researching Arctic organisms

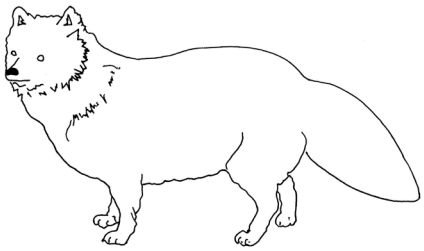
	What does it eat?	What eats it?	Producer or consumer?	Predator or prey?
Algae				
Arctic cod				
Arctic fox				
Beluga whale				
Clam				
Copepod				
Polar bear				
Ringed seal				
Walrus				

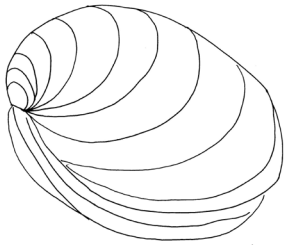
	What does it eat?	What eats it?	Producer or consumer?	Predator or prey?
Algae				
Arctic cod				
Arctic fox				
Beluga whale				
Clam				
Copepod				
Polar bear				
Ringed seal				
Walrus				

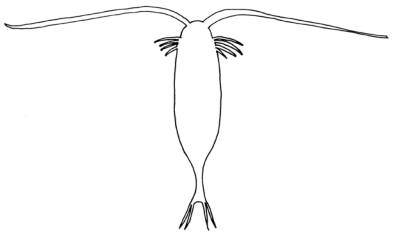
STUDENT SHEET 1b ARCTIC LIFE CARDS

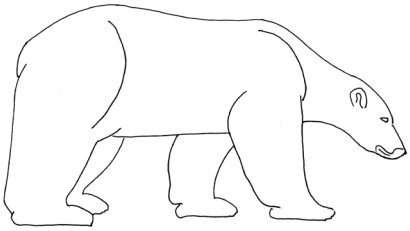


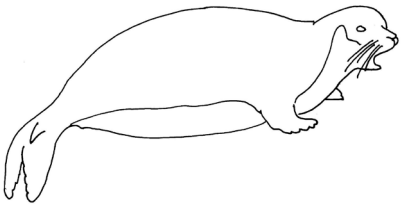


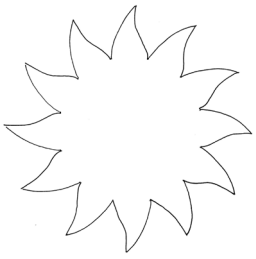


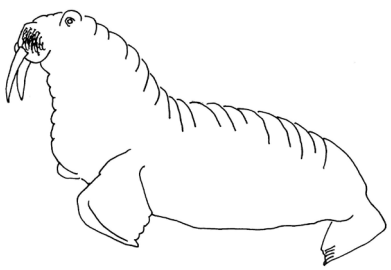












STUDENT SHEET 1b ARCTIC LIFE CARDS

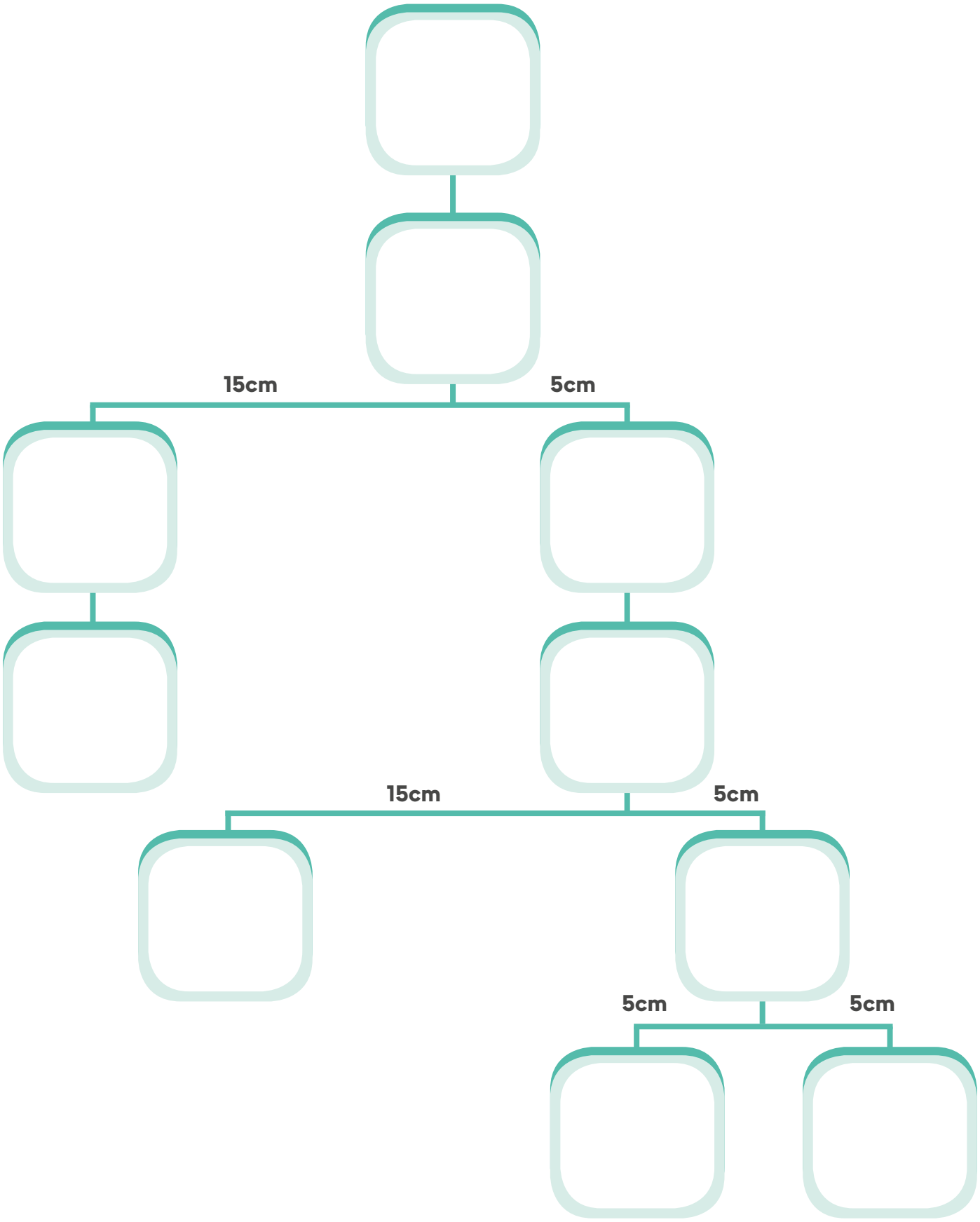
Name: Words used to describe this organism:	Name: Words used to describe this organism:
Name: Words used to describe this organism:	Name: Words used to describe this organism:
Name: Words used to describe this organism:	Name: Words used to describe this organism:
Name: Words used to describe this organism:	Name: Words used to describe this organism:
Name: Words used to describe this organism:	Name: Words used to describe this organism:

Arctic life mobiles

Developing	Competent	Expert
Build a food chain mobile. Name the organisms.	Use key words to describe each organism. Tell your teacher which way the arrows should point.	Build a food web mobile. Tell your teacher what would happen if one organism was removed.

Step	Instruction
Colour in	Neatly colour in the organisms on Student Sheet 1b.
Stick to card	Carefully stick the Student Sheet to a piece of cardboard.
Cut out	Carefully cut out the cards.
Fill in back	Fill in the details on the back using Student Sheet 1b.
Stick to back	Stick these to the back of the correct organisms.
Lay out cards	Choose the organisms you will be using for your chain. If you are building a web, you will need all of the cards.
Link the cards	If you are making a chain, link a series of cards together to make a chain of organisms. Do this by taping a section of string from the top of one card to the bottom of another. How many cards can you link together in a chain? If you are making a mobile, use the template on the next page to lay out your cards and lengths of dowelling or twigs before you attach them together with string. You may wish to check with your teacher before you start to tape the different sections together.
Make a mobile	If you are making the model, use the diagram on the next page to balance your food web.

Arctic life mobiles



How do you train like an Arctic explorer?

Age 7-11

60 minutes

Curriculum links

- Basic needs of animals and the importance of exercise
- Impact of exercise and lifestyle on the body
- Enquiry by observation
- Creative storyboard writing

Resources

Slideshow 2:
How do you train like an Arctic explorer?

Activity Overview 2a:
Tyre dragging relay

Activity Overview 2b:
Sleeping bag relay

Student Sheet 2a:
Training storyboard

Video:
Training for the Arctic in Devon

Video:
How do you sleep in the Arctic?

Subject Update:
What fitness training do Arctic explorers need?

Lesson overview

In this lesson students simulate the training of Arctic explorers to learn how lifestyles can affect physical and mental health.

The lesson is introduced by Ann Daniels, a record-breaking polar explorer as the first woman in history, along with expedition teammate Caroline Hamilton, to reach the North and South Poles as part of all women teams.

Lesson steps	Learning outcomes
1. Brief from Ann Daniels (10 mins) Use the slides to set the context and share the learning outcomes.	• Understand the wider context and learning outcomes
2. Tyre dragging relay (20 mins) Students watch the Training in Devon video to introduce the activity. Students simulate the training of Arctic explorers with a tyre dragging relay. They consider the benefits of this training for explorers.	• Describe conditions in the Arctic • Describe some of the challenges of surviving in the Arctic • Explain why physical training is needed for Arctic explorers
3. Sleeping bag relay (20 mins) Students watch the Sleeping at -35 video to introduce the activity. Students simulate the training of Arctic explorers with a sleeping bag relay. They consider the benefits of this training for explorers.	• Explain why mental training is needed for Arctic explorers
4. Summary questions (5 mins) Students demonstrate their learning by answering two questions from a selection on the slides.	• Demonstrate learning
5. Self reflection (5 mins) Using slides, students consider what they have learned using their eyes, ears and bodies.	• Reflect on learning

TEACHER GUIDANCE 2 (page 1 of 2)
HOW DO YOU TRAIN LIKE AN ARCTIC EXPLORER?

Step	Guidance	Resources
1 10 mins	 The purpose of Step 1 is to share the learning outcomes, set the context and engage students with the learning. · Ask students to write the lesson title from the top left of Slide 2, as well as the date and key question into their books. They can then try to guess the missing word from the key question, which in this case is "train". · Read the outcomes on Slide 3 with the students and ask them to put their hands up to show what they can already do. · Show students the location of the Arctic on Slide 3 and read the topic brief from Ann Daniels on Slide 4 to put the lesson into context. · Show students Slides 6 to 9. Ask students what challenges they can see in the photographs. · Make explicit links between the conditions in the Arctic and how difficult it is to find some of the things humans normally need to survive, such as liquid water and food.  Challenge students who you think are over or underestimating their current learning by asking targeted questions.	**Slideshow 2:** Slides 1-9
2 20 mins	 In step 2, students begin to understand the importance of physical training for an Arctic explorer. · Show students the Training in Devon video. Ask them how Ann is training and why they think this is important. · Students now take part in a relay to drag a tyre as Ann did in her video. · Use Activity Overview 2a to guide you through the preparation, set up and running of this practical activity. · Follow up on the activity using the discussion questions on slide 10 · An alternative to this activity is to make use of Student Sheet 2a to engage students creativity and create a training storyboard. Encourage students to think about which training activities are useful and for which reasons in the Arctic.  See Subject Update: What fitness training do Arctic explorers need? for more information. This is available at: https://encounteredu.com/cpd/subject-updates/learn-more-what-fitness-training-do-arctic-explorers-need  · This activity presents high risks of tripping and slipping, medium risks of pulls and strains and low risks of bruising. See Activity Overview 2a for detailed Health and Safety instructions.	**Activity Overview 2a:** Tyre dragging relay **Video:** Training for the Arctic in Devon **Slideshow 2:** Slide 10 **Student Sheet 2a:** Training storyboard

TEACHER GUIDANCE 2 (page 2 of 2)
HOW DO YOU TRAIN LIKE AN ARCTIC EXPLORER?

Step	Guidance	Resources
3 20 mins	 The purpose of Step 3 is for students to understand the importance of mental preparation for an Arctic explorer. · Show students the Sleeping at -35 C video. · Ask them why they think preparing mentally is important. · Students now take part in a relay to get ready for bed in the Arctic. · Use Activity Overview 2b to guide you through the preparation, set up and running of this practical activity. · Follow up on the activity using the discussion questions on slide 11 and the learning checkpoint on slide 12. · An alternative to this activity is to make use of Student Sheet 2a to engage students creativity and create a training storyboard. Encourage students to think about which training activities are useful and for which reasons in the Arctic.  This activity presents medium risks of tripping and slipping. See Activity Overview 2b for detailed Health and Safety instructions.	**Activity Overview 2b:** Sleeping bag relay **Video:** How do you sleep in the Arctic? **Slideshow 2:** Slides 11-12 **Student Sheet 2a:** Training storyboard
4 5 mins	 The purpose of Step 4 is for students to demonstrate their learning. · Using Slide 13, ask students to answer two questions. · Using Slides 14 and 15 ask students to peer assess each others' answers.	**Slideshow 2:** Slides 13-15
5 5 mins	 In Step 5, students reflect on their learning · Ask students to raise their hands to show what outcomes on Slide 16 they are confident they can do. · Challenge students by asking selected individuals what evidence they have that tells them they can meet an outcome. · Ask students to complete the reflection questions on Slide 17. Take feedback from the class. · This activity helps students re-contextualise their learning, by linking it to other areas.	**Slideshow 2:** Slides 16-17

Tyre drag relay

Age 7+
(adult supervision)

20 minutes

Details

Each group needs:

- Car or van tyre
- Length of rope
- Section of chain (Optional: see notes)

Safety and Guidance

Precautions

- Where possible conduct the relay on a grass surface rather than asphalt or concrete.
- Students should wear long trousers where possible.
- Footwear should be 'grippy' and appropriate to the weather and conditions.
- Add contextual elements to the activity briefing, for example what might happen if someone slipped or fell during an Arctic expedition.
- Brief students that any trip or slip during a relay leg will mean they have to walk back to the start and begin the leg again.
- Conduct a series of age appropriate warm up.
- Brief students that if the whole tyre is not completely flat during the relay,they will have to start the relay leg again, walking back to the start point.

Overview

This activity replicates part of the training completed by polar explorers before they headed to the Arctic. During the preparation for the 2011 Catlin Arctic Survey, the team would drag tyres for up to five hours a day across Dartmoor. It will probably not be possible to replicate this during the school day, although some students may be inspired to take up a new hobby! The emphasis during the actual training is on stamina and teamwork. Try to encourage and focus on these during the activity.

Running the Activity

1. Divide students into equal teams. Team sizes of about 6 students work well.
2. Outline the aim of the activity: to work as a team to drag the tyre across the playground as many times as there are members of the team. If team sizes are unequal, set the number of relay legs as the number of team members in the largest team.
3. Outline the health and safety instructions. Ideas for contextual briefing are included.
4. Ask students to spend 3 minutes deciding how they will do this, e.g. all team members pulling one tyre or taking it in turns individually or in pairs.
5. Start the relay!

Additional notes

Loop the chain around the tyre as above and tie the rope through the ends. The purpose of the chain is that just tying a rope around the tyre may well lead to fraying and the rope breaking.

If you are just conducting this activity a few times, you will probably be able to get away with tying a rope around the tyres.

Consider the length of rope you will need. Too short a rope will mean that the angle from the students' hands to the tyre is quite steep. This will make it harder to drag the tyre or for more than one or two students to drag the tyre at any one time. An ideal length of rope from the tyre would be 2 to 3 metres.

Old rope can be found for free from outdoor activity centres and climbing walls. You will probably need to tie loops in the end of the rope for students to hold on to.

Sleeping bag relay

Age 7+
(adult supervision)

20 minutes

Details

Each group needs:

- 3 sleeping bags
- Pair of thick gloves or mitts

Safety and Guidance

Precautions

- Students should walk to their sleeping bags from the group.
- Students should sit down or kneel gently before they start their attempt.
- Brief students that if they break or damage a sleeping bag on a real Arctic expedition that this could affect their safety.
- Brief students that a slow and steady approach works best, especially at -40°C.
- Monitor students to make sure they are not getting too frustrated. Stop them if they are.

Overview

Getting into one sleeping bag seems simple enough, but it is a lot harder when you have three or four sleeping bags to get into and the temperature in your tent is -40°C. It is easy to get frostbite in your fingers zipping up the sleeping bag at night, when you are tired after a long day. It can also be very frustrating to try to do up fiddly zips with gloves on. Equipment can get broken when you get tired and irritated and there isn't a nearby camping shop to pop down to for repairs or a new sleeping bag.

Running the Activity

1. Divide students into equal teams. Team sizes of about 6 students work well.
2. Outline the aim of the activity to show how patience and practice can help to make simple tasks in harsh environments that little bit easier.
3. Outline the health and safety instructions.
4. Each member of the team will need to get into and out of the three sleeping bags (one inside the other) wearing mitts or gloves. If they take the gloves off at any point, they could get frostbite and the team will be disqualified.
5. Lay out each team's sleeping bags, fully unzipped. Give each team their pair of gloves.
6. Only one person can touch the sleeping bags at any one time.
7. Each team member must get into all sleeping bags, zip each one up, one inside the other.
8. Once they are in the three sleeping bags, they will need to unzip them fully, ready for the next person.
9. The fastest team to complete the sleeping bag relay wins.
10. Start the relay!

Additional notes

If you cannot find enough sleeping bags for three per team, consider the following options:

1. Make the activity easier by using only one or two sleeping bags per team.
2. Create a class challenge with just three sleeping bags for the whole class. Challenge students to perform the task the quickest and create a leader board of times. Students can volunteer to take part in the challenge.

STUDENT SHEET 2a TRAINING STORYBOARD

Write a story about training to be an Arctic explorer

How do you eat like an Arctic explorer?

Age 7-11

60 minutes

Curriculum links

- The importance of a balanced diet.
- Impact of diet on your body
- Enquiry by research
- Comparing calories and weights

Resources

Slideshow 3:
How do you eat like an Arctic explorer?

Activity Overview 3a:
Make your own pemmican

Student Sheet 3a:
Researching food

Student Sheet 3b:
Polar menu

Video:
How many calories does a polar explorer need a day?

Video:
What are the challenges of cooking in an Arctic Ice Base?

Subject Update:
What do polar explorers eat?

Lesson overview

Students learn about diet and the importance of a balanced diet through the experiences of polar explorers. Using creativity and scientific research skills, students will create a menu suitable for an Arctic expedition.

The lesson is introduced by Fran Orio, a specialist polar cook, who can make amazing meals in the most extreme circumstances.

Lesson steps	Learning outcomes
1. Ann's food bag video (10 mins) Use the video set to the context and ask students if they would enjoy Ann's diet of chocolate, cake and nuts! Use the slides to share the learning outcomes.	• Understand the wider context and learning outcomes
2. What is a diet? (10 mins) Students learn the meaning of the key words and the role of different nutrients using the slides.	• Link calories to the energy in food. • Use keywords correctly. • Describe the role of carbohydrates, fats and proteins in the body.
3. What is an Arctic diet? (10 mins) To stimulate ideas, students try pemmican, an example of food eaten by explorers. Using the slides, students consider how conditions in the Arctic could affect explorers' diets.	• Describe the conditions in the Arctic. • Design a diet for a polar explorer. • Explain the differences between a regular and polar diet.
4. My polar menu (25 mins) Students research calories per gram of common foods and use this to plan a menu for Arctic explorers.	• Demonstrate learning
5. Self reflection (5 mins) Using slides, students consider how they have learned using their eyes, ears and bodies.	• Reflect on learning

TEACHER GUIDANCE 3 (page 1 of 3)
HOW DO YOU TRAIN LIKE AN ARCTIC EXPLORER?

Step	Guidance	Resources
1 10 mins	 The purpose of Step 1 is to share the learning outcomes, set the context and engage students with the learning. · Show students the location of the Arctic on Slide 1 and watch the Ann's food bag video to put the lesson into context. · Ask students if they would enjoy a diet of chocolate, cake and nuts! · Ask students to write the lesson title from the top left of Slide 2, as well as the date and key question into their books. They can then try to guess the missing word from the key question, which in this case is "eat". · Read the outcomes on Slide 3 with the students and ask them to put their hands up to show what they can already do. · Show students the location of the Arctic on Slide 4 and read the topic brief from Fran Orio on Slide 5 to put the lesson into context.  Challenge students who you think are over or underestimating their current learning by asking targeted questions.	**Slideshow 3:** Slides 1-5 **Video:** How many calories does a polar explorer need a day?
2 10 mins	 In step 2, students begin to understand the scientific meaning of the word 'diet'. · Show Slide 6 and ask pairs to discuss what a 'diet' is? · Students encounter the word diet in everyday speech, but this normally refers to 'calorie controlled diets' rather than all of the food and drink a person consumes. · Use Slide 7 to explain the meanings of the key words. · To challenge higher ability students, use Slide 8 to explain the role of specific nutrient groups. · Hand out traffic lights cards and recap the learning outcomes on Slide 9. · Assess students by asking them to show which colour arrow has the correct answer for the questions on Slides 10-23. · Slides 10-11 are for foundation. · Slides 12-19 are for competent learners. · Slides 20-23 are for advanced learners. · If you do not have traffic lights cards, students can point in the correct direction: left, right or up. · Note any students who struggle with this activity. Correct their misconceptions and ask them spot questions at some point during the next activity.	**Slideshow 3:** Slides 6-23

Step	Guidance	Resources
3 10 mins	The purpose of Step 3 is for students to understand that people with different lifestyles have different diets, for example, polar explorers. · Use Slide 24 to highlight that there are many different types of diets. Use Slide 25 to clearly define a calorie controlled diet and a balanced diet. · Highlight the importance of eating a balanced diet and that a calorie controlled diet should only be eaten after consulting a professional. · Using Slides 26-28, ask students how and why an Arctic explorer's diet may be different from their own. · Explain that the cold and physically demanding nature of the job means explorers need up to 8,000 calories a day, and that the lack of supermarkets and cooking facilities mean lots of dry, lightweight, precooked foods are needed. · Hand out some pieces of pemmican for students to try. Take their feedback on how it tastes and what it would be like to eat it every day. See Activity Overview 3 for details of how to make Pemmican. See Subject Update: What do polar explorers eat? for more information. This is available at: https://encounteredu.com/cpd/subject-updates/learn-more-what-do-polar-explorers-eat This activity presents high risks of allergies and the transmission of infections. See Activity Overview 3 for detailed Health and Safety instructions.	**Slideshow 3:** Slides 24-28 **Activity Overview 3a:** Make your own pemmican
4 25 mins	The purpose of Step 4 is for students to demonstrate their learning. · Highlight the factors students will need to consider as they design their Arctic menus on Slide 30. · Hand out Student Sheet 3a and ask students to work in pairs to research food to include in their menu. · Higher ability students should be challenged to create a daily menu of between 5,000 and 7,500 calories, and a mass limit of 1kg to 1.5kg. · Handout Student Sheet 3b and ask pairs to complete a menu for the day, with a calorie count at the bottom. · Ask students to peer assess each others' menus. The weightlossresources.co.uk website is referenced on Student Sheet 3b. Students can select from the categories in the left hand sidebar to find out the calories and mass of common food items.	**Slideshow 3:** Slides 29-30 **Student Sheet 3a:** Researching food **Student Sheet 3b:** Polar menu

TEACHER GUIDANCE 3 (page 3 of 3)
HOW DO YOU TRAIN LIKE AN ARCTIC EXPLORER?

Step	Guidance	Resources
5 5 mins	In Step 5, students reflect on their learning · Ask students to raise their hands to show what outcomes on Slide 31 they are confident they can do. · Challenge students by asking selected individuals what evidence they have that tells them they can meet an outcome. · Ask students to complete the reflection questions on Slide 32. Take feedback from the class. · This activity helps students re-contextualise their learning, by linking it to other areas.	**Slideshow 3:** Slides 31-32

Make your own pemmican

Age 7+
(adult supervision)

20 minutes

Details

Ingredients

The amounts have been listed in proportions, so you can make the amount you need, depending on whether you are heading out into the wilds or just want a class to have a small taste.

- 2 portions jerky / dried meat (beef, bison, caribou, tofu for example)
- 1.5 portions dried fruit (raisins, cranberries, cherries)
- 1 portion rendered fat (tallow, lard, vegetarian suet or use molasses* to bind the mixture)

Safety and Guidance

Precautions

Allergies

- Check the SEN register for medical issues.
- Check with parents before the lesson.
- Students with noted allergies should not consume the pemmican and may need to handle it with polythene gloves.

Transmission of infections

- Prepare the pemmican in a sterile environment.
- Students should wash their hands before handling their piece of pemmican.
- Students should not share their pemmican and dispose of any uneaten remains.

Overview

Pemmican is a food stuff that has been used on polar expeditions for hundreds of years. The name 'pemmican' originally comes from a Cree (a Native American people) word for rendered fat. It is a high-energy, and highly nutritious food, and also very easy to carry. It has been the ideal food for Native American scouts, 18th Century fur traders and polar explorers. Scott and Amundsen took pemmican with them on their expeditions to the South Pole. Traditionally, pemmican is a combination of dried meat, dried fruit and fat (typically from a cow or bison). In recent years, vegetarian and non-fat based variations have been developed. The aim of this activity is for students to understand that Arctic explorers' food stuffs need to be light and full of energy.

Running the Activity

1. Put the jerky in a blender until it is a coarse powder. You could also use a mortar and pestle. If the jerky is not dry enough, place it in an oven at 80°C / 180°F for an hour or more to dry it out further.
2. Render the fat by melting it in a pan over a very low heat. When the fat stops bubbling, it is ready.
3. Strain the rendered fat into an oven dish and add the powdered jerky and chopped or powdered berries. Mix all the ingredients thoroughly.
4. Leave the mixture to firm up, and then cut into bars or roll into small balls.
5. Wrap in greaseproof paper and keep dry. Nibble at will for an energy boost.

Additional notes

*If using molasses, there is no need to heat it. Just add enough to the jerky/ berry mix to bind it together.

Cultural awareness

Be aware of your students' dietary practices particularly surrounding meat and meat products for religious or cultural reasons.

Alternatives - Polar Sandwich

2 x hard biscuits

2cm thick peanut butter layer

1cm butter layer

Researching food

You are going to go shopping for the polar explorers and then design a menu for them.

1. Go to www.weightlossresources.co.uk/calories/calorie_counter.htm
2. Pick some foods.
3. Find out how large or heavy they are.
4. Record the calories.
5. Use your research to make a polar menu. Remember to consider the number of calories and the other important factors you discussed.

Morning meal	Serving size (g or ml)	Calories
Midday meal	Serving size (g or ml)	Calories
Evening meal	Serving size (g or ml)	Calories

Polar Menu

Arctic Café

Morning meal:
Midday meal:
Evening meal:

LESSON 4

How do humans and animals keep warm in the Arctic?

Age 7-11

60 minutes

Curriculum links

- Simple physical properties and uses of everyday materials
- Living things are suited to their habitats
- Give evidence from fair tests
- Identify how animals are adapted

Resources

Slideshow 4:
How do humans and animals keep warm in the Arctic?

Activity Overview 4a:
Investigating insulating materials

Student Sheet 4a:
Investigating insulating materials

Student Sheet 4b:
Scientific poster template

Student Sheet 4c:
Scientific poster template (Advanced)

Subject Update:
What equipment and clothing do polar explorers need?

Lesson overview

In this lesson students investigate the insulating properties of materials and consider how the adaptations of Arctic organisms help develop these.

The context of the lesson is helping to develop new clothing for Tyler Fish, one of the Catlin Arctic Survey explorers.

Lesson steps	Learning outcomes
1. Brief from Tyler Fish (10 mins) Use the slides to set the context and share the learning outcomes.	• Understand the wider context and learning outcomes
2. Keeping warm in the Arctic (10 mins) Use the slides to stimulate students' ideas about how materials are used to keep explorers and animals warm in the Arctic.	• Describe conditions in the Arctic • Make a prediction
3. Practical (25 mins) Students investigate the insulating abilities of three different materials.	• Investigate insulating properties
4. Scientific poster (15 mins) Students present and use their findings to make a recommendation to Tyler.	• Demonstrate learning

TEACHER GUIDANCE 4 (page 1 of 2)
HOW DO HUMANS AND ANIMALS KEEP WARM IN THE ARCTIC?

Step	Guidance	Resources
1 10 mins	The purpose of Step 1 is to share the learning outcomes, set the context and engage students with the learning. · Ask students to write the lesson title from the top left of Slide 2, as well as the date and key question into their books. They can then try to guess the missing word from the key question, which in this case is "warm". · Read the outcomes on Slide 3 with the students and ask them to put their hands up to show what they can already do. · Show students the location of the Arctic on Slide 4 and read the topic brief from Tyler Fish on Slide 5 to put the lesson into context. Challenge students who you think are over or underestimating their current learning by asking targeted questions.	**Slideshow 4:** Slides 1-5
2 10 mins	In step 2, students think about how different materials can keep us warm and what we can learn from animals about this. · Show students the thermal equipment on Slide 6 and ask them to produce a list of words to describe them. · Use Slides 7-10 to highlight the extremely cold conditions in the Arctic that clothing needs to protect against. · Clearly define the 'insulation' as a property of materials that prevents heat moving. · Do not say 'keeps things warm' as insulation will keep objects cold too: e.g. the insulation around your fridge. · Show students Slide 11 and ask them how polar clothing has been inspired by Tuk, the Inuit camp dog's, adaptations. See Subject Update: What do polar explorers eat? for more information. This is available at: https://encounteredu.com/cpd/subject-updates/learn-more-what-equipment-and-clothing-do-polar-explorers-need	**Slideshow 4:** Slides 7-11

TEACHER GUIDANCE 4 (page 2 of 2)
HOW DO HUMANS AND ANIMALS KEEP WARM IN THE ARCTIC?

Step	Guidance	Resources
3 25 mins	The purpose of Step 3 is for students to investigate the insulation properties of different materials. · Hand out Student Sheet 4a one between two. · Use Activity Overview 4 to guide you through the preparation, set up and running of this practical activity.	**Slideshow 4:** Slide 12 **Activity Overview 4a:** Investigating insulating materials **Student Sheet 4a:** Investigating insulating materials
	This experiment presents medium risks of burns and cuts and a low risk of slipping. See Activity Overview 4 for detailed Health and Safety instructions.	
4 15 mins	The purpose of Step 4 is for students to demonstrate their learning. · Using Student Sheet 4b or 4c, ask students to produce a poster of their findings for Tyler. · Using Slide 13, ask students to peer assess each others' posters.	**Slideshow 4:** Slides 13 **Student Sheet 4b:** Scientific poster template **Student Sheet 4c:** Scientific poster template (Advanced)
	Ask students to read out the comments they have made on their partners' work: this will highlight if they have understood the success criteria. Poor comments like 'good try' should be replaced using the success criteria and you may have to model this. For home learning, students could improve their posters and these can then be peer assessed again at the start of another lesson. At this point you can ask students who have made an improvement to show that using feedback drives learning.	

Keeping warm investigation

Age 7+
(adult supervision)

20 minutes

Details

Per group

- A thermometer
- A stopwatch
- 100ml measuring cylinder
- 3 heat resistant cups with their lids
- 6 elastic bands
- 3 different materials to wrap around the cups, e.g. fleece, cotton wool, and cloth
- Access to warm water
- Access to a cool area, for example a fridge
- 3 sticky labels

Safety and Guidance

Precautions

- Do not use boiling water. The government recommended safe limit is43°C.
- Students should work in the centre of the table.
- Breaks should be reported to an adult immediately, and students should not attempt to clear these themselves.
- Where possible, use break safe thermometers.
- Use thermometers with an anti-roll cap: if this is not possible, provide students with a cup to place the thermometers in, when they are not in use.

Overview

In this activity, students investigate the insulating properties of three different materials. They will go on to use their findings to make a recommendation to Tyler Fish about the materials for his new expedition clothing.

Running the Activity

1. Hand out the student sheets.
2. Outline the activity to students.
3. Outline the safety instructions.
4. Students collect their equipment.
5. Following the instructions on Student Sheet 4a, they should set up their containers.
6. Place the containers in a cold environment for 15 minutes. A fridge is ideal but outside in the shade is sufficient.
7. Following the instructions, students collect their measurement.
8. Students consider the discussion questions.

Additional notes

If you do not have measuring cylinders, you can ensure the same amount of water in each cup by either:

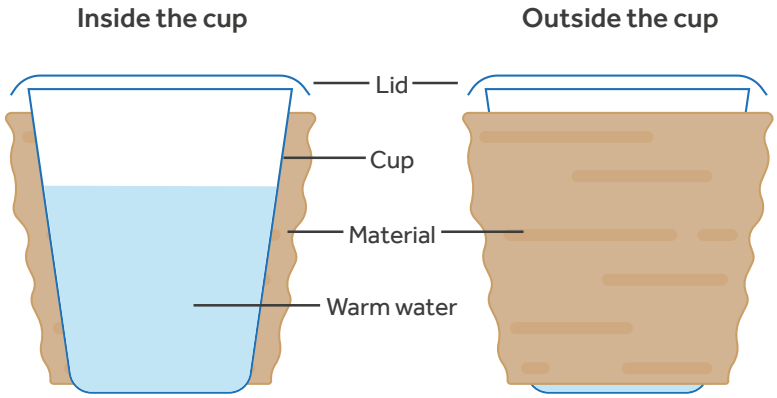
- Placing a ruler into the cups and pouring up to a certain level.
- Marking a line at a set height inside the cups.

As an alternative to heat resistant cups, you can use jam jars with their lids. However, this increases the risks of burning and cutting hazards.

Instructions

You will be setting up your experiment like the diagram below.

1. Half fill your three cups with warm water (no warmer than 43^0 C).
2. Measure the temperatures and record these for each of the different materials on a separate piece of paper.
3. Quickly and carefully put the lids on your cups and wrap each one in a different material using the elastic bands to keep the material in place.
4. Place the cups in a cool environment, e.g. a fridge.
5. Leave them for 15 minutes, use the stopwatch to time this. Can you guess or predict which material will keep the water warmest?
6. Collect your containers and unwrap them carefully.
7. Measure the temperatures again and record these new temperatures for each of the different materials on your sheet of paper.
8. Work out the difference between the temperatures before and after the experiment.
9. The material that shows the lowest decrease is the one which is the best insulator. Was your prediction correct? Would you choose this material for your next polar expedition?



Material	Temperature (°C)		
	Before	After	Difference

Presentation

You are going to make a short, 2-minute presentation to recommend a material to Tyler.

Use Student Sheet 4b or 4c to help you make a scientific poster to use in your presentation.

Use the success criteria on the board to help.

Insulation tests for Tyler Fish

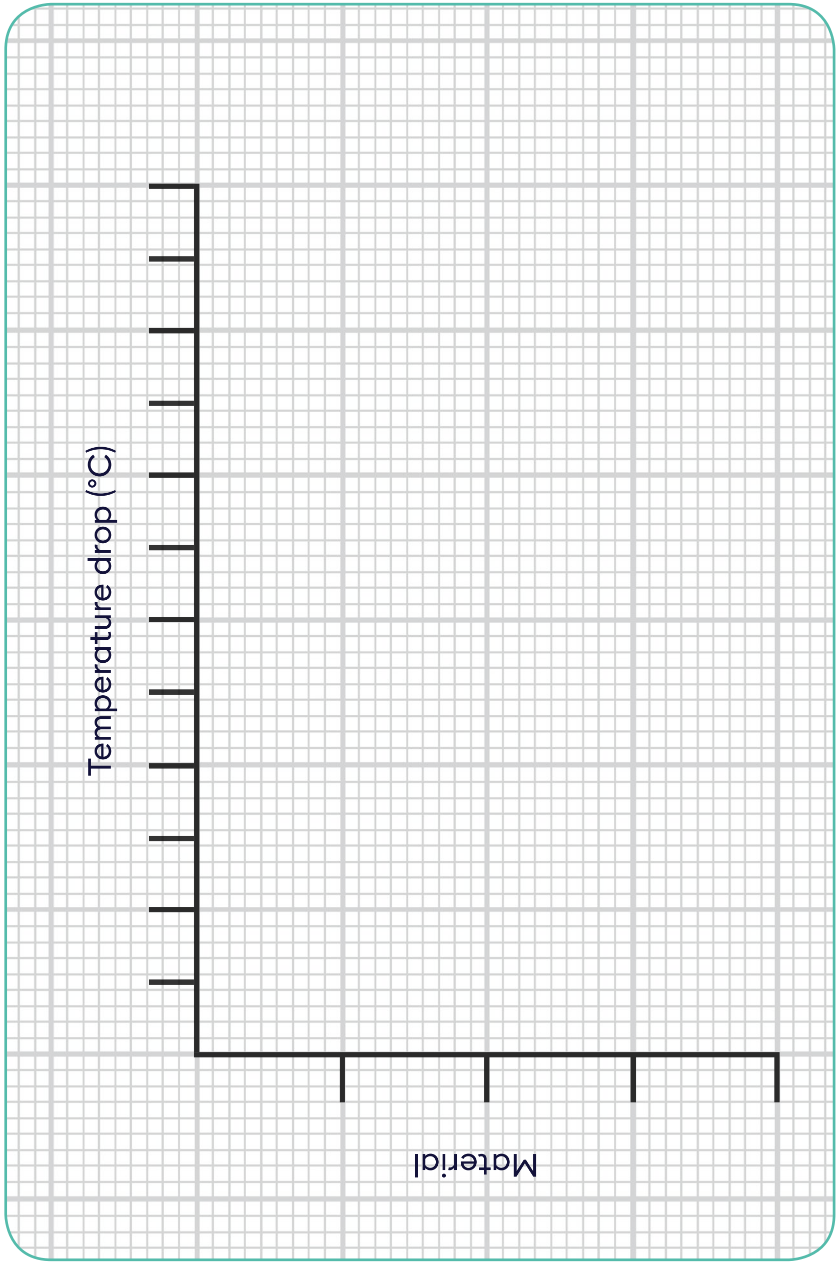
Introduction

In the Arctic it is ____________________ . This means explorers need special clothes to keep them ____________ .
We investigated three materials to see which one was best at keeping things __________________________ .

Conclusion

We predicted that __________________________ would keep the water warmest because __________________________ .
The results show ____ .
This means my prediction was ____________________________ .
This means the material that Tyler should use for their new coats is __________________________ .

Name ____

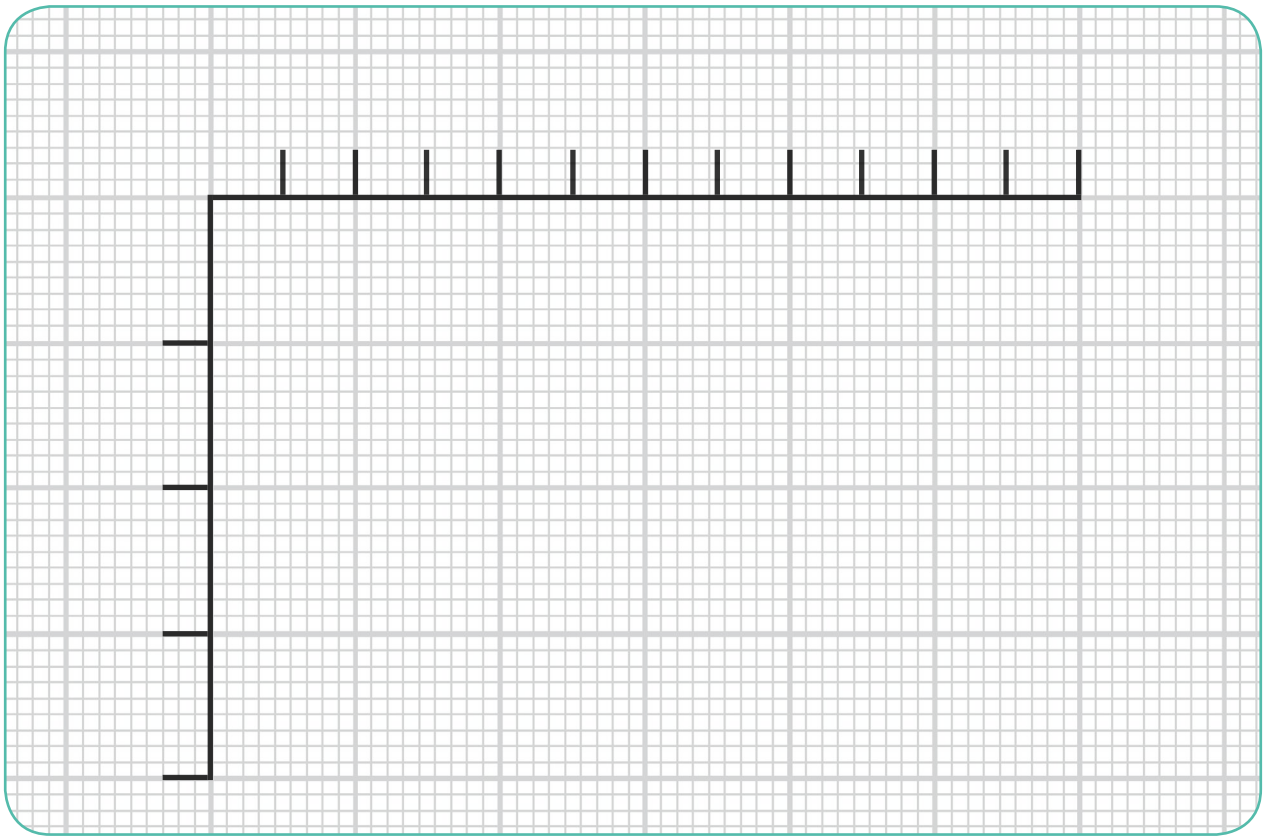


Insulation tests for Tyler Fish

Introduction

Conclusion

Name



How is the Arctic changing?

Age 7-11

60 minutes

Curriculum links

- Develop contextual knowledge of globally significant marine places
- Physical geography: describe and understand key aspects of polar biomes
- Impact of changing environments
- Enquiry by observation

Resources

Slideshow 5:
How is the Arctic changing?

Activity Overview 5a:
The albedo effect

Activity Overview 5b:
Sea level rise

Activity Overview 5c:
Ocean circulation

Student Sheet 5a:
Sentence card sort

Student Sheet 5b:
Storyboard

Video:
What trends are there in sea ice coverage?

Subject Update:
What are ice caps and how are they formed?

Subject Update:
Why is the Arctic melting and why is that a problem?

Subject Update:
How does ocean circulation affect the climate of the UK?

Lesson overview

In this lesson students learn about the impacts of ice in the Arctic melting by watching a series of demonstrations.

The context of the lesson is the work of Dr Helen Findlay who was investigating the effect of environmental change on the Arctic ecosystem.

Lesson steps	Learning outcomes
1. Inuit words for ice (10 mins) Use the slides to set the context and share the learning outcomes. Students describe the ice in different photos from the slides.	• Understand the wider context and learning outcomes
2. Why is the Arctic important and how is it changing? (10 mins) Students consider why the Arctic is important using the sides. Students watch the Sea ice (1979-2012) video and use the slides to learn how the Arctic is changing.	• Describe conditions in the Arctic • Describe how the Arctic is changing
3. Arctic problems demos (25 mins) Show students each of the demonstrations and use the slides to explain how the melting icecaps could cause a variety of problems.	• Explain the cause and possible outcome of problems facing the Arctic
4. Explaining issues (10 mins) Students demonstrate their learning by sorting short sentences into logical paragraphs or completing a storyboard.	• Demonstrate learning
5. Self reflection (5 mins) Using slides, students consider 'What ifs?' about learning in the lesson.	• Reflect on learning

TEACHER GUIDANCE 5 (page 1 of 4)
HOW IS THE ARCTIC CHANGING?

Step	Guidance	Resources
1 10 mins	 The purpose of Step 1 is to share the learning outcomes, set the context and engage students with the learning. · Ask students to write the lesson title from the top left of Slide 2, as well as the date and key question into their books. They can then try to guess the missing words from the key question, which in this case are "changing" and "Earth". · Read the outcomes on Slide 3 with the students and ask them to put their hands up to show what they can already do. · Show students the location of the Arctic on Slide 4 and read the topic brief from Dr Helen Findlay on Slide 5 to put the lesson into context. · This is a good opportunity for students to take the lead and practise reading aloud. · Show students the Inuit words for ice on Slide 6. · Show them the different types of ice on Slides 6 - 15 and ask them to apply the correct Inuit word for the ice they can see in the photos..  Challenge students who you think are over or underestimating their current learning by asking targeted questions. It may help to print slide 6 off and hand it out to students.	**Slideshow 5:** Slides 1-16
2 10 mins	 The purpose of Step 2 is for students to understand why the Arctic is important, and how it has changed over the past 30 or so years. · Show students Slide 17. Use this to gather their initial ideas about the Arctic. · This is an opportunity for a 'think, pair, share' activity: - Students think about the questions on their own for a minute. - They then discuss their ideas in pairs. - You can then ask any student to share their ideas with the class. · Use Slide 18 to explain the different types of ice to students and Slide 19 to explain why the ice is important. · Show students the Sea ice 1979-2012 video. · Explain to students that the animation shows the amount of sea ice in the Arctic of each year from 1979 to 2012. · Ask students: - What trend can they see in the area of sea ice? - Does the area get bigger or smaller? - What other information would they need to say whether there is more or less ice in the Arctic?	**Slideshow 5:** Slides 17-20 **Video:** What trends are there in sea ice coverage?

Step	Guidance	Resources

- Show students the graph on Slide 20. Ask them to describe what is shows.
- Higher ability students could answer the questions on Slide 20 in their books.
- Ask several students targeted questions. For example, for lower ability students ask: 'How does the Arctic change over the year?', 'Give two ways the Arctic is important'.
- To challenge higher ability students, ask questions like: 'can you think of reasons why the area of sea ice changes?'

See Subject Update: What are ice caps and how are they formed? for more detail.

This is available at: https://encounteredu.com/cpd/subject-updates/learn-more-what-are-ice-caps-and-how-are-they-formed

The video "What trends are there in sea ice coverage?" is hosted on the Encounter Edu website.

This is available at: https://encounteredu.com/multimedia/videos/what-trends-are-there-in-sea-ice-coverage

3
25 mins

The purpose of Step 3 is for students to understand the potential impacts of changes to ice in the Arctic and how these could affect not only this region, but also people living in the UK. There are three demonstrations in this section, depending on time constraints you may wish to do one, two or all of them. Alternatively, you may want to set the demonstration up as a circuit activity for your students to do as practicals.

Demonstration one: The albedo effect This activity looks at how decreasing sea ice in the Arctic Ocean contributes to a lowering of the albedo and an increase in the amount of solar energy absorbed in the region.

- Use Activity Overview 5a to guide you through the preparation, set up and running of this practical activity. Use Slide 21 to explain the albedo effect.
- Ask several students targeted questions. For example, 'Why does ice reflect heat?', 'Why is more heat absorbed when the ice melts?' and 'How does the albedo affect help to keep the Arctic cool?'

Slideshow 5:
Slides 21-23

Activity Overview 5a:
The albedo effect

Activity Overview 5b:
Sea level rise

Activity Overview 5c:
Ocean circulation

This activity presents a medium risk of burns and low risks of cutting injuries and electric shocks. See Activity Overview 5a for detailed Health and Safety instructions.

Step	Guidance	Resources

Demonstration two: Sea level rise A common misconception is that melting sea ice in the Arctic will cause sea levels to rise. This demonstration shows how the melting of different types of ice in the Arctic will affect sea level rise globally.

- Use Activity Overview 5b to guide you through the preparation, set up and running of this practical activity. Use Slide 22 to help explain how different types of ice melting will have different impacts.
- Ask several students targeted questions. For example, ask 'What problem is caused by ice sheets melting?' and 'What causes ice sheets to melt?'
- To challenge higher ability students, ask: 'How is the impact of melting sea ice different from melting ice sheets?' and 'If sea ice doesn't cause sea level rise, why are people worried about less sea ice forming every year?'

This activity presents low risk hazards of slipping and injuries from dropping food cans onto feet. See Activity Overview 5b for detailed Health and Safety instructions.

Demonstration three: Ocean circulation Ocean circulation relies on different densities of water falling and rising. The density of water is affected by salinity and temperature. This demonstration will help pupils understand that the ocean is not like a swimming pool where the water is stationary, but more like a river with deep currents.

- Use Activity Overview 5c to guide you through the preparation, set up and running of this practical activity.
- Use Slide 23 to help explain how ice sheets melting could affect ocean circulation.
- Ask several students targeted questions. For example, 'why is Arctic ice important to ocean circulation?', 'What could the ice sheets melting do to ocean circulation?'

This activity presents a low risk hazard of slipping. See Activity Overview 5c for detailed Health and Safety instructions.

Subject updates are available to aid with the teaching of these demonstrations.

For demonstrations one & two see Subject Update: Why is the Arctic melting and why is that a problem? https://encounteredu.com/cpd/subject-updates/learn-more-why-is-the-arctic-melting-and-why-is-that-a-problem

For demonstration three see Subject Update: How does ocean circulation affect the climate of the UK? https://encounteredu.com/cpd/subject-updates/learn-more-how-does-ocean-circulation-affect-the-climate-of-the-uk

Step	Guidance	Resources
4 10 mins	The purpose of Step 4 is for students to demonstrate their learning. · Ask students to explain one or more issues using either Student Sheet 5a Sentences card sort or 5b Storyboard. · Using Slide 24, ask students to peer assess each others' risk assessments. · Ask several students targeted questions. For example, 'Why does ice reflect heat?', 'Why is more heat absorbed when the ice melts?' and 'How does the albedo affect help to keep the Arctic cool?'	**Slideshow 5:** Slide 24 **Student Sheet 5a:** Sentences card sort **Student Sheet 5b:** Storyboard
5 5 mins	The purpose of Step 5 is for students to reflect on their learning. · Ask students to raise their hands to show what outcomes on Slide 25 they are confident they can do. · Challenge students by asking selected individuals what evidence they have that tells them they can meet an outcome. · Ask students to complete the reflection questions on Slide 26. Take feedback from the class. · This activity helps students re-contextualise their learning, by linking it to other areas.	**Slideshow 5:** Slides 25-26

The albedo effect

Age 7+
(adult supervision)

20 minutes

Details

- White or reflective material such as felt or aluminium foil
- Black material, such as felt
- 2 thermometers
- A heat source such as a lamp

Safety and Guidance

Precautions

- Allow lamp to cool before handling the lamp shade.
- Ensure all electrical equipment has been PAT tested.
- Ensure hands are dry before handling equipment.

Thermometers

- Work in the centre of the table.
- Breaks should be reported to an adult immediately, and students should not attempt to clear these themselves.
- Where possible, use break safe thermometers.
- Use thermometers with an anti-roll cap.

Overview

Albedo is the term used to describe surface reflectivity. The lighter a surface, the greater its albedo, meaning it reflects more heat and light and absorbs less. This activity looks at how decreasing sea ice in the Arctic Ocean contributes to a lowering of the albedo and an increase in the amount of solar energy absorbed in the region.

Running the Activity

1. Make sure that both thermometers are at room temperature.
2. Note the temperature of each thermometer.
3. Place one thermometer under the white or reflective material and the other under the black one.
4. Put the thermometers covered by the material under the light source, making sure that they are the same distance away.
5. Keep the thermometers there for 15 minutes.
6. Note the new temperature of each thermometer.
7. Ask students the following questions:
   a. Which colour absorbed more heat energy?
   b. Which colour reflected more heat energy?
   c. Which colour represents the ice and which one represents the water?
   d. How does the ice help to keep the Arctic cool?
   e. If there is less ice, what could happen to the temperature of the Arctic Ocean?

Misconceptions

Students often think that black 'attracts' more heat. This is not the case. Black materials do not pull energy towards them, they absorb more of the energy that hits their surfaces. They also release more of the energy that is inside them.

Students often think that ice keeps the Arctic cold by 'giving out cold'. There is no such thing as 'cold'. This is a pretty complex bit of science, but simply, imagine two objects of the same material. One is 'hot' and one is 'cold'. The hot one has more energy than the cold one. So the heat energy moves from the hot one to the cold one. If you have two 'cold' objects, the heat will move to which ever one is colder.

The ice helps maintain the temperature in the Arctic by reflecting vast amounts of the heat energy that hits it.

Sea level rise

Age 7+
(adult supervision)

60+ minutes

Details

- 2 full cans of food
- 2 plastic containers
- Some ice
- A marker pen

Safety and Guidance

Precautions

- Work in the centre of the table.
- Spills should be reported to an adult immediately.
- Carry containers with two hands, carefully observing the surroundings.
- Work in the centre of the table.

Expected results

- The 'Arctic Ocean' container will see little rise in the level of the water.
- The 'Greenland' or 'Antarctica' container will see a greater rise in the level of the water potentially 'flooding' over the top of the can.

Overview

Sea level rise is caused by two main factors: thermal expansion and melting ice. Thermal expansion refers to the fact that when the temperature of a liquid rises, so does its volume. You may also have seen news stories about how melting ice in the Polar Regions will also affect sea level rise, but not all ice is equal. A common misconception is that melting sea ice in the Arctic will cause sea levels to rise. This demonstration shows how the melting of different types of ice in the Arctic will affect sea level rise.

Running the Activity

1. Place the two cans of food in the plastic containers (ideally the height of the containers should be higher than the cans)
2. Into one container put a mixture of ice and water, until it comes up to about 1cm below the top of the can. This is the Arctic Ocean model.
3. In the other container pour water (again until it comes up to about 1cm below the top of the can. Then place the same amount of ice used or the Arctic on top of the can. This is the Greenland or Antarctica model.
4. Label each container and mark a line at the water level.
5. Ask students to guess what will happen to the water (sea) level as the ice melts.
6. Leave the cans for a time (up to 2 hours). The melt rate will of course vary with the warmth of the room and the amount of ice used.
7. Mark the level of the water after all the ice has melted.
8. Ask students:
   a. If there is a difference in impact from sea ice and ice on land.
   b. How could this affect people living in for example the UK or USA?

Answers

- a. Melting sea ice causes little impact on sea level. Melting ice on land can have a significant impact on sea level rise.
- b. People living in coastal areas around the world, including the UK and USA, would be more susceptible to flooding if the ice on land (for example the Greenland and Antarctic ice sheets) melted but melting sea ice would have little impact.

Ocean circulation demonstration

Age 7+
(adult supervision)

20 minutes

Details

- 1 large clear container to act as a mini-ocean (at least 3 litres capacity)
- Salt
- Water
- Food dye (red, blue and green)
- 3 beakers

Preparation

Standard seawater
- 2 litres room temperature water
- Stir in 60 grams of salt

Gulf stream water
- 0.2 litres warm water coloured with red food dye
- Stir in 6 grams of salt

Arctic seawater
- 0.2 litres cold water (4°C) coloured with blue food dye
- Stir in 12 grams of salt

Ice sheet meltwater
- 0.2 litres cold water (4°C) coloured with green food dye
- No salt

Safety and Guidance

Precautions

- Work in the centre of the table.
- Spills should be reported to an adult immediately.
- Carry containers with two hands, carefully observing the surroundings.

Overview

Ocean circulation relies on different densities of water falling and rising. The density of water is affected by salinity and temperature. This demonstration will help pupils understand that the ocean is not like a swimming pool where the water is stationary, but more like a river with deep currents.
You may need the help of your school's science technicians with some of the equipment and preparation.

Running the Activity

1. Fill the container halfway with up to 2 litres of the undyed '**standard seawater**'.
2. Explain to students that this is the Arctic Ocean. The system of ocean circulation relies on cold, salty water sinking in the Arctic Ocean.
3. You will be adding each of the water preparations seen on the left into the 'Arctic Ocean.' Ask students to predict what will happen before adding each water preparation and have them note down their observations and compare them to their predictions.
4. Take the red-dyed '**Gulf Stream seawater**'. The Gulf Stream carries warm water from the Caribbean towards the coast of England.
5. Pour the 'Gulf Stream seawater' gently down the side of the container.
6. Take the blue-dyed '**Arctic Ocean seawater**'. The surface waters of the Arctic Ocean are not only cold, but also very salty due to the salt being exuded during sea ice formation.
7. Pour the 'Arctic Ocean seawater' gently down the side of the container.
8. Take the green-dyed '**ice sheet meltwater**'. The melt water from the Greenland ice sheet and other glaciated Arctic regions, although cold is made from freshwater rather than salty seawater.
9. Pour the 'ice sheet meltwater' gently down the side of the container.

Discussion

Highlight to students that if the water doesn't sink then the 'pump', which keeps the ocean conveyor moving could stop.

Ask students what impact this might have.

This is a complex topic and students may struggle. The basic answer is that 'If cold, salty water does not sink rapidly in the Arctic, this will slow or stop ocean circulation. This means that warm water from the Caribbean will not be pulled towards the UK and so the climate in the UK may cool'.

Sentences card sort

Arrange these cards into the correct order.

The albedo effect

Even more ice melts	Global warming	Sea ice melt
Less heat is reflected, more heat is absorbed	Local area warms up	Smaller white surface

Sea level rise

Ice sheets melt	Coasts flood	More water in the sea
Global warming	Sea level rises	Ocean conveyor pump slows or stops

Ocean circulation demonstration

Climate changes and habitats are affected	Global warming	Arctic ocean becomes less salty
More fresh water in the sea	Ocean circulation changes	Ice sheets melt

STUDENT SHEET 5b ARCTIC ISSUES STORYBOARD

Write a story to describe the cause and impact of one of the issues in the Arctic

Encounter
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OCEAN
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