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SCIENCE WEEK

Science Week Classroom Resource

Heat Transfer and Insulators

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DPSM/ESERO
Framework for Inquiry

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THEME	Overall theme	
CURRICULUM	Strand:	
	Maths:	
	Strand Unit:	
	Curriculum Objectives:	
	Skills Development:	

ENGAGE

THE TRIGGER	WONDERING	EXPLORING

INVESTIGATE

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS

TAKE THE NEXT STEP

APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS

Considerations for inclusion

REFLECTION	

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Framework for Inquiry

THEME	HEAT TRANSFER AND INSULATORS
CURRICULUM	**Strand: SESE:** Energy and Forces / Materials/ Environmental Awareness and Care **Strand Unit:** Heat Transfer, Properties and Characteristics of Materials, Caring for the Environment **Curriculum Objectives:** Energy can be transferred, recognise a range of sources of heat, measure, record and use a thermometer, measure and compare temperatures in different places, and explore reasons for variations. Explore, investigate, identify and recognise ways of keeping things warm or cool. Identify and discuss a local, national or global environmental issue. **Maths:** Measurement of mass, volume, time, temperatures. Record and display data. **Skills Development:** Observing, questioning, predicting, measuring, investigating and analysing.

ENGAGE

THE TRIGGER	WONDERING	EXPLORING
Ocean convection currents (video) Simulation of convection current in action on ESERO http://www.spaceflight.esa.int/impress/text/education/Heat%20Transfer/Convection_01.html Video of convection demonstration https://www.youtube.com/watch?v=omUU69ParFM Observe the melting of a coloured (preferably) blue cube of ice in a litre or so of warm tap water. Snowman in the sun (image). Concept cartoon of snowman melting. Ice-cream stall in a sunny location (image or video) Feeling cold and warm things. Watching Ice melt. Satellite images of Polar Ice , how it changes through the seasons – summer to winter. Satellite Images of Polar Ice and how it has changed since images began in 1979. See images in http://esero.ie/wp-content/uploads/2015/01/47_The-ice-is-melting.pdf	What do we understand by heat and cold? How does heat/cold move? How does heat get transferred? What does the word convection mean? What can change the rate or amount of heat transfer? Why did the cold water from the ice cube sink downwards as it melted? Was it because of the food colouring or the temperature of the water? What are insulators? And how do they work? Do they slow down or speed up heat transfer? What happens to ice-lollies on a sunny day? And why do you have to eat them fairly quickly? If you want to bring some home to your family do you think it would be a good idea to wrap them up? What sort of stuff do you think would be best to wrap the ice lollies up in? – slow down heat transfer? How is ice made? At what temperature does water freeze? What happens when ice warms up? Images of ice at the North Pole (floating Ice on the water) and ice at the South Pole (frozen ice on land above sea level). NB: There is some land ice on Greenland near the North Pole and some sea ice around the land in the Antarctic. ESA's Cryosat satellite has been measuring the thickness of ice since it was launched in 2010.	Explore hot and cold things. What does ice feel like or a bag of frozen peas? How feel a cup of warn water or a hot water bottle? How could we measure the temperature? Can we estimate it? If cold water sinks, does hot water rise? What temperature was the melt water and the tap water in the container? Estimate by touch if they are difference or similar. Check temperatures with a thermometer. Discuss what might slow down/ speed up the rate of heat transfer, i.e. how quickly/ slowly the ice melts? Explore different types of materials and describe their properties. Discuss what might slow down/ speed up the rate of heat transfer, i.e. how quickly/ slowly the ice-lollies melts? Examine flasks and cool bags, items that are used for keeping things warm and cool. Show the children the various materials which you have brought in and ask them: "Which of these materials do you think would be the best for keeping ice lollies cool?" "Next best", etc. "How do you think we could carry out a fair test to try to answer this question?" Discuss what might slow down/ speed up the rate of heat transfer, i.e. how quickly/ slowly the ice melts? Leave ice cubes on a plate and in a cup of water. Place one cup and plate in a shady area and one in a sunny spot in the classroom. Observe what happens.

Considerations for inclusion

Words Hot, cold, heat, temperature, convection.

Opportunities for Sensory development – touching and feeling materials.

Why do some feel "hotter" or "warmer" that others.

Ice melting in the hand. Putting ice on different surfaces and look at different rates of melting.

Standard and non-standard measurements.

Digital and spirit thermometers.

Assigning key roles – chief time keeper, recorder etc.

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INVESTIGATE 1: OBSERVING CONVECTION CURRENTS

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
What causes the movement of water when a coloured ice cube is placed in a large container of warm tap water? Is it temperature? Does the same movement occur happen with hot water is placed into a container of cool water?	Get children to predict and give reasons for their predictions. Such as We will observe more movement when the temperature differences in our investigation are greater: - Yes - No Hot warm will / will not sink to the bottom when placed in warm/cold tap water.	Ask students how they would conduct this investigation. Explain the materials that are available to them to use – small (empty food colouring jars) and large jars (large coffee jar), food colouring, coloured ice cubes, trays, warm water, thermometers. Set up four trays, each with one Jar. Groups can be given more than one tray or samples can be split up between the groups. Insert the following: 1. Large Jar full of warm water, insert a blue ice cube. 2. Large jar full of chilled water, inset a blue ice cube. 3. Large jar full of cold water, insert a small jar of coloured warm water by placing it on the bottom of the large jar. 4. Large jar full of warm water, insert a small jar of coloured warm water by placing it on the bottom of the large jar. Record the temperature of the water in the jars and the ice cube at the beginning of the investigation. Also record observations. Is the colour moving down or up in the container? What was the temperature of the water at the top and bottom at the end (after 5 mins)?	Ask students to draw diagrams of their investigation. Ask them to note where the ice cube/ jar of warm water was, and the temperatures at the start. Now draw a second diagram showing what direction the coloured water moved in, and the end temperature. Photograph samples and line up images to compare results Video investigation in action. Discuss with your students. Was there as much movement in the Jars with a small temperature difference (ice with chilled water) or a large temperature difference (ice in warm water)? Did the samples with the small jars of coloured warm water behave the same as the samples with the ice? Again, was there as much movement in the jars with a small temperature difference (warm water in warm water) or a large temperature difference (warm water in cold water)?

INVESTIGATE 2: KEEPING ICE LOLLIES COOL

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
As this is a slow activity, teacher may need to have another topic/ activity going on while the ice is melting. Will a layer of material affect the rate of heat transfer by convection? And if so which material with result in the slowest / fastest rate of transfer?	Get children to predict if they think material with affect the rate of heat transfer and give reasons for their prediction. Get students to list materials and predict if they think they will speed up or slow down the rate of transfer. Ask them to predict which will result in the slowest rate of transfer – i.e. keep their ice lollies cool for the longest period of time.	Different groups of children wrap ice cubes in different materials and wait to see how long it takes for each cube to melt. They could compare these with an unwrapped ice cube. For fair testing, what do they keep the same? (Size of ice cube, number of layers of material, surface the ice is on). What do they change? (The material). What do they measure? (The time). The children note the order in which the ice cubes melted. Senior classes: Measure mass of remaining ice after pouring off melt water at fixed time intervals. Students could also measure volume of melt water at fixed time intervals. Both measurements give a measure of melting.	Junior Classes: Observe which melted fastest, sample with material, or without. How does that compare with your prediction? Any surprises? Of the samples with materials, which one melted the fastest and slowest? Which one had the slowest rate of heat transfer, i.e. would make the covering for the ice lolly? Senior Classes: Plot a graph of loss in mass of "ice lollies with different wrappers" against that of "unwrapped ice lolly" against time. Do on same page for comparison. Similar graphs could be done using volume of melt water. Volume could be measured using a syringe.

Considerations for inclusion

Words Hot, cold, heat, temperature, convection.

Opportunities for Sensory development – touching and feeling materials.

Why do some feel "hotter" or "warmer" that others.

Ice melting in the hand. Putting ice on different surfaces and look at different rates of melting.

Standard and non-standard measurements

Digital and spirit thermometers.

Assigning key roles – chief time keeper, recorder etc.

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INVESTIGATE 3: THE ICE IS MELTING			
STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
Will sea levels change when ice at the poles melt?	Get children to predict if they think the sea level to rise in both samples, representing both sea ice and land ice. Ask them to give reasons for their prediction.	Set up two cups of tap water, each on a plate. Cup 1, with water and floating ice, represents sea ice at the North Pole. Cup 2, with the ice cube on the clay, represents land ice at the South Pole. The top of the water represents the sea level and should be to the top of the cup in both samples. To make sure it is a fair test keep the size of the cups and ice cubes the same. Observe what happens as the ice melts. Does the water overflow onto the plate? If so can the students measure it using a syringe? Can the students use measuring jugs to calculate the volume of water.	Ask students to calculate the volume of water which overflowed? Did water overflow in each sample (Cup 1 and Cup 2)? Can students answer the starter question: Will sea levels change when the ice at the Poles melts? Only land ice will change the sea level, so we are most concerned about the Antarctic and the ice on Greenland and Siberia.

TAKE THE NEXT STEP		
APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS
Does this happen in air? How does it affect ocean currents? (the great ocean conveyor belt). How do we measure ocean temperatures – satellites images? The water cycle. History – Ice Houses – materials used. Does the colour of the materials make any difference? Does the thickness make a difference? Are materials which are good at keeping heat out good at keeping heat in? How does the temperature of the room (surrounding air) affect the rate of melting in ice? At a constant temperature does sea ice melt faster than the land ice?	Try different materials around a cup of hot chocolate. Measure temperature at fixed time intervals. Design a suitable hot chocolate cup. See www.seai.ie for ideas. Where will the ice melt the fastest – test different locations. Does putting the ice on different surfaces make any difference to the time it took for them to melt? What sorts of coats do animals and birds have? Test coats for a snowman – using plastic mineral bottles filled with water and frozen. How will the Earth's temperature change as ice melts and more land is exposed? (see http://esero.ie/wp-content/uploads/2015/01/47_The-ice-is-melting.pdf) Will land be flooded? Observe how flat and high stones get covered in a tray as small quantities of water are pourers in. Explain now low lying land or islands will be more affected by sea levels rises than areas high above sea level.	Does this transfer of energy from hot to cold affect our weather? Hurricanes and storms. How would we conserve energy – stop energy flow – slow it down. Environmental concerns – would I be better wearing an extra layer of clothing indoors rather than turning up the central heating? Comparing cost, durability, etc. of materials. Washing versus dry cleaning? Environmental concerns – Climate Change. Actions we can take to help reduce the impact of climate change, reduce, reuse and recycle. Our **"New Words"** sheet.

Considerations for inclusion

Words Hot, cold, heat, temperature, convection.

Opportunities for Sensory development – touching and feeling materials.

Why do some feel "hotter" or "warmer" that others.

Ice melting in the hand. Putting ice on different surfaces and look at different rates of melting.

Standard and non-standard measurements.

Digital and spirit thermometers.

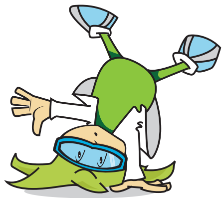
Assigning key roles – chief time keeper, recorder etc.

REFLECTION

- Teacher self reflection.
- Teacher and pupil reflection.
- Teacher and fellow teachers.
- Pupils with pupils.
- What worked well?
- What further questions did students have?
- What was a good quantity of water to use?
- Which thermometers worked best?
- Did we see temperature differences between the top and the bottom in the samples with ice?
- Was 10 minutes long enough to see results or do we need to change the time? Reduce or increase?

INVESTIGATION 1

Observing Convection Currents



Preparation

Have blue ice cubes ready to use.

Class level

Senior Cycle: 3rd – 6th

Curriculum Objectives

Science: Energy can be transferred, recognise a range of sources of heat, measure, record and use a thermometer, measure and compare temperatures in different places… and explore reasons for variations. Explore, investigate, identify, and recognise ways of keeping things warm or cool. Identify and discuss a local, national or global environmental issue.

Maths: Measurement of mass, volume, time, temperatures. Record and display data.

Skills Development

Observing, questioning, predicting, measuring, investigating and analysing.

Curriculum Links

Strand: Energy and Forces / Materials/ Environmental Awareness and Care
Strand Unit: Heat Transfer, Properties and Characteristics of Materials, Caring for the Environment.

Background Information

"Convection is the transfer of heat energy by the movement of matter." There are a few points in that short statement that aren't quite right but it is adequate for most situations.

For thermal convection to occur we have to have the following:

- Some matter that can flow, literally a fluid. This is usually a gas or a liquid but in extreme cases even rock will flow, this happens in the Earth's mantle and leads to the plate tectonics that have shaped our world.
- The fluid must change its density as its temperature changes. It is usually assumed that materials will expand when it heated but this is not always the case, the density of water is highest at around 4°C as a result if you put ice cubes in a drink on a hot day the bottom of the drink won't drop below 4°C unless you stir it; the cooled drink stays at the top of the glass along with the ice cubes!
- The fluid must be able to flow. This isn't always the case as fluids can be trapped by porous materials such as sponges or the fluid may be too viscous; convection isn't usually very effective in cold treacle or bitumen!
- There must be a gravitational difference so that the less dense material will rise due to buoyancy. This breaks down in some situations; an extreme case would be a flame inside a spacecraft sitting on an asteroid, the force of gravity would be so weak that convection would be very weak, assuming that it worked at all. This situation can be reproduced on or close to the Earth by making use of the microgravity produced in freefall. Again a flame will behave very oddly under these conditions.

If all the conditions are met then the warm fluid will expand and rise carrying the heat energy with it.

This information is taken from http://www.spaceflight.esa.int/impress/text/education/Heat%20Transfer/Convection_01.html

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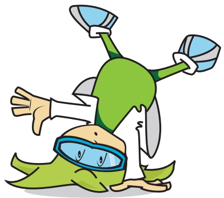
INVESTIGATION 1

Observing Convection Currents



Preparation

Show the students a video a simulation of convection current in action on ESERO
http://www.spaceflight.esa.int/impress/text/education/Heat%20Transfer/Convection_01.html

Place a blue ice cube in a large clear container of tap water. Observe what happens.

Trigger Questions

- What do we understand by heat and cold?
- What does ice feel like or a bag of frozen peas? Now feel a cup of warn water or a hot water bottle?
- How does heat/cold move?
- How does heat get transferred?
- What does the word convection mean?
- What can change the rate or amount of heat transfer?
- Why did the cold water from the ice cube sink downwards as it melted?
- What causes the movement of water when a coloured ice cube is placed in a large container of warm tap water?
- Is it temperature?
- Does the same movement occur happen with hot water is placed into a container of cool water?
- How could we measure the temperature? Can we estimate it?
- If cold water sinks, does hot water rise?
- What temperature was the melt water and the tap water in the container?
- Can we estimate by touch if they are difference or similar?
- Could we check temperatures with a thermometer?

Materials/Equipment

Large clear jars or plastic containers (1L capacity minimum)*

Trays to place the jars in*

Small jars or bottles (such as old food colouring jars)*

Food Colouring

Droppers

Blue Ice Cubes

Warm water

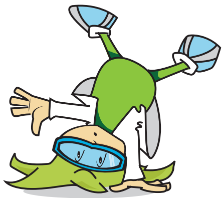
Chilled water

Tap water

** Quantities: The class can be broken up into small groups, with each group getting one, two or four jars or this activity can also be carried out as a demonstration.*

INVESTIGATION 1

Observing Convection Currents



Activity

Ask students to think about the starter question:

What causes the movement of water when a coloured ice cube is placed in a large container of warm tap water? Is it temperature or the food colouring which causes the movement?

Does the same movement occur when hot water is placed into a container of cool water?

Get students to write down their prediction or communicate it verbally to the class.

Ask students how they would conduct this investigation.

Explain the materials that are available to them to use – small (empty food colouring jars) and large jars or plastic containers (such as large coffee jar), food colouring, coloured ice cubes, trays, warm water, thermometers.

Set up trays, each with one Jar. Groups can be given more than one tray or samples can be split up between the groups.

Insert the following:

1. Large Jar ¾ full of warm water, insert a blue ice cube (cold into warm).
2. Large jar ¾ full of chilled water, inset a blue ice cube (control sample).
3. Large jar ¾ full of cold chilled water, insert a small jar of coloured warm water by placing it on the bottom of the large jar (warm into cold).
4. Large jar ¾ full of warm water, insert a small jar of coloured warm water by placing it on the bottom of the large jar (control)

   Record the temperature of the water in the jars and the ice cube at the beginning of the investigation. Also record observations. Is the colour moving down or up in the container? What was the temperature of the water at the top and bottom at the end (after 5 mins)?

   Ask students to draw diagrams of their investigation. Ask them to note where the ice cubes/ jars of warm water were, and the temperatures at the start.

   Now draw a second diagram showing what direction the coloured water moved in and temperature after 5 minutes.

   Alternatively photograph samples every minute, and line up images to compare results. Temperature at the top and bottom of the samples should also be recorded every minute.

   Video investigation in action.
5. Discuss with your students:

   Was there as much movement in the jars with a small temperature difference (controls) or a large temperature difference (ice in warm water, warm water in cold)?

   Did the samples with the small jars of coloured warm water behave the same as the samples with the ice?

   How did the temperatures change in the jars? Can these temperatures be plotted on a graph?

INVESTIGATION 1

Observing Convection Currents

Follow up Activity

Watch and/ or replicate a convection investigation showing currents moving due to a heat source:
https://www.youtube.com/watch?v=0mUU69ParFM

Does convection happen in air?

The following investigation can be used for observing convection currents in air:
http://www.primaryscience.ie/media/pdfs/col/snake_spiral.pdf

How do convection currents affect nature? Check out satellite images of ocean temperatures and currents:
https://oceanservice.noaa.gov/podcast/apr14/mw123-currents.html

How materials affect Heat Transfer? Insulators for keeping Ice Lollies cool, the best material for coats and keeping people warm?
http://www.primaryscience.ie/media/pdfs/col/keeping_ice_lollies_cool.pdf

http://www.primaryscience.ie/media/pdfs/col/dpsm_class_activity_coats.pdf

Review

What further questions did students have?

What was a good quantity of water to use?

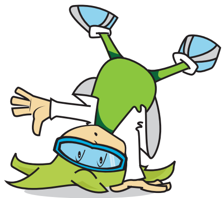
Which thermometers worked best?

Did we see temperature differences between the top and the bottom in the samples with ice?

Was our set time long enough to see results or do we need to change? Reduce or increase?

INVESTIGATION 1

Observing Convection Currents



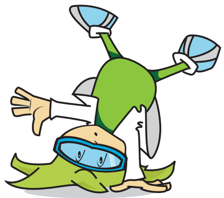
Observing Convection Currents: Students Observations

Draw diagrams of your investigation at the beginning and after 5 minutes. Place images of the different samples in the space provided and use colours to show movement. Record the temperatures at the top and bottom of your sample at the beginning and after 5 minutes.

SAMPLE 1: ICE INTO WARM WATER		**SAMPLE 2: ICE INTO COLD WATER**	
Diagram at the start:	Temperature (°C)	Diagram at the start:	Temperature (°C)
Diagram after 5 minutes:	Temperature (°C)	Diagram after 5 minutes:	Temperature (°C)
SAMPLE 3: WARM INTO COLD WATER		**SAMPLE 4: WARM INTO WARM WATER**	
Diagram at the start:	Temperature (°C)	Diagram at the start:	Temperature (°C)
Diagram after 5 minutes:	Temperature (°C)	Diagram after 5 minutes:	Temperature (°C)
Circle the samples where you saw the most movement – the move evidence of heat transfer occurring.			

INVESTIGATION 2

What material will keep ice lollies the coolest?



Equipment

Ice cubes, variety of materials (e.g. newspaper, kitchen foil, bubble wrap), plastic tray.

Class level

Younger classes

Preparation

Have ice cubes ready to use. (To make this more fun and realistic for small children: Make ice cubes/lollipops with the children beforehand, and mix with fruit juice for fun colours and taste. Link this with 'Senses')

Background information

Some discussion should have taken place previously on heating and cooling. The effect of heating and cooling water, heating ice, chocolate etc.

Heat passes from the warmer thing to the cooler thing, if there is a way for it to pass. Things like metals pass heat easily and therefore are not good insulators. Anything with lots of air pockets does not let heat through easily, so wool, bubble wrap, cotton wool etc. are good insulators. They neither let heat out or in, so they keep the warmer thing warm and the cooler thing cool!

Flasks keep things really hot, or really cool, because a flask has two layers with a vacuum (nothing, not even air) in- between. So there is nothing to let the heat in or out.

(See DPSM activity 'Keeping Warm' for more on this topic).

Trigger questions

Try to have visual cues to help children focus on how to keep warm or cool, e.g. posters of winter clothing and summer clothing.

What happens to ice lollies on a hot summer day?

Why do you have to eat them fairly quickly?

If you want to bring some home to your family do you think it would be a good idea to wrap them up?

If so, what sort of stuff do you think would be best to wrap them up in?

Do you think the children in this picture should put the coat on the snowman if they want to keep him for longer?

Content

SCIENCE: Materials: properties and characteristics.
Energy: Heat

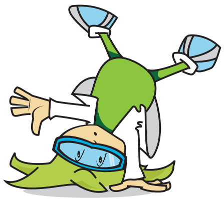
MATHS: Measures: Time
Number: Comparing and ordering
Data: Representing
Shape and Space: Spatial awareness

Skills

Predicting, investigating, experimenting, analysing, recording.

INVESTIGATION 2

What material will keep ice lollies the coolest?



Activity

As this is a slow activity, teacher may need to have another topic/activity going on while the ice is melting.

Show the children the various materials which you have brought in and ask them: “Which of these materials do you think would be the best for keeping ice lollies cool?” “Next best” etc.

“How do you think we could carry out a fair test to try to answer this question?”

A suggested approach could be: different groups of children wrap ice cubes in different materials and wait to see how long it takes for each cube to melt. They could compare these with an unwrapped ice cube.

For fair testing, what do they keep the same? (Size of ice cube, number of layers of material, surface the ice is on).

What do they change? (The material)

What do they measure? (The time)

The children note the order in which the ice cubes melted.

MATHS: Count the materials and ice cubes.

Time: Look at the clock, see where the big hand is at when the ice had melted.

Order and compare which materials were the best and the worst.

Spatial awareness and positional language when putting the ice in different places, e.g. the ice is BESIDE the heater, UP on the shelf, on the LEFT of the door, etc.

Follow-up activities

1. “Where will the ice cube melt the fastest?”

This time put ice cubes on identical plates (these can be plastic or paper), leave them uncovered and place them in different parts of the classroom, e.g. on the window ledge, beside the radiator, in a cupboard.

OR They could compare placing the ice cubes above and below the radiator, and ask them “What does that tell us about hot air? (It rises)

Investigating:
Keep the same: cube, plate.

Change: temperature.

Measure the time for each cube to melt.

Discuss why they think they got these results.

2. “Does putting the ice cubes on different surfaces make any difference to the time it takes for them to melt?”

The uncovered ice cubes can be put on different things, e.g. wood, metal (perhaps a tin lid), newspaper, kitchen foil etc. in the same place (i.e. at the same temperature) Again the time can be measured.

“Did it make any difference what the ice was put on?”

Note on the Snowman!

Coats keep you warm by keeping the heat of you body in (remember heat travels from hotter to cooler). So the coat will keep the snowman cold by not letting the warmer air in!

The top of a plastic mineral bottle, filled with water and frozen, would make a good model snowman.

The ice is melting!

Climate

time
65 minutes.

learning outcomes
To:
- know where ice can be found on Earth
- know that the amount of ice on Earth is shrinking
- know the difference between land ice and sea ice
- discover that melting sea ice does not affect rising sea levels
- discover that melting land ice does affect rising sea levels
- discover that it is colder on areas of ice (white) than on land and water (dark)

end product
- the results of an experiment using ice cubes
- a shoebox landscape which is partially made up from ice (white) and partially land (black)

materials needed
- 12 plastic cups
- 12 small plates or saucers
- 12 ice cubes
- 3 jugs of water
- 2 thermometers
- information sources, such as internet, encyclopaedias and an atlas
- colouring pencils
- clay
- shoebox
- piece of stiff card
- black paper
- white paper
- glue
- clingfilm
- sunlight

Tip.
Use small cups so you don't need so much clay.

Preparation

For the activity **Are water levels changing?** you will need the cups, plates, clay, and jugs of water. The day before the lesson, make at least 12 ice cubes. Take them out of the freezer just before you start this activity.
For the activity **Is the temperature changing?** divide a shoebox in two by placing a piece of stiff card in the middle.
Line the inside of one half with black paper and the other half with white paper.
Check that both thermometers show the same temperature.

Good to know.
The polar ice cap at the North Pole has shrunk by 9 percent in the last 10 years! But the situation used to be very different. During the most severe ice age the Earth was covered in ice sheets from the Poles to the Equator.

Ice 15 min.

The children complete Task 1 on the worksheet. They can use internet the encyclopaedia, and an atlas to find the answers.
Discuss the answers with the class. Explain that ice is formed when water freezes. Water freezes at zero degrees Celsius. Ice can appear as ice, hail, and snow. Most of the ice on Earth can be found at the North and South Poles, Greenland, and Siberia. The ice at the North Pole is sea ice, the ice at the South Pole is land ice. The photographs on the worksheet show that the ice at the North Pole has shrunk considerably in recent years. Ask the children if they know why this is.
Do the children have any idea about what happens when the ice melts? There will be more water in the sea. Explain the concept of sea levels.

The children investigate what will happen to sea levels and the temperature on Earth if the ice melts.

What do you think? 5 min.

The children complete Task 2 on the worksheet and write down what they think the answer to the research question is.

Will sea levels change? 15 min.

Organise the children into groups of four. The children complete Task 3 on the worksheet. Explain that cup 1 represents the sea ice at the North Pole and cup 2 represents the land ice at the South Pole. The water in the cups represents the sea level.
Explain that they have to be careful when handling the ice cubes. They should wet their hands before they pick up their ice cube, this will stop the ice cube from sticking to their fingers.
It might take quite a long time for the ice cubes to melt. You can speed up the process by putting the cups on a sunny windowsill. You may find a few drops of water on the plate with cup 1, but these will be condensation from the warm air coming into contact with the cold cup.

Will the temperature change? 15 min.

What will happen to the temperature on Earth if the ice melts? Show the shoebox. Explain that the white half represents the ice on Earth and the black half represents land or water. Place a thermometer in each half of the shoebox. Cover the box with clingfilm. Place the box on a sunny windowsill. The children complete Task 4 on the worksheet.
Wait ten minutes and then encourage the children to read the thermometers in groups of four. What do they see? The children complete Task 4 on the worksheet.

Will the Earth flood? 15 min.

Finally, the children complete Task 5 on the worksheet. When they have finished, discuss the answers from both experiments. What did the children discover? Explain that cup 1 did not overflow because the weight of the water in the ice cube was already in the water. Cup 2 overflowed because the melted water from the ice cube was added to the water that was already there. From this we can see that the melting land ice at the South Pole will cause sea levels to rise, but the melting sea ice at the North Pole will not.
In the second experiment the temperature in the black half of the shoe box will be higher than in the white half. This is because light colours (white) reflect more heat and light than dark colours (black). White acts like a mirror, reflecting almost all the Sun's rays. If more ice melts, a larger area of the Earth's surface will be darker. This means that less sunlight and heat will be reflected and it will become increasingly warmer on Earth. This will cause the remaining ice to melt even more quickly. Is this what the children predicted in Task 4?

Good to know.
The melting ice in Greenland and Siberia will also contribute to rising sea levels.

The ice is melting!

1 Ice

a How is ice made?

b At what temperature does water freeze?

c What forms of frozen water can you name?

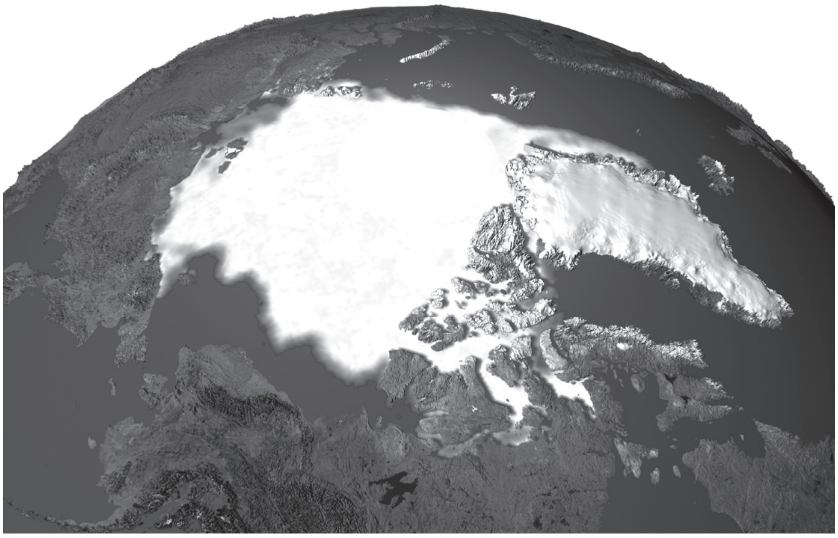
d Both the North Pole and the South Pole are covered in ice. But there is an important difference between the two sorts of ice. The ice at one pole is land ice and the ice at the other is sea ice. Do you know which is which?

Write your answers in the spaces provided.

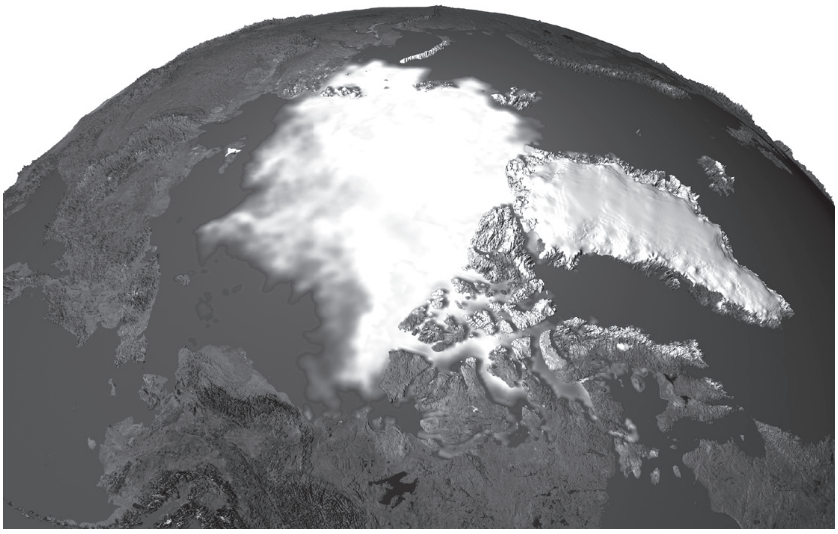
The North Pole is covered by ______________ ice.

The South Pole is covered by ______________ ice.

e Look at the two photographs on the next page. The photographs show the North Pole. The one on the left was taken in 1979. The one on the right was taken in 2003. What difference can you see?



polar ice cap at the North Pole in **1979**



polar ice cap at the North Pole in **2003**

2 What do you think?

Now you are going to investigate what will happen to sea levels and the temperature on Earth if the ice on Earth melts.

a What do you think will happen to sea levels if the ice melts?

b What do you think will happen to the temperature on Earth if the ice melts?

3 Will sea levels change?

You are going to investigate what will happen to the water if the ice at the North Pole and the South Pole melts.

What do you need?

- 2 plastic cups
- 2 plates
- 2 ice cubes
- clay
- jug of water

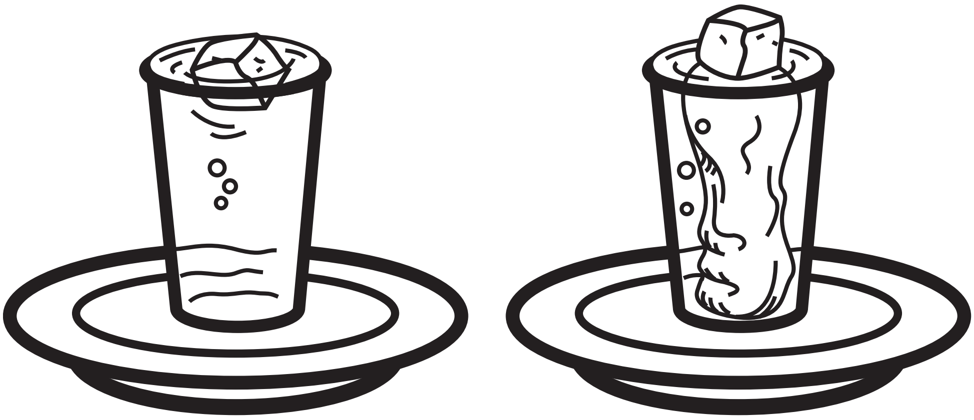
What do you need to do?

- **CUP 1**

1 Put the cup on the plate.
2 Put one ice cube in the cup. Wet your hands before you pick up the ice cube!
3 Fill the cup to the brim with water. This cup represents the sea ice at the North Pole.

- **CUP 2**

1 Put the cup on the plate.
2 Put some clay into the cup. Make sure the tip of the clay is just above the rim of the cup.
3 Fill the cup to the brim with water.
4 Put one ice cube on top of the clay. This cup represents the land ice at the South Pole.



CUP 1 CUP 2

a Do you think the water in cup 1 will overflow?

b Do you think the water in cup 2 will overflow?

Wait for five minutes and then examine your cups.

c Is cup 1 overflowing?

Yes / No

CIRCLE the correct answer

d Is cup 2 overflowing?

Yes / No

CIRCLE the correct answer

e Will sea levels rise if the ice at the North Pole melts?

f Will sea levels rise if the ice at the South Pole melts?

g Why is that?

4 Will the temperature change?

You are going to investigate whether the temperature will rise if the ice melts.

You are going to do this together with your teacher, using the black and white box.

a Look at the thermometers together. What temperature do they show?

__________ degrees and __________ degrees

b What do you see? Put a tick against your answer.

- ○ Both thermometers show the same temperature.
- ○ The thermometer in the white half shows a higher temperature.
- ○ The thermometer in the black half shows a higher temperature.

c What does this mean for the temperature on Earth if there is less ice (white) and more land and water (dark)?

5 Will the Earth flood?

a Return to your answers to Question 3.

What will happen to sea levels if the ice melts?

b Return to your answers to Question 4.

What will happen to the temperature on Earth if the ice melts?

DPSM/ESERO

Framework for Inquiry - Promoting Inclusion

SPECIAL EDUCATION SUPPORT SERVICE
building on ability

When planning science activities for students with Special Educational Needs (SEN), a number of issues need to be considered. Careful planning for inclusion using the framework for inquiry should aim to engage students in science with real purpose. Potential areas of difficulty are identified below along with suggested strategies. This list is not exhaustive, further strategies are available in the Guidelines for Teachers of Students with General Learning Disabilities (NCCA, 2007).

ENGAGE

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Delayed language development/poor vocabulary/concepts	• Teach the language of science demonstrating meaning and/or using visual aids (material, property, strong, weak, textured, dimpled, absorbent, force, gravity). • Have the student demonstrate scientific phenomena, for example gravity —using 'give me, show me, make me,' as much as possible. • Assist the student in expressing ideas through scaffolding, verbalising a demonstration, modelling. • Use outdoor play to develop concepts.

INVESTIGATE

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Fear of failure/poor self-esteem/fear of taking risks	• Model the speculation of a range of answers/ideas. • Repeat and record suggestions from the students and refer back to them.
Understanding Time and Chronology	• Practice recording the passing of time, establish classroom routines that draw the students' attention to the measurement of time. • Teach and practice the language of time.
Fine/Gross Motor Difficulties	• Allow time to practice handling new equipment. • Allow additional time for drawing diagrams, making models etc. • Give students the option to explain work orally or in another format.
Short Term Memory	• Provide the student with visual clues/symbols which can be used to remind him/her of various stages of the investigation.

TAKE THE NEXT STEP

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Developing Ideas	• Keep ideas as simple as possible, use visuals as a reminder of earlier ideas. • Discuss ideas with the whole group. • Repeat and record suggestions from students and refer back to them. • Encourage work in small group and in pairs.
Communicating Ideas	• Ask students to describe observations verbally or nonverbally using an increasing vocabulary. • Display findings from investigations; sing, do drawings or take pictures. • Use ICT: simple written or word-processed accounts taking photographs, making video recordings of an investigation.

REFLECTION

- Did I take into account the individual learning needs of my students with SEN? What differentiation strategies worked well?
- Did I ensure that the lesson content was clear and that the materials used were appropriate?
- Was I aware of the pace at which students worked and the physical effort required?
- Are there cross curriculum opportunities here?
- Are the students moving on with their skills? Did the students enjoy the activity?

More strategies, resources and support available at **www.sess.ie**

Cross-curricular Links

HEAT TRANSFER AND INSULATORS

There are many opportunities to extend Heat Transfer and Insulators to other curricular areas.
Here are some suggestions:

PE:

- Plan, observe, describe and discuss activities outdoors, discuss the safety aspects of activities undertaken. What materials work will to insulate - conserve heat and reduce heat transfer?
- Alternatively, what is good to wear when carrying out physical exercise on a hot day?
- English: Oral Language:
- Talk about stories, films or books based around snow or Ice melting such as the snowman or the day after tomorrow. How do people stay warm? What makes ice melt?
- Writing: Ask students to write a story about visiting the Arctic / Antarctic and how they would plan their trip, what they would need to bring with them?

SESE Geography

- Recognise how the actions of people may have an impact on environments.
- Climate change and Global warming: have a class discussion about what will happen as ice at the arctic and Antarctic melts and how it will impact people living in different parts of the world.

SESE History

- Actively explore some features of the local environment. Investigate various aspects of Ice Houses in Ireland and present findings using a variety of media and appropriate timelines.
- Mathematics:
- Estimate, compare and measure the area of regular and irregular shapes by looking at the area of the sea ice at the Arctic and Antarctic over many years.

SPHE

- Myself and the wider world - Climate change and global warming: Appreciate and respect the environment and learn that there is an individual and community responsibility in caring for the environment and protecting it for future generations.

Music

- Listening and responding to music, listen to and describe a broad range of musical styles and traditions, including familiar excerpts, recognising where appropriate its function and historical context.
- Listen to the music of the snowman short film. How does the music tempo and style change as the snowman is happy and when he begins to melt?

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