A PINCH OF SALT

A science investigation pack for teachers of 7-11 year olds

CENTRE *for* INDUSTRY EDUCATION COLLABORATION

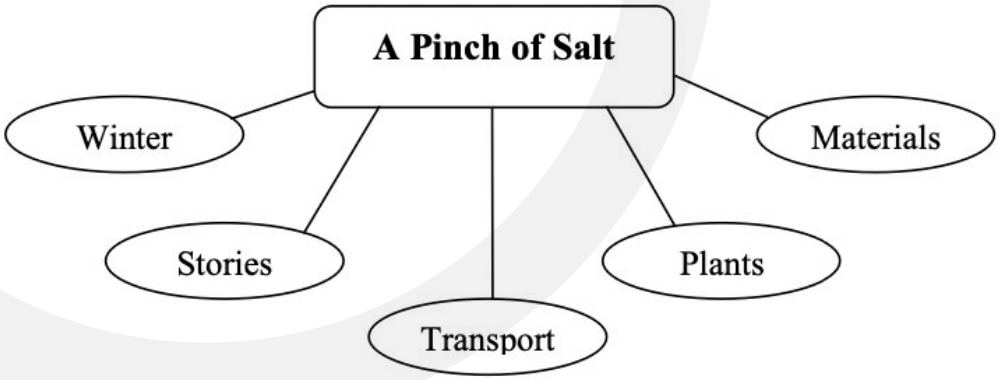
AkzoNobel

Contents

Introduction

This package provides a focus for planning and carrying out science and technology based activities. It also contains suggestions for activities in English, mathematics, history, geography and religious education. The package can be used in its entirety or activities can be selected from it to support another teaching programme.

Activities in the pack are suitable to use in the following topics:



The pack is aimed at 9-11 year old children but teachers will find the ideas adaptable for other age-groups.

The pack is not intended to be 'worksheet-led' in nature, though a few Activity sheets are provided for children's use during science activities. The Activity sheets are intended to stimulate discussion, support the development of investigative skills and processes, and help in the recording of information. The children are encouraged to plan their own investigations and present their findings using a variety of creative methods.

The main focus of the pack is the **science** related to salt's use as a de-icer on roads during cold weather. The activities are linked using a cartoon character 'Chris' who discovers a salt bin at the end of the street and learns that using salt on roads has advantages and disadvantages. During the series of science activities the children learn about:

- The effect of salt on melting ice.
- The difference between melting and dissolving.
- Evaporation of water from a salt solution, leaving salt crystals.
- The effect of surface area on the rate of evaporation of water from salt solution.
- Obtaining table salt from rock salt, by dissolving, filtering and evaporating.
- The effect of salt on the germination and growth of seedlings.
- The effect of salt on the rate of corrosion of iron or steel.

Activities and ideas for other curriculum areas are outlined on the following page.

RESOURCES

Quantities of resources are given for a group of 4-6 children.

A 750 g container of table salt and 1 kg of rock salt will be sufficient for a class to complete all activities. Rock salt can be bought from building suppliers and costs around £2.00 per 5 kg bag.

ACTIVITY 1

- Table salt
- Freezer
- 2 baking or tidy trays
- 2 sheets of sandpaper
- 1-2 ice-cube trays
- 1-2 stop clocks or egg-timers 2 funnels
- 20 ml measuring cylinder or 5 ml teaspoon
- Plastic jugs (at least 2)
- Yogurt pots (several)
- Weights (100-500 g)
- Copies of Activity sheets S3-S4

ACTIVITY 2

- Table salt
- Candle
- Grater
- 4 freezer bags and twisters bowl (preferably transparent)
- Flask of hot water or kettle[1]
- 2 teaspoons
- Stop clock or egg-timers
- 2 alcohol-filled thermometers
- (-10 to 100°C range) copies of Activity sheets S5-7

1 See the safety note on the relevant page of the teachers' notes

Activity 3

- Table salt
- Desk lamp[1]
- Radiator
- Cooker hob[1]
- Hair-dryer[1]
- Saucer
- Egg-cup
- Plastic plate
- Yogurt pot
- Copies of Activity sheets S8-9 tea-cup

Activity 4

- Table salt
- Filter paper or paper towels funnel
- Transparent containers (e.g. miniature pop bottles)
- 1 freezer bag and twister
- Rolling pin
- Heat source[1] (e.g. desk lamp, radiator, cooker hob, tea light and heat stand)
- Copies of Activity sheet S10

Activity 5

- Rock salt
- Table salt
- Commercial compost[1] or cotton-wool
- Snowdrop bulbs or cress or mustard seeds or bunches of flowers (daisies, snowdrops, etc.) daffodils
- Copies of Activity sheet S11

1 See the safety note on the relevant page of the teachers' notes.

1. A Pinch of Salt

Children investigate the use of salt on icy roads. Cartoon character, Chris, finds a container of salt near his new house at the top of a steep road. He does not know what the salt is for. This prompts the children to plan an investigation into the effect of adding salt to ice.

OBJECTIVES

- To describe changes that occur when materials are mixed.
- Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs

RESOURCES

Copies of Activity sheets S3-S4, salt, freezer compartment, baking trays, tidy trays, ice-cube trays, stop clocks or stopwatches or egg- timers, funnels, plastic jugs, yogurt pots, 20 ml plastic measuring cylinders (or teaspoons, as non-standard or 5 ml measures), range of weights (100-500 g). Other resources, depending on the children's planned investigations.

Activity sheet S3 provides the stimulus for this activity and is intended to promote class discussion once children have completed the final box. The cartoon introduces the character Chris, who is featured throughout the activities. Chris moves to a new house at the top of a steep road and discovers a container of salt nearby. Chris does not know what the salt is for.

Children fill in the final box of the cartoon with their suggestion for the salt's use. Most children are aware that such containers of salt are used to de-ice roads in winter and will have drawn this option in the final box. The teacher can also complete a cartoon strip, which can be used if children have not thought of the possibility of de-icing. The children will enjoy seeing the teacher's artwork, good or bad!

Activity sheet S4 prompts an investigation into the use of salt on roads. On this sheet Mum tells Chris that salt is put on icy roads in winter. Children plan a test to find the answer to Chris's question, "What good will that do?" They are guided through the planning stages, by considering resources, 'fair' test conditions, and what and how they will measure and record.

During planning the children must decide on quantities of salt and ice, whether to stir the mixtures, drain water away, add more salt at regular intervals, etc. If children want to change their investigation once they have started, they should give the teacher a valid reason before doing so.

RECORDING THE ACTIVITY

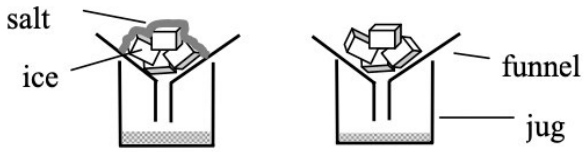
Results are best initially jotted down in a table during the test. During quieter moments of the investigation, the results can be transferred to a bar chart or a line graph (see page 65). The choice of graph will depend on the ability of the children. Different coloured bars or lines can represent the ice with and without added salt.

N.B. *Children prepare their table layout before beginning their investigation. Some children will require support to achieve this, or the teacher may prepare blank tables for those with learning difficulties.*

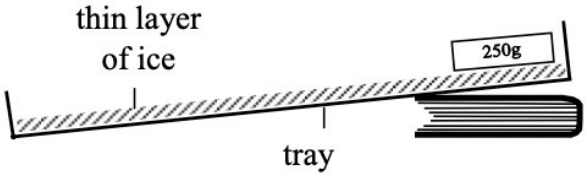
The following ideas for investigations may be used with children who have difficulties with open-ended tasks of this nature. They are **not** intended to be given to children before they have tried to devise an investigation.

Two yogurt pots containing equal numbers of ice-cubes, one covered with salt. The time taken for both tubs of ice to melt can be measured.

Two funnels containing ice cubes resting above two jugs, one covered with salt. The *volume* of the drained water is measured at regular *time* intervals.



Modelling a real situation is popular with children, but can result in an investigation which is difficult to carry out successfully. Slide objects (such as 250 g weights) down two trays coated with a thin layer of ice (see hint 4), one with salt added and one without. Children collect and measure the *volume* of water at regular intervals. Alternatively, the objects are released together, and children observe which one reaches the end of its tray first.



HANDY HINTS

1. To prevent the ice melting before the tests begin, carry out tests close to the freezer or collect the ice at the latest opportunity. Ice can be kept in a cool box in the classroom.
2. The smaller the quantity of ice, the faster the experiment. For example, 1 ice-cube will melt in about an hour, whereas 4 ice- cubes in a funnel take 5-6 hours to melt! Crushed ice can be used, made with a liquidizer.
3. Adding salt at regular intervals makes a marked difference to the results, especially in the funnel test, as a lot of salt drains away during melting.
4. If preparing ice-filled trays, they must be horizontal in the freezer, so the water freezes evenly. A layer of sandpaper stuck to the bottom of the tray before the water is added can represent road friction.

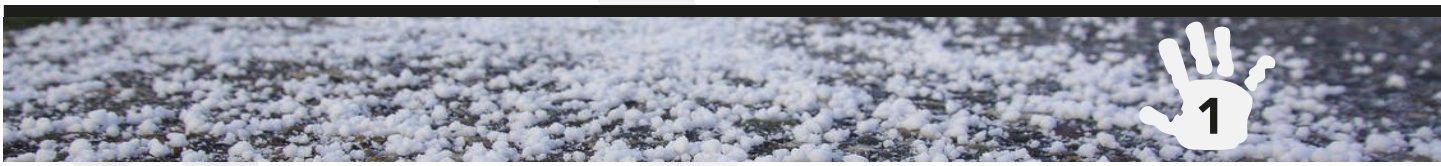
N.B. *The focus of this activity is the speeding up of the melting process, and not on the resulting temperature change. The concept of the salt solution being a liquid at sub-zero temperatures is very difficult for children to understand, and should not be tackled. An explanation of the change in temperature is provided in Appendix 1 for teachers.*

EXTENSION ACTIVITY

The children find out if other substances (sugar, flour and sand) speed up the melting of ice in a similar way to salt. They can research the advantages and disadvantages (e.g. costs) of using these substances on the road.

Discuss the fact that rock salt can also provide friction for car tyres on icy roads.

Activity Sheet S1: What you can measure or change...

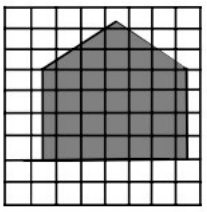


Time

Temperature

Volume

Area

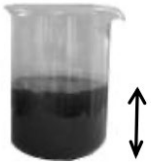


Area = 28 squares

Mass

Length

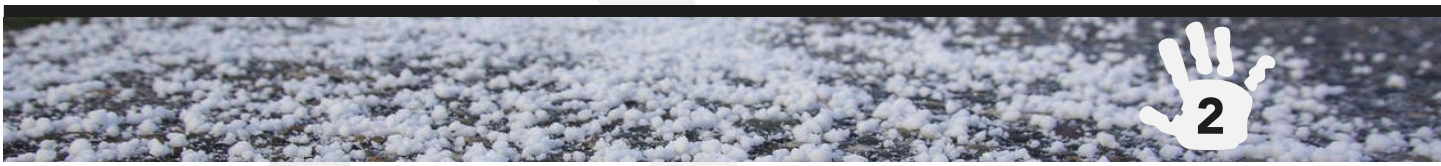
Depth



Force

Speed

Activity Sheet S2: How you can record your work...



Writing

Salt and Ice

We were trying to find out why the roads are sprinkled with salt in icy weather. We decided that we would use there things.

4 ice-cubes
1 jug
1 teaspoon
1 funnel
1 stopclock

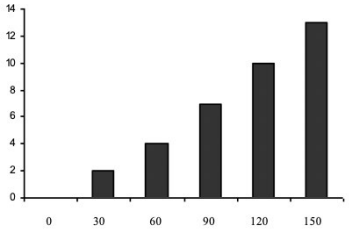
We decided to measure the amount of water that has melted every 30 mins.

Group poster

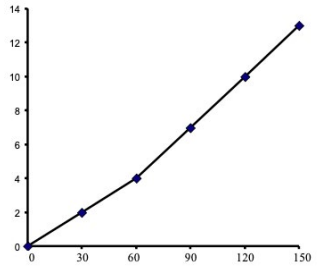
Table

Time in minutes	Temperature of water collected
0	0
30	1.5
60	4.5
90	7.5
160	10.5
180	13.5

Bar chart

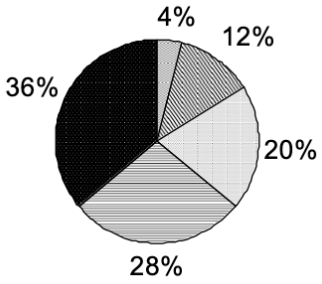


Line graph

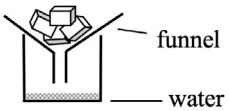


Computer

Pie Chart



Drawings or pictures



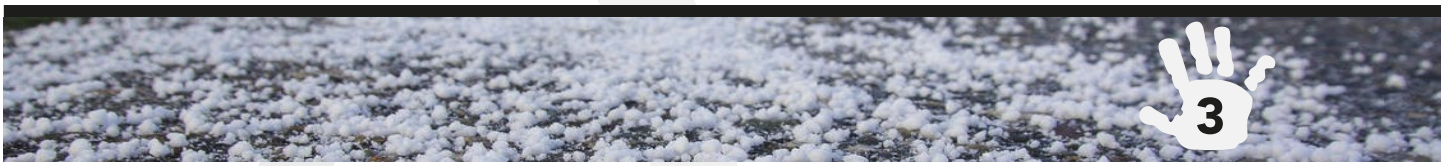
Cassette

Photographs

Microscope

Video

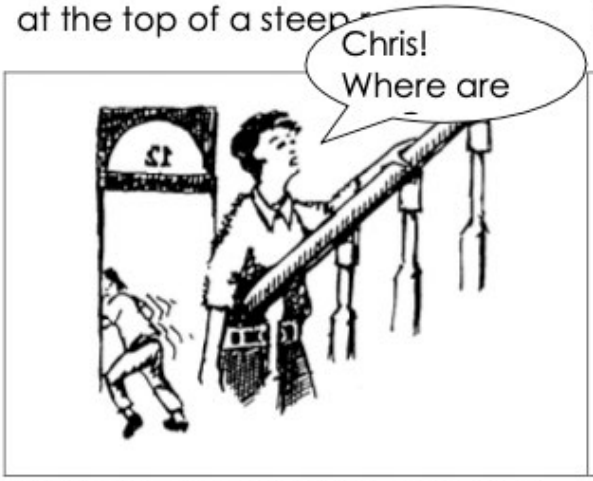
Activity Sheet S3: A pinch of salt



Read the cartoon then complete the last box yourself.

Chris has moved to a new house at the top of a steep

Chris finishes putting posters on the bedroom walls.

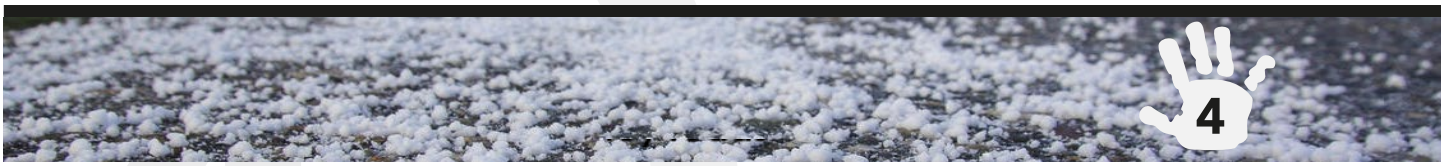


Chris sneaks past Mum, who is on the look-out for 'helpers', and runs into the back yard.

Chris is wandering round outside and discovers a yellow plastic 'bin' labelled salt, and wonders what it is for.

Is it to sprinkle on chips? Or . . .

Activity Sheet S4: Icy roads



Plan a test to find an answer to Chris's question	
List what you will need:	How will you make the test fair?

Ring the things you will measure:

time depth length area

volume mass force

Ring the ways you will record your results.

bar chart table pie chart

line graph writing pictures

Draw and label your test:
Ask your teacher if you can start!

2. In the melting pot

Children investigate the difference between the processes of melting and dissolving by predicting, then finding out, what will happen when a sealed bag of salt and a sealed bag of grated candle wax are added to hot water. Cartoon character, Chris, then hypothesizes that 'There's still some salt on the road because the water is so cold. If the sun warms up the water, more salt will dissolve'. The children plan an investigation to test if he is correct.

OBJECTIVES

- Observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C)
- Demonstrate that dissolving, mixing and changes of state are reversible changes
- Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs

RESOURCES

Copies of Activity sheets S5-7, salt, candle, transparent freezer bags, transparent and heat-resistant bowl, flask of hot water or kettle, cold water, grater, teaspoons, stop clocks or egg-timers, transparent containers, alcohol-filled thermometers.

INTRODUCTION TO DISSOLVING

The introduction to this activity requires the children to follow carefully the instructions on Activity sheets S5-7 and complete the relevant sections as the activity progresses. The instructions can be recorded on a tape-recorder for children to play back. This will assist those who have reading difficulties or who are visually impaired.

The children are asked to predict what will happen when a sealed bag of salt and a sealed bag of grated candle wax are added to hot water. The children then try this and compare their observations with the prediction. This procedure is repeated for adding a teaspoon of grated candle wax and a teaspoon of salt to about 500 ml cold water.

Safety note

It must be emphasised that children need close adult supervision during this activity. The temperature of the hot water must be no hotter than 60°C. The children should be warned of the dangers of burns and scalds.

N.B. *The candle wax is grated to eliminate the possibility of children thinking that the wax does not dissolve because it is in one large piece. It also makes the melting wax easier to observe.*

The children should explain their observations and be introduced to the word 'dissolve' if they do not offer this word during discussion.

With more able children, the teacher can introduce the idea that salt can melt, and ask them to discuss what would be needed to make this happen. Some children may appreciate that much higher temperatures than those achievable in their classroom or home are required for the salt to melt. Salt melts at 801°C.

REINFORCING THE CONCEPT

Additional activities may help some children to understand the differences between melting and dissolving. Other substances can be tested in a similar way to salt and wax, and the children make predictions before putting the substances in water. Suitable substances include sugar and coffee for dissolving, and chocolate and margarine for melting. Saucers of different substances can be left in a warm place, and a prediction made as to whether any will dissolve or melt. This should reinforce the concept that dissolving requires water, but melting does not.

EFFECT OF HEAT ON DISSOLVING SALT

Activity sheet S7 provides the children with Chris's hypothesis that "There's still some salt on the road because the water is so cold. If the sun warms up the water, more salt will dissolve." They are asked to find out whether Chris is right, and are encouraged to think about:

- The equipment they need (thermometers, teaspoon, hot water, etc.).
- The variables/factors they will control or keep the same (the volume of water, the number of stirs or shakes, the size of spoon used to add the salt).
- What they will change (the water temperature) - independent factor.
- What they will measure (quantity of salt added) – dependent factor.

Investigations may range in complexity from counting the spoonfuls of salt added to jugs of cold and hot water, to recording how many grams of salt will dissolve in water at a variety of different temperatures (e.g. across a temperature range of 0-60°C, with 10°C intervals).

Carrying out a more complex investigation provides children with the opportunity to record results in tables and bar charts or line graphs. Pages 63-65 provide support for this activity.

The children should find that Chris's hypothesis was a good one, and that more salt will dissolve in water with an increased temperature.

HANDY HINTS

1. The children may confuse cloudy water with undissolved salt. They should look for undissolved salt granules on the bottom of the container, once the mixture has settled after any stirring or shaking.
2. A large jug of water at 60°C can be mixed by the teacher using hot and cold water. The children can then collect smaller quantities of water from the teacher's jug as it cools, to test water at 50, 40 and 30°C.
3. The teacher can freeze a bottle half-filled with water. This can then be brought in to the classroom and filled to the top with cold water. This allows children to test water at 3-4°C, and also at 10 and 20°C, by mixing warm water with the cold water.
4. Spoons larger than a teaspoon should not be used, as the quantity added each time is too great. If half or quarter teaspoon measures are available, these give a more accurate measurement of dissolved salt.

EXTENSION ACTIVITIES

The molten wax can be poured into a mould to regenerate the candle with which they started.

The children think of an alternative hypothesis for the salt left on the road, i.e. that too much salt was added for the amount of ice/water on the road.

Children formulate another hypothesis about the dissolving of salt, e.g. stirring the salt and water helps the salt dissolve faster, grinding the salt into a powder helps the salt dissolve faster, or that the evaporation of water leaves salt on the road when the sun comes out. They could then carry out an investigation to prove their hypothesis.

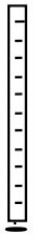
N.B. *The last hypothesis forms the basis for the next activity.*

A range of substances can be investigated to find out which ones dissolve. These substances could include coffee, tea, flour, custard powder, sand, sugar, etc.

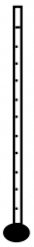
N.B. *Substances such as flour and custard powder will be suspended in (floating in the middle of) the water, thus forming a suspension. These substances have not dissolved, as the particles can still be seen in the water. The substances which dissolve cannot be seen, but the solution may change colour.*

More able children can be asked "Could salt in water help things float?" (see page 117 for links with geography).

These children plan an investigation to answer this question. They can be given suggestions for making a suitable float, e.g.



A thin strip of balsa wood with a drawing pin to add weight to the end. Mark with a permanent marker pen.



A straw sealed with plasticine, marked with a permanent marker pen.

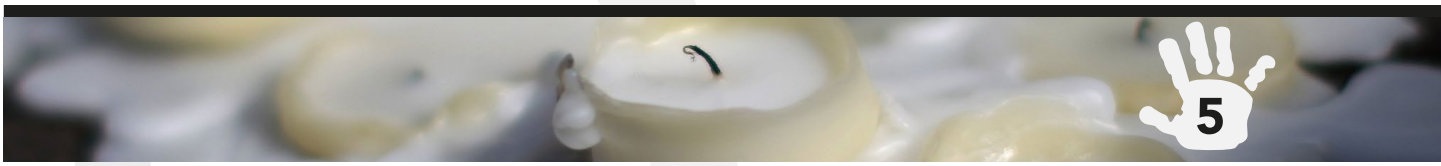
The children consider aspects of fair-testing, e.g. keeping the type of container and the amount of water the same, changing the amount of salt added to the water, and measuring the floating position of the floater with each addition of salt.

The children should observe that the floater will be higher in the water with increasing amounts of salt. This is because salty water is denser than fresh water. The more salt in the water, the denser it becomes.

N.B. *Due to the focus on density in this activity, it is advisable that it is used as an extension activity to challenge more able children.*

The investigation can be extended further by finding out whether other substances that dissolve have a similar effect on floating objects.

Activity Sheet S5: In the melting pot



Get these things ready:

bag of salt 

bag of grated wax 

bowl of hot water 

Predict what will happen when the bags are put in the water.

The salt will _____

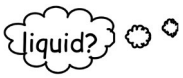
_____

The wax will _____

_____

Try it.

Were you right? Explain why.



What does **melting** mean?

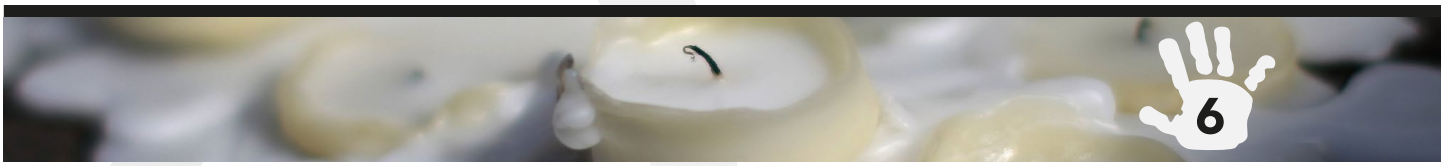
_____

_____

_____

_____

Activity Sheet S6: In the dissolving pot



Get these things ready:

teaspoon of salt 

teaspoon of grated wax 

bowl of cold water 

Predict what will happen when the wax or salt is tipped in the water.

The salt will _____

_____

The wax will _____

_____

Try it

Salt	Wax
Were you right? _____ Explain what happened.	Were you right? _____ Explain what happened.

How can we get the wax back? _____

_____

How can we get the salt back? _____

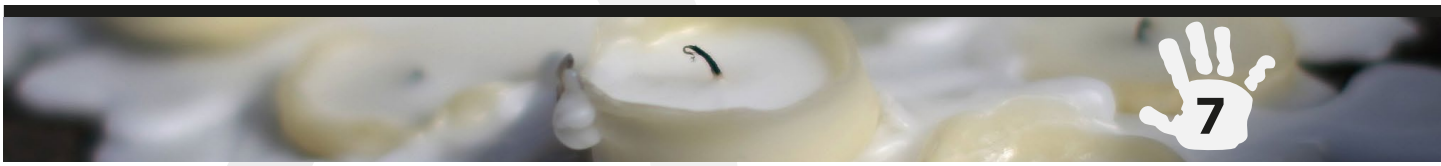
_____

Explain the differences between what happened using hot and cold water:

_____

_____

Activity Sheet S7: Dissolve that salt!



There's still some salt on the road because the water is so cold. If the sun warms up the water, more salt will

Chris has tried to explain an idea.
Chris has made a hypothesis.

Plan a test to find out if Chris is right or not.

Think about

The things you need.
What you will change.
What you will keep the same.
What you will measure.

Plan your test here, then try it!

What do your results tell you about Chris's hypothesis? _____

_____

_____

3. In the melting pot

Children are introduced to the word 'evaporation' by considering how objects are dried at home. They then set up an investigation using different methods to evaporate salt from salty water. They then plan an investigation into the effect of the size and shape of the container on the speed of evaporation.

OBJECTIVES

- Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution.
- Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.

RESOURCES

Copies of Activity sheets S8-9, salt, desk lamp, radiator, hair-dryer, tea- cup, saucer, egg-cup, plastic plate, yogurt pot. Other resources, depending on the children's planned investigations.

To introduce the concept of evaporation, the children are given Activity sheet S8 and asked what all the pictures have in common. The pictures show wet clothes on a washing-line, a hair-dryer being used to dry wet hair, paintings being left to dry, a draining rack of wet dishes and a towel on a radiator.

Once children have established that each picture shows something drying, they are asked what happens to make wet things dry and where the water goes. The children should be introduced to the word 'evaporation', if it is not suggested as a reason for the water 'disappearing'.

The children are asked to put the examples in order, starting with the one where evaporation (drying) takes the longest. Children may want to introduce factors such as the quantity of water in/on the wet object, the size of the wet object, whether water is trapped inside the object or on the surface, etc. The teacher should avoid introducing these factors, as they can lead to confusion if a child is not ready for them.

Safety note

All mains appliances used in schools must be checked annually. If a desk lamp or hair-dryer is brought from home, it must go through a standard safety check. Children should be told not to try this activity at home.

The children are given Activity sheet S9, which asks them to obtain salt from salty water in three different ways. Groups of children should decide on appropriate quantities of salt and water, estimate and measure evaporation times, and give reasons for their findings. Teachers can guide children in their decision-making, asking questions such as how long the test will take.

HANDY HINTS

1. The smaller the quantity of water used, the quicker it will evaporate. One tablespoon of water in a saucer takes the following approximate times to evaporate:

With hot air from a hair-dryer blown across the surface.	30 mins
On a hot radiator.	60-90 mins
Under a desk lamp with a low wattage bulb.	8+ hours
On a sunny window sill in summer.	8+ hours

2. The slower the evaporation, the larger the size of the salt crystals. This is demonstrated by using a variety of evaporation methods.
3. Using dark-coloured saucers, etc. aids the observation of the salt crystals.
4. When using a hair-dryer, the air should initially be directed across the surface of the water, to avoid blowing water out of the saucer. As the water evaporates, hot air can be blown directly at and closer to the solution. Children can take turns to hold the hair-dryer or it could be supported in some way.

WATER HOLDER INVESTIGATION

The children then plan an investigation into the effect of the container on the speed of evaporation. They use a tea-cup, saucer, egg-cup and plate and choose additional resources and variables to be controlled and measured. Ideally, they should control the quantity of salt and water and the method of evaporating the water (under a lamp, etc.)

N.B. *This experiment will take 2-3 weeks if the water is left to evaporate at room temperature with no added heat source. However, slow evaporation will demonstrate the larger crystal size.*

The children should find that the larger the surface area of the exposed solution, the faster the evaporation.

TEACHER INFORMATION

During evaporation the water changes from a liquid to a gas. Most gases cannot be seen (like air) and so the water seems to have disappeared. The warmer the temperature, the faster the evaporation.

Water evaporates very slowly at temperatures below boiling point. Water molecules (particles) at the surface of the water slowly 'escape' from the water as a gas. Therefore, the greater the surface area, the greater the number of water molecules that escape.

EXTENSION ACTIVITIES

Challenge children to make coloured salt. Salt is dissolved in water with food colouring and then the water is evaporated.

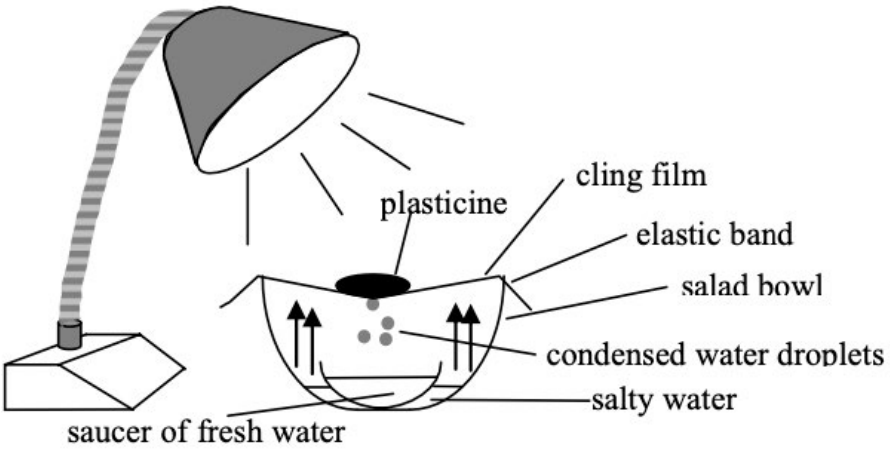
Children can investigate the possibilities of retrieving other solids from solution, e.g. coffee or sugar.

In some hot countries drinking water is obtained by evaporating water from salt water (see geography, page 117). The water is condensed and collected. The teacher can demonstrate condensation by holding a pan lid over a pan of boiling water.

N.B. *The teacher should wear an oven glove when holding the lid.*

The children will observe water condensing on the lid and dripping back in to the pan.

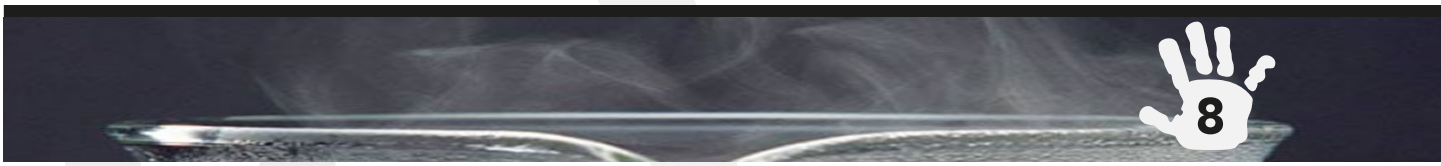
The children can devise an investigation to obtain fresh water from salty water using a desk lamp to represent the Sun and their knowledge of evaporation and condensation. Alternatively, the teacher or a group of children can set up a simple model of this process in the classroom:

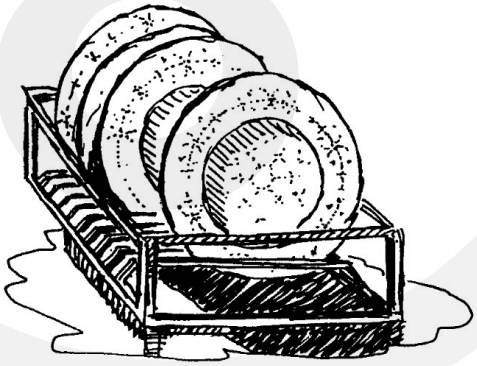


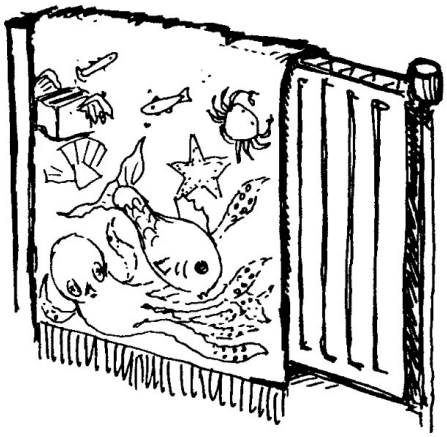
The cling film must be secured firmly to the bowl with an elastic band. The desk lamp (angled directly over the bowl if possible) heats the salty water through the cling film. The water evaporates and the resulting condensation on the surface of the cling film can be seen after a couple of hours. When heavy enough drops of water have formed they drop into the saucer.

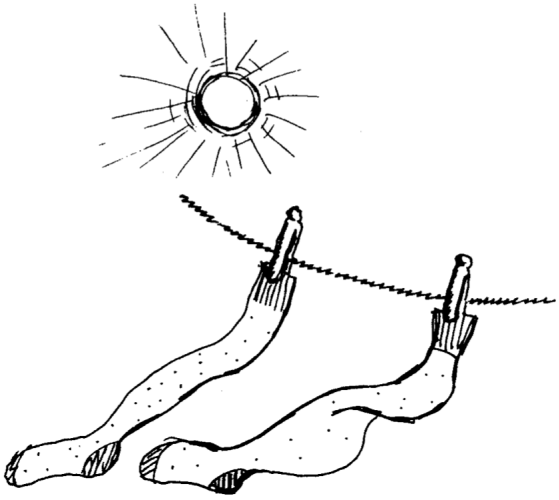
N.B. *This takes more than 24 hours using a 60 watt bulb, and about 12 hours using a 100 watt bulb.*

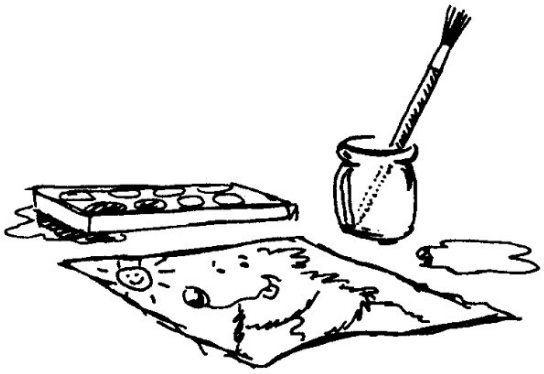
Activity Sheet S8: What do they have in common?



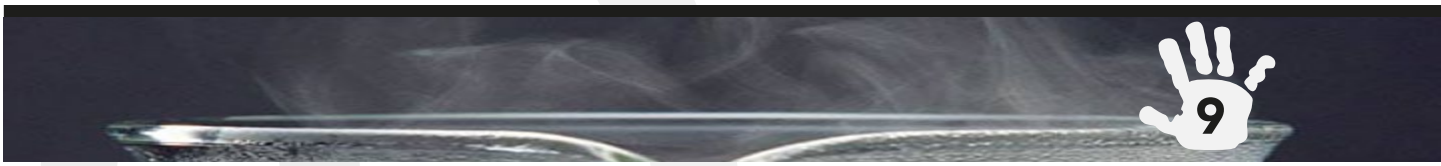








Activity Sheet S9: Salt from salty water



Think of three ways to get salt from a saucer of salty water.

1. _____

2. _____

3. _____

What will you keep the **same** each time? _____

_____

Predict the evaporation time.

1.	2.	3.

Now get the salt! What was the evaporation time?

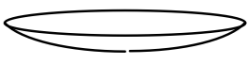
1.	2.	3.

Were you right? Why?

Has the salt evaporated? Why?

Now plan an investigation to find out if the water holder changes the speed of evaporation. Use the following;

saucer 

plastic plate 

egg-cup 

tea-cup 

Remember to make your test

4. Salt for my chips!

Children make observational drawings of dry rock salt and table salt. They then compare the rock salt and table salt in solution, noticing that both salts dissolve but rock salt contains solids that do not dissolve. Children then plan an investigation to clean rock salt used for de-icing roads, so that it is pure enough to sprinkle on chips. This introduces the children to the processes of crushing and filtering.

OBJECTIVES

- Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.
- Demonstrate that dissolving, mixing and changes of state are reversible changes.
- Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

RESOURCES

Copies of Activity sheet S10, rock salt, table salt, magnifiers, filter paper or paper towels, funnel, transparent containers (e.g. miniature pop-bottles), freezer bags and fasteners, rolling pin, heat source, e.g. tea-light, hair-dryer or desk lamp, heat stand, sand, foil dish. Other resources, depending on children's investigations.

The children observe dry rock salt and table salt, preferably with a magnifier, and draw them on Activity sheet S10. Their attention should be drawn to the relative shape, size and colour of the salts. Both types of salt have regular cubic shapes, though the rock salt crystals are larger and coloured and the additional solid impurities can be seen clearly.

Safety note

Children require close adult supervision when using a cooker hob, tea-light or hair-dryer. All mains appliances used in schools must be checked annually. The children should be warned of the dangers of burns and scalds.

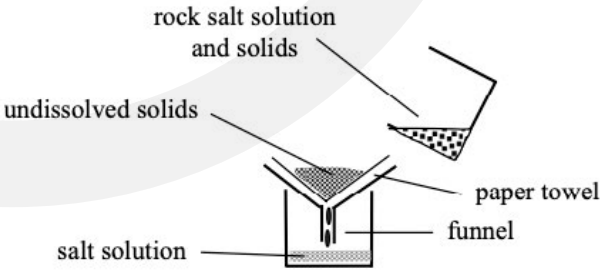
The children compare the rock salt and table salt in solution, stirring or shaking a bottle of solution to accelerate the rate of dissolving. They should notice that both salts dissolve, but that rock salt contains solids that do not dissolve, which can be seen at the bottom of the salt solution.

Finally, the children are challenged to "Clean the rock salt so that it is pure enough to sprinkle on chips."

This challenge is presented on Activity sheet S10 with the processes (not in the correct order) they need to use. Some processes have been dealt with in previous activities but children may need advice on crushing and filtering. The crushing process accelerates the rate of dissolving. To crush the salt place it in a freezer bag, fasten with a 'twister', and roll with a rolling pin.

N.B. *If the children have access to scales sensitive to a few grams, more able children can be asked to find out how many grams of table salt can be obtained from 50 grams of rock salt.*

From earlier observations the children should appreciate that dissolving rock salt results in other solids being separated from the salt. This solution can be filtered using filter paper or paper towel cones, leaving solids on the filter and a cleaner solution in a fresh container.



The salt can be retrieved by evaporating the water. This process can be repeated to obtain purer salt.

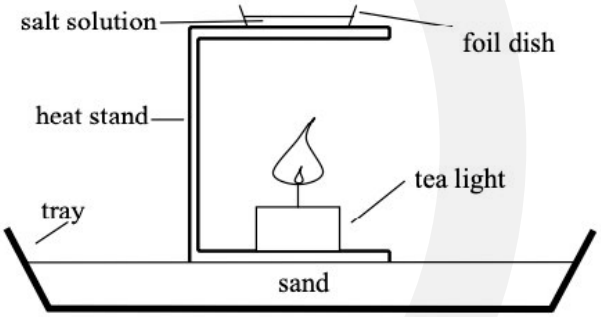
RECORDING THE ACTIVITY

Children produce a step-by-step account in words and pictures of the process they used to obtain 'table salt'. The written account should be limited to 50-100 words, to encourage children to write concisely. The final sample of salt can be displayed alongside commercial table salt, original rock salt, filter residues (which are finer with each filtration), children's work and their equipment.

HANDY HINTS

Use the quickest evaporation method possible, within the constraints of safety and adult supervision levels. Filtration of a tea-cup of salt solution takes about 15 minutes and evaporation over a cooker hob takes 10-20 minutes. Ledges over hot radiators or high wattage bulbs in a desk lamp provide reasonable alternatives, though they will require more time.

Another method that can be employed as shown in the diagram below. Evaporate 1 teaspoon of salt solution in a foil dish using a heat stand and a tea light candle. This method takes 10-15 minutes for 10-15ml.

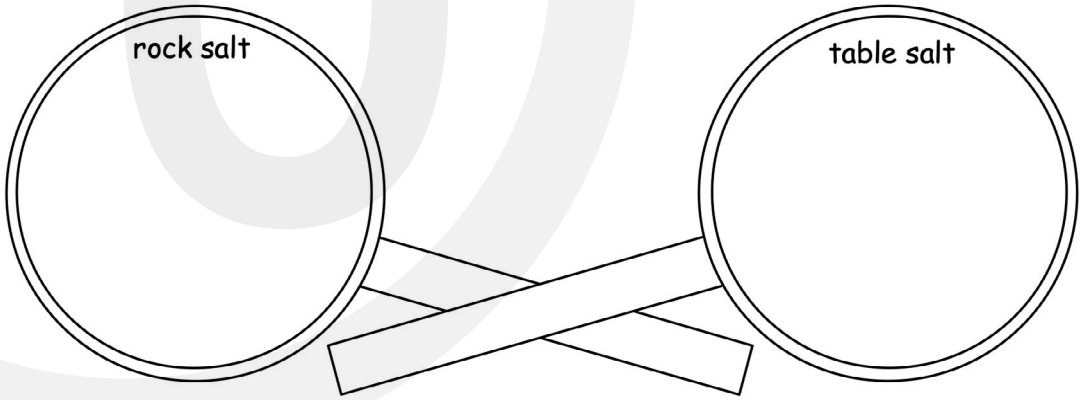


EXTENSION ACTIVITY

The children can be introduced to other applications of this 'extraction' process, i.e. the manufacture of instant coffee and tea by dissolving of the tea or coffee followed by evaporation of the water. They could try out the process for themselves.

Activity Sheet S10: Salt for my chips!

Use a hand lens to look at rock salt and table salt. Draw them carefully.



What is **the same** about them?

What is **different** about them?

Half-fill two bottles with water. Add some rock salt to one bottle and some table salt to the other. What is **the same** and **different** now?

Same: _____

Different: _____

Challenge! Clean the rock salt so it is pure enough to sprinkle on chips. Clues:

evaporate

crush

stir

dissolve

filter

5. Salt and plants

Cartoon character, Chris, notices that snowdrops growing on the roadside have turned yellow, and asks what has happened to them. This prompts the children to plan a test to investigate the hypothesis that salty water has splashed onto the soil and affected plant growth.

OBJECTIVES

- Explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant.
- Recognise that environments can change and that this can sometimes pose dangers to living things.
- Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

RESOURCES

Copies of Activity sheet S11, salt, yogurt pots, a combination of commercial compost, cotton-wool, snowdrop bulbs or cress seeds or bunches of flowers such as daisies, snowdrops or daffodils.

The combination will depend on the children's investigations. The teacher may limit children's choices or inform children that using snowdrop bulbs will take several weeks to show results, whereas cress seeds will show results in a few days. Snowdrop bulbs can be used September-January and flowering snowdrops can be used January-March.

The activity is introduced with Activity sheet S11, which shows a car splashing roadside plants and Chris looking at these plants. Chris notices that the snowdrops that were tall and green last week have turned yellow. What has happened to them?

The children formulate a hypothesis about what has happened to the plant shoots, based on the pictures and the knowledge they already have. The information they have is that Chris's street has been icy and salt has been sprinkled on the road and salt dissolves in water. They need to think about where the salty water goes, i.e. down the drain or splashed onto pavements and grass on the roadside. The salty water soaks into the soil where plants are growing.

Safety note

Garden soil must not be used in this activity, as harmful microbes can grow in the soil. Sterilised commercial compost provides a suitable alternative.

A good hypothesis would be; "The snowdrops have turned yellow because salty water from the road has splashed onto the soil in which the snowdrops are growing." There will be many variations on this hypothesis. If children have difficulty formulating a hypothesis, the teacher can ask children to list the information they have about salt and Chris's street.

The children plan a test to prove their hypothesis, deciding on the equipment they need, how to make the test fair, what to measure and how to record the results.

Children could consider the following points:

- Whether to use plants, seeds, bulbs, flowers, etc. (time scale of experiment and growth rate of different seeds/bulbs).
- What concentration of salty water to use and whether to test several pots of seeds/bulbs with increasing concentrations of salty water (1-2 teaspoons of salt dissolved in 500 ml water gives good results).
- Whether to plant one or more seeds/bulbs per pot.
- If using ready-grown flowers, whether to water and/or spray them with salty water.
- Whether to test different varieties of plants/seeds/bulbs to find out if other plants are sensitive to salty water.
- If several bulbs are potted, which bulb's growth rate will be measured (measure all and take an average or measure maximum and minimum growth).
- Should sketches or descriptions of seedlings be kept in diary form as well as, or instead of, measurements being made?
- Should digital photographs be taken and transferred to a power- point presentation as time lapse photography?

Fair test conditions could include keeping the following the same:

- Quantity of compost used per pot
- Type of pot
- Number of bulbs/seeds per pot
- Position of pots in the classroom
- Quantity of water added
- Frequency of watering
- Frequency of measuring and recording.

The higher the concentration of salt, the poorer the growth of the plants is likely to be. If using seeds or bulbs they may not germinate at all!

RECORDING THE ACTIVITY

The children write a letter to Chris's local council, complaining about the effect rock salt is having on the roadside plants. The complaint should be supported with reasoned arguments and data from their tests.

Alternatively, the children design posters to protest against the use of salt on the roads. In the interests of road safety, they may suggest an alternative method for de-icing the roads, such as heating them, though they should appreciate that the expense of this would prevent such a decision. They could be given information on other 'chemical' de-icers which cause less harm to plants. The posters could show, and provide concise information about, plants or flowers 'before and after' de-icing.

HANDY HINTS

Using cress or mustard seeds gives the quickest results. These are grown in tubs, (i.e. margarine,) on moist tissue paper, the tissue paper of one tub being moisten with salty water. After 24 hours one tub of seeds will have germinated (with shoots about 1 mm) whilst the other pot will not germinate at all. After a week, the pot moistened with non- salty water will have a crop of mustard or cress ready to be harvested!

TEACHER INFORMATION

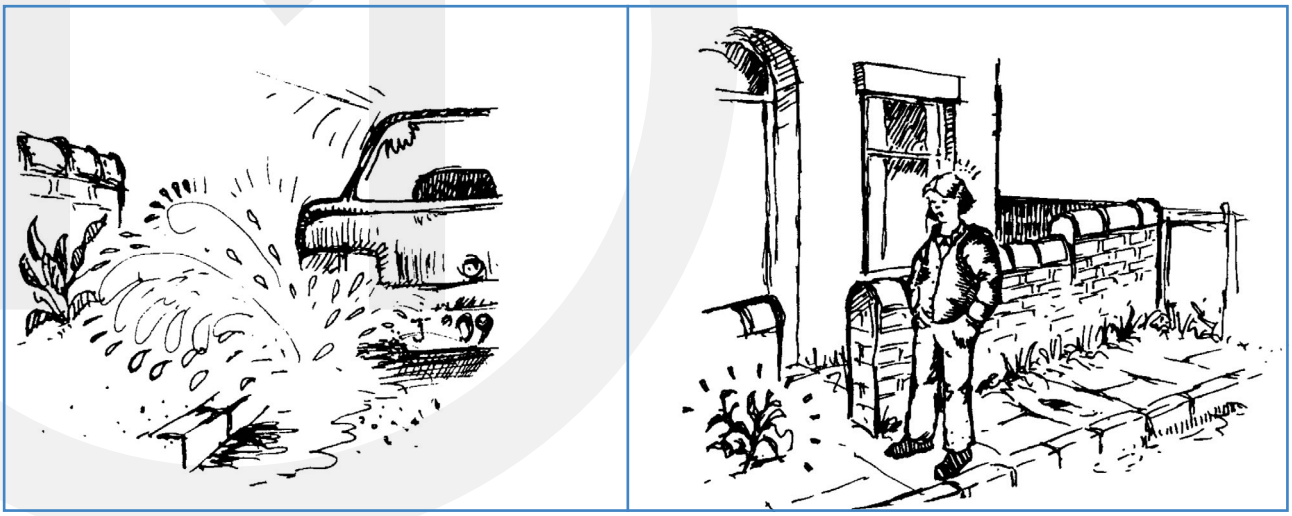
Up to 90% of salt used for de-icing ends up on the roadside verge. Some of the salt is scattered there by poor spreading methods but most of it is moved to the side by the spray from traffic, by wind, snow ploughs or by dissolved salt draining off the road surface. Plants growing by the roadside are vulnerable to damage from salt that soaks into the soil and from spray. A very low concentration of salt occurs naturally in soil, but most plants are sensitive to increases in this concentration. It badly affects their growth and can prevent germination.

Leaves of affected trees become brown and the tree's growth rate is reduced in spring. Damaged leaves may contain up to two and a half times as much salt by weight as salted crisps! Some trees are resistant to salt, such as cherry trees and oak trees. There are plants that prefer to grow in salt water, i.e. sea-weed or plants that grow in salt marshes.

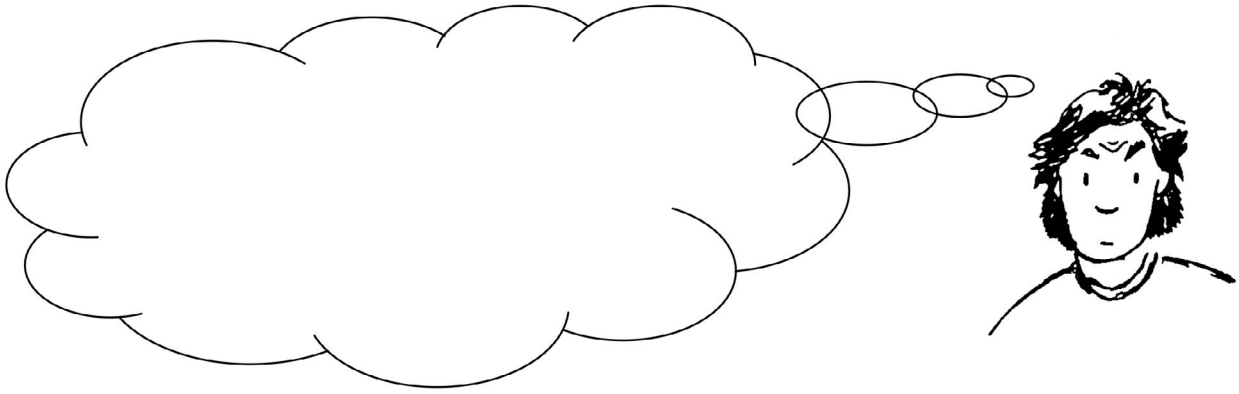
EXTENSION ACTIVITIES

Children can use books to research plant growth in oceans (including the Dead Sea and the Baltic Sea) and salt marshes, to learn that not all plants have the same sensitivity to salt (see geography, page 117).

Activity Sheet S11: Roadside plants



Fill in Chris' think bubble with a question or hypothesis about the flower shoots. Think about what you already know.



How can you test your hypothesis at school?

Tick the boxes when you have written or drawn about each part of your test.

- What you need. ☐
- What you will change. ☐
- Recording results. ☐
- What you will keep the same. ☐
- What you will measure, and how often. ☐
- What the test will look like. ☐

6. The problem with salt...

Cartoon character, Chris, discovers that, although salt is good for preventing cars from slipping, cars will corrode more quickly when driven on salted roads. Children follow instructions to test this hypothesis, using nails to represent car body work, into the corrosion of iron by salt. They moisten nails daily with salt water and record their observations.

OBJECTIVES

- Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible (rusting).
- Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

RESOURCES

Copies of Activity sheet S12, salt, new iron or steel nails, magnet, coffee lids or Petri dishes, paper towels or filter paper, pipette or medicine dropper.

Activity sheet S12 begins with a cartoon in which Chris discovers that, although salt is good for preventing cars from slipping, cars will corrode more quickly when driven on salted roads.

The children are asked to make a connection between the car and the salt, i.e. that salty water is splashed onto the car whilst it is moving.

The children follow instructions on Activity sheet S12 to carry out a test using nails to represent the car bodywork, as they are made from the same metal. These instructions can be recorded on a tape- recorder and played back by children with reading difficulties or visual impairment.

Ensure that the coffee lids and jugs of salty and tap water are clearly labelled, so that they do not get mixed up.

The rate of corrosion of nails in salty or tap water is compared. The children moisten the nails and record their observations daily. They record the corrosion process using sketches, descriptive language, digital photographs or by scoring the condition of the nails from 1 to 10.

Dissolving 3 teaspoons of salt in about 500 ml water and dripping it onto a nail will cause a few rust spots on the nail within 24 hours. After a week, the same nail will have many rust spots, whilst the nail dripped with non-salty water will show little or no corrosion.

RECORDING THE ACTIVITY

In role playing as Chris, the children design a leaflet to be distributed to Chris's neighbours. The leaflet advises them to hose beneath their cars in icy weather and explains to the neighbours why they should do this.

N.B. *Children may want to consider the implications of hosing more water on to the road in freezing weather. They could suggest the use of a commercial de-icer that does not accelerate corrosion. The commercial de-icer 'CMA' actually slows down corrosion, but it is much more expensive.*

TEACHER INFORMATION

Corrosion of steel or iron occurs in the presence of air and water. The metal reacts with the oxygen in the air to form a metal oxide. Rusting is the term given to the corrosion of metals containing iron, such as steel. The rate of corrosion is increased when salt is present. Corrosion can not be stopped but it can be controlled. New cars are put through a series of anti-corrosion treatments when they are manufactured, including being painted.

Coatings which are used to prevent the corrosion of iron or steel include zinc, chromium plate and silver plate.

EXTENSION ACTIVITIES

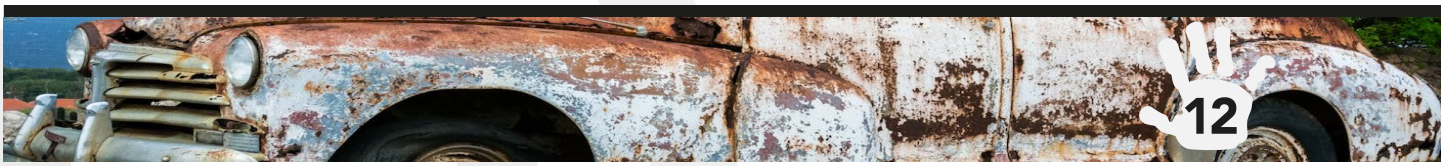
The investigation is extended to include dry nails with and without salt, to find out if water needs to be present to cause corrosion.

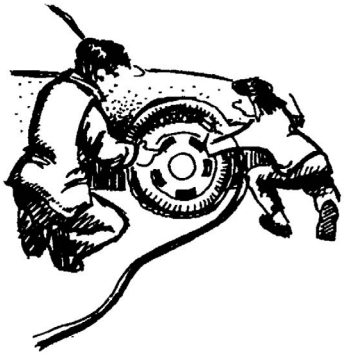
The children use a variety of coatings to try and protect the nails from corrosion. Coatings could include paint, cling film, grease, glue, wax crayon, etc.

Children find out if other materials corrode, such as plastics. Are all council salt containers made from plastic? Is this because the plastic does not corrode? Children write to the maintenance department of their local council to find out the answers to these questions. They could consider the use of other materials, e.g. glass and cardboard, which do not corrode.

Children consider the use of other substances as de-icers (see extension activity on page 12) and the environmental impact they might have.

Activity Sheet S12: The problem with salt . . .

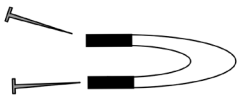




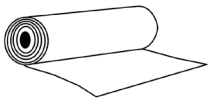
What do you think putting salt on the road has to do with the car rusting?

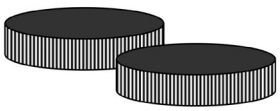
You can find out about rusting using nails instead of a car! Why nails?

You will need:

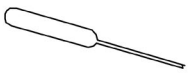

2 iron and steel nails


Scissors


Paper towel


2 coffee lids

salt


1 dropper

What to do

1. Put a circle of paper towel in each coffee lid.
2. Label the lids, TAP WATER and SALT WATER.
3. Dip one nail in tap water and one nail in salty water and put each one in its labelled lid.
4. Wet the nails daily by adding a few drops of either tap or salt water.
   IMPORTANT! Always add the same water to the same nail!
5. Keep a record of the daily changes.

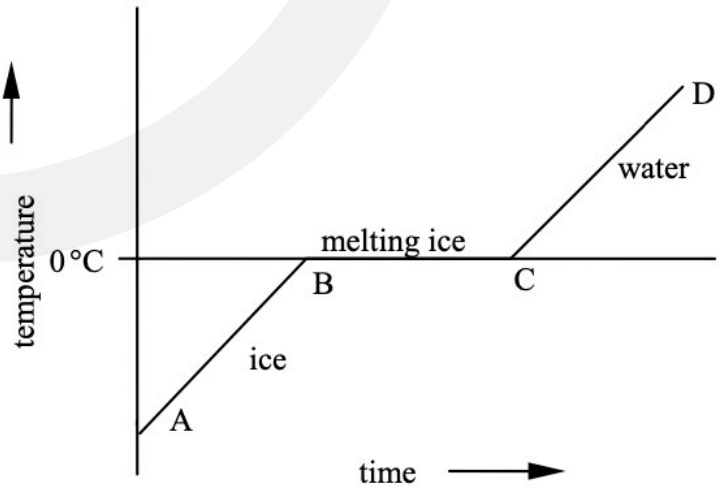
Appendix 1: The melting of ice

At low temperatures, water molecules (particles) have so little energy that they cannot move in relation to each other. They are therefore held in a crystalline structure called ice, and the crystalline structure explains the beautiful shapes which some ice particles, particularly snow flakes, possess.

In order to become liquid the molecules must obtain enough energy to break the bonds which hold them in a crystalline structure. When ice warms up, the molecules obtain more energy and the ice is converted to water. The temperature of the ice and water which it produces remains 0°C until all the ice is melted. The process can be shown by the equation:

ice + energy (heat) = water (at 0°C)

The melting process is represented by the line B to C in the graph below.



This process is reversed when energy is removed from water by placing it in an environment which is below 0°C (refrigerator freezer compartment) in which case the equation is:

water - energy (heat) = ice (at 0°C)

Normally ice is converted to water by adding energy in the form of heat, but ice can be converted into water by other processes such as compression or by the addition of chemicals such as salt.

ADDING SALT TO ICE

The addition of salt to water converts it to brine. Since the melting (freezing) point of brine is less that 0°C, frozen water is converted to liquid brine. In other words, the ice is converted to water without the addition of heat.

Energy is lost, and so the temperature falls. This can be measured by placing a thermometer in the ice, to which salt is added. This effect can be observed with other water soluble materials.

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