A Pinch of Salt
A Cross Curricular Teaching Pack for 9-11 year olds
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Curriculum coverage in <em>A Pinch of Salt</em></td>
<td>2</td>
</tr>
<tr>
<td>Salt and Industry</td>
<td>3</td>
</tr>
<tr>
<td>Useful addresses</td>
<td>5</td>
</tr>
<tr>
<td>Teachers' notes</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>6</td>
</tr>
<tr>
<td>Technology</td>
<td>37</td>
</tr>
<tr>
<td>Information and Communication Technology</td>
<td>41</td>
</tr>
<tr>
<td>Mathematics</td>
<td>49</td>
</tr>
<tr>
<td>English</td>
<td>66</td>
</tr>
<tr>
<td>History</td>
<td>84</td>
</tr>
<tr>
<td>Geography</td>
<td>90</td>
</tr>
<tr>
<td>Religious Education</td>
<td>93</td>
</tr>
</tbody>
</table>
Acknowledgements

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Artwork (science section): Mike Shaw, York.
Artwork (English section): Martin Cottam, York.

Copyright was kindly released on the story *Salt and Gold* by Blackie Publishing. A modified version is told in this pack.

Joy Parvin
*Primary Projects Manager*
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.
Curriculum coverage in "A Pinch of Salt"

**Science**

- Investigating:
  - the effect of salt on ice, plants and metals
  - the effect of heat on the dissolving of salt in water
  - evaporation of water from salt solution
  - purifying rock salt by dissolving, filtering and evaporating

**English**

- Ideas centre around the story 'Salt and Gold', a fairy tale from Eastern Europe. Ideas include looking at familiar elements in fairy tales, letter-writing, keeping a diary, writing news reports and carrying out research.

**Technology**

- Children are presented with a 'blocked' salt cellar, and asked to think about why it gets blocked and how they can solve the problem. Children evaluate manufactured salt cellars or design and make their own.

**Geography**

- Activity suggestions include:
  - researching salt production around the world
  - locating salt producers around Britain
  - finding names of places in Britain containing references to ancient salt routes.

**Mathematics**

- Three themes covered are:
  - estimation and measurement
  - data handling
  - properties of three dimensional shapes, particularly cubes and cuboids.

**History**

- Factual information explaining how salt has been obtained and used, from pre-historic to modern times.

**Religious Education**

- Information on the symbolism of salt in different religions is given. Salt has several symbolic meanings are Judaism, Christianity and Shintoism, and is referenced in Islam and other religions.

**Information Technology**

- Suggestions on how to link the use of a range of computer software and audio-visual aids with activities in other curricular areas in this pack.
Salt and industry

Why is the chemical formula of salt NaCl?
Salt contains two elements, sodium and chlorine; hence its chemical name is sodium chloride. The chemical symbol for sodium is Na, and that for chlorine is Cl. As chemistry is an international science and uses many foreign words, the symbol for sodium is Na and not So. This is because Na is an abbreviation of the Latin name for sodium which is natrium.

Salt and the chemical industry
Salt has been used to improve flavour or preserve food for thousands of years (see the history section). More recently it has been used to de-ice roads in countries where winter temperatures fall below zero degrees Celsius (see the science section). Most people are familiar with these applications, which together account for approximately 30% of the total world salt production.

However, the majority of the world's salt is used by the chemical industry to produce other useful materials, without which we could not enjoy the comforts of modern life.

The chemical industry is relatively young and many chemical companies had their beginnings near to a salt source. Imperial Chemical Industries (ICI) grew from salt processing activities which were close to Northwich in Cheshire.

Industry obtains the salt it requires primarily by two processes. A small quantity of salt used in Britain is mined underground by cutting, drilling and blasting, but most salt used in the chemical industry is extracted by pumping water down into the rock. The salt dissolves and is brought to the surface as a solution called brine. This process is called solution mining.

Salt is also obtained by evaporating sea water. This salt is not used industrially as much smaller quantities are produced. Sea salt is used for culinary purposes, (see page 5, for details of the Maldon Crystal Salt Company).

In industry, sodium chloride is converted into other materials which have many uses, some of which are well known, others less so.

If the new material is based on the sodium element, this is often indicated in its name. Some examples are:

- Caustic soda, used to make soap
- Washing soda, used to soften water
- Baking soda, used to raise bread
- Bicarbonate of soda, used as medicine and in baking
- Sodium silicate, used to make glass.
Materials based on chlorine have quite different uses to those based on sodium. Chlorine is a powerful bleaching agent which kills bacteria. It is used as a sterilising agent to:

- Purify drinking water
- Sterilise swimming pools (the presence or chlorine can often be detected by its reaction on the eyes - causing them to sting)
- Sterilise baby feeding bottles
- Kill germs in kitchens, bathrooms and toilets.

Many diseases are controlled by the germicidal or bactericidal properties of chlorine based materials. Before their discovery and application, millions of people died each year due to epidemics of diseases caused by contaminated drinking water.

More recently, chlorine has been used to manufacture plastics such as PVC (an abbreviation for polyvinyl chloride) which is used to make many different objects such as:

- Plastic bottles
- Drain pipes
- Window frames
- Clothing
- Car interiors
- Furniture.

From the above it can be seen that salt or sodium chloride (NaCl) is one of the chemical industry's basic building blocks. The following are a few examples of materials which are built from it:

- adhesives
- car tyres
- cling film
- decaffeinated coffee
- dry cleaning fluids
- fabric softener
- fire extinguishers
- floor tiles
- gramophone records
- hair conditioners
- laundry detergent
- leather tanning
- moth-balls
- paint
- paint stripper
- pesticides
- pharmaceuticals (medicine)
- raincoats
- rust remover
- stain removers
- shoes
- skin creams
- tents
- wallpaper.
Useful addresses

The Maldon Crystal Salt Company produces educational pamphlets detailing salt production from early times through to modern day production at their Essex site. For further information write to:

Maldon Crystal Salt Company Limited
Wycke Hill Business Park
Maldon
Essex
CM9 7HR
Tel: 01621 853315 Fax: 01621 853191
Website: http://www.maldonsalt.co.uk
e-mail: info@maldonsalt.co.uk

Britain’s only museum documenting the history of salt is based at another of the oldest sites of salt production in Britain. As well as welcoming parties of school children, they produce a range of educational leaflets, resource packs, posters and postcards. One pack of particular interest, Investigating Salt, is a document pack containing secondary evidence of salt mining in Cheshire in the nineteenth and early twentieth century. The evidence includes copies of newspaper extracts, records of mining accidents, maps, photographs of the early salt miners, etc. Other relevant leaflets include The Effects of Salt on Local Plants and Other Wildlife in Cheshire, The Salt Tax, Roman Salt Making, Open Pan Salt Making, and Salt and Subsidence, Salt in the Home and many more. For further information write to:

The Curator
The Salt Museum
162 London Road
Northwich
Cheshire
CW9 8AB
Tel: 01606 41331

Website: http://www.saltmuseum.org.uk
e-mail: cheshiremuseums@cheshire.gov.uk
Science

in

A Pinch of Salt
Science

All the main science activities focus on the use of salt as a de-icer for roads. 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.

There are many extension activities suggested, which provide challenges for more able children, as well as extending the science to link strongly with other curriculum subjects, such as history or geography.

Table salt is used for Activities 1-5 and rock salt is used for Activity 6. The chemical name for table salt is sodium chloride and, when not mixed with anything else, is 'pure'.

Rock salt is used on icy roads to form salt solution (brine), which remains a liquid at sub-zero temperatures. An explanation for teachers of how this works is given in Appendix 1 on page 24. Rock salt is mixed with grit and rock, and may be familiar to children as 'salt' when initially introduced to them.

Many of the activities involve the children in planning their own investigations. The teacher must decide how much additional support is given to the children, depending on their understanding and confidence with investigative work. Appendix 2 provides a glossary of terms used in the pack to describe scientific investigations. Activity sheets for individual activities guide them through the process and Activity sheets S1 and S2 are provided to remind children of possible options they may choose to try, and methods they can use to record their work. These Activity sheets can be enlarged and displayed in the science area of the classroom.

Sheets are provided for all the activities, labelled Activity sheet S1 to S12, which can be photocopied.

A summary of the activities and their relationship with curriculum documents can be found on page 8.

The resources required for each activity are listed together on page 9 and again with the notes on individual activities.

In the primary school the terms weight and mass are often used synonymously. Scientifically speaking this is incorrect. The weight of an object is its mass multiplied by the gravitational force acting on it. Weight is measured in newtons and mass in kilograms. In these notes the term 'weight' has been used, as it is not an aim of the activities to teach this concept. The teacher may choose to use the term 'mass' if children have some prior knowledge of the difference.
## Links with Curriculum Documents

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Investigation Skills</th>
<th>National Curriculum Science Programme of Study Key Stage 2 (England and Wales)</th>
<th>Environmental Studies 5-14 Science (Scotland)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 p. 11</td>
<td>Investigating the effect of salt on ice.</td>
<td>Raise and answer questions, decide when, what and how to measure, develop a 'fair test', and communicate data appropriately.</td>
<td><strong>Sc 3</strong> To describe changes that occur when materials are mixed.</td>
<td>Understand earth &amp; space Study the relationship between a material's property and its use.</td>
</tr>
<tr>
<td>2 p. 13</td>
<td>Comparing the dissolving of salt in water with the melting of wax. Investigating the effect of heat on the dissolving of salt.</td>
<td>Predict, use observation to draw conclusions, decide whether conclusions agree with predictions made.</td>
<td><strong>Sc 3</strong> About reversible changes including dissolving, melting and freezing. <strong>Sc 3</strong> Describe changes that occur when familiar substances are heated and cooled.</td>
<td>Understand earth &amp; space Introduce melting. <strong>Understanding energy and forces</strong> Use thermometers to measure 'hotness'.</td>
</tr>
<tr>
<td>3 p. 16</td>
<td>Evaporating water from salt solution and investigating whether there is a relationship between surface area and evaporation rates.</td>
<td>Predict, decide when, what and how to measure, record data systematically, use and develop scientific knowledge.</td>
<td><strong>Sc 3</strong> Describe how surface area can affect the rate of evaporation.</td>
<td>Understand earth &amp; space Introduce evaporation.</td>
</tr>
<tr>
<td>4 p. 18</td>
<td>Obtain 'purer' salt from rock salt, using dissolving, filtering and evaporating techniques.</td>
<td>Compare and observe, predict, select &amp; use equipment, control risks, communicate data appropriately, review work.</td>
<td><strong>Sc 3</strong> Explore ways of recovering solids by evaporating the liquid from the solution.</td>
<td>Understand earth &amp; space Study methods to extract useful materials found in the Earth's crust as mixtures, e.g. rock salt.</td>
</tr>
<tr>
<td>5 p. 20</td>
<td>Investigating the effects of salt on the growth of seed or plants.</td>
<td>Think creatively, establish links between cause and effect, hypothesize, develop skills of using equipment &amp; measurement, develop a fair test, and interpret results.</td>
<td><strong>Sc 2</strong> Investigate the factors involved in plant growth.</td>
<td>Understanding things and the processes of life Study factors which affect germination and growth.</td>
</tr>
<tr>
<td>6 p. 22</td>
<td>Observing the corrosion of iron sprayed with tap water and salty water.</td>
<td>Think creatively, establish links between cause and effect, hypothesize, observe, record data systematically, interpret results.</td>
<td><strong>Sc 3</strong> Explore how non reversible changes (e.g. rusting) result in the formation of new materials.</td>
<td>Understand earth &amp; space Study how materials can be changed.</td>
</tr>
</tbody>
</table>
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 S3-4

**Activity 2**

- table salt
- candle
- grater
- 4 freezer bags and twisters
- bowl (preferably transparent)
- flask of hot water or kettle*
- 2 teaspoons
- stop clock or egg-timers
- 2 alcohol-filled thermometers (-10 to 100°C range)
- copies of Activity sheets S5-7

**Activity 3**

- table salt
- desk lamp*
- radiator
- cooker hob*
- hair-dryer*
- saucer
- egg-cup
- plastic plate
- yogurt pot
- copies of Activity sheet 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*
  - (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* or cotton-wool
- snowdrop bulbs or cress or mustard seeds or bunches of flowers (daisies, snowdrops, etc.)
- daffodils
- copies of Activity sheet S11

**Activity 6**

- table salt
- 2 steel or iron nails
- magnet
- sandpaper
- 2 coffee-lids or petri-dishes
- 2 paper towels or filter papers
- medicine dropper or pipette
- copies of Activity sheet S12

*See the safety note on the relevant page of the teachers' notes.
Activity 1  A Pinch of Salt

Aim
To understand that adding salt to ice causes the ice to melt faster.

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 2  
### In the melting pot

**Aims**
To understand the difference between the processes of melting and dissolving. To investigate the effect of heat on dissolving.

**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.

**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.

**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.

**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 3  Salt from salty water

Aims  To show that salt can be separated from a solution by evaporating the water, leaving salt crystals. To look at the relationship between evaporation time and surface area.

Resources  Copies of Activity sheet 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.

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.
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.

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.

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 4  Salt for my chips!

Aim

To understand that rock salt, used for de-icing roads, contains impurities which can be filtered out of a solution of rock salt.

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.

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 5  Salt and plants**

**Aim**

To understand that growth of seeds and/or flowers is adversely affected by salt in the water.

**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.

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 powerpoint 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 6  The problem with salt . . .

Aim  
To learn about the corrosion of iron and how salt affects the rate of corrosion.

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.
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:

\[
\text{ice} + \text{energy (heat)} = \text{water (at } 0°C)\]

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:

\[
\text{water} - \text{energy (heat)} = \text{ice (at } 0°C)\]

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 than 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.
Appendix 2  
Science Investigations - A glossary of terms

This list defines some terms used in the science section of this pack, but is by no means exhaustive.

**Planning**

The children *think* about their ideas for 'finding something out'. They use 'talk partners' and group discussion to enable them to share their ideas, asking questions and incorporating knowledge they already have. The teacher can support this process by asking the children specific questions, such as:

- What are you trying to find out?
- What will you change?
- What will you measure, and how?
- How will you make the test fair?
- How will you record your results?

Their plans can be written, pictorial, recorded on tape, and discussed with the teacher. Often children need to alter their plans during an investigation, as this interaction with materials and equipment provides them with more practical ideas. They should be encouraged to make these changes, whilst considering how the changes will affect other aspects of their investigation, i.e. will the test still be fair?

**Prediction**

A suggestion about what the outcome of an investigation might be. It need not be specific, and could simply suggest a trend in data.

**Question/Hypothesis**

A tentative explanation of an observed event. To be scientific, a hypothesis must be testable via prediction and investigation.

**Fair test**

A test in which all the variables are kept the same, other than the one(s) being investigated. This is to ensure that any observations or measurements made can be attributed to the variable(s) being changed.

**Observation**

This is the *process* by which perceptions of objects or events are selected, interpreted, and their significance judged against experience and understanding. Observations can use all the senses, and not just sight.

**Factors/Variables**

A factor/variable is a quantity that can take different values. It can be categoric, discrete or continuous. *Categoric* variables could be the colour of a flower or the shape of an object; *discrete* variables can only be whole numbers, e.g. number of layers of insulation round a cup or seeds germinated; *continuous* variables can have any value, e.g. weight, volume, temperature or time.

*Key* factors/variables define the investigation and are either independent or dependent. The *independent* factor/variable is the one the investigator chooses to change systematically. It is the effect of changing this factor/variable which the investigation is designed to explore, e.g. the presence of salt and its effect on plant growth or the effect of heat on the quantity of salt which dissolves in water i.e. what I will change. The *dependent* variable is the effect, or that which changes, and is observed or measured. In the examples above, it would be the size of the plant or the amount of dissolved salt in water i.e. what I will measure. The *control* variables are those which are kept the same, to ensure the validity of the results, to ensure a fair test and the validity of the results. i.e. what I will keep the same.
What you can measure or change . . .

- Time
- Temperature
- Volume
- Area
- Mass
- Length
- Depth
- Force
- Speed

Area = 28 squares
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 these things.
- 4 ice-cubes
- 1 funnel
- 1 jug
- 1 teaspoon
We decided to measure the amount of water that has melted every 30 mins.

Group poster

HOSE THAT CAR

Bar chart

Table

<table>
<thead>
<tr>
<th>Time in minutes</th>
<th>Temperature of water collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>1.5</td>
</tr>
<tr>
<td>60</td>
<td>4.5</td>
</tr>
<tr>
<td>90</td>
<td>7.5</td>
</tr>
<tr>
<td>120</td>
<td>10.5</td>
</tr>
<tr>
<td>180</td>
<td>13.5</td>
</tr>
</tbody>
</table>

Line graph

Computer

Drawings or pictures

funnel

water

Pie chart

36% 4% 12% 20% 28%

Photographs

Cassette

Video

Microscope
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 road.

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 . . .
**Icy roads**

Mum says they put salt on icy roads in winter. What good will that do?

Plan a test to find an answer to Chris’s question.

<table>
<thead>
<tr>
<th>List what you will need:</th>
<th>How will you make the test fair?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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!
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?

liquid? solid?
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 |
---|
Were you right? _______
Explain what happened.

Wax |
---|
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:
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
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 dissolve.

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? ____________________________

__________________________________________

__________________________________________
What do they have in common?
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 fair.
Salt for my chips!

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

rock salt

table salt

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
Fill in Chris's 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 keep the same.**
- **What you will change.**
- **What you will measure, and how often.**
- **Recording results.**
- **What the test will look like.**
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.
Technology
in
A Pinch of Salt
Technology

Why won't the salt come out?

Setting the scene

It is important that technology activities are set in a context which is familiar, or readily understood, by all children. In this way, the problem they are solving has a purpose which is not contrived.

The context here is a familiar one to many people, the problem of a blocked salt cellar. The teacher can introduce the problem using a salt cellar from the school kitchen that is blocked (if one cannot be found, the teacher can moisten the salt a little). The teacher holds the salt cellar upside-down, shakes it and poses the questions:

"Does this ever happen to you?"

"Why won't the salt come out?"

Children are often creative in their thinking and they may suggest many alternative reasons to dampness, e.g. 'the hole is too small' or 'there aren't enough holes' or the 'salt grains are too big'. Write all the children's ideas for why the salt cellar is blocked on a large piece of paper or on the board. These ideas can then be used as the basis for small group discussion to identify which idea the children want to investigate further.

N.B. Teachers might like to consider health issues linked with eating salt. Salt is an essential part of our diet, as it helps to control fluid balance in our bodies, muscles and nerves work correctly, and normal blood pressure to be maintained. It is thought, however, that too much salt in our diet may be a contributing factor to high blood pressure. Therefore it is important to control salt intake. We need about a teaspoon of salt per day, but this amount increases in hot weather, after sport or heavy physical work, because when we sweat we lose salt as well as water.

Researching the problem

Once each group of children has identified the idea they want to investigate, the teacher asks them to find out more information about the problem, by carrying out a survey or interviews. The survey could be of the number of blocked salt cellars in the dining hall that day, or of children in one or more classes who have had the problem of a blocked salt cellar at home or school. The interviews could be with kitchen staff and/or dinner supervisors.

The children organise and interpret the data they have collected. They can organise the data by putting the information onto a computer database, or by drawing their own bar charts, etc. They then interpret the data in relation to the original idea they wanted to research, i.e. was it common for people to choose a blocked salt cellar? How did they deal with the problem?

Children should be encouraged to devise survey Activity sheets and questionnaires. Groups discuss the suitability of a question and whether the answers will provide useful information to add to their own responses to the problem.
Solving the problem

The direction the children take next will depend on the analysis of their information and whether they then want to investigate numbers of holes, hole size, types of salt, or the dampness, etc.

They may want to a) **design and model an alternative** salt cellar (they could use film canisters or card cylinders, etc.) or they may want to b) **test and evaluate** a variety of manufactured salt cellars or a range of storage facilities for school salt cellars. The criteria they use could include hole size, number of holes, size of container, type of cap or opening for filling, material of manufacture, etc.

The children may have been told during their survey of kitchen staff of ways to keep the salt dry that the children want to investigate, such as putting the salt cellar in the fridge, or adding a few grains of rice.

N.B. **If children follow their initial surveys by designing and making a salt cellar and go on to evaluate their model, they will carry out the entire technology process. If, however, they test and evaluate manufactured salt cellars instead of making their own model, they will carry out part of the technology process. Thus product evaluation (b) is a valid technology-based activity, but cannot be deemed to take children through the entire process.**

The teacher may choose to direct children towards (a) or (b), depending on the style of technology project that is desirable.

Handy hints

1. As the diameters of the holes are too small for most children to measure, rubbings can be made instead. Children can make several rubbings on one sheet of A4 paper, writing the salt cellar type beside each one.

2. Film canisters can be used to model the salt cellars and holes pierced in the lid. (The canister lid is placed on a piece of wood and a nail or panel pin pushed on to the lid and tapped gently with a hammer). Alternatively cardboard or paper lids can be made, though it is harder to create a good seal that the salt will not leak through. Holes of different sizes can be created using panel pins and nails of varying diameters. The rough indentations around each hole can be smoothed using sand paper.

3. If the children want to model the pouring action, a funnel can be used, with a card or paper 'lid' attached to the bottom with holes pierced through. Different sizes of funnels can be made from card.

Evaluating a model salt cellar

Groups of children could provide their salt cellars for use in the school dining hall. They may choose to store the salt cellars somewhere in the school kitchen overnight before use. They may choose to ask children of different ages to try the salt cellar and record the efficiency of the salt cellar and/or children's comments on their model.

Finally, each group presents their models and evaluations to the rest of the class. A comparison can be made between the model salt cellars made by the groups in the class.
Other technology activities

Children investigate the problem of salt cellar lids dropping off when held upside-down and all the salt pouring onto the food. This can happen as a result of children deliberately unscrewing the lids. Teachers can introduce a variety of child-proof caps on medicine and detergent bottles to test and evaluate. The children may consider the use of such a lid on a salt cellar, bearing in mind factors such as cost. N.B. This activity will only be possible if the school uses salt cellars with screw-top lids.

Children design and make a 1, 2, 3 or 5-minute timer using salt. The desired length of time will depend on the purpose of the timer. The teacher must set the activity in a context in which a specific timer is required. For example, children may take a long time to settle in their chairs or on the carpet when they come in from the playground. The children could decide how long they think would be reasonable to allow them to settle down, and design and make a timer for this purpose.

Food technology

The following activity is a highly enjoyable one for children to carry out. It demonstrates an application of salt and is intended purely as an observation of this application, and it is not intended to develop children's understanding of the effect of salt on ice.

Children attempt to make ice-cream, cooling down cream and sugar using ice or an ice and salt mixture. Yellow food colouring and vanilla flavouring can be added to the mixture to produce 'frozen cream' that is closer to ice-cream. To carry out this activity children need the following things:

- 2 catering-size coffee tins (or similar).
- Crushed ice-cubes (enough to fill the two tins) mixed with a little water.
- 2 food tins (opened with a safety tin-opener that leaves a smooth edge).
- Salt (about 4-5 tablespoons).
- Teaspoons (to stir the mixtures).

Ingredients

- Cream (to half-fill the food tins, about 150 ml).
- 2 tablespoons sugar.
- 2-3 drops of food colouring (optional).
- 2-3 drops of vanilla essence (optional).

All ingredients are mixed and half of the mixture is poured into each food can. Immediately before adding the food tins to the tins of ice, the salt is sprinkled on to the ice and water in one tin. To prevent the formation of one lump of ice-cream, the two mixtures are stirred intermittently. The children observe the ice-cream being formed in about 15-20 minutes in the presence of the salt and ice mixture, and not at all in the presence of ice alone.

N.B. Only if a child offers the information, or poses a question, concerning the temperature of the tin containing salt and ice compared with the container of ice, should the temperature of the salt and ice be measured. They will observe that the mixture is at a lower temperature. The explanation for salt lowering the freezing point of ice is extremely complicated and inappropriate to tackle with this age group. It is explained in Appendix 1 of the science notes.
Information and Communication Technology

in

A Pinch of Salt
Information and Communication Technology

Primary teachers are encouraged to teach Information and Communication Technology (ICT) using the context of other subjects to reinforce children's competence with ICT. Therefore, the ideas presented here can be linked to activities that appear elsewhere in the pack.

Using a Word Processor

Children can write reports, letters and so on using a word processor, as an alternative to hand-written text. They can learn about reviewing work, moving sections of text, correcting mistakes, and changing the style of text to suit different audiences. The 'professional' appearance of the finished result often motivates children to learn the functions of word-processing.

Without prompting, children often choose inappropriately large text sizes in order to fill the page. Provide the children with guidelines to enable them to use appropriate fonts and font sizes for headings and normal 'body text'.

Templates

One way of encouraging appropriate layout is to use templates as starting points for children's work, rather than completely new blank files. In some instances, this could include other features (such as pictures, page numbering) that children would otherwise find difficult to use.

A word processor such as MS Word has a template feature, but children will find it easier to open an ordinary document that has been created by the teacher. In this case, the file should be made read-only so the template is not over-written. To do this in Windows®:

1. Locate the word processing file you want to use as a template.
2. Right-click on the file and select properties.
3. Tick the read-only box and click OK.

Children will now be able to open this file and add their own content, but will not be able to over-write it. They will need to save their own work with a new file name.

Supporting Word Processing

Some children have difficulty 'writing' with a keyboard because they cannot easily find the letter they want (especially as most keyboards use upper case) or have spelling difficulties that confound spell-checkers. There are support facilities for children with specific learning difficulties, but other children can benefit from imaginative use of standard programmes:

- Keywords can be included at the top of a template file. Children can refer to these to help their spelling, or even copy and paste them within the document.

- Rather than include the words at the top of the document, a template file could contain an additional toolbar populated with keywords. To achieve this, you would need to record a macro for each word or phrase, and attach these to a new toolbar. See page 60 for instructions on how to do this.
Spreadsheets and Graphs

Many schools have MS Excel available for pupil use. Much of the calculating functionality of a spreadsheet is beyond primary level, but some children will be able to use it for simple arithmetic.

Children will also benefit from using the Chart Wizard to produce graphs as an alternative to hand drawing. Science Activities 1 and 2 generate data that can be plotted as graphs.

When creating graphs using MS Excel, bear in mind the following:

- MS Excel does not like gaps. Labels and data should be entered on the worksheet in adjacent columns and rows. Widen columns if necessary to fit text, but don’t leave blank columns or rows.

- If you use a year as a column heading (for example 1985 as in the 'Salt around the World' Maths activity), MS Excel will assume it is a number and will attempt to plot it. To ensure it is regarded as a label, type a single quote before the year: ’1985.

- MS Excel does not like units. If you enter 5cm, for example, it will be treated as text, and its value will be zero. Enter numbers only, and include units in column labels.

After entering the labels and data, select these before starting the wizard. Make sure you do not select any 'empty' cells.

Graphing Tips

Once a graph is finished, you can return to the four wizard steps again using the first four items in the Chart menu.

- By default, all MS Excel graphs use a 'legend' (key), which is not appropriate if you only have one series of data. Step 3 of the wizard includes a legend section where it can be removed.

- The use of a legend is particularly unhelpful with pie charts. Remove the legend and, in step 3, add data labels so each pie segment has its own label.

- If you intend printing the graph from Excel, it is best to create the graph as a separate sheet (step 4 of the chart wizard).

- As an alternative to printing from Excel, a graph can be placed in a MS Word document (or PowerPoint presentation) containing other written work using copy-and-paste.

Data Logging

Science Activity 2 involves investigating the effect of heat on dissolving salt, and so requires the control and measurement of temperature. As an alternative to an alcohol in glass thermometer, a temperature sensor could be used, allowing the easy display and reading of temperature.

Systems available are easy to use, require very little setting up for use, but effectively demonstrate the use of ICT in collecting both continuous and discrete data. The software supplied should ideally permit collected data to be converted into a suitable graph, and also allow export to an alternative programme such as MS Excel.
Cameras

Being able to draw meaningful diagrams is an important skill, but there are times when a still photograph can convey additional information. Photographs can be used in many different ways:

- As a reminder of an activity for future work.
- To illustrate work written by hand, produced on a word processor, or in a Power-Point presentation.
- As a means of collecting data (e.g. a sequence showing the formation of salt crystals in Science Activity 3, or the growth of a plant as in Science Activity 5).

Photograph tips

If you intend using photographs depicting children in any published material (including web sites), parent/carer permission should be obtained before pictures are taken.

- Digital cameras can produce very large image files, and this will affect the file-size of any document the picture is used in, even if it is 'shrunk' on the page. Where time and resources allow, time spent cropping and editing pictures can help develop important ICT skills.

Picture file size is particularly critical when photographs are used on web sites, and they should be 'optimised' for web use. This means the size and quality are adjusted so the image is clear when viewed on the web page, but will degrade if enlarged. Images should ideally be no bigger than about 20Kb.

Video

Reviewing a video of an activity with children can give an opportunity to reflect on what they did in a way that is not possible when relying on memory alone. Presenting to a camera also helps develop communication skills.

Digital Video (DV) opens new avenues to explore as movies can be downloaded to a PC, edited and viewed directly. Children could, for example, present the findings of an investigation in the form of a short documentary style film. Many children will have seen this modelled on TV programmes, and can be encouraged to imitate the approaches used. The advantage of using digital video is that scenes can be shot at different times and spliced together at a later date using a computer.

The minimum requirement is a digital video camera (perhaps borrowed from a local secondary school), a computer with suitable sockets, and some video editing software. For the best results, keep it simple and keep it short.
Digital Microscopes

Conventional microscopes are not always easy to use, particularly for younger children. Digital microscopes, which can be thought of as adapted cameras, bring several specific advantages, not least the ability to display an image to a group of children or even a whole class using a computer monitor or data projector. Digital microscopes can also usually illuminate the subject from below or above.

Images can be saved for future use, and incorporated by children into word processed documents or presentations. Moving images can also be captured, either in 'real time' or with a time-lapse feature. This can be particularly useful to show changes that take place too slow to observe easily.

A microscope could be used to compare the appearance of salt crystals formed by the evaporation of water from salt solution in different ways (Science Activity 3). Slower evaporation usually results in larger crystals – in this example the use of the same magnification is important for a fair comparison.

One of the suggested 'Further Mathematics Activities' is concerned with identifying crystal geometry. Samples of some common crystalline materials, such as sugar and salt, could be examined with a microscope. You may also be able to obtain other safe materials from a secondary school.

Audio

Learning to discuss in Science is an important skill, but unlike writing, no permanent record is produced. In order to help children develop these skills, a simple tape-recorder can capture discussion, and both the children and teacher can evaluate their contributions. Radio remains an important medium, and children could present their conclusions in the form of a radio programme. Science Activity 5 examines the effect of salt on roadside plants, and instead of recording the activity in a letter or poster, an item for a radio nature or news programme could be written and recorded. Audio-based activities are particularly appropriate when a class includes visually impaired children.

When using a tape-recorder, it is advisable to position the microphone as close as possible to the speaker in order to minimise background noise and room ambience. Be aware that many microphones are fairly directional so they pick up sound effectively from the front, but not very well from the sides or behind.

PowerPoint Presentations

These are now quite easy to create, and can be a lot of fun. Making a presentation provides the opportunity to develop ICT competence and communication skills using a less common medium. Whenever possible let children give a presentation to the rest of the class or some other audience.

If children have used a digital camera to record a sequence of events (see page 57), one easy way to display these as an animation is to insert the photographs into a PowerPoint presentation. Slides can then be advanced automatically or manually.
Children should be encouraged to experiment, but at some point they may need to begin to understand how to make an effective presentation, rather than one with the greatest variety of colours, sounds and flying text. Here are some useful tips to pass on to children:

- Summarise important points, using short phrases rather than long sentences.
- In short presentations choose a colour scheme and stick to it.
- In longer presentations, only change background or colour scheme to start a new section.
- Use a limited palette of effects, rather than a different one every time.
- When inserting photographs, use short captions and let the picture speak for itself.
- When children produce a good presentation, and want to show it to others, bear in mind there are some compatibility issues between PowerPoint versions. In particular, an ‘XP’ version may not work correctly if used on ’2000’ software as there are many new features, particular a different approach to using effects.

The World Wide Web

Surfing the Internet is very easy; finding the information you are looking for is not. In order to find something useful, children need plenty of strong hints.

If you want them to find out more about ‘salt’, for example, do some research yourself and then suggest either specific sites or search words that you know will yield useful results. Searching on ‘salt’ in Google is likely to lead you to Salt Lake City, government advice on dietary salt, or even a large South African telescope!

Creating Links

Another option is to locate useful sites and create links that will allow children to access the sites without searching or typing in lengthy web addresses (Uniform Resource Locators, or URLs). You could make a simple ‘web’ page, and insert links, but you could also create the links in a MS Word document or PowerPoint presentation.

In both of these, the method is the same:

1. Type the text you want to use as the link (it does not have to be the URL).
2. Select the text you want to make into a link.
3. Use Insert (menu) | Hyperlink... to open a dialogue box.
4. Enter the web page URL in Type the file or web page name and click OK.

Note that all web addresses must begin with http:// or https:// to be valid.
Useful Sites

New web sites are being created all the time, many are updated so the URL changes, and so there is always a risk when printing suggestions. These are certainly worth trying:

www.industry-animated.org
This CIEC site includes several animated diagrams, including a brine evaporator used for commercial salt manufacture.

www.bbc.co.uk/schools
The BBC schools area includes many useful resources, including interactive activities, to help reinforce ideas about dissolving.

www.saltsense.co.uk
The site of the UK salt industry. The content of this site is very good, if aimed a little high for primary.

www.saltinstitute.org
This is the site of the US salt industry. It’s a bit dense for children, but there is some excellent background for teachers on it.

www.lionsaltworkstrust.co.uk
The Lion Salt Works closed in 1986, and there is now a museum on the site of the works. This web site relates to the museum.

Creating Macros for Keywords

There are three parts to this: recording macros, creating the toolbar and adding the keywords as buttons.

Recording a Macro

1. Start a new file, to be used as a template for the piece of work, and save it immediately.

2. Use Tools / Macro / Record New Macro… to open the recording dialogue box.

3. Name the macro. It is best to use the keyword you want it to insert (spaces are not allowed).

4. At Store Macro In: select the name of the file you’re making. – Don’t leave it on All Documents.

5. A description is not essential, but it may help to remind you what the macro does.

6. Now click on OK – everything you do will now be recorded. Carefully type the key word (don’t capitalise the first letter, and spell it right).

7. When you start recording, a small toolbar should appear with a square, blue stop button. Click this now to stop the recorder. If you can’t see it (or you closed the toolbar), use Tools / Macro / Stop recording.

8. To check you have recorded the macro, use Tools / Macro / Macros… and look for your new macro in the list. This is also where you can delete a macro if it goes wrong.

9. Record a new macro for each key word, starting from step 2.
Creating a Toolbar

The macros now need attaching to buttons on a new toolbar. First, create the toolbar:

1. Use **Tools / Customise …** and select the **toolbars** tab.
2. Click on the **New** button to create a new toolbar. In the **Toolbar name control** label it something suitable, for example **Key Words**. You won’t be able to read this at first, as the toolbar is too small.
3. In the **Make toolbar available to**: control, select the name of the file, *not* 'normal.dot', and click **OK**.

Adding the macros to the toolbar

1. Now switch to the **Commands** tab of the dialogue box, and scroll down the list of **categories** on the left until you find **Macros**, and click on this. The right hand column should list the macros you have recorded.
2. Point to the first of these, and drag it onto the new toolbar. You should see a black bar to indicate where it is going to go. Release the mouse button when this bar is visible.
3. You now have the macro attached as a button, but the label on the button needs editing. Right-click on this new button, and edit the **Name** box in the short-cut menu. Spaces are allowed in this. Press **enter** on the keyboard when you’ve changed it.
4. Repeat from step 2 to add the other keywords, and then **Close** the dialogue box.
5. Test each button in turn. When you click it, the keyword should be inserted.
6. Re-save the file, and make it **read-only**.

It may seem a lot of work, but this only has to be set up once, and many children can then use the file as a starting point for their work.
Mathematics

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A Pinch of Salt
Mathematics

It is suggested in the notes for science activities 1 and 2 (pages 11-15) that children present their findings in tables, charts or graphs. The first section of these notes provide support for this in aiding children to construct these forms of presentation.

The second section provides some additional activities for children to carry out, relating both to the theme of salt and to reinforcing table and graph construction techniques.

Activity sheets M1-M5 accompany these activities and are located after these notes.

Tables of results

Children can spend a great deal of time drawing the skeleton of a table, as it is a skill in itself. However, as the more important decisions are in the planning of the table and not in the actual construction, some blank tables have been provided for children's use. These Activity sheets are labelled M1 and M2.

More able children can be given all three blank tables to choose from; otherwise the teacher selects which blank table the children should use. The children then decide on how many rows and columns they will require, and give them headings. They can then shade in any rows and columns they do not need.

Here are some examples of how the tables can be used:

**Table showing the amount of water collected from 6 melting ice-cubes, with and without salt.**

<table>
<thead>
<tr>
<th>Volume of water (in mls) collected every 5 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>Ice only</td>
</tr>
<tr>
<td>Salt + ice</td>
</tr>
</tbody>
</table>

**Table showing the amount of salt that dissolves in 100 ml of water at different temperatures.**

<table>
<thead>
<tr>
<th>Temp</th>
<th>10°C</th>
<th>20°C</th>
<th>30°C</th>
<th>40°C</th>
<th>50°C</th>
<th>60°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-spns</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table describing the rusting of two nails in water, with and without salt.

<table>
<thead>
<tr>
<th>Day</th>
<th>Nail in salty water</th>
<th>Nail in tap water</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bar charts

Bar charts are most commonly used to represent discrete numbers or data, e.g. numbers of pets owned by children in the class or numbers of children liking particular television programmes. These charts are initially constructed with 'blocks' which are pieces of gummed paper added to a chart, or shaded squares on 2 or 4 cm squared paper.

The next step is for children to construct a bar chart in which one block or square represents a group of units, rather than only one.

Constructing the axes

The children draw the 'L' for their axes utilising the space available to them, but leaving a few squares to the left and below the axes to add numerical and written information.

The children then need to establish the number of units each square will represent. They must divide the largest number they want to show on their chart by the number of squares on the axis (the vertical axis if the blocks are going to be shaded vertically, and the horizontal axis if the blocks are going to be shaded horizontally).

How this division is done will vary with the ability of the child. Some children will use trial and error, counting in two's then three's, etc. until the number of units fits the number of squares available. Other children may use a calculator to carry out the division problem.

If using a calculator, the answer will require approximation or rounding up or down to a whole number, or to the nearest multiple of 2, 5 or 10. For example, in science activity 1, children may measure the volume of water collected over time. If the final volume of water collected is 65 ml and the number of squares available on the axis is 10, a square can represent 7 ml of water. However, for ease of handling numbers and dividing up squares, the teacher can suggest that a square represents 10 ml of water.
A similar calculation is then carried out for the other axis, i.e. if the water was collected over a 40 minute period, there will be 8 measurements to add to the graph. The number of blocks to be shown is divided by the number of squares available, to determine the width of each bar.

Children could also now be thinking in terms of the bar height rather than separate blocks. Therefore they construct bars or rectangles of varying heights rather than drawing and shading each block.

Finally, they should label each axis and choose an appropriate title for the graph.

The bar chart they produce may look something like the one shown below.

![Bar Chart Example](image)

**Bar line charts**

This type of chart provides a useful step between constructing bar charts and line graphs. The children now draw a line to represent their data rather than a bar, adding an 'x' to indicate the measurement. So, for the example given above, the same data represented in a bar line chart looks like the one shown here.

![Bar Line Chart Example](image)
**Line graphs**

This type of graph is most suitable for representing *continuous* data, e.g. the data which is given in the example above.

The ice is melting and the water collected continuously, but measurement of the volume of water is taken at specific times along this continuum. The crosses on the bar line chart can be joined, to look for a pattern in the results. N.B. *The points along this line give a suggestion for the volume of water collected at other times but may not be accurate.*

The next stage of development is to draw only the points joined by the line, as shown below.
Further mathematics activities

**Activity 1**  
**Flowing salt**

**Aims**  
To estimate and measure the time taken for salt to flow through a funnel. To calculate the mean from several measurements. To produce a graph of results to extrapolate the mass of salt that will flow in a specific time period.

**Resources**  
5 tubs containing 100 g, 200 g, 300 g, 400 g and 500 g of salt respectively, labels, funnel (about 0.5 cm diameter 'hole'), stop clock or stopwatch, weighing scales, graph paper, rulers.

The children are given blank table 1 or 3 from M1-2 to produce a chart like one of those shown below, or teachers could duplicate a chart with the headings for less able children:

<table>
<thead>
<tr>
<th>Mass in grams</th>
<th>Time in seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
</tr>
<tr>
<td>100 g</td>
<td></td>
</tr>
<tr>
<td>200 g</td>
<td></td>
</tr>
<tr>
<td>300 g</td>
<td></td>
</tr>
<tr>
<td>400 g</td>
<td></td>
</tr>
</tbody>
</table>

Alternatively, the children could find the mean of two rather than three measurements. The choice of table chosen should reflect the ability of the children concerned. Where children do calculate the mean of several measurements, the teacher should discuss with the group why taking several measurements might be better than taking only one (i.e. improving accuracy and allowing for errors).

Children should be asked to estimate the time that the salt will take to flow through the funnel before each tub of salt is poured and measured. They should **not** estimate the time for all the tubs of salt before taking any measurements. The children's estimates should improve after each measurement, as they base each estimate on the previous measurement.
It should also be stressed that it *is acceptable* for their estimates to differ from their measurements. Often children will rub out their estimates once they have made a measurement, as they feel they are 'wrong'.

The children can now transfer their results onto either a **bar chart** or a **line graph**, depending on their ability. Again, the teacher may choose to construct the axes of the graph for less able children.

N.B. *The axes of the graph should be extended to allow for the measurement of 500 g of salt to be added.*

Here is a sample bar chart:

![Bar chart](image)

Once the children have produced a graph of results, they can look for any patterns that exist and what they mean. The children can use their graph or chart to estimate the amount of salt that would be required to make a 1 minute timer using salt.

They can also be asked to use their graph to estimate the time taken for 250 g and 500 g of salt to flow through the funnel. Children using a bar chart for this purpose will not be able to provide as accurate an estimate as those using a line graph.
The children then pour 250 g and 500 g of salt through a funnel to check their estimate. They can also compare the accuracy of their estimate with those made simply by looking at the times recorded in their table.

N.B. *It should be made clear to children that joining the discrete points on a line graph provides a method of looking for a pattern in data. The line between points *suggests* other measurements conforming to a pattern, which is not always the case. *Therefore, measurements required for a specific purpose, i.e. the one minute timer, should be verified.*

**Extension activities**

The children could investigate the effect of the size of the funnel's hole on the time taken for salt to flow through. The base of a funnel is often angled, as shown opposite, though the tube through which the salt flows is circular. In this case, the shortest measurement represents the diameter of the base.

The children will find that the time taken for salt to flow through a funnel decreases with increasing the tubes diameter.

![Diagram showing the diameter of a funnel](image)

Children can compare the times taken for sand and salt to flow through the funnel. If the children have carried out the technology activity on salt cellars or understand that salt becomes damp in a moist atmosphere more readily than sand does, they could discuss why sand was used in preference to salt for time measurement historically.
Activity 2  
Salt around the world

**Aims**
To use tables of data to produce and interpret bar charts.

**Resources**
Graph paper, rulers, copies of Activity sheet M3 or M4.

Children are given the data from one of the tables on Activity sheets M3 or M4 which is appropriate for their ability. They use this data to produce a bar chart. Children can be asked some of the following questions, again choosing the questions which are suitable for their ability:

- What information does this graph give you?
- Do some countries use a lot more salt than others? If so, which ones? Why do you think this is?
- Which country used the most salt in 1975? In 1985? In 1995? Who do you think used the most salt in 2005?
- Which country used the least salt in 1975? In 1985? In 1995? Who do you think used the least salt in 2005?
- Which countries used more salt in 1995 than 1975? Do you think this will be the same for 2005? Why?
- Which countries used less salt in 1995 than 1975? Do you think this will be the same for 2005? Why?
- Are there any countries which used the same amount of salt in more than one year? Which ones?

**Extension activity**
The world's salt production is used in the following ways:

- 60% chemical producers
- 19% food industry
- 10% de-icing roads in North America & Western Europe
- 11% other.

Able children can be asked to produce a pie chart using this data.
Activity 3  Bags of salt

Aims
To estimate and measure the mass of a range of bags of salt of different sizes.

Resources
7 freezer bags, 4 kg salt, labels, scales masses, copies of Activity sheets M5 (cut in two).

The teacher prepares the seven bags before the lesson. The bags are labelled 1 to 7 and filled with the following amounts of salt:

- bag 1 - 1000g
- bag 2 - 100g
- bag 3 - 750g
- bag 4 - 500g
- bag 5 - 400g
- bag 6 - 250g
- bag 7 - 600g

Part 1 of Activity sheet M3 asks the children to arrange the bags 'from left to right, from heavy to light', in role as Marushka's cook (from the story 'Salt and Gold'). The children do this without the use of scales, simply by holding pairs of salt bags in their hands and arranging.

They can then check their estimates by placing a salt bag in each pan of a pan-balance and testing pairs of salt bags against each other in this way.

They are then given part two, Activity sheet M4 to write down the bag numbers in the left column of the table, before estimating the 'mass' of the bags. They should be encouraged to use bag number four to guide them in their estimates, holding bag 4 in one hand and the bag being estimated in the other hand.

Once all the children's estimates have been made and recorded, they are given the scales to find out the exact weights of the bags of salt.

Finally, the children calculate the difference between their estimate and the exact weight of each bag of salt. The teacher may decide to give the children the choice between a manual calculation and the use of a calculator. If carrying out a manual calculation, children can write on the back of Activity sheet M3 or in their mathematics books.

N.B. The children must appreciate that they must subtract the smaller number from the larger number each time.
Activity 4  Crystal shapes

Aims
To learn about the properties of cubes and cuboids, the common shapes of (salt) crystals. To make paper or card cubes and cuboids, using nets.

Resources
Magnifiers, squared paper (1-2 cm), a selection of three-dimensional shapes (e.g. cones, prisms, spheres, cubes, cuboids), selection of boxes (chocolate boxes, etc.), paper, card, scissors, glue, silver paper (optional).

The children familiarise themselves with a variety of three-dimensional shapes before looking specifically at cubes and cuboids. They can sort the shapes using P.E. hoops and labels to create Venn diagrams. The teacher chooses labels according to the ability of the children and the knowledge they already have about the properties of three-dimensional shapes. Some possibilities are:

- Corners
- Curved edges
- Straight edges
- Curved faces
- Right angles
- Flat faces
- Equal sides
- Equal faces

They could record their 'real' sorting of shapes (in hoops) in a Venn diagram, writing the names of the shapes in overlapping circles. Alternatively, Carroll diagrams could be produced. Here are examples of both types of diagram:

**Venn diagram**

**Carroll diagram**

N.B. Children may not immediately see the right angles (or square corners) in a cylinder. This can be aided by using an 'L' shaped piece of card or wood into which the different shapes are placed to observe whether they 'fit'.
The children tabulate data (they could use the blank table on Activity sheet M2 about the shapes, e.g. number of right angles, number of flat/curved faces, number of equal sides/faces, etc. This tabulated data can then be used to compare cubes and cuboids, listing similarities and differences.

The children should note the following:

<table>
<thead>
<tr>
<th>Property</th>
<th>Cube</th>
<th>Cuboid</th>
</tr>
</thead>
<tbody>
<tr>
<td>right angles</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>flat faces</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>straight edges</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>equal edges</td>
<td>12</td>
<td>8 + 4</td>
</tr>
<tr>
<td>equal faces</td>
<td>12</td>
<td>8 + 4</td>
</tr>
</tbody>
</table>

At this point the children can establish the shapes of salt crystals by looking at them through a magnifier (the greater the magnification, the clearer the shapes will be to the children). They should be able to name the shapes, following the work they have just completed.

The children then make nets of cubes and cuboids. This can be done by opening out a box and drawing round it; or opening up a box and transferring measurements to square paper; or by opening up a box to use simply as a guide and choosing measurements according to the scale required. The choice of method will depend on the ability of the children.

Once the nets are complete, they can be stuck onto silver paper before scoring and gluing into cubes or cuboids. The ‘crystals’ can then be hung in mobiles.
<table>
<thead>
<tr>
<th>Table one</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table two</th>
</tr>
</thead>
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Table three
Salt around the world

Table to show the use of salt in different countries

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<td>17</td>
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<td>TOTAL</td>
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<td>150</td>
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<td>199</td>
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</table>

Data adapted from 'The Economics of Salt', 1987 and 2001, by Roskill.

*Russia only
## Salt around the world

Table to show the use of salt in different countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Millions of tonnes of salt</th>
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<tbody>
<tr>
<td>Brazil</td>
<td>2</td>
</tr>
<tr>
<td>China</td>
<td>20</td>
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<tr>
<td>India</td>
<td>3</td>
</tr>
<tr>
<td>Spain</td>
<td>3</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>7</td>
</tr>
<tr>
<td>USA</td>
<td>39</td>
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</tbody>
</table>

Data adapted from 'The Economics of Salt', 1987 and 2001, by Roskill.

## Salt in Europe

Table to show the use of salt in some European countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Millions of tonnes of salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>5</td>
</tr>
<tr>
<td>Italy</td>
<td>4</td>
</tr>
<tr>
<td>Poland</td>
<td>3</td>
</tr>
<tr>
<td>Romania</td>
<td>3</td>
</tr>
<tr>
<td>Spain</td>
<td>3</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>7</td>
</tr>
</tbody>
</table>

Data adapted from 'The Economics of Salt', 1987 and 2001, by Roskill.
Bags of salt - 1

Marushka gives the cook 7 bags of salt when she returns from the salt cavern. The cook has to put them on his shelf ‘from left to right - from heavy to light’. Can you help him?

Feel and look at the bags!

<table>
<thead>
<tr>
<th>Estimated order</th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual order</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bags of salt - 2

Bag 4 weighs 400 grams. Estimate how much the other bags weigh and write your answers below.

<table>
<thead>
<tr>
<th>Bag</th>
<th>Estimate</th>
<th>Actual weight</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>not needed</td>
<td>500 grams</td>
<td></td>
</tr>
</tbody>
</table>

Now weigh the bags of salt and write down the actual weight.

Can you work out the differences between the estimated and the actual weights? Have a try!
English

In

A Pinch of Salt
English

Aspects of English are covered in the science section of this pack. The activities are investigative by nature and children are involved in a great deal of group discussion and decision-making, as well as reporting their work in many ways. The ‘reporting back’ of their work includes writing letters, making posters, designing leaflets for door-to-door distribution and more formal report-writing. To add to these tasks, the cartoon story used as a stimulus for the science activities can also be used to prompt English activities. Here are a few suggestions:

Photocopy all the cartoons from Activity sheets S3, S4, S7, S11 and S12. Jumble them up and photocopy them on to a sheet of A3 (or two sheets of A4) paper. Ask the children to cut them out and sequence them on a piece of A3 paper, filling in gaps in the story with their own ideas.

Introduce or reinforce the use of speech marks using Activity sheet S1 as the stimulus. Ask the children to write the story using speech marks to replace the ‘cartoon bubbles’. Some children may also be able to think of a variety of alternatives to the word 'said', e.g. shouted, whispered.

The story
Salt and Gold

The majority of the ideas for this English section are based on a fairy-tale from the Czech Republic and Slovakia. It is a traditional story which can be used as part of a comparative study with modern fairy stories, such as The Practical Princess and Other Liberating Fairy Tales or Princess Smartypants, in order to take a close look at gender issues; or one of a variety of fairy tales from other lands and cultures. It can also be used to stimulate many other activities which are outlined below.

The story is intended to be read by the teacher to the children, though the children can read it themselves, or sections of the story can be photocopied to accompany specific tasks.

Some ideas can be used at any point during the story, whilst others are for use before beginning the story, or following a specific chapter.

It is not intended that children work through all the activities, but that the teacher selects those most suitable for the children.

Children could work individually, in pairs or in groups for all the activities, unless otherwise stated.

Before reading the story

1. The children are asked to make up their own fairy-tale titled Salt and Gold which incorporates all the following elements:

- three princesses
- a wise old woman
- a cottage in a forest
- a bag of salt
- a magic twig
- a king
- a castle
- gold
- illness
dwarfs

The teacher may reduce the number of elements children incorporate, according to their ability. When the traditional story has been read, it can be compared with the children's stories.
2. Children list fairy-tales that have any of the above elements, e.g.:

<table>
<thead>
<tr>
<th>Element</th>
<th>Fairy-tale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cottage in a forest</td>
<td>Hansel and Gretel</td>
</tr>
<tr>
<td></td>
<td>Little Red Riding Hood</td>
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<tr>
<td></td>
<td>Goldilocks &amp; the Three Bears</td>
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<tr>
<td>Gold</td>
<td>Jack and the Beanstalk</td>
</tr>
<tr>
<td></td>
<td>The Golden Goose</td>
</tr>
<tr>
<td>Dwarfs</td>
<td>Snow White &amp; the Seven Dwarfs</td>
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<td></td>
<td>Rumpelstiltskin</td>
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<tr>
<td>Princesses</td>
<td>The Princess &amp; the Pea</td>
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<tr>
<td></td>
<td>The Handsome Prince</td>
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<tr>
<td>Castles</td>
<td>Sleeping Beauty</td>
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<td></td>
<td>Cinderella</td>
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<tr>
<td></td>
<td>Snow-White &amp; the Seven Dwarfs</td>
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<tr>
<td>Wood</td>
<td>Pinocchio</td>
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3. Children draw a princess and a king and surround their pictures with words to describe the two people. Often children use words such as brave and strong to describe kings and princes, and pretty, gentle and quiet to describe queens and princesses. This is often due to the images portrayed in traditional tales. After reading the first chapter, groups of children discuss how similar their princess and king are to those in the story. The illustrations are traditional, though the princess has strong characteristics, which become clear as the story develops.

The children are then asked if they could use any of the words for their king to describe a modern princess, and vice-versa. The modern princess and king could be taken from 'real-life' or from modern fairy-tales such as *The Wrestling Princess and Other Stories*. Children often realise that boys and men today can be attributed with the more sensitive characteristics, and girls and women with stronger and more assertive characteristics.

**General ideas**

These ideas can be used after any chapter in the story.

4. **Cloze procedure.** Part of a chapter is re-written by the teacher, with every fifth word replaced by a line on which the children write the missing word. A grid is provided at the bottom of the passage, each box in the grid containing a missing word. When a missing word has been replaced, the child colours in the relevant box in the grid.

5. **Sequencing and chapter-writing.** Key sentences are written on strips of card and jumbled for children to re-arrange. They then re-write the chapter, adding more detail and using the key sentences as a reminder. For example, key sentences for chapter one could be:

- The king lived happily with his three daughters, Katrina, Lenka, and Marushka.
• The time had come for him to decide which of his three daughters should be Queen when he died.

• Finally, he decided to choose the daughter who loved him the most.

• "I love you as much as salt, Father" said Marushka.

• "If I don't mean any more to you than common salt, I do not want to see you again until salt is worth more than gold!"

• Marushka packed a small bag of clothes and food, took one long look back at the castle that had been her home so long, then walked briskly away towards the hills ahead.

6. **Cartoons.** Children make a cartoon strip of the story or a chapter (one group could be responsible for each chapter). A long strip of pale-coloured sugar paper could be folded as follows and both sides used:

   ![Cartoon Format](image)

   - **Closed format** - looks like a cartoon book.
   - **Open format** - make attractive 3-dimensional wall displays.

   Alternatively, the plain side of a roll of wallpaper can be used by groups of children to make a cartoon scroll. Strips of wood, dowelling or kitchen roll tubes are attached to the scroll ends to complete the scroll.

7. **Letter-writing.** The children write letters 'in role' as one character to another. For example, after chapter three, Marushka writes to King Pavel, or vice-versa. The children can be asked to simply describe events that the other character knows nothing about; they could add extra details of their own, or they could add the character's thoughts and feelings whilst they are separated from each other. This will depend upon the ability of the children writing the letters. In laying the letter out correctly, children could create their own addresses for the king's castle or Eva's cottage.

8. **Diary-keeping.** Children keep a diary 'in role' as Marushka after each or selected chapters (except chapter 3). A starting sentence could be given each time, e.g. for chapter one:

   **Sunday.** "I cannot believe what has happened today. Everything was as usual until suppertime when . . . "

   Children could write descriptively, recalling the main events, or they could add Marushka's feelings as well.

   Some children do not keep a diary, so to appreciate the diary-writing style, extracts of *The Diary of Adrian Mole* by Sue Townsend can be read to the class and the style discussed.
9. **Newspaper reports.** Children write a short report about the main events in a chapter. The report could include an interview with one of the characters featured in the chapter. Children could be provided with a newspaper name or headline, or could invent their own. The newspaper could be called 'The Kingdom Times' or 'The Royal Herald'. Headlines could be:

- Chapter One: 'Royal Rage - Princess Leaves!'
- Chapter Three: 'No Salt - No Banquet.'
- Chapter Five: 'Princess and Salt Return to Kingdom!'
- Chapter Six: 'New Queen's First Adventure.'

10. **Active comprehension.** Groups of children formulate their own comprehension questions. They then choose 2-3 of these questions to ask the rest of the class. Children should be encouraged to think of questions that require personal opinions or evaluations rather than 'factual recall' style questions. For example, at the end of chapter one:

"Why do you think Marushka left home rather than trying to talk to her father?"

is better than:

"Why did Marushka leave home?"

11. **Map or plan.** Children draw or model the journeys made by Marushka from the castle to Eva's cottage and to the salt caverns. They should incorporate all the features given in the story, and could add some of their own. Therefore, the map or plan must include the castle, the forest, Eva's cottage, and three hills and valleys north of the castle. The detail on the map or plan will depend on the ability of the children and could use symbols and a key as well as show the points of the compass.

12. **Chapter titles.** Groups of children invent titles for each chapter to replace the numbers. They then give 'title cards' to another group, in order to match the correct title to chapter.

13. **Name that character!** The children or teacher prepare a quiz, taking snatches of dialogue from all the characters and asking the rest of the class to name the character who said each piece of dialogue. The class could be split into six groups, and each group uses a chapter of the story to prepare their part of the quiz.

14. **Oral story-telling.** This was the way in which many folk tales were passed from generation to generation; it is interesting to let children try this for themselves. The class is split into groups of 5-6 children, and one group leaves the room. One member of the group comes into the classroom and the teacher reads the first chapter of the story to the child. The child then has to repeat as much of the chapter as he/she can remember to the next group member to come into the classroom. This continues until all group members have returned to the classroom. The teacher then re-reads the chapter so the children can appreciate how much it has been changed by only a few people. Each group can have a go with a different chapter.
Children's activities following specific chapters

Chapter One

15. Children are asked to list the things they would take with them if they had to leave home quickly and they could only take a small bag (a bag could be shown to the class to indicate the size). They could brainstorm ideas initially, listing survival items such as chocolate bars, warm clothes, etc. as well as personal things such as photographs of their family. Then they could narrow the list down to those items that realistically will fit into the designated bag.

Chapter Two

16. Discussion. Groups of children discuss what makes someone wise and whether elderly people are any wiser than young people. They could talk about elderly people they know, like grandparents or great grandparents, and whether these old people are wiser than they are.

17. Metaphors and similes. Eva says "Well, just tell me what makes your heart heavy". Children are introduced to metaphors, i.e. the fact that Marushka's heart is not actually heavy, but that her feeling of sadness is likened to heaviness. Children are asked to draw a picture of a 'heavy heart', literally, next to a 'heavy heart', metaphorically. They could be given other metaphors to represent using artwork.

Chapter Three

18. Research. Children, in role as King Pavel's doctor, find out why a lack of salt is making everyone in the kingdom ill. As a class or in groups, they discuss the types of books they might use, such as those on 'our bodies' or 'healthy eating', etc. They could also decide which key words they might look for in the index, such as 'salt', 'illness', 'minerals', etc. When they have the books for research, they could discuss the reasons for looking at one chapter rather than another (if the chapters have titles). To encourage children to write reports in their own words, ask them to read a paragraph from their book in pairs; close the book and discuss the main points of the paragraph; write down key words or phrases; repeat for 2-3 paragraphs (possibly from other books) before using their notes to write a report to King Pavel.

Children find out where King Pavel's salt comes from (see Children's activity 25).

19. Similes. Children draw a picture to literally represent the king and his daughters 'as thin as shadow'. They could be given other similes to represent in drawings. They can discuss why a simile conjures up a literal picture in the mind's eye, though it does not provide a literal meaning. N.B. It may be confusing to carry out this activity and the one on metaphors (suggested in Children's activity 17) together.

20. Food survey. Children collect empty food containers or labels, e.g. crisp packets, sauce labels, labels from tined food, ice-cream tubs, yogurt pots, biscuit wrappers, frozen vegetable bags, cake boxes, etc. and use these to find out how many different food-stuffs contain salt. They may be surprised to find out the number of sweet foods that contain salt.
21. *Plan a banquet.* Challenge the children to plan a menu without salt. Give the children a range of recipe books to work from. Allow them to choose recipes which use 'a pinch of salt' which could be missed out.

Chapter Four

22. *Choose an ending.* This is a suitable point to ask children to write their own final chapter to the story. To refresh their memories of the story so far, groups of children discuss the main events, before brainstorming possible endings. The group identifies key spellings they will need and find them in a dictionary. The children write these words on a large piece of paper and pin to the wall for the entire group to use.

Chapter Five

23. *Description.* Children discuss ways in which Marushka disguises herself, i.e. she wears a large hood over her face, and speaks into her clothes so the sound of her voice is muffled. They then write a description of a disguise they might use if they did not want anyone to recognise them, and did not want to draw attention to themselves. They can accompany their descriptive writing with a drawing of the disguise.

24. *Food traditions.* In the Czech Republic and Slovenia, it is traditional to eat bread with salt. Ask the children to list as many 'pairs' of food as possible that we eat here in Britain. Allow as much diversity as possible, including Asian, American, African, Italian, Chinese or Caribbean food, if these are the traditional foods of children in the class. Examples could include fish and chips, curry and rice, bread and butter, etc.

Chapter Six

25. Research. Children find out where salt comes from, i.e. the sea and the ground, and how it is extracted (dissolving and evaporating, etc.). A similar research process can be used as detailed in *Children's activity 18.*

26. Changing the story. The children write a modern version of the story. They are given similar elements to include, e.g. the wise old woman could live in an old people's home, the sisters live in a terraced house, the gold might be changed to a thousand pounds, or a sports car, etc.

27. Who is Eva? The story implies that Eva was not just an 'ordinary' old woman, but does not say who she was. The children discuss the possibilities in small groups, e.g. a good fairy, an angel, etc.
Once upon a time in another time and another place, there lived a king. The king lived happily with his three daughters, Katrina, Lenka, and Marushka. King Pavel had ruled over his country for more years than he could remember, and the time had come for him to decide which of his three daughters should be Queen when he died. He thought long and hard about the problem he had, how could he choose one daughter from three, all of whom he loved equally? Finally, he decided to choose the daughter who loved him the most.

That evening, when they all sat together for supper, King Pavel turned to Katrina and asked "How much do you love me, Katrina?"

Katrina was surprised by the sudden question, and answered "Why, I love you more than gold, Father" and looked at him, puzzled.

The king did not explain why he had asked the question, he simply turned to Lenka and said again, "And how much do you love me?"

"I love you more than anything else in the world!" replied Lenka, confidently.

King Pavel repeated the question again to Marushka, Who smiled and said "I love you as much as salt, Father."

Katrina and Lenka turned to look at Marushka in amazement, saying "How can you compare the love of your father with common salt? What are you talking about?"

It was Marushka's turn to look puzzled, as she turned to her father and said "Father, I really do love you very much, as much as salt."
But, like Marushka's sisters, King Pavel also could not believe what his daughter had said. He was upset and angry to hear Marushka's words, "Marushka, I cannot believe that you could be so cruel as to liken your love of me to salt. If I don't mean any more to you than common salt, I do not want to see you again until salt is worth more than gold!" With that, the king left his chair and stamped loudly out of the room.

Katrina and Lenka would not look at their sister, but ate their supper with bent heads, as Marushka sat in a stunned silence. Only five minutes ago her father had been smiling and laughing with her, and now he didn't want to see her again! Slowly she got up from her place at the table and decided that she would leave home at once. She thought it would be a good idea to leave her father alone for a while, as he was too hurt and angry to listen to her true feelings now.

Marushka packed a small bag of clothes and food, took one long look back at the castle that had always been her home, then walked briskly towards the hills ahead.
Chapter Two

Marushka walked many miles through a dark forest before resting beneath a tall pine tree. The forest was quiet, and Marushka began to feel alone and sad. She had eaten the food in her bag hours ago. She did not know whether she had made the right decision to leave home; maybe her father had already calmed down and regretted the things he had said to her? Marushka was so deep in thought that she did not hear the rustling of leaves that accompanied the slow steps of an old woman walking towards her. Marushka jumped when the woman spoke.

"What are you doing here, Marushka? Why do you look so sad?"

"Oh, what's the use in telling anyone? No-one can help me." replied Marushka, as she kicked hard at the leaves on the ground.

"Well, just tell me what makes your heart heavy. I might be able to give you some advice. Don't you know that many old people are wise?" The woman sat down beside Marushka, and looked at her with kind, patient eyes.

Marushka told her new friend, Eva, all about what had happened earlier that day. She had only one wish, to convince her father that she loved him with all her heart. Eva knew all along that Marushka would tell her everything, for she was a wise woman who could also see into the future. Eva wanted to help and invited Marushka to stay and work with her. Marushka was glad to have found someone she could talk to so easily, so she followed Eva to her small cottage in the heart of the pine forest. Marushka warmed herself in front of the fire and enjoyed some bread and hot stew that Eva had prepared for her.

The next day Eva woke Marushka at dawn. "Right! Let's get to work! Can you spin? Can you weave? Can you chop firewood? Can you shear my sheep?"

Marushka had not done a day's work in her life and told Eva, "I don't know how to do any of these things, but I am very willing to learn as much as I can."
So Eva showed Marushka how to carry out all the tasks she had been asked to help with. Within a few days Marushka became fit and strong, and she soon became used to doing all the jobs she had never done before.
Chapter Three

Whilst Marushka worked with Eva, Katrina and Lenka were enjoying their lives in the castle. They flattered King Pavel and told him how much they loved him. King Pavel granted all their wishes. The sisters did exactly what they pleased, Katrina wore the finest gold-embroidered clothes, and Lenka arranged endless parties and dances.

King Pavel began to worry that Katrina loved her gold-embroidered clothes more than she loved him. When Lenka announced that she wanted to marry, King Pavel felt that he would now take second place in her affections. He thought about Marushka, he so much wanted to see her, but he had no idea where she was. He deeply regretted the angry words he had spoken, though he still did not understand why Marushka had said she loved him as much as salt!

King Pavel's thoughts were interrupted by the loud bang of a door, which had been slammed behind one of the cooks, who was now running towards the king. The king's staff had been rushed off their feet since Lenka had decided to hold a large banquet in order to choose a husband from all her admirers, so King Pavel was not surprised to see the cook in such a state.

"Sire, there has been a terrible misfortune. All the salt has disappeared into thin air! There isn't a pinch of salt to be found in the castle! What shall I season the banquet's food with?"

"Send for some more salt," replied the king.

"But sire, where shall I send for it? It is the same in every house in the country. There's no salt anywhere, not a pinch."

"Well, use something else instead of salt, or cook food that doesn't need salt," and with these words King Pavel sent the cook away.

The cook prepared as many different dishes as he could think of without salt, and made many sweet dishes too. Yet it was a strange banquet, just imagine a meal without salt! No-one enjoyed the food they were given, and one by one the visitors began to leave. The king felt angry and embarrassed, and his two daughters were very annoyed.
No banquets, no visitors, no fun. What a life! Times really had changed. There was plenty of gold about, but not a pinch of salt anywhere. It had simply disappeared.

People began to lose their appetites, they did not want to eat at all, they craved for salt . . . the tiniest amount of salt would do, if only they could get it. Animals suffered too, cows and sheep stopped feeding because they had no salt. People became ill and as thin as shadows, including the king and his daughters.

For a pinch of salt people would gladly have given its weight in gold. By now the king had realised how precious salt was. In realising this, he also realised how wrong he had been to treat Marushka so badly.
Chapter Four

Marushka, of course, knew nothing about the events in her father's kingdom. She continued to grow strong and confident about her work. She had a good home and was short of nothing – except the company of her family. However, Eva did know about the sad state of affairs at Marushka's home and, knowing when it was time to act, she called Marushka to her.

"My dear child, we shall have to part. It is time for you to return to your father."

"But Eva, how will I know whether my father wants to see me?"

"Don't worry, my child, all will be well. In your father's kingdom salt is worth more than gold now. Didn't he say you could return if this ever happened?" Eva gave Marushka the rest of the news of her family. "You have worked well for me. What would you like from me in return for your services?"

"You have been a very dear friend to me, given me good advice and treated me well. I am grateful for all of these things and ask for nothing more than a handful of salt to take to my father."

"Is that all you want? I can grant anything you wish for."

Marushka shook her head firmly, "I want only a handful of salt."

"I shall make sure that you are never short of salt," the wise woman promised, "and you must also accept this special twig. When you feel the south wind blowing, follow the wind and stop when you pass three hills and valleys. Then crack the twig and point it to the ground and the earth will open up for you. You must enter the opening and follow the steps that you see. I give everything you see there to you," finished Eva.

Marushka was surprised by this final gift that Eva offered her, but she accepted it and the bag of salt gratefully and gave her dear friend a big hug. She waved to Eva until she could no longer see her and the cottage was a small dot in the distance, and then she faced the path ahead, sighed and stepped out with a smile at the thought of going home.
Chapter Five

As Marushka approached the castle, she gathered the large hood from her heavy cloak and pulled it over her head, so it hung down close to her cheeks. With this, and the clothes she now wore, few were likely to recognise her. She entered the castle gate and walked slowly through the streets, looking around as much as the heavy hood would allow. Eva was right; people looked thin and pale, could all this be only because there was no salt in the kingdom?

Eventually Marushka arrived at the large wooden door through which she would meet her father. She hesitated for a moment, thinking about her dear father and how he too would look frail and ill. Then she stepped forward, knocked loudly on the huge door and listened to the echo inside. One of the servants answered her knock, asking who was calling to see the king.

"A tired and weary traveller who has brought him something that is worth more than gold, medicine to cure his illness," mumbled Marushka into her hood.

The servant was gone for a few moments, which seemed look hours to Marushka, then he returned to the door and nodded towards the hooded figure. "The king will see you."

Marushka followed the servant through the corridors she knew so well, to the large hall in which she and her father had parted a few months before. He looked much older than Marushka remembered, and seemed small sitting in a very large chair.

"What news do you bring me?" asked King Pavel in a tired and weary voice. Marushka looked at the floor, "First, may I have some bread to eat? I have travelled far and I am very hungry."

The king sent a servant to the kitchens, who returned quickly with a plate of warm crusty brown bread. Marushka knew, of course, that it was the custom to offer salt with bread when it was not served with other food.

"I am afraid we cannot offer you salt for your bread, as we haven't any," the king sighed. Whilst he was speaking, Marushka reached down into her bag, took a pinch of salt between finger and thumb, and sprinkled it slowly on her bread
"Where did you get that salt from?" asked the king, sitting upright in his chair. "Why, salt is more precious than gold in this land!"

"And I love you as much as I love salt," replied Marushka, as she pulled back the hood to reveal her face to King Pavel. He gasped in surprise; he had not for one moment thought that this stranger was his daughter. He started to struggle to his feet, but Marushka jumped up and ran over to hug him. Tears were in their eyes as they laughed and hugged each other, the bitter words once spoken now forgotten.

The news of Marushka's return soon spread throughout the kingdom. Everyone passed on the news of the happy reunion to others, of course telling of the bag of salt she had brought with her, and they were overjoyed. Even Marushka's sisters were pleased to see her once again, and happily accepted the slice of salted bread she offered them, quickly forgetting how they had treated her only months before.

Marushka gave salt from her bag to everyone who came to see her, and the king was worried that she would have none left for herself.

"There's enough for everyone, father," assured Marushka. And it was true, however much salt she gave away, there was always more in her miraculous bag. It was just as Eva had said; she would never be short of salt.
Chapter Six

King Pavel gradually recovered from his illness and called together the wise men and women who were the elders of his kingdom and asked them to proclaim Marushka as Queen. This they did, and as Queen Marushka stood in the sunshine amongst the elders, she faced into the warm wind, closed her eyes, and felt the gentle breeze on her face. She stood still, as she slowly began to remember something. Of course! Eva's parting words! . . . "When you feel the south wind blowing, follow the wind . . ." this wind was blowing from the south!

Marushka had already told her father about her life with Eva, and she now hurriedly explained to him the final words Eva had said to her. The king agreed that she should go at once and follow Eva's advice. So Marushka took the twig with her and she followed the south wind. When she had passed three valleys and three hills she stopped, cracked the twig and pointed it downwards. True to Eva's words, the ground opened and the brave Marushka stepped inside.

She found herself in a huge hall that seemed to be entirely made of ice. The ceiling, walls and floor all glistened and sparkled brightly. Tiny men and women, carrying shining lamps, hurried up the steps to welcome Marushka.

"We salute you, Queen Marushka! We've been waiting for you, for we knew you would be coming soon. Let us show you around, as everything here belongs to you!"

Marushka was led up some sparkling steps, through passages where long icicles hung from the ceiling, sparkling like silver. They took her to a garden filled with ice flowers; roses, daisies, and many more. One of the dwarfs picked the most beautiful of the roses to present to their new queen.
"I've never seen anything as beautiful as this garden" Queen Marushka exclaimed, "but I don't understand, where am I?"

"This is the cavern of salt. Everything you see here is made of salt," explained the dwarfs. "All of it is yours."

"Is it possible?" the amazed queen asked, "Is this the place where the salt grows?"

She thought it would be a great pity to spoil the beauty of the place by taking anything away. But the dwarfs put her mind at rest, crying "Help yourself, Marushka! Take what you like, it won't even be noticed. There will always be salt down here."

After thanking her new friends, Marushka left. The opening through which she had arrived stayed open so she could return at any time.

She told her father everything and he realised just what Eva had done for Marushka. They decided to go and thank Eva together, and travelled to the forest on fine horses. They wanted to ask Eva to come and live in the castle with them. Yet in spite of Marushka knowing the forest so well, they could not find a single trace of Eva's cottage. Only then did it occur to Marushka who the wise woman really was. She knew that they would never find Eva, no matter how long they searched, so they returned home.

Soon there was no more salt in Marushka's bag, but that did not matter, for now she knew where to go for salt.
History

in

A Pinch of Salt
History

This section provides a range of historical facts relating to salt. How these facts are used is left to the teacher, as the range of topics and time periods being covered in primary schools today is wide and therefore beyond the scope of this pack. It is hoped that teachers will be able to incorporate chosen ideas from this section into planned schemes of work.

Further historical information, can be obtained by writing to the organisations listed on page 5.

The facts have been presented in chronological order and key words highlighted for quick reference.

Information given on salt production by evaporation methods can be linked to science activities 3 and 4 (pages 16-19).

Salt has played an important role in the everyday life of people for thousands of years. Salt has been used through the ages, since Prehistoric times to flavour and preserve food and tan hides for clothing and shelter.

The archaeological evidence suggests the first widespread production of salt from sea-water occurred during the Iron Age, in 1500-600 B.C. The sea-water was probably evaporated off in large open saucepans and the remaining concentrated brine reduced by boiling. The latter stage of this process left evidence - the clay vessels and stands used for the boiling of brine. Salt-making was probably seasonal, as the natural evaporation would require hot, sunny days during the summer months.

It is not clear why there should be large-scale production of salt at this time. It was possibly due to the increase in 'ranching' and the need to give animals salt in their feed, as well as preserving the meat through winter months.

In the period 600-100 B.C. brine springs were used to obtain salt, as well as continuing with the method described above. These springs were found in the West Midlands (a major site being at Droitwich) and Cheshire, and it is believed that salt from these areas was transported up to 120 kilometres (75 miles) from source.

By 100 B.C. to 50 A.D. salt was being exported, along with tin, copper, iron and lead.

By the time of the Celts (around 500 B.C.), salt was being mined as well as being produced by the evaporation of sea-water. The Celts preserved meat with the salt, as well as eating it with porridge.

Those nations that the Celts traded with began to realise that Britain was rich in salt deposits. It is believed that one of the reasons that the Romans invaded Britain (in 55 A.D.) was to gain these salt supplies for their ever growing Empire. Campaigning Roman soldiers were paid 'salt money' or 'salarium', and the word 'salary' comes from this practice.
In **Roman Britain** salt continued to be produced by the evaporation of brine. The Romans extended centres of production (salterns) around Britain, in areas such as the Lincolnshire Fens, where production had begun during the Iron Age. These salterns were often located on or close to settlements. Peasants from these settlements probably added salt-making to their farming activities. Those salterns which were far from settlements were worked by convicts (both male and female) who had been condemned to hard labour.

Evidence shows that these salterns reached their hey-day in the first two centuries, and little evidence has been found to suggest that they were worked after about 300 A.D.

The Roman name for the town of Droitwich (home of brine springs) was **Salinae**.

Italy's oldest road, Via Salaria, was built to carry salt from Rome to the Adriatic Coast. The **Anglo-Saxons** used salt to preserve meat, flavour food and disguise the taste of rotting food! Salt was also used in the butter and cheese-making processes. Although salt was obtained by the evaporation method it was expensive. Sometimes only the 'Lord-of-the-manor' could afford to buy salt and the poor often had to go without. The map below shows the salt roads (or 'saltways') that had developed from Droitwich to other parts of the country by Saxon times. The salt was carried by pack-horse or waggon to markets in central England.

The names of ancient salt routes can still be spotted today, such as 'Salt Way' or 'White Way'.

The map has been reproduced by kind permission of Della Hook, *The Anglo-Saxon Landscape, the Kingdom of Hwicce*, (Manchester University Press, 1985).
In Gloucestershire some saltways can be seen on the Ordnance Survey map. One begins near Dumbleton in the north, passed through Hailes, up Salters Lane to the top of Salters Hill, along the Salt Way past Hawling and Chedworth, past Saltway Farm, east of Colne St Dennis and down to Lechlade. Many of these routes were pre-Saxon and probably pre-Roman.

Wood was used as fuel for boiling brine in the salterns, and by the late Saxon period was being transported considerable distances.

By the Middle Ages (1300-1500) salt was being widely used, in the preparation of leather, in a process called 'the rubbing of chimneys', in the soldering of pipes and gutters, in the manufacture of distillates from wine, in remedies thought to cure toothache or relieve acidity and, above all, in the preservation and flavouring of the majority of foods. The large-scale herring-industry of the period demanded particularly large quantities of salt for curing. Butter and cheese were heavily salted in the Middle Ages, 1 lb. of salt being added to every 10 lb. produced!

The demand for these vast quantities of salt was met by three main centres of production in northern Germany, the coast of the Low Countries (Holland, etc.) and the east coast of England. The German centre boiled brine from local springs, the Dutch dried and
burnt peat which had been impregnated with salt by the action of sea-water (salt remained, being non-inflammable) and the English used brine-springs, evaporation of sea-water and impregnated peat. Obtaining peat-salt, especially in the Low Countries, decreased during the Middle Ages. The reasons were two-fold, the raw material became scarce and the digging of peat right up to the dykes undermined the Low Countries’ only defence against the sea.

Salt was clearly a very precious commodity and during the Middle Ages whether you sat at the meal table above or 'below the salt' indicated your status. If you sat above the salt cellar you were of the rank and could use the salt. If you were below the salt cellar, you were of less importance and could not use the salt!

Salt taxes have been imposed during many periods of history and many parts of the world. For example, peat-salt was taxed in the Middle Ages. One of the most famous salt-taxes was that imposed by the British government in India. When the British took over rule of India in the mid-nineteenth century they abolished most of the Muslim taxes, but kept the salt tax. A 'salt office' was set up in 1780 and the British assumed a monopoly and the rights to manufacture, thus making private manufacture and the possession of salt from non-government sources illegal. This tax remained throughout British rule and the bitterness towards it reached its height during the 1920s when Lord Reading increased the salt tax.

As part of a general struggle with the British government, Mahatma Gandhi and the Indian National Congress led a national campaign of defiance against the salt laws in 1930. Throughout the nineteenth century there had been regional attempts to oppose the salt laws, but this was the first on a national scale. To Gandhi the British policy had led to the destruction of an easy village industry and involved wanton wastage of natural salt available in abundance. The tax itself exceeded 1000 per cent of the cost of the original salt!

Gandhi wrote a letter to the Viceroy Lord Irwin on 2 March 1930. He wrote:

If you cannot see your way to deal with these evils and my letter makes no appeal to your heart, then on the twelfth day of this month I shall proceed with such co-workers of the Ashram as I can take, to disregard the provisions of the salt laws. I regard this tax to be the most iniquitous of all from the poor man's standpoint. As the independence movement is essentially for the poorest in the land, the beginning will be made with this evil. The wonder is that we have submitted to the cruel (salt) monopoly for so long.

The Viceroy replied, expressing his regret at Gandhi's intended campaign, and so Gandhi began his three week march from Sabaramati to the sea at Dandi, reaching the shore on 6 April 1930. On his arrival he started to pick up pieces of salt lying on the beach, and his countrymen all over India followed his example; a nation-wide violation of the salt laws had begun. The spirit of resistance to the salt laws remained until the conclusion of the Gandhi-Irwin Pact in March 1931.
### References

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<th>Year</th>
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Geography

in

A Pinch of Salt
Geography

Suggestions given for activities in this section are linked to the science activities (pages 7-25) and historical information (pages 111-115).

1. In science Activity 5 (pages 20-21) the children investigate the effect of salty water on seed germination and plant growth. Children can research plant life in bodies of water such as the Dead Sea and the Baltic Sea. No plant life can survive the high levels of salt present in the Dead Sea, whereas the plant varieties change as you move from one end of the Baltic Sea to the other, as the salinity changes.

Children could locate the Dead Sea and the Baltic Sea on a globe or in an atlas, as well as other bodies of salt water such as The Great Salt Lake in the United States of America.

2. Linked with a science extension activity (page 14-15) children can learn about an application of the 'floaters' they used in their salt water investigation, i.e. the Plimsoll line. Ships float at different heights in different water because of the variation in density. Ships may carry identical cargo in weight but will; however, float higher in salt water than in fresh water, because the salt water is denser. Before loading ships the captain needs to know the route in order to determine the amount of cargo to carry. If a ship is loaded to its limits and then travels through sea water less dense than expected, it could sink dangerously low. Most ships are marked on a hull with a scale called the Plimsoll line, which became compulsory in 1876. It shows the maximum safe level to which the ship can be loaded, depending on the route and seas to be sailed.

3. Linked with a science extension activity (pages 17) children can be asked to think about why some countries take the salt out of water to obtain pure water? Hot and arid countries as well as small islands often obtain drinking water from sea water using desalination plants. The process used is a more sophisticated version of the evaporation of water from salty water that the children carry out in science Activity 3. The sun is usually used as the heat source, combined with the availability of large areas of land (semi-desert) to channel the sea water into large shallow pools. As the children discover in their science investigation (page 17) the greater the surface area of water exposed to the heat source, the faster the rate of evaporation of the water. Countries in the Middle East use natural gas as the source of heat for desalination plants, as it is a waste product from the huge oil refineries.

Desalinated water is used to irrigate land for crop growth in these hot countries, as well as for drinking water.
4. Linked with both science Activity 3 (pages 16-17) and history (pages 111-115) children can also be asked to find out information on different methods of salt production around the world today. For example, many hot countries still obtain salt by evaporating water from brine using the sun as the heat source, whereas the heat source used in Britain is often natural gas.

Every coastal country has produced sea salt commercially, and about 60 countries still do, either by industrial processes or by solar evaporation.

5. Also linked with evaporation, using information books and postcards, etc. children can find out about the large deposits of salt which are found in countries in the Mediterranean, such as Turkey. These are 300-500 metres thick and look like beautiful sculptures. These deposits formed in shallow water 5-6 million years ago. They suggest that they Mediterranean basin must have been cut off from the Atlantic and evaporated to near dryness, for so much salt to have been deposited.

Some children may have visited some of these Mediterranean countries and have photographs, etc. of the salt deposits.

6. The names of ancient salt routes still remain in some areas of Britain today (see the example on page 113). The children can be asked to look at maps (either local or of a well-known salt-producing county such as Gloucestershire) to try and find names that relate to the salt trade of Britain.

7. A collection of as many different brands of salt as possible can be collected and the labels read to identify the town or country of origin. These places can then be found on a map of the British Isles or Europe, etc.

8. The children can find out why the sea is salty. Some reasons are too complicated for children to understand, but one of the three main reasons can be studied. This reason is to do with the weathering of rocks exposed on land. These exposed rocks slowly break down when exposed to wind and rain. Any salts contained in the rocks are dissolved, washed into the soils, then the rivers, and finally the ocean.

9. Children could find out about salt mines in Britain, locate them, find out if they are in use, and if not, what they are used for today. The vast disused salt caverns under areas of Britain are often used today for storage purposes. See the list of useful addresses on page 5 for further information.
Religious Education

in

A Pinch of Salt
Religious Education

The selection the teacher makes from the following information to share with children should be handled sensitively and with the children's age and ability in mind. The context for the information should also be considered carefully, to provide a meaningful activity for children. An example of such an activity is given on page 122.

The symbolism of salt

The use of salt as a preservative and a seasoning has been so important throughout history that it gained a wide variety of symbolic meanings in many cultures and religions. Below are a few examples of these symbols, which feature predominantly in the Jewish, Christian and Shinto faiths.

Judaism

Salt was offered up with every sacrifice made in the Temple (Lev. 2:13) in Jerusalem and represented the eternal covenant between God and Israel, as salt does not decompose. The Kashrut (dietary laws) says 'The eating of meat is a compromise of human weakness and need that we must therefore have reverence for the life of the animal which we take.' and the rituals involved in the sacrifice reflected this. This sacred symbolism continued in the Jewish home after the destruction of the Temple. The home became a sanctuary, the table became an alter, every meal a sacrifice and each Jew a priest. Therefore, salt is sprinkled on bread with which Jewish people begin a meal.

Some people still maintain the tradition of washing hands after a meal to prevent rubbing any salt remaining on their fingers into their eyes. This hand-washing was encouraged by the Kabbalah (the oral tradition of the Old Testament) as an offering to appease the powers of evil.

Also to ward off evil, salt is put in children's pockets or hung in little packets round their necks.

Bread and salt would be the first things brought into a new home and were also used to greet visitors.

Salt also signified the fellowship of the table and the shared meal, as it did for the Greeks and Romans.

Christianity

In the Acts of the Apostles (1:4), the Greek word 'sunalizomenos' is usually translated 'eating together' but literally means 'taking salt together'.

In the early Christian faith salt was thought to ward off evil or bad luck. Salt was thought to drive off the devil (explaining today's custom of throwing salt over one's left shoulder if any was spilled, as the Devil is said to sit there). This symbolic use of salt derived from its ability to preserve meat from 'corruption'.

Salt also gives wisdom, according to the pre-baptism rites in Catholicism. It also symbolised spiritual health, as it was an ingredient of many medicines.
Early Christians interpreted salt as God's word, spiritual discourse and preaching. Saint Paul said 'Let your speech be grace, seasoned with salt' (Col. 4:16).

Jesus says, in the sermon on the mount 'Ye are the salt of the earth' (Matthew 5:13), salt being used as a symbol of great worth.

As with most other symbols, salt has a negative aspect. References to salt in the Bible include; salt being sown on a destroyed city as a symbol of sterility; a curse producing a salt marsh, a salt pit or a land of brimstone and salt; Lot's wife being turned into a pillar of salt after looking back at a city.

**Shinto**

In Shinto, salt is used to purify. Little piles of "mori shio" (piled up salt) are left outside houses so that people who pass through the door are purified. People that come back from a funeral use this salt or other salt to purify themselves by scattering salt upon their body. Salt will be scattered on the ground in the pacifying of spirits of the land ceremony held on the empty plot before the buildings are erected.

The purifying and protecting virtue of salt is evoked in Japanese Shinto ceremonies. This can be observed today, when sumo wrestlers sprinkle salt on the mat as part of the ceremony before beginning a fight, to drive off malevolent spirits.

Salt is an offering made to the spirits (kami) on the household altar in a little dish (again in a little conical pile) and at shrines again in piles, sometimes enormous conical piles.

In Shinto mythology we are told that the first land mass Onogoro Shima, (self congealing island) was formed when the salt separated from the brine when Izanagi(-no-mikoto) stirred it up with his jewelled lance.

Salt is very popular in Japanese culture. A great deal of Japanese food is salt, especially shoyu (soy sauce) and miso (curdled soya bean paste) which is eaten at almost every traditional meal. There are also salt saunas were people rub salt on themselves as they sweat to make themselves sweat more to purify their skin.

**Islam**

References to salt in Islam are limited. Salt is described as hot and dry and in the 'third degree' (which refers to it's perfection in it's purified form). There are several sayings (known as Hadiths) by the Prophet Mohammed that relate to salt, listed below. There is also a story that the Prophet Mohammed was once stung by a scorpion whilst praying, and was then treated repeatedly with salt water until the swelling went down and the Prophet was cured.

'The lord of your food is salt.'

'Truly Allah has sent down four blessings from heaven: iron, fire, water and salt.'

'Start eating with salt and end off eating with salt, for salt carries the cure of 70 sickneses.'
Salt's ability to preserve meat from 'corruption' provides the reason for salt being rubbed on to newborn babies by ancient Greeks and Persians. It is still practiced by people of the Toda of India and Lao of Asia.

In early Hindu literature (Upanisads) a grain of salt dissolved in water is a symbol of the re-absorption of the ego in the 'universal self', i.e. in simple terms, a symbol of selfless rather than selfish thoughts and actions.

References to salt among early Native Americans are rare, although there was an Aztec goddess of salt, Huixtocihautl.

In Buddhist tradition, salt repels evil spirits. That's why it's customary to throw salt over your shoulder before entering your house after a funeral: It scares off evil spirits that may be clinging to your back.

In the Southwest, the Pueblo worship the Salt Mother. Other native tribes had significant restrictions on who was permitted to eat salt. Hopi legend holds that the angry Warrior Twins punished mankind by placing valuable salt deposits far from civilization, requiring hard work and bravery to harvest the precious mineral.

In 1933 the Dali Lama was buried sitting up in a bed of salt.
Sample activity using this information

The information on the Jewish tradition of eating bread and salt before a meal (given on page 117) is introduced to children during chapter 5 of *Salt and Gold* (see Activity sheets E1-6), as bread and salt plays an important role in the story.

The class discusses customs and traditions and where children think they originate from. The teacher tells children that the tradition of giving visitors bread and salt comes from a religious **symbol**. Children may be familiar with signs as symbols, such as a cross representing Christianity or the Star of David representing Judaism, but less familiar with physical symbols. The teacher could use a modern-day example of a school Harvest Festival to which children bring food from home. Amongst the display (or displayed in shop windows) there is often a bundle of wheat or a loaf shaped into a wheat sheaf. This symbolises the good harvest collected in autumn.

After discussion, groups of children are presented with a set of cards, each card containing a statement. The statements on the cards could include:

| Jewish people eat salt and bread before a meal. |
| In the Japanese religion of 'Shinto' salt is a symbol of protection. |
| If salt is spilled, some people throw a pinch over their left shoulder to prevent anything unlucky happening to them. |
| Early Christians and Jews believed that salt helped to keep bad luck of the Devil away. Early Christians also thought the Devil sat on someone's left shoulder. |
| Many years ago, priests sprinkled salt on the altar before a sacrifice. Today the meal table is a symbol of this altar. |
| Before a contest, Sumo wrestlers sprinkle the mat in front of them with salt. |

The children are asked to match pairs of statements, one statement linking a practice or custom today with a religious reason from the past.

The matched statements can provide the basis for further discussion or research.