Contents

Introduction

Hello! We hope you enjoy using this revised book and CD and that the ideas in it help add to your toolbox of resources for teaching science.

About the book

The main idea behind *Using Stories to teach Science Ages 9-11* is to use stories as a different way of initiating a science lesson. A science concept is presented in a format that shows how science can relate to normal (or imagined!) life and that helps the children learn about science concepts in a fun way. The more ways, especially fun ways, we look at a subject we're learning, the more likely we are to understand it and to remember it!

The stories and poems in the book have been written and road-tested over a number of years in schools across the UK. Inevitably, over the years the science curriculum has changed and been modified, however as the core skills and concepts children need to learn at any age are essentially the same, we have been able to link the stories to the new curriculum.

We hope that the stories and poems can provide a resource for initiating or supporting work to cover the Programmes of Study for each year group. Therefore in the teachers' notes accompanying each piece, we quote the Programmes of Study and supporting Notes and Guidance specified within the new curriculum. In the teachers' notes we also suggest follow-up work, often incorporating worksheets or the illustrations that accompany the pieces, which you can use to create a whole lesson, or several lessons, around each piece.

In each case, the story and its associated lesson could be used to introduce each topic or could be incorporated into the series of lessons you are planning for that area of science. Of course suggested lesson plans are only a guide and so you can pick and choose the suggestions and ideas that will work best in your school, with your class etc.

Reading the story

When you read the children the story we recommend that you read them the story twice. The first time as a story in its truest sense – a story they can listen to and enjoy as a piece of narrative, without it being broken up and dissected as it's told. Hopefully the enjoyment they get from the story will enhance their enjoyment of the science they are learning. However, on the first reading of the story, they may have been so involved in the plot etc. that they miss some of the science ideas that are used in the story.

On the second reading, you can get the children to focus on the science ideas by stopping at the points where a new science concept enters into the narrative and discussing its role in the story, using an enlarged copy. This also means that the children will be able to enjoy seeing – and learning from – the illustrations as well and many of the children will enjoy reading the story with you.

Using the lesson plans

Each lesson plan highlights aspects of the programmes of study covered by each piece. The stories can introduce topics, cover key specific points or reinforce particular concepts.

Within the planning we have added reference statements headed **WALT**, **WILF** and **TIB** as these or similar systems are often used to ensure lessons are focused, objective led and in context for the learner. They help summarise purpose of the lesson, what is required of the children in order for them to successfully learn that lesson and why what they are learning is important.

WALT stands for "We Are Learning Today."

WILF stands for "What I'm Looking For."

TIB stands for "This Is Because."

The worksheets/record sheets are designed to support the learning the children are making in science. We recognise that completing them will often require literacy skills, which in a few cases the children will not have at the required level. In order that the work remains focused on science, we suggest that you or your classroom assistants etc. scribes for such children so that their capability in science is not held back by specific difficulties with literacy. The investigative lessons support assessment for learning by enabling time for teachers and/or classroom assistants to record comments made by the children as they plan experiments/discuss predictions etc.

Links to curriculum

Story	Science topic(s) covered	Curriculum links Year Five	Curriculum links Year Six
		Programme of Study (PS)	**Programme of Study (PS)**
		Notes & Guidance (NG)	**Notes & Guidance (NG)**
		Follow-up material from each section supports "Working scientifically" requirements.	Follow-up material from each section supports "Working scientifically" requirements.
Insulation frustration	Use of materials for insulation	Properties and changes of materials (PS & NG)	
A cutlass for Captain Crook	Separation by sieving/Changes to materials by heating	Properties and changes of materials (PS & NG) Also useful for Y4 "States of Matter"	
Galoncs and bearded lizards	Dissolved substances and how to separate them	Properties and changes of materials (PS & NG)	
The un-mixed mixed salad	Reversible and irreversible changes	Properties and changes of materials (PS & NG)	
Bank friction	Friction	Forces (PS & NG)	
Forces poem	Forces in action	Forces (PS & NG) (Also useful "Hoppy springs back in to action" in *Using Stories to teach Science Ages 7-9*)	
No ageing at all gel	Ageing of the body	Animals including humans (PS & NG)	
Rose tours	Life cycles of plants/ structure of flowers	Living things and their habitats (PS & NG)	(Useful resource for All living things Y6 section is "Fabulo's exotic pets" in *Using Stories to teach Science Ages 7-9)*
Not in the middle poem **How to be a healthy planet** **Planets poem**	Earth, Sun and Moon	Earth and space (PS & NG)	

Story	Maths topic(s) covered	Curriculum links Year Five	Curriculum links Year Six
		Programme of Study (PS)	Programme of Study (PS)
		Notes & Guidance (NG)	Notes & Guidance (NG)
Conductors v. Insulators	Changing circuits	Properties and changes of materials (PS & NG)	Electricity (PS & NG) (Also useful "Ernie the Electron" and "Mouse Story" in *Using Stories to teach Science Ages 7-9*)
Not a good idea **Goldilocks and the three beers** **How to be a healthy…** **Body parts poem**	Keeping Healthy/ body parts		Animals including humans (PS & NG)
Evolution revolution	Evolution		Evolution and inheritance (PS & NG) (Also useful "Same Planet" in *Using Stories to teach Science Ages 6-7*)
Today with Trevor MacIntosh	Micro-organisms		Living things and their habitats (PS)
Find the bone	How we see things		Light (PS & NG) (Also useful "Romeo and Juliet II" in *Using Stories to teach Science Ages 7-9*)
Silly circulation	Blood circulation system		Animals including humans (PS & NG)
Classification Calypso	Classification		Living things and their habitats (PS & NG) (Also useful "Fabulo's exotic pets" in *Using Stories to teach Science Ages 7-9*)

Insulation frustration

Links to curriculum

Year Five
Properties and changes of materials
Compare and group together everyday materials on the basis of their properties including their conductivity (thermal). (PS)

Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials. (PS)

Pupils might work scientifically by: carrying out tests to answer questions, for example "Which materials would be the most effective for making a warm jacket, for wrapping ice cream to stop it melting? (NG)

Background

The poem that goes with this section, called "Insulation Frustration", explores a child's confusion that her coat can keep her warm but also keep her gran's milk cold when they have a power cut. Many children can find it a challenging idea to think that an insulator can both keep things warm, by slowing down loss of heat to the surroundings, but also keep things cold, by reducing the rate at which the warmth of the surroundings can warm them up. (It's actually important to help them avoid thinking thermal insulators stop the "cold escaping" in this later case – the surroundings provide heat energy that raises the temperature of the cold substances.)

Some of the tests that the children plan as part of this unit could involve melting ice. You may find the poem "Loopy Leticia's Long-Lasting Lolly" and the story "Holiday Resort Competition" in our Age 6-7 book a useful way of reminding the children about how ice melts to water.

The poem could be read and presented by you, or you could read the poem yourself but get some of the children to take on the roles of girl, mum and gran and act out the action of the poem as you read it. Or, you could ask a confident reader to share the poem with the class while other children act it out. The only "props" needed are a coat (which may not be fawn as in the poem but you can ask the children to pretend that it is!) and a milk bottle – one of the children's water bottles could stand in as a milk bottle. (Also gran could have a chair to sit on!!)

The poem suggests the testing of materials to see how good (and possibly why) they are as insulators and for this lesson we suggest that you ask the children to design suitable and safe experiments in order to do this. Some experiments could use different materials, others could involve using increasing levels of insulation by the same material e.g. by adding more layers of bubble wrap and the effect of insulators slowing down cooling or warming could also be investigated. This work could also incorporate use of ICT approaches, encouraging the children to record their work in suitable ways, so that they can then chose appropriate ways of presenting their results, such as a continuous line graph.

Resources

- Different materials to be tested, such as; bubble wrap, sponge sheeting, aluminium foil, blanket material, cotton paper, polystyrene wrap, polythene bags.
- Temperature sensors or suitable thermometers*
- Containers – such as metal pie tins – in which ice cubes and warm water can be placed.**
- Ice cubes. Warm water.
- Planning resource sheets.
- Recording material – paper and pencils
- Suitable ICT graphing package
- Clock/timer/stopwatch.

*Mercury thermometers are not safe to use in primary schools.

**N.B. Ice cubes should not be touched by the children when they first come out of the freezer and any water used should be warm but not hot.

Lesson plan

Present the poem to the children, possibly with some of the children acting out the plot, (see chapter on friction for a list of possible audiences the children could also perform the poem to!) and then discuss the poem with them. Ask the children what it was that the girl in the poem found confusing and why. (The same insulator – her coat – kept her warm but the milk cold.) Find out if any of the children were surprised as well and ask them to explain what they may have learned from the poem. The poem suggests some ideas that the children could test through their own experiments. Ask the children to explain what these ideas were and to suggest any other ways in which the idea of insulation could be tested. (The poem suggests testing different materials but for example the children might want to test the same material in different conditions – e.g. increasing layers.)

Tell the children that you are going to ask them to design their own experiments to test the use of insulators, using the materials you've got available for them and utilising the planning sheet as a way of helping them plan a suitable and safe experiment. When they have collected their results they will be asked to use a computer programme to help them present their results, which they will then be reporting back to the rest of the class.

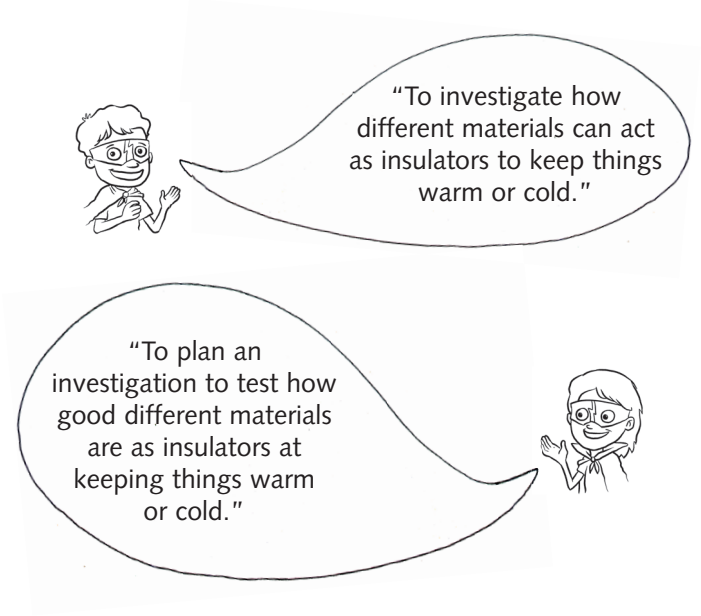
In order to help get across one of the main ideas of the poem, i.e. that the same insulator can keep things warm as well as keeping things cold, you may need to ask half the class test to test warming while the other tests heating – unless the children divide themselves up naturally this way! Review safety procedures regarding use of ice cubes and warm water. The children must not touch ice cubes when they first come out of a freezer and the water that they use must be warm but not hot.

Check that the children know how to safely and accurately use the temperature sensors or thermometers they are using, possibly by demonstrating how to use them. Ask them why it is necessary to use them safely and accurately.

Remind them that the planning sheet will encourage and remind them to make their investigation a fair test, such as using the same number of ice cubes or containers of the same size. Ask them to give examples of ways in which they can ensure their experiment is a fair test. They will also be prompted to carry out a "control" test. This is a test all scientists will do to make sure what they are testing has an effect in the first place – the ice and water are going to warm up/cool down anyway! – so a "control" test in this case is to see how quickly/slowly they reach room temperature without any insulation being used at all.

Ask the children to go through the plan of their experiment outlined on their planning resource sheet before they begin their investigation, so that you can check the safety and suitability of their plan. As the children are designing their own experiments, the work will be differentiated by outcome.

As the children work on presenting their results using the ICT package, you could show them how with the results they are likely to gather varying with both temperature and time that a pie chart is not a suitable way to display their results. Bar charts comparing the temperatures at different times will also not be the clearest way to do so either, as the change in temperature of the water or the ice will be continuous, changing in between the times they check the temperature. So it will be probably be clearer to display the results of the different tests they will have done as line graphs that can be shown together.



Plenary

At the end of the lesson you could ask the children to present their results to the rest of the class and discuss the results of each test and the overall findings of the class. Discuss how successfully the way each group has presented its results using the ICT resources and ask what other tests the children might do in light of what they have discovered so far about the different materials they tested.

It would be interesting if the children can describe any common features of the materials that they used, which proved to be good insulators. Many of them will have lots of air spaces in them (air is a very poor conductor of heat so trapped air slows down the transfer of heat) however they may be surprised by results gained from using silver foil, which of course is fairly thin and doesn't trap much air, even when placed in layers! Foil works by reflecting one form of heat energy (radiant energy) so it either reflects it back to the warm water or away from the ice it's covering. (Some types of vacuum flask contain shiny metal layers and fire-fighters wearing shiny clothing can stand closer to a fire.)

Insulation frustration

Please help me out,
I'm all confused,
About the way,
My coat was used.

We went out,
One windy day,
(Around about
The middle of May.)

Mum said "coats on,
To keep you warm."
(Mine is lovely,
A beautiful fawn.)

My thick coat,
Kept in the heat,
As we went to gran's,
In Albion Street.

Poor old gran,
Had had a power cut,
A gas fire kept her warm but
The lights had all gone "phut".

Gran sat by the fire,
Keeping good and hot,
We did some useful jobs for her
And filled up the teapot.

Without the fridge, to keep it cold,
The milk was warming up,
It would go sour, in half an hour –
Before my gran's next cup!

Mum looked for something
To keep it nice and cool,
That was when she saw my coat,
Dangling on the stool.

She put my coat all over it,
To keep the heat at bay,
Personally I was so amazed,
I didn't know what to say.

It worked though I tell you,
The bottle stayed cool OK,
With my coat all over it,
It kept the heat away.

Now can you see why
I'm feeling so confused –
About the two different ways
In which my coat was used.

When I had my coat on,
I was warm and bold,
But then on the bottle,
It kept it very cold!

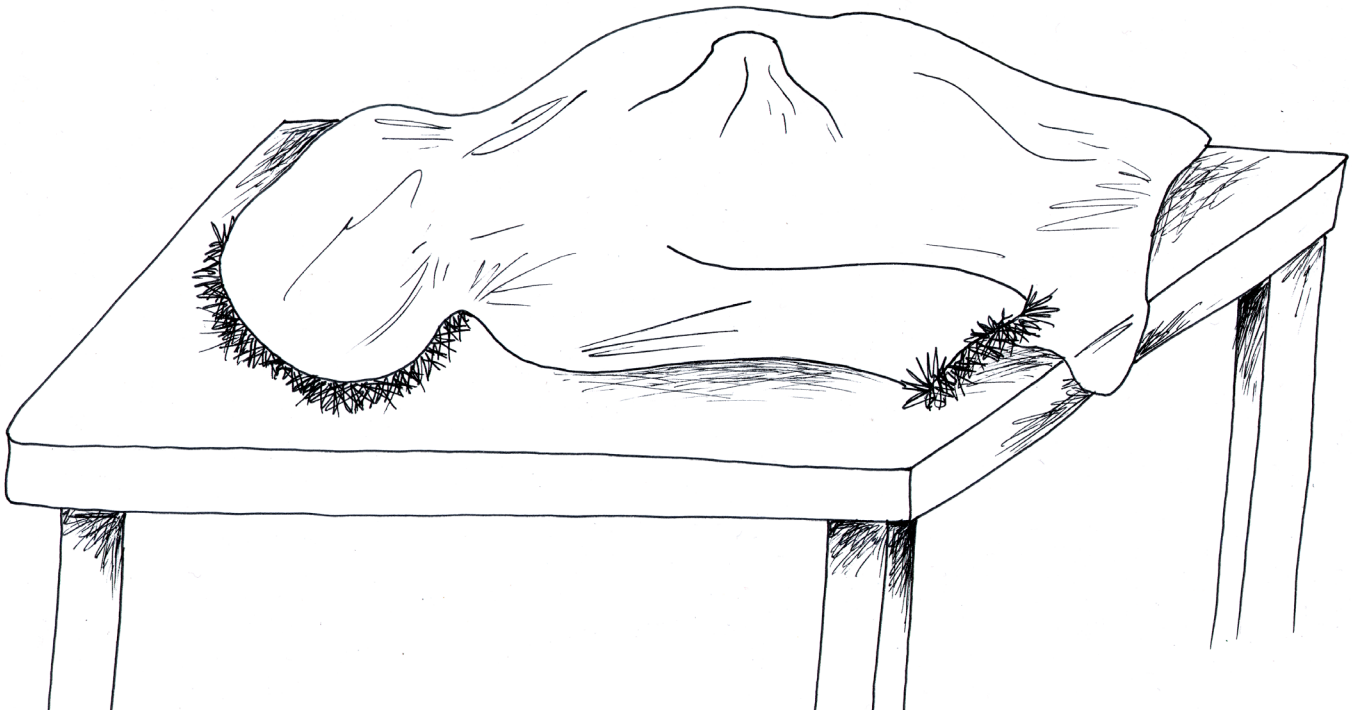
My mum tried to explain,
And spoke of "Insulation",
I didn't understand –
Hence my frustration.

Somehow my coat stopped
Heat getting through,
Whether keeping heat inside,
Or out, was what we had to do.

My furry jacket,
Is full of pockets of air,
Maybe heat has trouble,
Passing through there?

Perhaps you could help me?
Maybe do a test?
To see which material
Stops heat moving best.

If you find something out,
Write and let me know!
I wonder what materials
Make heat change real slow?



Warming up

Name: _____

You are going to carry out an investigation to see **if materials can affect how quickly ice melts to water and warms up to room temperature**. You might want to test different materials, or different amounts of the same material.

As this is a science investigation, before you begin you need to think carefully about what you are going to do. Discuss your investigation and then answer the questions on this sheet before beginning your investigation.

Are you going to test different materials or different amounts of same material? _____

_____

Why have you decided to do this test you have chosen?_____

_____

How many different tests will you do? _____

What test do you need to do to make sure it is the material you are testing that is affecting how

quickly the ice warms up? (Scientists would call this your "control" test.) _____

_____

How often will you measure the temperature of the ice/water until it reaches room temperature?

_____

How will you record your measurements as you make them? _____

How will you make sure you are carrying our fair tests? _____

How will you present your measurements to show what you have found in your investigation?

_____

What is your prediction about what you will find? _____

_____

Good luck with your investigation!

Cooling down

Name: _____

You are going to carry out an investigation to see **if materials affect how quickly warm water cools down to room temperature**. You might want to test different materials, or different amounts of the same material.

As this is a science investigation, before you begin you need to think carefully about what you are going to do. Discuss your investigation and then answer the questions on this sheet before beginning your investigation.

Are you going to test different materials or different amounts of same material? _____

_____

Why have you decided to do this test you have chosen? _____

_____

How many different tests will you do? _____

What test do you need to do to make sure it is the material you are testing that is affecting how quickly the water cools down? (Scientists would call this your "control" test.)

_____

_____

How often will you measure the temperature of the water until it reaches room temperature?

_____

How will you record your measurements as you make them? _____

How will you make sure you are carrying our fair tests? _____

How will you present your measurements to show what you have found in your investigation?

_____

What is your prediction about what you will find? _____

Good luck with your investigation!

A cutlass for Captain Crook

Links to curriculum

Year Four
States of matter
Observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C). (PS)

Pupils might work scientifically by: They could research the temperature at which materials change state, such as when iron melts. (NG)

Year Five
Properties and changes of materials
Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating. (PS)

They should explore reversible changes, including… filtering, sieving. (NG)

Background

This is a story about the captain of a British ship in pursuit of pirates, Joel Christian, who is marooned on an island by the infamous Captain Crook. The pirates, led by Captain Crook contaminate the three pools of water on the island in different ways. One is filled with Plaster of Paris and so becomes solid and unusable, one with salt and one with sand. Joel works out that he can purify the water from the pool contaminated with sand by filtering out the water. He thinks he should be able to purify the salty water but doesn't know how to – this is a clue to future work regarding separation of dissolved substances from a liquid. (See "Galoncs and bearded lizards".)

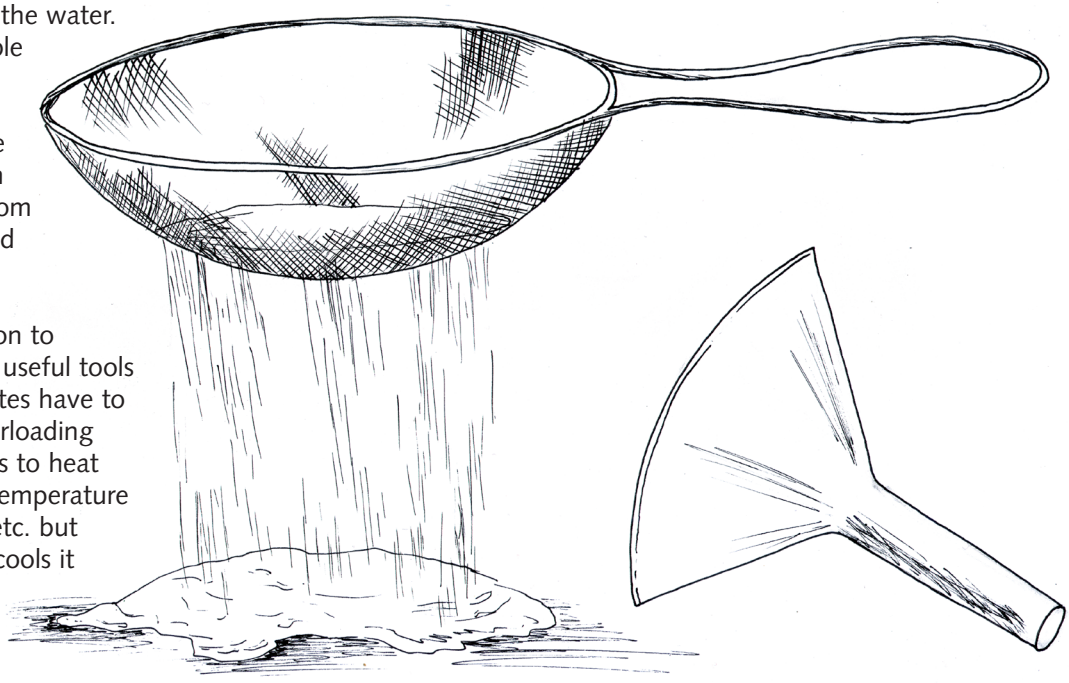
Joel then turns his attention to making swords and other useful tools from the treasure the pirates have to leave behind to avoid overloading their boat. He finds he has to heat the metal to a very high temperature before melting the coins etc. but that as the molten metal cools it solidifies again in the moulds he makes. Of course, once again, good triumphs over evil (not entirely true or the staff of our banks would be in prison!) and Joel overcomes the pirates when they return to the island!

The story provides a stimulus for experiments involving filtering/sieving and introduces the idea that metals can be changed to liquid form by melting – but only by heating them up to very high temperatures. The term "alloy" is introduced. These are formed when a metal is made from a mixture of pure metals, usually giving them new metal better qualities. The invention of bronze by mixing copper and tin fuelled the developments of the Bronze Age of human history.

Resources

- Measuring jugs
- Funnels
- Filters/sieves e.g. narrow & wide mesh colanders, Hessian material, and filter paper
- Sand, salt*, sugar*, rice, glass beads, marbles, ball bearings
- Differentiated worksheets.

*Should you decide to do a "taste test" to demonstrate that the dissolved substances got through the filter, it is only safe to let the children taste a little of the solutions where only salt or sugar is dissolved. To avoid danger of contamination, buy salt and sugar specifically for this investigation.



Lesson plan

The aim is to give the children practical experience of filtering and sieving and to see that some substances can be separated by doing this, but others cannot. Their investigations should also show that filters and sieves vary in their capacity to separate substances – the finer filters letting fewer substances through – so choice of filter is an important consideration when carrying out a particular filtering task.

The narrative and illustrations of the story will enable you to give the children a good idea of how Joel separates the sand from the water and you could ask the children to describe back to you what is going on so that the concept of filtering/sieving becomes clearer to them. You could also act through what he does, with the equipment that you will have prepared for the investigation that the children will do.

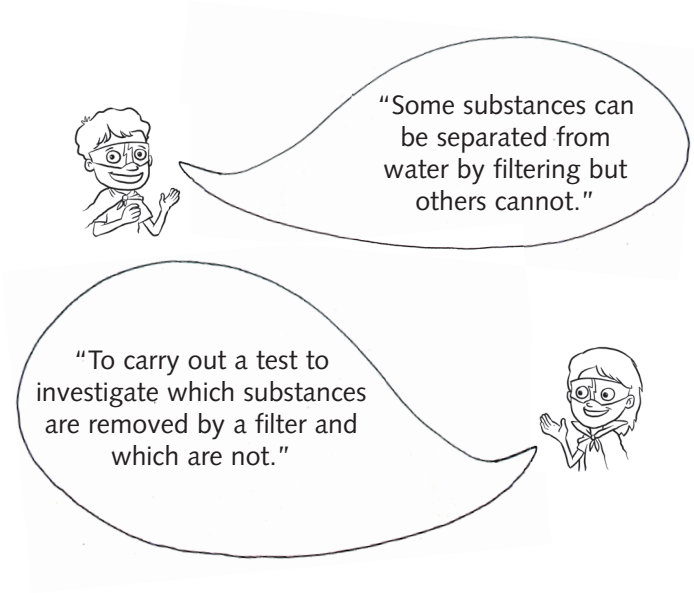
It is also necessary for the children to appreciate the difference between substances which dissolve in water and those that don't – as the children will see, dissolved substances get through all the filters. You could demonstrate stirring-in some salt or sugar into a glass of water compared to stirring in some sand. The sand will of course remain visible but the salt or sugar will cease to become visible. It is important to emphasise that the salt or sugar has not disappeared it has just broken down into such small "particles" it is now not possible to see it. (If you use too much sugar or salt it won't all dissolve – the water eventually becomes "saturated" with salt/sugar and no more can dissolve into it.)

Provide the children with different mixtures (or you could get them to make them for you, having first discussed which would be interesting mixtures to try and filter) – such as sand and water/salt and water/ sugar, sand and water. Also provide the children with different potential filters, such as fine mesh colanders, large mesh colanders, Hessian material etc.

Divide the children into groups and assign them different filters to see what will pass though each filter and what won't.

The high achiever groups are asked to pour the same volume of mixture through their filter and measure how much liquid passes through each time, so they will have to be prepared to measure this accurately. On the high achiever worksheet (b), they are asked to choose the volume of mixture they will use each time but you could check that this is a sensible amount. (We suggest somewhere in the region of ½ a litre – 50cl or 500ml in other ways of describing it) They will also have to filter their mixtures into a measuring container each time so they can measure how much passes though each time.

Each group is asked to make a prediction about what will happen each time, the average and higher attainer groups are asked to explain their predictions. They are also asked to explain their results. The higher attainer groups are asked to think about what their filter could be useful for, perhaps partly influenced by how successfully liquid passed though their filter. (For example it could work well in a similar way to that described in the story separating sand from water.)



Plenary

The children could be asked to report their results back to the class and as a class you can discuss the findings of the experiments.

A cutlass for Captain Crook

He called himself Captain Crook in mockery of the British sailing hero Captain Cook. He headed the vilest gang of pirates in the Caribbean at the time. A far larger network than we imagined when I, Joel Christian, was given the task of hunting him down for the British Navy. That was why we were so hopelessly outnumbered when he turned the hunt around and we suddenly became the hunted instead of the hunter.

We were chasing him in what we thought was his only ship, when to our horror, we found another two ships waiting for us as we pursued him around the peninsula of the island that became my prison for so many months!

So we were then just one ship against three. We didn't have a chance, though all my men fought bravely and we managed to sink one of his ships, an achievement that proved to be his undoing in the end.

Those of my men that survived were taken away to be sold as slaves but for me Captain Crook had a special punishment.

"I don't likes people chasing me," he sneered at me holding his face so close to mine that all I could breathe in was his foul smelling breath. I couldn't move because two strong men were holding my arms behind my back. "I thinks we should leaves a little warning for other sailors who thinks they can follow Captain Crook. Take him to the island!" he commanded his men.

So I was to be marooned on the island. That was a bitter enough fate as there was very little prospect of my ever being rescued. But Captain Crook had further evil in mind. The island was so small that it only had three small pools of fresh drinking water on it.

"We wants our little guest to really regret trying to chase us," the Captain joked to his men whilst leering at me. "So we is going to fill one of the pools with sand, another with salt and the third one with Plaster of Paris. When Mister Christian is feeling thirsty and has nothing to drink, maybe he'll regret chasing us."

Just as I was contemplating this further downturn in my fortunes and thinking that I would probably die of thirst on the island, one of Crook's men approached him.

"We've put as much treasure as we can from the sunken ship onto the others but there be four chests full of gold doubloons and other coins left over, if we tries to take them we'll sail too low in the water."

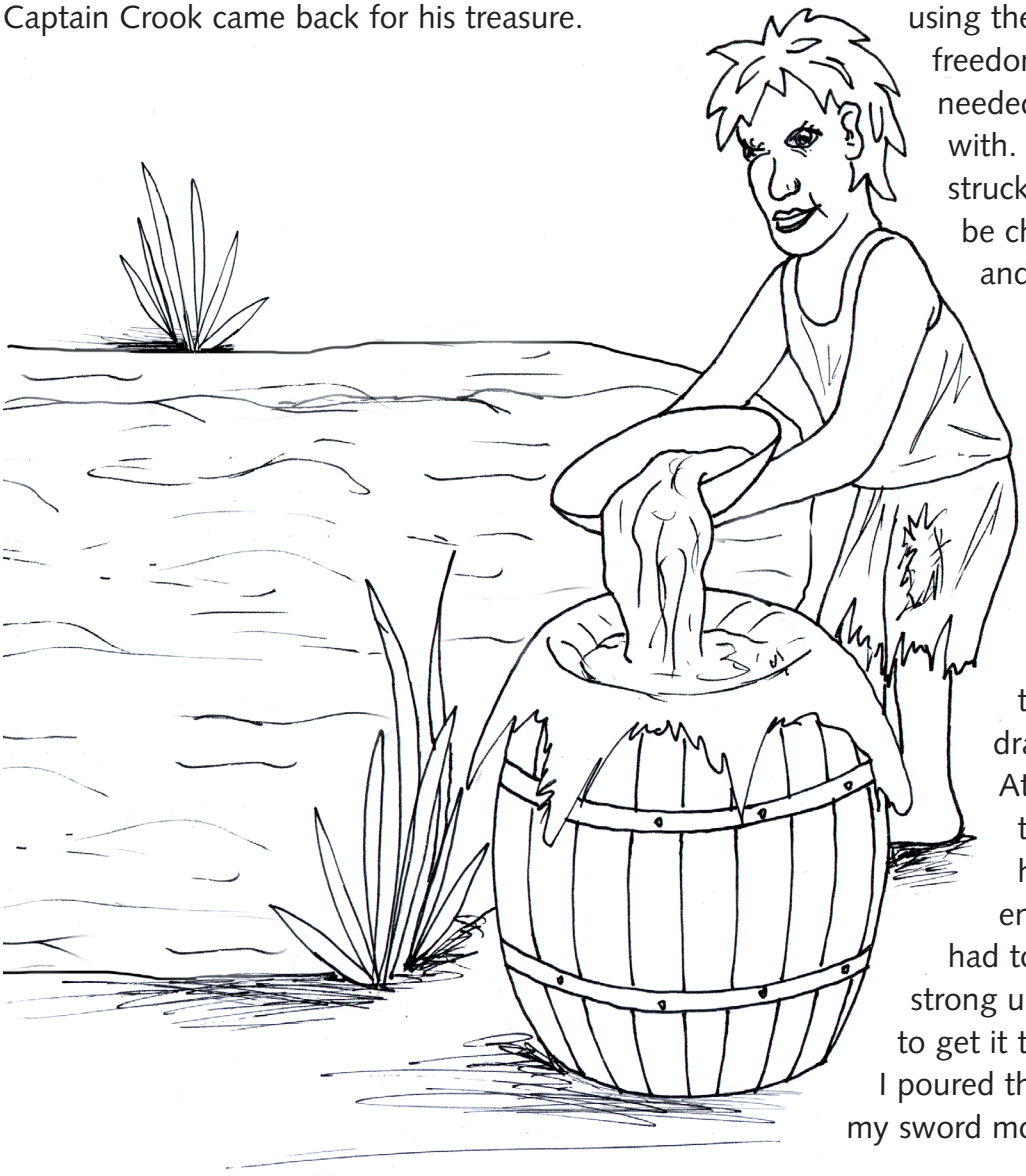
"Leave them here," replied Crook grinning maliciously at me again. "He'll have no use for them. He can't drink gold doubloons can he? We'll come back and collects them later and see if Mister Christian's bones has been picked clean by the birds. Ha ha ha ha ha!"

So he left me laughing evilly as he returned to his ship. Meanwhile I was racking my brains as to what to do so that I could have some fresh water to drink. The pool that they'd put some Plaster of Paris in was now completely solid, that would never be of any use to me. The pool that they'd poured salt in now tasted so strongly of salt it was even more undrinkable than seawater.

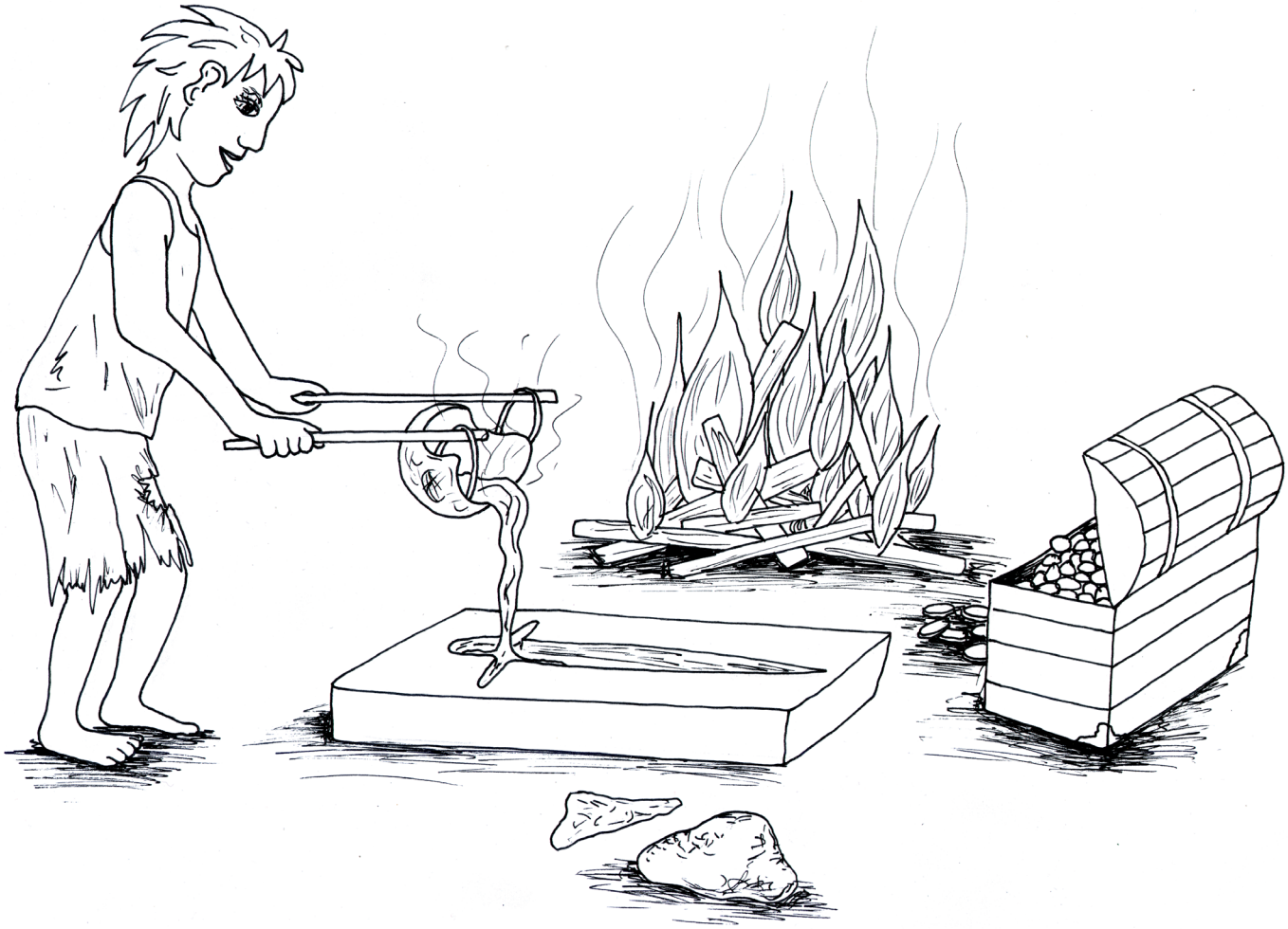
Then I remembered that some solids, like sand, don't dissolve into water and can be separated from it. I needed something to use to filter out the sand and decided to use some of the old sacking the pirates had left behind having littered the island with their rubbish. I fastened it over an empty barrel and scooped out the sand and water sludge that now filled the third pool. After a time I had clear fresh water in my barrel and sand I could clear away trapped on my makeshift filter! I started to believe that I might be able to survive on my prison island. I hoped the pool of sand and water sludge would keep me going until Captain Crook came back for his treasure.

I felt sure there must be a way to make drinkable water from the pool contaminated with salt but didn't know how to go about it. Then I thought about the return of the terrifying Captain Crook. He might not be pleased to find me still alive when he returned and might decide on some even more awful fate for me. I needed some way to defend myself but all I had on the island with me were the chests full of coins!

For many days I fretted and cursed my fate. Here I was on my island with a fortune in coins as company but no way of using the fortune to buy my freedom or the weapons I needed to defend myself with. Then inspiration struck. Of course! Metal can be changed if it's heated and reformed!



Using the hardest stones I could find, I chiselled the shape of a sword into a log. Then I tried heating the metal coins near my mould until the metal turned to liquid and I could drain it into my mould. At first I couldn't melt the metal because I hadn't made a big enough fire; the fire had to be very big and strong until I finally managed to get it to melt. When it did I poured the molten metal into my sword mould. When the metal



cooled again my mould had formed a crude sword! My first sword wasn't very good but I had plenty of time to practice. I found that using a mixture of different metals to make an alloy, often produced the best results. When I had made some good strong swords, I made myself other tools by melting down the metal and then cooling it down in moulds the shape of the tools I wanted.

Finally after weeks of waiting for him to retrieve his treasure, Captain Crook returned in his ship. It was a timely return for the sludge I was filtering was getting thicker and thicker producing less and less drinking water.

I had plenty of time to prepare myself before the rascals reached me and I concealed myself in a cavern I'd discovered. The captain and two men sailed up to the island on a small boat, just as it was becoming dark, which was perfect timing as far as I was concerned.

Crook burst into a rage when he found his chests of coins empty and he and his men began exploring the island to find me… or my remains. As they foolishly split up, I was able to capture them one by one. I then returned to their ship with the three of them bound and gagged. As the rest of Crook's crew weren't expecting any trouble, I soon captured them all too, one by one.

I then took sole charge of the ship. Ten days later I sailed into Kingston harbour in Jamaica, with a shipload of very precious cargo – pirate prisoners!

The End