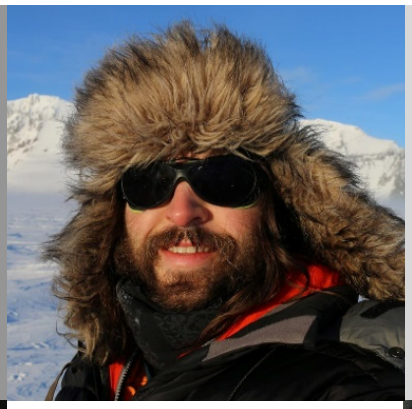
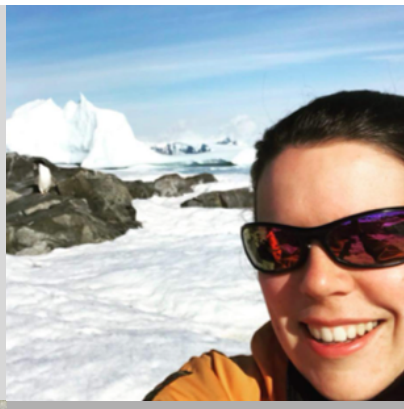
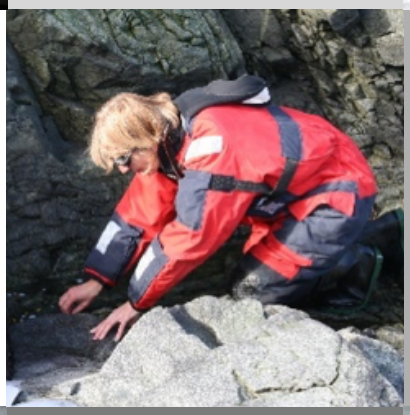
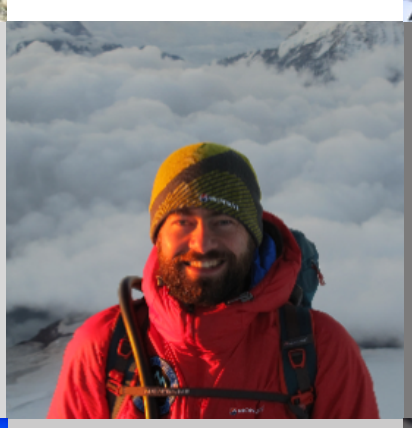
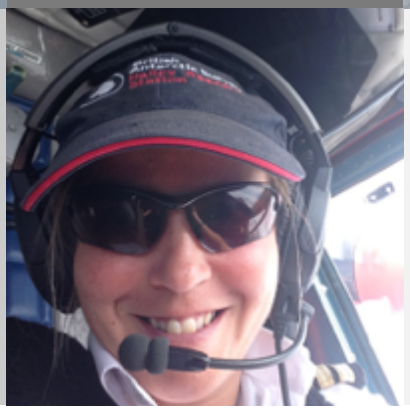
STEM LEARNING

POLAR EXPLORER PROGRAMME

COOKBOOK

HOW TO USE THIS BOOK

There are five activities in this book. They are designed to be delivered in a sequence but can also work as stand-alone activities. The activities are as follows:

Activity 1

Menu planning: Children will work together in pairs or threes to assemble and then compare two contrasting meals for different STEM professionals. They will consider the differing calorific needs of Melody, Ricky or Ibrar based on their differing roles. Careful consideration of the requirements and food available will be needed whilst planning and may also work to a budget and limited mass.

Activity 2

Follow the recipe: By using recipes to create at least two different dishes, one that is eaten in polar research bases today and another from historical explorations. The children will be able to show accuracy of measurements and comparative report writing.

Activity 3

What is the best way of preserving food? Children will set up an investigation to observe changes over time using their chosen method of preservation and notice and record changes to their food sample made in Activity 2 (ideally bread). NOTE: this activity needs at least one week before starting Activity 4.

Activity 4

Food storage: By investigating different approaches to storing and protecting food, children will understand how Station Managers manage food storage and protection in the polar regions. The children will test and select their preferred method based on the outcomes of a comparative test.

Activity 5

Transport logistics: By carrying the food the children have made (preserved and packaged), it will now be used to evaluate the best way to transport it from drop-off point in a place to the research base. The children will design an assault course or circuit for themselves and test out their earlier findings in a tough environment. Children will evaluate the different methods and advise Victoria of their recommendations.

This booklet is designed to support the Polar Explorer Programme, and the teachers' notes for each activity will also signpost you towards further activities in the Polar Explorer Programme Activity Pack. Links to external organisations and websites are also provided to allow you to plan for follow-up or enrichment activities. Links with home learning opportunities are provided in each activity.

Meet the STEM professionals

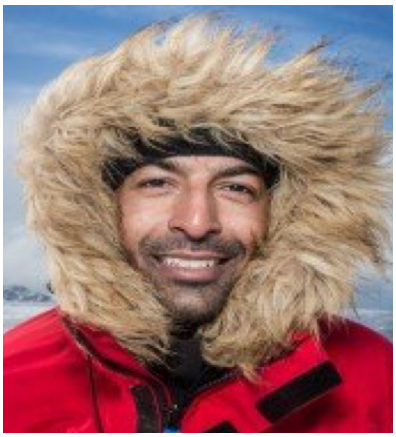
Each activity has one or more STEM professionals associated with it. Profiles for the STEM professionals can be found on pages 4 – 14. You may also want to use the profiles to develop science capital and STEM aspirations in your pupils, or simply for further literacy-based research. This section has been kindly written by real STEM professionals who are working in a STEM career currently and have all provided suitable contact details (see activity plans) should you wish to make further connections with them beyond this resource.

Recipes

Each activity is associated with one or more polar recipes. Typically, these are foods that might be eaten by explorers in the polar regions or scientists working at an Antarctic station. Recipes can be found on pages 16 –26. You may want to plan some lessons that give children the chance to research, prepare and taste different 'Polar Explorer' foods!

CONTENTS

STEM PROFESSIONAL PROFILE



Name

Captain (Retd) Ibrar Ali MC

Job title

Ex-Army Officer, Charity Ambassador and Adventurer

My job involves

Helping to fundraise for military charities

I've visited the Arctic and Antarctic

In order to complete various challenges – in 2013 I was part of a team that skied the last three degrees of Antarctica to the South Pole. I've done some husky sled racing in northern Sweden inside the Arctic Circle and then returned to Antarctica in January 2017 to run a marathon there.

I became a charity ambassador because

I wanted to help other injured military veterans have the great opportunities that I have had.

The challenges I have faced in my career are

Working in extreme environments from the heat of Iraq and Afghanistan to the humidity of the jungles of Belize and the cold and windy conditions in the Falkland Islands. Also, in 2007, I was injured by a bomb in Iraq. This led to me having my right arm amputated but after some rehabilitation, I went back to Iraq and Afghanistan 18 months later.

In my career, I am most proud of

Serving in The Yorkshire Regiment and the resilience and toughness of the Yorkshire soldiers I had the privilege of working with.

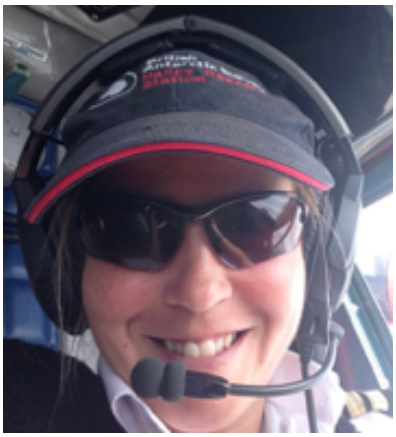
The best thing about my job is

Travelling lots and meeting a variety of people. Experiencing new cultures and trying the local food.

The advice I would offer someone wanting to become an adventurer is

If you keep yourself fit and healthy then you can achieve anything you want. Staying mentally agile and flexible means that if you face challenges you'll be better equipped to deal with them. Look at life through a wide-angle lens!

STEM PROFESSIONAL PROFILE



Name

Victoria Auld

Job title

Pilot

My job involves

Flying Twin Otter aircraft in Antarctica up to six months of the year, moving scientists, cargo and fuel from our main station to deep field sites. I also fly scientific survey flights worldwide.

The experience and qualifications I needed were

Minimum two A levels, preferably in maths and physics, and a commercial pilot's licence (18 months training including technical and flight exams).

I work in

Both the Arctic and the Antarctic.

I became a pilot because

I had trained as a meteorologist at university then got a chance to fly in a Twin Otter aircraft in Antarctica and it became a goal to learn to fly and eventually fly in Antarctica.

The challenges I have faced in my career are

I was over 30 when I re-trained as a pilot and the older you get the harder it is to absorb all the information in the relatively short training period! It is also very costly to train as a pilot, but I was lucky enough to get commercial airline sponsorship which helped enormously.

In my career, I am most proud of

Being signed off on 'initial input – mountains'. This means I can land scientists at a brand-new site, in mountainous terrain, where people have never landed before. That feels good!

The best thing about my job is

On good weather days flying in Antarctica always feels magical and is made even more special when there are people on board for whom this is a first flight in the region. Everyone feels very much in awe of their surroundings.

The advice I would offer someone wanting to become a pilot is

Think carefully about the type of job you want to end up doing and where you want to live. Pilot work can be very varied but each needs specific training (long and short haul airlines, survey, instructing, etc). Then, plan your finances as you will probably not be able to afford university and then pilot training, unless you get sponsorship. Go and take a trial flight and get your hands on the controls to see how you like it and before you get serious about commercial pilot training, take a commercial pilot medical and make sure you don't have any issues to stop you in your tracks.

STEM PROFESSIONAL PROFILE

Name

Dr Joanna Buckley

Job title

Chemical Scientist, University of Sheffield

My job involves

I aim to get people to enjoy chemistry as much as I do. I'm particularly passionate about food chemistry. They say chemistry and cooking are basically the same thing. just don't lick the spoon when you're doing chemistry!

I first became interested in food chemistry when a batch of fudge I'd made at home tasted awful and I wondered what I'd done wrong. So, I started to apply my scientific background to some edible experiments. You can hear me answering some unusual food questions here: **https://www.sheffield.ac.uk/chemistry/edibleexperiments**

On a day-to-day basis, I write and talk about chemistry whenever I can and to whoever will listen. I also teach in the Kroto Schools Laboratory in the Department of Chemistry at the University of Sheffield. Students of all ages visit to learn key skills that are needed to be a good chemist: **https://www.sheffield.ac.uk/chemistry/schools**

The experience and qualifications I needed were

At school, the three subjects I enjoyed the most were chemistry, English and music. I wanted to go to university to study music but I made a last-minute decision and applied to study chemistry instead. Looking back now, it was a great choice. I went to the University of York where I studied for eight years, completing a master's and PhD in chemistry. Eight years of studying sounds like a long time, but imagine doing something you love for eight years? There's lots of experience you gain whilst you work too. I'm always learning new skills from work colleagues or challenging myself to do something new.

I work

At the University of Sheffield.

I became a chemical scientist because

I enjoy the practical side of chemistry; I love nothing more than working in the laboratory. At the age of seven, I was given a chemistry set for Christmas. I instantly thought this was amazing; mixing different substances and transforming one material into another. I was hooked! One day when I was experimenting, I dropped a test tube and it stained our dining room carpet. A few years later, when we changed the carpet, my dad cut around the stain and has always kept it in the garage! It's a great reminder about where it all started and, thankfully, that I'm not as clumsy now.

The challenges I have faced in my career are

Sometimes science just doesn't work like you want it to and you've got to develop a pretty thick skin and not get too disheartened. If something doesn't work, you pick yourself up, learn from it and make it better next time. A good metaphor for life!

In my career, I am most proud of

My patents – when you discover something new that no one else has before, you can patent it. It's a very important process because it makes it illegal for someone to copy your work. Imagine inventing something brand new? You'd need to protect it, so someone can't steal your ideas and make money from your work.

The best thing about my job is

The variety – one day I'll be having a quiet day in the laboratory, another day I'll be giving a lecture about the sweets JK Rowling writes about in the Harry Potter books or talking on the radio about why some people don't like beetroot, or being interviewed about why hot curries make your eyes water, or spinning candyfloss in a shopping centre and telling everyone how it's made. There can't be many food-related questions I've not been asked!

The advice I would offer someone wanting to become a chemical scientist is

Stay curious and never be afraid to follow a less-trodden path.

STEM PROFESSIONAL PROFILE

Name	Job title
Professor Melody Clark	Project Leader and Molecular Biologist at the British Antarctic Survey

My job involves

Running a team studying the genes of marine animals. In particular, how Antarctic species have adapted to life in the cold and how they respond to climate change. I also run another big project on how animals (molluscs) make shells.

The experience and qualifications I needed were

A degree (BSc) and a PhD in genetics. I then had a whole series of jobs, starting in cytogenetics (looking at chromosomes) in humans and in plants, gradually moving more towards molecular biology in plants. I then went, for a bit of a change, to doing molecular biology in the Japanese Pufferfish Genome Project (yes, it is the one that can kill you!), followed by a move to the British Antarctic Survey (BAS) where I work on the molecular biology of small marine invertebrates like limpets, clams, starfish and sea urchins. So basically, lots of different jobs, all with a strong element of genetics to them, with no career plan what-so-ever!

I work

Mainly in the Antarctic but have worked in the Arctic and also work on European species.

I became a molecular biologist because

I've always been fascinated by genetics. Working out what is going on in an animal's cells in response to changing environmental conditions is like assembling a big jigsaw without a picture!

The challenges I have faced in my career are

From changing tack quite a bit, in terms of what I've worked on and the areas I've worked in. But all of these different experiences have always come in useful at some time or another and mean I never get bored or stop learning new things.

In my career, I am most proud of

Being the first female scientist in the British Antarctic Survey to be awarded an Individual Merit promotion, which is awarded for scientific excellence.

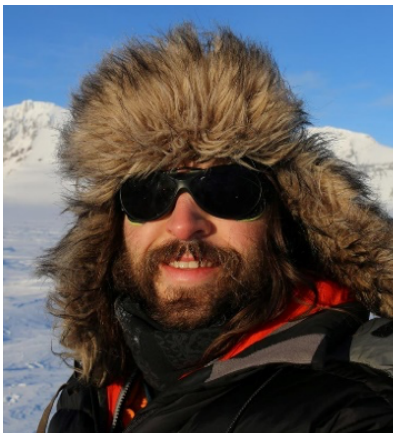
The best thing about my job is

I get to answer questions, for example on why animals respond the way they do to climate change and how genes shape that response.

The advice I would offer someone wanting to become a molecular biologist is

To do a job that you enjoy. Your dream job may not appear straight away, but you never know what is around the corner.

STEM PROFESSIONAL PROFILE



Name

Lewis Georgiades

Job title

Chef

My job involves

Cooking for the staff who run and operate the base. Taking care of the stock levels, looking after the freezers and putting the orders together for the forthcoming season.

The experience and qualifications I needed were

NVQs level 1 and 2 in professional catering and I have an advanced hygiene qualification enabling me to oversee and maintain hygiene standards in the kitchen. I have been a chef for 22 years, working in a variety of different establishments which is crucial so that I can keep the menu as varied as possible.

I work at

The Rothera Research Station on the Antarctic Peninsula for the British Antarctic Survey.

I became a chef because

I always loved cooking from an early age and enjoyed sitting around a table eating dinner with my family.

The challenges I have faced in my career are

Long hours; little rest; very little social time; low pay; hot and noisy kitchens. Also, planning a whole year ahead is hard as we only get food deliveries once a year!

In my career, I am most proud of

The opportunities it has given me to work abroad.

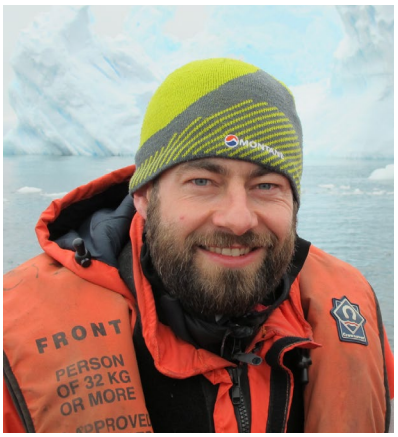
The best thing about my job is

I get to do what I love.

The advice I would offer someone wanting to become a chef is

It's all about passion and, if you don't have it, choose a career where you do.

STEM PROFESSIONAL PROFILE



Name

Ricky Munday

Job title

Founding Director, Inspire Alpine. Polar Ambassador.
Former Head of Corporate Services, British Antarctic Survey (BAS).

My job involves

At BAS, my job involved supporting the Director of BAS in ensuring that the strategic planning, allocation and use of resources by BAS enabled it to deliver its mission and I led the key professional services teams – Finance, Human Resources, Science Support, Legal & Procurement. I was a member of the Executive Team and I chaired the BAS Senior Management Team and I was heavily involved in the project to build the new polar research vessel. I left BAS in February 2018 to set up my own social enterprise and am training to become a mountain leader.

The experience and qualifications I needed were

I have a science undergraduate degree and I am a qualified chartered accountant. I worked for several years in the humanitarian sector and gained certification in Management of Staff Safety & Security, and First Aid in the Field (FAF). These diverse experiences prepared me well for my role at BAS.

I worked in Cambridge

I had the opportunity to visit Rothera Station on the Antarctic Peninsula in 2015.

I became a chartered accountant because

I realised that this qualification would allow me to work as a finance professional in any industry. So far, I've worked in the private, public and charity sectors for a range of diverse organisations in seven countries on four continents.

The challenges I have faced in my career are

I've faced many different challenges – fraud, corruption and insecurity in developing countries in the charity sector and severe funding constraints in the public sector. Being responsible for human resources means that you see the very best and worst of people and I have had to deal with many unpleasant situations, including unethical behaviour and people using their position or influence to bully others. Integrity and kindness are key values for me.

In my career, I am most proud of

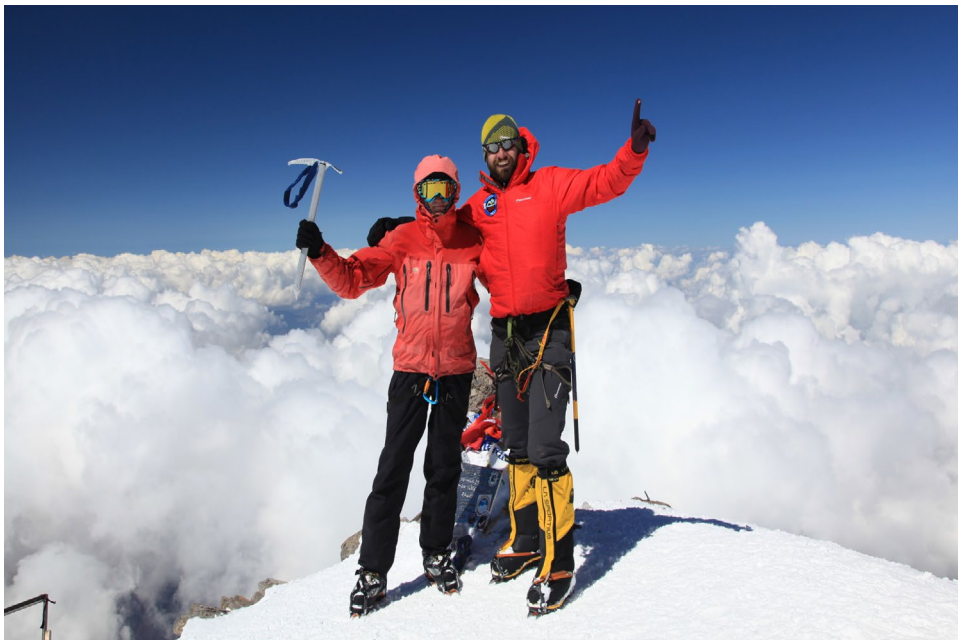
Sharing my diverse experiences – including reaching the summit of Mount Everest in May 2018 – with school pupils. I've overcome my fear of public speaking by stepping out of my comfort zone to help children raise their aspirations in STEM subjects, and life in general.

The best thing about my job is

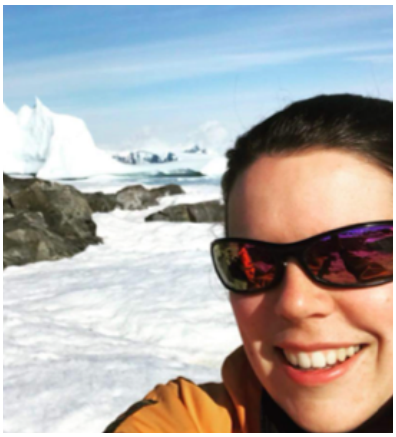
Having the opportunity to engage with and positively influence young people's life choices as a STEM and Polar Ambassador is one of the most satisfying things I've ever done – shaping young minds is a privilege and has become a real passion. Having recently established my own business, the second best thing about my new job is that I have the opportunity to share my love of the outdoors with so many other people.

The advice I would offer someone wanting to become a chartered accountant, polar explorer or mountaineer is

Go for it! Follow your dreams, stay focused and surround yourself with positive and supportive people. Don't be afraid of failure – failure itself is not a bad thing, because it means you had the courage to try something. And if you're brave enough to try something, but fail, then take the opportunity to learn and understand why you failed, and then try again. And don't ever give up. Keep following your dreams. Because eventually, you will succeed – and your dreams could take you to the top of the world!



STEM PROFESSIONAL PROFILE



Name

Dr Jess Walkup

Job title

Station Leader

My job involves

The management of Rothera Research Station in Antarctica. I am responsible for the day-to-day running of the research station making sure that the scientific research is supported, the station is well maintained and that the 120+ people who work here are looked after. Day to day I do all sorts of things – from organising training for new station arrivals to going out on the boats when the marine biologists are diving or donning firefighting kit and providing fire cover for planes that are landing at the station – every day is different.

The experience and qualifications I needed were

None specifically for my current job. The requirements are all based on skill and experience. These included: living and working in remote environments (I had previously worked in Antarctica as a scientist, but I could equally have been a chef, electrician, mechanic etc); management experience; IT, English and maths skills and good communication skills.

I work in

The Antarctic.

I became a station leader because

I loved working for the British Antarctic Survey as a bird scientist and wanted to continue working for this organisation but did not want to follow a career in scientific research. I had always had some natural leaderships skills (sometimes mistaken for 'bossiness' when I was a child!) and becoming a station leader meant I could develop new management skills while continuing to work within a scientific area that interested me. Finally, I really enjoy working with people and love the challenge that comes with working in an extreme environment – who wouldn't want the opportunity to spend more time in the Antarctic?

The challenges I have faced in my career are

I am dyslexic, so job applications, written work and reports are more challenging and I worry about people thinking I lack attention to detail or that I am not clever enough. To overcome this, I always ask someone to proof read applications for me and at work I am honest about these issues, so my colleagues are happy to overlook small mistakes. Choosing between the jobs I love and spending time with my friends and family. In order to work in Antarctica, I have spent up to 18 months away at a time which can be really difficult.

In my career, I am most proud of

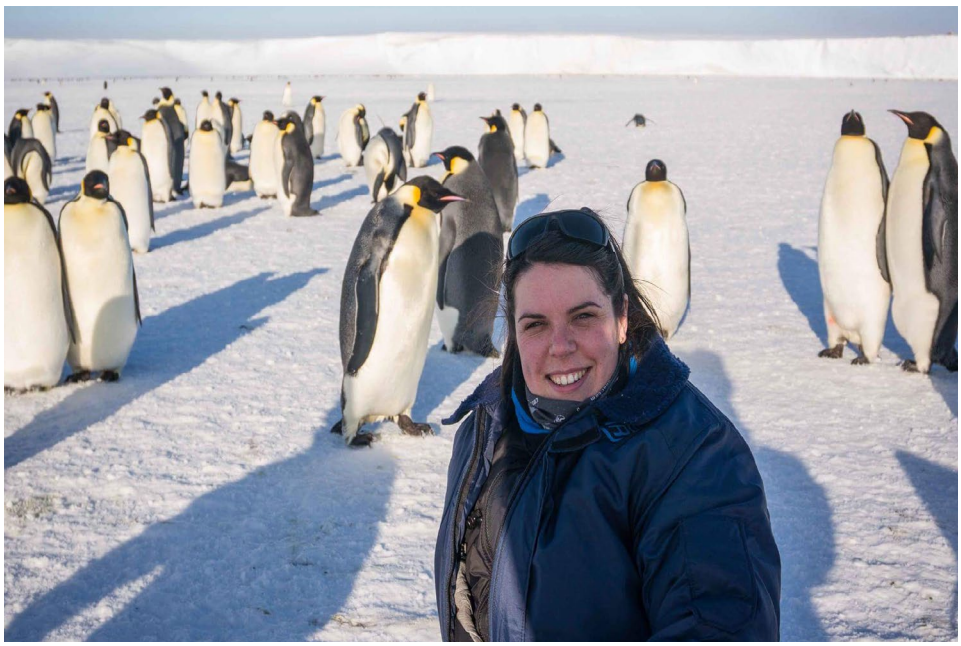
Gaining a PhD and being able to call myself 'Dr'. Also, becoming a person that my organisation trusts and relies upon, it was a brilliant moment when I realised that people were actually listening to the ideas I have and the opinions I express. Plus, managing to always have jobs that I really enjoy and that take me to amazing places.

The best thing about my job is

When I have a hard day at work I don't feel like I am working my socks off for no reason, I feel like I am doing it because the research that is carried out at the station is helping people learn about our planet and how best to look after it and that makes me feel like I am making a difference in the world. On top of that I get to live in Antarctica, which is unbelievably beautiful, and I see whales and penguins from my desk!

The advice I would offer someone wanting to become a station leader in Antarctica is

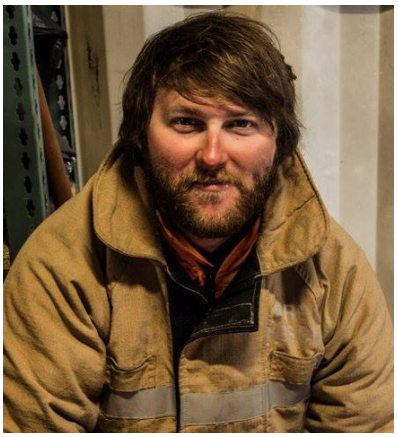
There are a lot of jobs that need doing in Antarctica – a lot of them result from the studying of STEM subjects. These include medical doctors, electronics engineers, mechanical engineers, pilots, marine biologists, physicists, atmospheric chemists and geologists. Working in Antarctica requires other personal skills too so make sure you develop your 'soft skills' at the same time as you work on your STEM qualifications. That might be taking part in a camping trip or an expedition, or fieldwork in a remote place, developing outdoor or extreme skills like skiing, climbing or caving, or developing your teamworking or team-leading skills as part of a sports team. But most of all choose something that you LOVE doing because if you are going to travel to the ends of the earth for your job you definitely want to enjoy it.



STEM PROFESSIONAL PROFILE

Name

Richard Warren



Job title

Halley Station Leader

My job involves

Planning and then delivering an Antarctic season. On station I am responsible for the health and safety of everyone, and take the lead in skiway operations, cargo transfer, training of emergency teams and delivering the season objectives.

The experience and qualifications I needed were

- Proven managerial experience
- Previous time spent in Antarctica
- Familiarity with the British Antarctic Survey and its Antarctic operations
- Good level of verbal and written English

I work in

The Antarctic.

I became a station leader because

I spent a winter at Halley for 15 months in 2014/2015 which was my first taste of Antarctica. I absolutely loved every second of it. Since then I have been back every Antarctic summertime in a variety of roles, each time drawing upon my additional knowledge and experience and taking on more responsibility. Eventually I applied for the Winter Station Leader in 2017 and then moved up to Halley Station Leader in June 2018 after my first successful season. I couldn't imagine doing anything else now!

The challenges I have faced in my career are

I have never been the most vocally confident person and communicating negative feedback or 'telling people off' when appropriate has always felt awkward. On station, you have such little personal space that it's very important to communicate things before they become an issue. Also now as Station Leader, maintaining station discipline and giving negative feedback where appropriate is part of the job. I struggled with it in my early career and have found it becomes more natural the more I do it.

In my career, I am most proud of

I wintered as the meteorologist, going in as a last-minute replacement [wintering means to stay at the research base for up to 18 months at a time]. Despite the lack of training and very short handover period, I had a very successful season, even carrying out a month of weather observations by manual means when the weather station had technical issues. It was the first time manual observations had been carried out at Halley for the many years since the instruments became automated. I took the measurements for a month on manual wind gauges and thermometers in temperatures as low as -55 Celsius.

The best thing about my job is

I have loved every role I've had in Antarctica but being the Station Leader gives a very unique insight into the whole Antarctic picture. Doing the planning in Cambridge and then delivering the season gives a large-scale view of Antarctic operations and I love working with the many departments and other national programmes to deliver successfully. In the past, I would be told which flight to get on, which bases I would transit through, and what kit to bring with me. Now I am the one who decides which bases everyone transits through, which people go in first, and what we are going to achieve each season. I love seeing the big picture and making the decisions that will decide how the season goes.

Also penguins, seeing penguins is pretty cool!

The advice I would offer someone wanting to become a station leader is

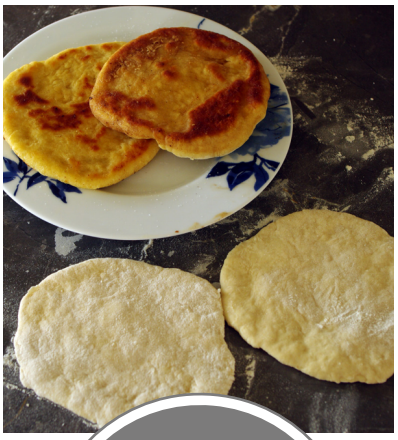
It sounds cheesy, but don't worry about overachieving. You could be the best in your profession, the best and most knowledgeable person in the world. But if you are an unlikeable person, or difficult to work with, no one is going to want to hire you. I started working at BAS in the ice core labs as a technician, and then my Antarctic career began a year later on none of my own merit. I can hold my hands up and say honestly that I was not chosen as the replacement meteorologist because I was the next best. I was chosen because they needed someone to go to Antarctica immediately to receive a handover, and I am amicable, had shown interest in the role before and was super keen for it. I love that I can tell people honestly that sometimes life just throws you a wild card and if you're in the right place at the right time, something good can happen for you. Being the right person is often as important as having the right qualifications.

ERNEST SHACKLETON'S BANNOCKS RECIPE

Background

After the Endurance sank amongst the ice floes of the Weddell Sea, this simple flatbread sustained the crew as it could be made easily with minimal equipment on a blubber stove made of scavenged metal from the shipwreck.

Bannocks became a very important foodstuff for Ernest Shackleton and his men when adrift on the ice after their ship the Endurance sank in November 1915. They were cooked on an improvised stove fuelled with seal and penguin blubber.



Top tip
These taste delicious when served with butter and honey

Preparation time	Cooking time
20 minutes	10 minutes
Difficulty rating	**Calorie content**
Easy	300 calories each

Ingredients

- 200g plain white flour
- 10g baking powder
- 100ml cold water
- 1 tsp salt
- 40g butter

Instructions

Step 1 Mix the flour, salt and baking powder together gently and thoroughly.

Step 2 Add a little of the water and mix to a soft pliable dough, adding a little water at a time to get the right consistency. You may not need all of the water and while you can add more, you can't remove it. Knead the dough for a couple of minutes.

Step 3 Take the ball of dough on a lightly floured surface, tear it into four equally sized pieces.

Step 4 Roll each piece into a ball using the palms of your hands.

Step 5 Flatten the balls into rounds. You could use a rolling pin or just use your hands to press them outwards, thin is good here so they cook quickly, they should be about 5mm thick.

Health and safety

Always refer to the ASE's 'Be Safe' book and CLEAPSS for guidance on health and safety in science lessons.

Recipe from: https://coolantarctica.com/schools/antarctic_bannocks_recipe.php

CHOCOLATE TRUFFLES

Background

These are special high-calorie truffles made with chocolate, butter and macadamia nuts. They come in milk chocolate, dark chocolate and white chocolate flavours. These provide long lasting-energy as they contain about 700 calories per hundred grams.

Chocolate truffles are often eaten as part of the mid-winter celebrations:
https://www.livescience.com/37650-antarctica-midwinters-day.html

Preparation time	Chilling time
10 minutes	60 minutes
Difficulty rating	**Calorie content**
Easy	700 calories

Top tip

Note that there is no cream in this recipe because it would not be possible to keep it fresh in the polar regions. There are many chocolate truffle recipes available online if you want to compare.

Ingredients

- 75g medjool dates, pitted and chopped (comes to about four dates)
- 75g unsweetened cocoa powder
- 150g whole macadamia nuts
- 2 tbsp macadamia nut butter
  (make your own by grinding up about 12-15 macadamia nuts in a food processor until smooth!)
- Dash of sea salt

Instructions

Step 1 Add all of the ingredients into a food processor. Blend on high until the ingredients form a smooth dough.

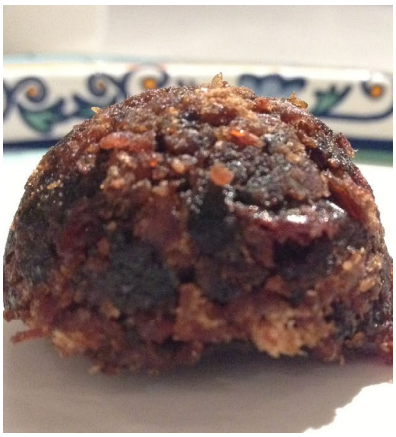
Step 2 Divide the dough into 15 equal parts (about 1 tbsp each). Roll with your hands into balls. Chill in the fridge for 1 hour before serving.

Health and safety

Check for nut allergies before making these.
Always refer to the ASE's 'Be Safe' book and CLEAPSS for guidance on health and safety in science lessons.

Recipe from: https://pickyeaterblog.com/chocolate-macadamia-nut-truffles/

EXPEDITION CAKE



Background

This cake is made mostly from dry fruit and nuts, and contains very little water, so it tastes good at low temperatures, and does not freeze. Expedition cake is a bit contrary to most polar food, as it is not as high in calories. However, we find it is a very effective trail food, because it provides a lot of energy very quickly.

Scott's 106-year-old cake was found in 2017 and is still almost edible.
Read more about it here: **https://www.bbc.co.uk/news/world-asia-40907084**

Preparation time	Cooking time
30 minutes	90 minutes
Difficulty rating	**Calorie content**
Medium	324 calories/slice

Ingredients

- 175g plain flour
- 150g soft brown sugar
- 1 tbsp black treacle
- 500g dried mixed fruit
- 1/2 tsp ground mixed spice
- Grated rind of 1 lemon
- 3 large eggs
- 50g blanched almonds, roughly chopped
- 150g butter or dairy free spread
- 1/2 tsp ground nutmeg
- 40g ground almonds
- 50g glace cherries

Instructions

Step 1 Preheat the oven to 180°C/350°F/Gas Mark 4.

Step 2 Grease and double line six tin cans (eg baked bean cans) with greaseproof paper. Stand the lined tins on a small baking tray or roasting tin.

Step 3 Sift the flour and spices into a bowl and stir to combine.

Step 4 In a separate large mixing bowl, whisk the butter, sugar and lemon rind together until light and fluffy. Add the treacle and whisk again until combined.

Step 5 Whisk in the eggs one at a time, adding a tablespoon of flour with each one and whisking before adding the next.

Step 6 Fold in the remaining flour, ground almonds, dried fruit, glace cherries and almonds and stir to completely combine.

Step 7 Spoon the mixture into the prepared tins.

Step 8 Place in the oven and bake for 15 minutes. After 15 minutes, turn the temperature down to 140°C/275°F/Gas Mark 1 and bake for another hour.

Step 9 Check with a skewer to see if they are ready – the skewer should come out clean when stuck down in the centre of one of the cakes. When ready, remove the cakes from the oven and leave to cool in the tins for about half an hour. Once cool enough to handle, carefully coax the cakes from the tins then place on a wire rack to cool completely.

Step 10 Once cool, remove the greaseproof paper. Once completely cool, cakes can be decorated.

Health and safety

Make sure that children wash their hands thoroughly before baking.
Always refer to the ASE's 'Be Safe' book and CLEAPSS for guidance on health and safety in science lessons.

Top tips

To line the tins, cut a long strip of paper, roll it up, make cuts at one end and put it cuts-side down into the tin, unrolling it once in the tin to fit around the edges. Use the tin as a template to cut out two circles of greaseproof paper and add them to the bottom of the tin, then trim down the paper to stand about 2cm above the edge of the tin.

Recipe from: **https://www.eatsamazing.co.uk/family-friendly-recipes/dessert-sweet-treat-recipes/tin-can-mini-christmas-cakes**

FRESHLY BAKED BREAD

Background

With no other fresh foodstuff regularly available, this already fabulous food attains new heights. A particular joy of being on night watch is to bake a day's worth of bread for the whole base. This is a recommended way of gaining kudos with your fellow base members when they wake up for breakfast and a very satisfying thing to do when you're the only one awake on a darkened base! This has been the case for over a hundred years and continues to this day. If you are particularly ambitious you could stretch to croissants or brioche, though these take more practice, and a shocking amount of butter for the croissants if you've never made them before.

Preparation time	Cooking time
75 minutes	15 minutes
Difficulty rating	**Calorie content**
Medium	300 calories/roll

Ingredients

- 2.5kg strong flour (extra flour to sprinkle on the tables for kneading)
- 5 tsp salt
- 10 x 7g sachets of fast action yeast
- 1.5l warm water

Instructions

Step 1 Preheat the oven to 220°C/Gas Mark 7. Grease or line the baking tray.

Step 2 Place the flour and salt into the mixing bowl.

Step 3 Stir in the yeast.

Step 4 Make a well in the middle of the flour mixture and add the warm water. Mix to form a soft dough.

Step 5 Knead the dough for 10 minutes.

Step 6 Divide the dough into enough pieces for each member of the class and shape into rolls.

Step 7 Place the rolls on the baking tray.

Step 8 Cover the rolls and leave to prove for 30 minutes in a warm place until they double in size.

Step 9 Bake for 10-15 minutes until golden brown.

Health and safety

Always refer to the ASE's 'Be Safe' book and CLEAPSS for guidance on health and safety in science lessons.
Make sure children wash their hands thoroughly before making bread.

Top tips

Use gluten free flour if children have specific dietary needs, but be aware that you may need to amend the recipe as gluten free flour has different characteristics to standard flour.
Extra ingredients such as grated cheese or dried herbs can be kneaded into the dough before it is shaped and left to rise.

Further advice on bread-making can be found here:

https://www.warburtons.co.uk/corporate/teaching-resources/bread-making-project

PEMMICAN

Background

Pemmican in Antarctica is one of the foods that Antarctic exploration was built on. Pemmican was used as a sledging food when travelling away from the main base and camping in sub-zero temperatures. It is a highly condensed form of food made from dried and ground meat mixed with a similar weight of fat; a small amount provides a lot of energy – it is almost entirely protein and fat with very little carbohydrate. These days in Antarctica, pemmican has been replaced by freeze-dried meat for use when camping; this recipe attempts to create the kind of pemmican that the early explorers of Antarctica would have had.

Preparation time	Cooking time
20 minutes	60 minutes
Difficulty rating	**Calorie content**
Easy	800 calories/slice

Ingredients

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

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

Instructions

Step 1 Put the jerky in a blender until it is a coarse powder. You could also use a pestle and mortar. If the jerky is not dry enough, place it in an oven at 80°C/180°F for an hour or more to dry it out further.

Step 2 Render the fat by melting it in a pan over a very low heat. When the fat stops bubbling, it is ready. If using molasses, there is no need to heat it. Just add enough to the jerky or berry mix to bind it together.

Step 3 Strain the rendered fat into an oven dish and add the powdered jerky and chopped or powdered berries. Mix all the ingredients thoroughly.

Step 4 Leave the mixture to firm up, and then cut into bars or roll into small balls.

Step 5 Wrap in greaseproof paper and keep dry. Nibble at will for an energy boost.

Health and safety

Check the school database for medical issues. Students with noted allergies should not consume the pemmican and may need to handle it with polythene gloves.

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

Always refer to the ASE's 'Be Safe' book and CLEAPSS for guidance on health and safety in science lessons.

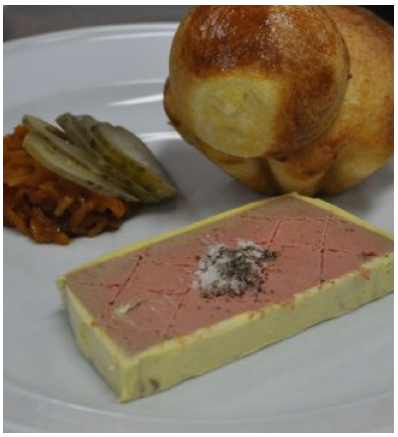
Top tips

You can use a pestle and mortar to grind up dried beef jerky.
Be aware of your pupils' dietary practices particularly surrounding meat and meat products.

Recipe from: https://coolantarctica.com/schools/antarctic_pemmican_recipe.php

POLAR PÂTÉ

Background



Polar pâté, made from meat, suet, vegetable fats and grains, is a good base for a polar diet. It is high in calories, about 700 per 100 grams. When mixed with noodles or rice it makes a thick gravy, and can be a morning or evening staple.

Preparation time	Cooking time
20 minutes	10 minutes
Difficulty rating	**Calorie content**
Easy	320 calories

Ingredients

- 250g cooked meat
- Vegetable or meat suet
- 250g grains such as lentils or pearl barley

Top tip

This will make a very basic polar pâté. More palatable pâté recipes can be found here: **www.bbc.com/food/pate**

Instructions

Step 1 Powder the grains – this can be done with a pestle and mortar or food processor. Cut the meat into tiny pieces or put into a food processor.

Step 2 Mix together the grains and meat in a bowl.

Step 3 Melt the suet and then mix with the dried mixture.

Step 4 Serve with freshly baked bread when cool.

Health and safety

Melted fat is very hot.
Always refer to the ASE's 'Be Safe' book and CLEAPSS for guidance on health and safety in science lessons.

Recipe from: **http://www.antarctica.gov.au/living-and-working/stations/casey/this-week-at-casey/2014/this-week-at-casey-25-july-2014**

SLEDGING BISCUITS

Background

Sledging biscuits were a staple part of historic polar explorers' diets, and they are still regularly eaten on Antarctic bases today.

Sledging biscuits are simple to make, easy to store and nutritious. Sledging biscuits are often used in place of bread when scientists and explorers are working away from the base.

Preparation time	Cooking time
15 minutes	20 minutes
Difficulty rating	**Calorie content**
Easy	300 calories

Ingredients

- 150g plain white flour
- ½ tsp baking soda
- ½ tsp salt
- 30g butter
- 50ml cold water

Instructions

Step 1 Mix the flour, baking soda, salt and butter together in a bowl. Add a little water to start; add more if needed to make a soft but not sticky dough.

Step 2 Roll the dough out to about 1cm thick.

Step 3 Cut the dough into eight equal sized pieces, place on a baking sheet and prick each one gently with a fork five times.

Step 4 Bake for about 20 mins at 190°C or until the biscuits are a pale golden colour.

Health and safety

Always refer to the ASE's 'Be Safe' book and CLEAPSS for guidance on health and safety in science lessons.

Top tips

Try breaking up the biscuits and serving them with melted pemmican to make a stew called 'hoosh'!
Try adding oats to your mixture.

Recipe from: https://coolantarctica.com/schools/antarctic_sledging_biscuit_recipe.php

SUGGESTED FOODS SIMILAR TO THOSE USED ON EXPEDITIONS CURRENTLY TO TRY

- Instant porridge
- Instant cous cous
- Freeze-dried porridge
- Freeze-dried curry or similar
- Seed bars
- Biltong (beef jerky)
- Protein bars
- Trail mix

Lots of these foods are available in the supermarket, outdoor pursuits shops or online simply and cheaply.

Ask the children to consider the preservation and packaging methods used in each of these foods.

Look carefully at the food packaging for calorie content and compare this to recipes from the past.

ACTIVITY 1 – MENU PLANNING | AGE 7-12

Meet the STEM professional linked to this activity

Professor Melody Clark Project Leader and Molecular Biologist in Antarctica at the British Antarctic Survey (BAS).

Ricky Munday Former Head of Corporate Services at British Antarctic Survey (BAS), Polar Ambassador and Founding Director of Inspire Alpine.

Captain Ibrar Ali Ex-Army Officer, Charity Ambassador and Adventurer.

Recipes that could be linked to this activity

Expedition cake

Cookbook theme

Nutrition

Polar Explorer Programme theme

Exploration

Tag to specific Polar Explorer Programme activities

- Exploration: Activity 4 – How do you eat like an Arctic explorer?
- Exploration: Activity 5 – Planning an Antarctic expedition

Objectives

To assemble and compare two meals for two different STEM professionals with differing roles and dietary requirements.

Unit summary

Children will work together in pairs or threes to assemble and then compare two contrasting meals for different STEM professionals. They will consider the differing calorific needs of Melody and Ricky or Ibrar based on their differing roles. Careful consideration of the requirements and food available will be needed whilst planning and may also work to a budget and limited mass.

Background

Polar expeditions require careful planning to ensure survival in a treacherous environment. The children are told that Melody is based mainly in the laboratory at the Rothera Station in Antarctica researching adaptations of animals to climate change. Ricky, the former Head of Corporate Services at BAS in Cambridge, has recently left his role to pursue a career as a mountain guide and explorer himself. Having recently climbed Everest, he is now planning his next mission and wants their help to choose some food ideas for him to pack. Ibrar is a former army officer, who now works as a charity ambassador and adventurer. He recently completed an expedition to the South Pole, and would like the children's help in planning his menu for his next expedition.

ACTIVITY 1 – MENU PLANNING | AGE 7-12

Extreme cold makes people hungry and the hard work conducted on field trips uses lots of energy. This means that food needs to be high energy and relatively high fat. Calories are carefully planned for a field trip; the method of travel is important when considering this. The average adult needs 2,250 calories a day. Based on UK guidelines, within a healthy, balanced diet, males need 2,500 calories and women 2,000 calories per day to maintain their weight. When travelling by skidoo, each adult needs 3,350 calories per day.

Explain that the children will be planning the food they will take on an overnight field research trip. Explain that in extreme cold, people get very hungry and the hard work uses lots of energy. Ricky and Ibrar and their teams will need to carry their food on sledges they will pull themselves or in a backpack, so it should be light and take up as little room as possible. Depending on how much the children know about the polar regions and if they are/have taken part in the Polar Explorer Programme (PEP), you may wish to plan some time to explore some of the key websites such as British Antarctic Survey (BAS) and Natural Environment Research Council (NERC) and Cool Antarctica – a good place to start with this one would be: **https://www.coolantarctica.com/Antarctica%20fact%20file/frequently_asked_questions.php**

Curriculum links

Science Year 3: identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat.

Science Year 6: recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.

KS3 Biology: Nutrition and Digestion – content of a healthy human diet: carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water, and why each is needed.

Calculations of energy requirements in a healthy daily diet.

KS3 Physics: Energy – comparing energy values of different foods (from labels) (kJ).

Working scientifically

Year 3 and 4: reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

Year 5 and 6: reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

Key stage 3: ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience.

Enquiry type

Research using secondary sources

Resources

STEM professional profiles of Melody Clark and Ricky Munday or Ibrar Ali to share with the children

ACTIVITY 1 – MENU PLANNING | AGE 7-12


PowerPoint 1A to outline task


1B Food content list including calorie information, cost and mass


1C Menu planning template (if needed)

Introduction

Meet the STEM professional – spend time, perhaps prior to the lesson, reading the STEM professional profiles. Children will plan a menu for Melody, and may choose between planning a meal for Ricky or Ibrar – or, as the teacher, you may wish to direct your class towards one or the other. Perhaps they might have some questions they may wish to send onto them: Melody's email address is mscl@bas.ac.uk and Ricky's contact details are: rickymunday@hotmail.com or @rickymunday on Twitter. Ibrar has not provided contact details.

Ask the children to talk about what they had for their evening meal last night with a partner. What did it include? How did they decide what it was? Did someone else choose?

Depending on how recently the children have studied diet and nutrition, remind them that an average adult needs 2,000 – 2,500 calories a day to maintain a balanced diet and explain that a polar researcher in the field needs 3,350 a day. Ask them to talk with a partner about why that might be and what type of foods a polar researcher might need to eat.

Activity

Design two meals: one for Ricky or Ibrar when they are in the field and one for Melody when she is working in the lab. Take account of the calorific requirements for each and how they differ. Compare the differences between them. Why are they different?

You may wish to ask children to calculate the cost and the mass as well as the calories in their report. They should use the information on the food resource list to help with this.

Children could be challenged further by designing a three course meal or a full day's food for Melody, Ricky, Ibrar or any other STEM professional from this book. They can be supported by providing a template for their meal planning.

KS3 children may wish to discuss the consequences of an imbalanced diet as part of this activity.

Plenary

Write a note to one of the station leaders at Rothera, Dr Jess Walkup, who you will meet in Activity 4, explaining why you have designed each meal as you have.

ACTIVITY 1 – MENU PLANNING | AGE 7-12

Follow-up session and links

Read about Ibrar Ali's marathon on every continent:
https://www.bbc.co.uk/news/uk-england-york-north-yorkshire-38800083

Watch this YouTube clip in which Ibrar Ali tells the story of his injury, recovery and subsequent plans to take part in an expedition to the South Pole with Prince Harry: **https://www.youtube.com/watch?v=iQEZoYPBuYs**

Watch this clip where Ibrar Ali and his teammate are interviewed about their South Pole expedition with Prince Harry:
https://www.youtube.com/watch?v=J5YTfTj2lYU

Ben Saunders talking about food planning for an 1,800 mile unsupported journey retracing Captain Scott's journey to the south pole in Antarctica: **http://media.digitalexplorer.com/resource/601**

Planning an Antarctic expedition: food slides 12 – 20 from **https://stem.org.uk/rxekyz** page 82 of the PEP book.
Digital Explorer have some excellent resources on the Arctic:
http://digitalexplorer.com/resources/bank/?subject=science&age=07-11&topic=food

Find out about Sarah Outen, a round the world traveller:
http://www.sarahouten.com/ or **http://digitalexplorer.com/resources/bank/?resource=so-resource-booklet**

Find out about Aaron Linsdau's polar expedition food:
http://www.ncexped.com/polar-expedition/polar-expedition-food/

This company makes and sells food for exploration directly to explorers:
http://www.icetrek.com/polar-food-and-diet

This 'Day of Temptation' drama activity from the Wellcome Trust focuses on how to eat a healthy diet:
https://thecrunch.wellcome.ac.uk/schools-and-colleges/plays-and-drama-resources

In this set of activities, children investigate digestion, in all its glory. From what happens inside us, to why certain foods are so good for us to eat, they learn enough to design menus for astronauts, gladiators and any superhero who needs their help:
https://thecrunch.wellcome.ac.uk/schools-and-colleges/dazzling-digestion

Further information about food in Antarctica can be found here:
https://www.coolantarctica.com/Antarctica%20fact%20file/science/food.php

Cross-curricular

English: Reading

Maths: Calculation

Science at home

Consider the foods you will eat tonight – are any of them suitable to take to the polar regions?

RESOURCE 1B – FOOD LIST

Food	Price	Calories	Mass
BREAKFAST			
Instant porridge sachet	52p	180kcal per sachet	36g per sachet
Box Crunchy Nut Cornflakes	£2.69	121kcal per serving	500g box/40g per serving
Tinned full English breakfast	£1.50	418kcal per tin	395g per tin
Fresh full fat milk 4 litre	£1.84	146kcal 250ml	4 litre bottle/250ml per portion
Bacon 6 slice pack	£1.75	130kcal per 2 slices	360g per pack/120g per 2 slices
Powdered milk tub	£1.88	313kcal per cup	10g per cup
Sausage 6 pack	£2.25	188kcal per sausage	312g per pack/52g per sausage
6 large eggs	£1.30	156kcal per 2 eggs	360g pack of 6/120g per 2 eggs
Muesli bar 5 pack	£3.45	185kcal per bar	175g per pack of 5/35g per bar
Tin of baked beans	79p	390kcal per tin	420g per tin
Bread loaf	83p	94kcal per slice	800g per loaf/40g per slice
Jam jar	85p	40kcal per tablespoon	454g per jar/15g per tablespoon
LUNCH			
Ham sandwich pack	£1.10	271kcal per pack	200g per pack
Cup-a-soup pack of 6	£1.19	80kcal per sachet	88g per pack/18g per sachet
Sausage roll pack of 6	£1.75	349kcal per sausage roll	360g per pack/60g per roll
Tinned oxtail soup	95p	178kcal per can	400g per tin
Instant noodles per pack	85p	157kcal per pack	80g per pack
Instant pasta per pack	99p	257kcal per pack	110g per pack
Crackers box	69p	15kcal per cracker	300g per box/4g per cracker
Beef jerky 25g bag	£1.50	336kcal per bag	25g per bag
Chicken pie	85p	377kcal per pie	150g per pie
Cornish pasty pack of 6	£1.85	371kcal per pasty	520g per pack/130g per pasty

RESOURCE 1B – FOOD LIST

Food	Price	Calories	Mass
DINNER			
Frozen roast potatoes	£1.95	128kcal per serving	800g per bag/100g per portion
Tinned chilli	£1.79	520kcal per can	400g per tin
Instant pasta per pack	99p	257kcal per pack	110g per pack
Tin of carrots	90p	24kcal per serving	240g per tin/80g per serving
Cup-a-soup pack of 6	£1.19	80kcal per sachet	88g per pack/15g per sachet
Smoked sausage	£2.50	147kcal per portion	250g per pack/50g per portion
Tinned mackerel in tomato sauce	66p	240kcal per tin	125g per tin
Tin of baked beans	79p	390kcal per tin	420g per tin
Dried rice	89p	123kcal per serving	500g bag/75g per portion
Jelly cube pack	65p	110kcal per serving	37g per pack
Tin instant custard	£1.00	127kcal per serving	400g per tin/130g per portion
Ice cream tub	£1.89	286kcal per serving	900ml per tub/150g per portion
DRINKS AND SNACKS			
Hot chocolate per sachet	32p	66kcal per sachet	11g per sachet
Can of coke	68p	139kcal per can	330ml per can
Tea per box	£2.99	3kcal per bag	250g per box 80 bags/3g per bag
Coffee per jar	£2.70	3kcal per tsp	100g per jar/2g per spoon
Orange juice	75p	112kcal per 200ml	1 per litre/200ml per portion
Crisps per bag	78p	184kcal per bag	150g per bag
Apple	32p	52kcal per apple	150g per apple
Nuts	69p	255kcal per 30 nuts	70g per 30 nuts
Dried fruit	£1.43	97kcal per handful	30g per handful
Muesli bar 5 pack	£3.45	185kcal per bar	175g per pack of 5/35g per bar
Biscuits pack	86p	84kcal per biscuit	300g per pack/16g per biscuit
Banana pack of 6	£1.11	105kcal per banana	960g per 6 bananas/160g per banana
Flapjack box of 5	£1.00	132kcal per bar	155g per pack of 5/31g per flapjack
Crackers box	69p	15kcal per cracker	300g per box/4g per cracker
Chocolate bar	60p	240kcal 45g bar	45g per bar
Fruit Winders pack of 6	£2.00	89kcal per pouch	108g per pack/18g each

RESOURCE 1C – MENU PLANNING TEMPLATE

In the field	In the laboratory
Starter Calories: Cost: Mass:	**Starter** Calories: Cost: Mass:
Main course Calories: Cost: Mass:	**Main course** Calories: Cost: Mass:
Dessert Calories: Cost: Mass:	**Dessert** Calories: Cost: Mass:
Total Calories: Cost: Mass:	**Total** Calories: Cost: Mass:

ACTIVITY 2 – FOLLOW THE RECIPE | AGE 7-12

Meet the STEM professional linked to this activity

Lewis Georgiades Chef at Rothera Research Station, Antarctica.

Recipes that could be linked to this activity

Baking bread

- And one other historical recipe such as sledging biscuits or Bannocks
- Plus, a range of foods to try

All other recipes can be used here but note the link to Activity 3 is about food preservation and some of these recipes will not deteriorate over time, hence why they are good foods to take to the polar regions and out in the field. This is a useful discussion point with the children.

Cookbook theme

Recipes

Polar Explorer Programme theme

Exploration

Tag to specific Polar Explorer Programme activities

- Exploration: Activity 4 – How do you eat like an Arctic explorer?

Objectives

To measure ingredients and use a recipe to make some food typically eaten in the Antarctic now and compare them to food eaten historically.

Unit summary

By using recipes to create at least two different dishes, one that is eaten in polar research bases today and another from historical explorations. The children will be able to show accuracy of measurements and comparative report writing.

Background

Food in the polar regions is varied. The main aspect that is hard to find is fresh fruit and vegetables... ask anyone who has been to Antarctica other than just for a short period of months and they will tell you that one of the strongest food memories is of fresh vegetables arriving after months without. You wouldn't believe how delicious a simple boiled carrot or potato can taste. You could try it in isolation to see. It could be argued that fresh veg simply prepared is a true taste of Antarctica as it provides the most memorable and intense food experiences while there, though you need to go without for a few months first to get the real experience.

ACTIVITY 2 – FOLLOW THE RECIPE | AGE 7-12

In June 2013, the Terra Nova expedition was a recreation of Robert Scott's ill-fated expedition to the South Pole. The unsupported mission, led by British polar adventurers Ben Saunders and Tarka L'Herpiniere was hugely different in all aspects, but their food was a particular example of the scientific advances in nutrition and food technology. Some of the key differences are noted here in an article from the National Geographic and are worth exploring further with the children to give them a deeper understanding of the challenges of expeditions such as these in the past as well as currently.

'The staple food of Scott's five-man party was pemmican, a mixture of dried beef and fat, to which water was added. Researchers have calculated that the team's rations, which also included pony meat and lots of biscuits, were 2,000 to 3,000 calories short of the daily intake necessary to keep up with the extreme physical demands'. (See 'Rare Pictures: Scott's South Pole Expedition, 100 Years Later'.)

By contrast, Saunders and L'Herpiniere will consume almost 6,000 calories a day – a combined total of 1.3 million calories for the trip. The largely freeze-dried menu includes porridge and cream for breakfast, energy and protein bar snacks washed down with hot carbohydrate and electrolyte drinks, and chicken curry with added fat for dinner.
Diet is the main difference between then and now, according to Saunders. "We've invested many years of trial and testing into customizing a diet that will give us the sustenance we need to cover the full 1,800 miles," he said.

Curriculum links

Science Year 3: identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat.

Science Year 6: recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.

Science KS3 Biology: content of a healthy human diet: carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water, and why each is needed. Calculations of energy requirements in a healthy daily diet.

Science KS3 Physics: comparing energy values of different foods (from labels) (kJ).

Working scientifically

UKS2: taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Key stage 3: use appropriate techniques, apparatus and materials during fieldwork and laboratory work, paying attention to health and safety.

Enquiry type

Research using secondary sources

Resources

Meet the STEM professional profile of Chef, Lewis Georgiades

PowerPoint 2A to outline task

ACTIVITY 2 – FOLLOW THE RECIPE | AGE 7-12

- Recipes for bread and sledging biscuits or Bannocks
- Ingredients for chosen recipes
- Report writing template [if needed]

Introduction

Meet the STEM professional – spend time, perhaps prior to the lesson, reading Lewis' profile. Perhaps they might have some questions they may wish to send him via his email address: rchef@bas.ac.uk. Please note: Lewis has given his permission for teachers only to use this email address for this purpose. You should carefully select any email content you send. As a busy chef preparing all the food for everyone at the Rothera Base, he may not have time to answer individual emails.

Explain that one of the jobs of sensory scientists or taste scientists is to ensure that food tastes as good as it can. Offer the children several foods to try that are typical exploration food. They should choose what information they wish to record during this session, for example: taste; texture; information on the packaging; type of packaging; mass of the food or cost.

Ask them to talk to a partner about what it would be like to eat foods such as these all day, every day for several months as a 'winterer' might do at the research stations.

Activity

Lewis, one of the chefs at the Rothera Research Station, wants the children to help him try out some new bread recipes and to compare them to the food that was taken to the polar regions in the past during some of the early days of exploration. Explain to the children that Lewis wants them to write a short report, explaining to him what they have found out during their evaluation of the foods and to offer their recommendations.

Gather the ingredients and follow the recipes carefully to make at least two different foods, one should be bread and the other from an historical expedition.

Plenary

Write a short report to Lewis comparing the different foods you have made and tasted. You should include scientific information referring to dietary requirements and how food for such expeditions has developed over the last 100 or more years.

Differentiation

If you wish to develop this lesson into a full design and technology project, children could design, make and evaluate their own recipe for a polar explorer. Older children could refer directly back to the nutritional guidance, younger children could create a variant of one of the recipes provided.

ACTIVITY 2 – FOLLOW THE RECIPE | AGE 7-12

Follow-up session and links

For more recipes to try: **https://www.coolantarctica.com/schools/antarctic-recipes.php**

A comparison of Scott's journey with the recent recreation of the mission by British polar adventurer Ben Saunders and teammate Tarka L'Herpiniere:
https://news.nationalgeographic.com/news/2013/10/131025-antarctica-south-pole-scott-expedition-science-polar/

Read about how polar chef, Antony Dubber, caters for the team at the Halley Station:
http://www.dailymail.co.uk/home/moslive/article-2195789/British-Antarctic-Station-How-does-chef-feed-90-people-nearest-supermarket-4-000-miles-away.html

Find out about the work of a taste scientist:
https://www.stem.org.uk/resources/elibrary/resource/29305/taste-key-stage-two

Learn about the work of a sensory scientist: **http://www.smelltraining.co.uk/news/a-look-at-sensory-science**

Take part in the BBC's Terrific Scientific Taste Investigation: **https://www.bbc.co.uk/terrificscientific/curations/zxrb97h**

Cross-curricular

Design technology: food

English: reading and following instructions

Science at home

Take home recipes to try with your family

RESOURCE 2B – MY REPORT TO THE CHEF

Foods we tried:	Our findings:
Recipe 1:	Recipe 2:
Taste: Appearance: Any other comparative factors:	Taste: Appearance: Any other comparative factors:
What we found:	

ACTIVITY 3 – WHAT IS THE BEST WAY OF PRESERVING FOOD? | AGE 7-12

Meet the STEM professional linked to this activity

Dr Joanna Buckley Chemical Scientist, University of Sheffield

Recipes that could be linked to this activity

Bread made in Activity 2

Bannocks

Cookbook theme

Preservation

Polar Explorer Programme theme

Engineering

Tag to specific Polar Explorer Programme activities

- Exploration: Activity 4 – How do you eat like an Arctic explorer?
- Exploration: Activity 5 – Planning an Antarctic expedition

Objectives

To evaluate different ways of preserving food in preparation for an expedition.

Unit summary

Children will set up an investigation to observe changes over time using their chosen method of preservation and notice and record changes to their food sample made in Activity 2 (ideally bread). NOTE: this activity needs at least one week before starting Activity 4.

Background

Food and drink can spoil for three main reasons:

- Oxygen – some parts of the food can react with oxygen and make a bitter chemical.
- Water – sometimes water is taken in and the food gets soft, other times water is lost and the food gets hard.
- Microbes – these can make foods unsafe to eat.

Some foods and drinks are made using microbes. Yeast is a common microbe and is used to make bread and beer. Bacteria, which is a type of microbe, are used to turn milk into yoghurt. Bacteria are small living things – it would take a million to cover a pin head! They live on and around water, air, people, food, soil and animals.

ACTIVITY 3 – WHAT IS THE BEST WAY OF PRESERVING FOOD? | AGE 7-12

Bacteria grow best when they have food, warmth, water and time. We need certain bacteria to help with things like digestion. Some bacteria, however, such as salmonella, are harmful and can cause illness or even death. Food scientists can reduce microbe growth by adding natural acids. Citric acid, found in lemons, can be put into drinks to increase the acidity. The lower pH makes it difficult for microbes to grow. Natural chemicals can also be added to fruit juice to reduce the growth of microbes such as yeast and increase the shelf life of the fruit juice. Alternatively, food scientists pasteurise food and drinks that are designed to be stored chilled.

Food scientists use many methods to try and prevent food from spoiling. In the field, polar explorers not only have to carry their own food but have nowhere to store it other than in a backpack or a sledge. This activity looks at methods of preserving such as pickling, salting, canning, refrigeration and vac packing.

Curriculum links

Science Year 5: give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.

Science Year 6: describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals.

Working scientifically

LKS2: gathering, recording, classifying and presenting data in a variety of ways to help in answering questions; making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers; setting up simple practical enquiries, comparative and fair tests.

UKS2: planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary; taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate; recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

Key stage 3: evaluate risks; ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience; make predictions using scientific knowledge and understanding; select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate; use appropriate techniques, apparatus and materials during fieldwork and laboratory work, paying attention to health and safety.

Enquiry type

Observation over time, comparative testing

Resources

Meet the STEM professional profile for Dr Joanna Buckley

PowerPoint 3A to outline task

ACTIVITY 3 – WHAT IS THE BEST WAY OF PRESERVING FOOD? | AGE 7-12


Samples of food made during Activity 2 (bread is recommended)


Apples


Access to range of preservation techniques to suit your setting
(minimum of pickling vinegar, lemon juice, fridge, freezer and ziplock plastic bags)

Introduction

Meet the STEM professional – spend time, perhaps prior to the lesson, reading Joanna's profile. Perhaps the children may have some questions about her role they may wish to send via email or Twitter via these contact details: @JoannaBuckley on Twitter or via email: Joanna.Buckley@sheffield.ac.uk

Put children into groups of two or three. Give each group an apple to cut in half. Ask them to think about what might happen if they left the cut apple out in the open? Establish that it will turn brown. Ask them to suggest ways in which they might stop it going brown; collect these ideas. All groups should then have a control apple half and a half smeared in lemon juice. If it is practical, children may want to suggest their own alternative ways of stopping the apples from browning. Check back at the end of the session to compare the apple halves.

Activity

Establish that preserving food is to make it last longer than without preserving. Share information about preservation techniques from some of the 'Follow-up session/links' weblinks below. Explain that Joanna needs their help to find out more about how best to preserve bread so it stays fresh and edible for longer.

Using the images on the PowerPoint, ask the children to talk to a partner about how many different ways you can see. Can they name them? Have they got any of these at their houses? Explain to the children they are going to try and preserve some samples of the food they made in Activity 2 and ask them to discuss which preservation methods would not be suitable for preserving bread (eg pickling).

In pairs or threes, children work together to devise a way of noticing changes and deterioration of food samples over time. Encourage them to record their dependent and independent variables and then keep a 'control' sample open to the air for natural deterioration.

HEALTH AND SAFETY: check with CLEAPSS for safe growing of micro-organisms and ensure all safety procedures are followed.

Children to observe, notice and record changes daily for at least a week before comparing the differences.

Plenary

Create a pictorial presentation for Joanna to explain the differences the preserving technique made to appearance and other factors they decided on at the start of their investigation.

ACTIVITY 3 – WHAT IS THE BEST WAY OF PRESERVING FOOD? | AGE 7-12

Differentiation

- Research ways in which the first Antarctic explorers preserved food
- Research risks associated with growing micro-organisms and reduce the risks accordingly

Higher attainers or older children may benefit from this:
http://www.rsc.org/learn-chemistry/resource/res00000930/faces-of-chemistry-packaging-gases

Follow-up session and links

More recipes to try can be found here: **https://www.coolantarctica.com/schools/antarctic-recipes.php**

Read about Shackleton's hut found with all the food still preserved 100 years later!
http://www.fogonazos.es/2008/03/scott-and-shackletons-abandoned-huts-in.html

Find out how a chef in the Antarctic caters for staff at the Halley Research Station: **http://www.dailymail.co.uk/home/moslive/article-2195789/British-Antarctic-Station-How-does-chef-feed-90-people-nearest-supermarket-4-000-miles-away.html**

Listen to this clip which explains more about food preservation:
http://www.rsc.org/learn-chemistry/resource/res00002338/kitchen-k-mistry-fast-facts-preserves

Find out about the growth of food bacteria:
https://www.stem.org.uk/resources/elibrary/resource/29306/food-bacteria-key-stage-three

Find out how to inhibit microbial growth:
https://www.stem.org.uk/resources/elibrary/resource/35850/fruit-juice-key-stage-three

Learn how to observe the growth of bacteria: **https://www.stem.org.uk/resources/elibrary/resource/36599/microbes-yoghurt**

Find out more about how food can be preserved on these three websites:
http://www.bbc.co.uk/schools/gcsebitesize/science/add_gateway_pre_2011/greenworld/decayrev2.shtml
https://www.highspeedtraining.co.uk/hub/food-preservation-methods/
https://melissaknorris.com/6waysto-preservefoodat-home/

Cross-curricular

History: ways of preserving food for travel

Science at home

How many different ways can you find to preserve food? Look in the cupboards at home and next time you are in the shop or supermarket. Share them with your classmates.

ACTIVITY 4 – FOOD STORAGE | AGE 7-12

Meet the STEM professional linked to this activity

Dr Jess Walkup Rothera Station Leader

Richard Warren Halley Station Leader

Recipes that could be linked to this activity

Bread (made in Activity 2) which was preserved in Activity 3

As an alternative, you might consider making more sledging biscuits

Cookbook theme

Storage

Polar Explorer Programme theme

Engineering

Tag to specific Polar Explorer Programme activities

- Engineering: Activity 3 – Loading cargo

Objectives

To compare and contrast different approaches to storing and protecting food.

To collect data to illustrate which approach to storing and protecting food would be 'best'.

Unit summary

By investigating different approaches to storing and protecting food, children will understand how station managers manage food storage and protection in the polar regions. The children will test and select their preferred method based on the outcomes of a comparative test.

Background

Station leaders will be responsible for ensuring that food is stored and packaged safely and sensibly on research stations. At home, we also have to store food safely and sensibly. We usually buy it pre-packaged; often, the British Antarctic Survey will buy the same foods as you or I do at home. This activity looks at different approaches to packaging food, giving children the opportunity to plan and carry out their own investigations.

Food needs to be packaged for many reasons: to preserve it, keep it safe for human consumption and reduce wastage. The use of the correct packing material is important to allow food to be transported without damage.

ACTIVITY 4 – FOOD STORAGE | AGE 7-12

Curriculum links

Science Year 5: compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal) and response to magnets.

Science Year 5: give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic.

Working scientifically

Year 3 and 4: asking relevant questions and using different types of scientific enquiries to answer them; setting up simple practical enquiries, comparative and fair tests; making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers; gathering, recording, classifying and presenting data in a variety of ways to help in answering questions; recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.

Year 5 and 6: planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary; reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

Key stage 3: ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience; make predictions using scientific knowledge and understanding; select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables; use appropriate techniques, apparatus and materials during fieldwork and laboratory work, paying attention to health and safety; make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements; interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions; evaluate data, showing awareness of potential sources of random and systematic error; identify further questions arising from their results.

Enquiry type

Pattern seeking, comparative testing

Resources

- STEM professional profile to share with the children
- PowerPoint 4A to outline task
- Table of results template (if required)
- Eggs

ACTIVITY 4 – FOOD STORAGE | AGE 7-12


Bread made in Activity 2 (or alternative food such as chocolate truffles or eggs)


Food bags and a range of dry foodstuff such as rice krispies, flour, rice etc


Variety of packaging types
(eg bubblewrap, cardboard, tissue paper, fabric, foam packaging, egg boxes, tin cans, plastic bags)

Introduction

Meet the STEM professionals – spend time, perhaps prior to the lesson, reading Jess and Richard's profiles. Perhaps they might have some questions they may wish to send via their email addresses: Dr Jess Walkup email jeslku@bas.ac.uk, Twitter @jawalkup; Richard Warren email ricwar@bas.ac.uk

Establish that most of the food we eat at home, and most of the food that scientists and researchers eat in the polar regions, comes pre-packaged. Show PowerPoint and ask questions about food packaging. Can you name any examples of food packaging? Why does food come pre-packaged? Which food packaging approaches are environmentally friendly? Depending on the age and ability of your cohort, you may wish to share this video about food packaging using gases:
http://www.rsc.org/learn-chemistry/resource/res00000930/faces-of-chemistry-packaging-gases

In small groups, give each one a raw egg and access to some different materials to test which is 'best', by putting the egg into different bags of materials (rice, rice krispies, cotton wool, dry pasta, flour) and dropping from an agreed height.

Ask the children to establish what 'best' means in terms of testing the materials suitable for packaging and what properties the material needs to have to protect the food during transport.

Activity

Jess and Richard would like help to work out the best way to stop the freshly baked bread supply getting squashed. Working together in small teams (2/3), the children should use some of the food they made in Activity 2 and preserved in Activity 3 (or suitable alternative) to plan an investigation to find out which packaging will be the best. Encourage children to make their investigations as fair as possible. However, children may find it difficult to control all dependent variables, so this may become a pattern-seeking investigation.

Children may wish to use packaging from other foods such as a tin can, egg box, cardboard box and plastic bag. Children will come up with a way of testing which packaging is most effective drawing on their earlier learning as a starting point. Suggestions include: dropping or rolling the packaging or stacking them on top of each other.

Ask children which type of packaging is most effective? Why?

ACTIVITY 4 – FOOD STORAGE | AGE 7-12

Plenary

Use your table of results to help you write a letter to either Jess or Richard explaining what you have found out. What advice would you give them and why? Remember to refer to the data collected and the properties of the materials you are recommending.

You may wish to link directly to the next activity in this booklet using the 'best' packaging from this activity.

Differentiation

Support can be provided with a writing frame to record results if required.

Follow-up session and links

Design and build a model to move tomatoes down a mountain:
https://practicalaction.org/squashed-tomato-challenge-5

'It's a Wrap!' Most of the food we buy comes packed in plastic, cardboard or tins and jars, but why? Children explore this question, by investigating the properties of different materials, and finding out what the best packaging is for keeping food fresh: **https://thecrunch.wellcome.ac.uk/schools-and-colleges/its-a-wrap**

Read about storing food in an ice cave: **https://antarctic-logistics.com/2014/06/13/keeping-cool-in-antarctica/**

Cross-curricular

Design and Technology: design, make and evaluate

History: how was food stored in the past?

English: compare the profiles from Jess Walkup and Richard Warren. How are they similar and how do they differ?

Science at home

How do you get food home from the shops? How does it get to the shops in the first place? What packaging is used? How does it help the safe transportation of food?

RESOURCE 4B – MY RESULTS TABLE

Packaging type 1:	Packaging type 2:	Packaging type 3:
Observations:	**Observations:**	**Observations:**
1st attempt	1st attempt	1st attempt
2nd attempt	2nd attempt	2nd attempt
3rd attempt	3rd attempt	3rd attempt
Photograph or diagram	Photograph or diagram	Photograph or diagram

ACTIVITY 5 – TRANSPORT LOGISTICS | AGE 7-12

Meet the STEM professional linked to this activity

Victoria Auld Pilot

Recipes that could be linked to this activity

Bread – made in Activity 2, preserved in Activity 3 and stored in Activity 4

Chocolate truffles would work well as an alternative

Cookbook theme

Transport

Polar Explorer Programme theme(s)

Engineering, Climate Change

Tag to specific Polar Explorer Programme activities

- Engineering: Activity 1 – Design a boat activity
- Engineering: Activity 3 – Loading cargo
- Climate Change: Activity 2 – Watching a glacier

Objectives

To evaluate the best method for transporting food safely in the polar regions.

Unit summary

By carrying the food the children have made (preserved and packaged), it can now be used to evaluate the best way to transport it from drop off point in a place to the research base. The children will design an assault course or circuit for themselves and test out their earlier findings in a tough environment. Children will evaluate the different methods and advise Victoria of their recommendations.

Background

Pilots, like Victoria, spend their time transporting people, food and other supplies around the polar regions. Modern-day explorers and scientists also use snowmobiles and other vehicles. In the past, animals were often used to pull sleds, but much of the work was done by men hauling their supplies.

It is important to bust the myths of travel in the polar regions, especially that everything is transported via husky dogs. Their use was ended in 1994, more information can be found below.

ACTIVITY 5 – TRANSPORT LOGISTICS | AGE 7-12

A huge range of vehicles are used and many are multi-purpose. These include: tractors, snow mobile with plastic cargo sled, a 'delta' or 'ice-bus'; different types of planes including: LC-130A (a ski-equipped Hercules), a Twin Otter and a Boeing 757 plus helicopters. These are all in addition to the research vessels RRS Ernest Shackleton, RRS Sir James Clark Ross and the brand new RRS Sir David Attenborough. Images of some of these are on the PowerPoint.

Children might be interested to learn that food deliveries are only made to the Rothera base once a year!

Curriculum links

Science Year 5: identify the effects of air resistance, water resistance and friction, that act between moving surfaces.

Science Year 5: recognise that some mechanisms including levers, pulleys and gears allow a smaller force to have a greater effect.

Working scientifically

LKS2: asking relevant questions and using different types of scientific enquiries to answer them; setting up simple practical enquiries, comparative and fair tests; making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers; gathering, recording, classifying and presenting data in a variety of ways to help in answering questions; recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables; reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.

UKS2: planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary; reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.

Key stage 3: ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience; make predictions using scientific knowledge and understanding; select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables; use appropriate techniques, apparatus and materials during fieldwork and laboratory work, paying attention to health and safety; make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements; interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions; evaluate data, showing awareness of potential sources of random and systematic error; identify further questions arising from their results.

Enquiry type

Comparative testing; research using secondary sources

Resources

STEM professional profile to share with the children

Food or food substitute (beanbags for example) – could use packaged food from Activity 4

ACTIVITY 5 – TRANSPORT LOGISTICS | AGE 7-12

- Plastic tray
- Rope
- Rucksack
- Carrier bag
- PE equipment to construct an assault course

Introduction

Meet the STEM professional – spend time, perhaps prior to the lesson, reading Victoria's profile. Perhaps they might have some questions they may wish to send via her email address: vja@bas.ac.uk

Ask children what ideas they have about how food is transported in the polar regions. Share the photos on the PowerPoint and ask them to talk to each other about what each one might be called and what each might be used for. Lots more information about transport and comparisons with historical transport in the polar regions with today's transport are on this website: **https://www.freezeframe.ac.uk/resources/transport/2**

Activity

Victoria has some food to transport from one base to another and has had to land the plane further away from the research base than planned due to lack of fuel. She is asking the children to evaluate different methods of transport by putting it through a series of rigorous tests.

Children work together in small teams of no more than four to set up a circuit using PE equipment. The circuit represents a journey in the polar regions so might include obstacles that need to be climbed, a variety of different surfaces, and obstacles that need to be manoeuvred through or around.

Ask the children to use all of their previous knowledge from earlier activities to apply to the transport challenge. Together, they should agree some success criteria by which the transport methods should be judged.

Encourage the children to test out different methods including:

- plastic tray attached to rope – to simulate sledge
- rucksack
- carrier bag
- other methods the children may suggest – depending on resources available in your school

Support children to plan a comparative test. You may consider using post-it planning sheets such as these from Primarily Science to support the children's planning:
https://primarilyscience.co.uk/resource/7-11-years-investigation-posters-a4/

ACTIVITY 5 – TRANSPORT LOGISTICS | AGE 7-12

Plenary

Using a storyboard approach, each group should present back to the class. What was the best method and why. The class may wish to address their findings to Victoria.

Follow-up session and links

Further research about the removal of dog sleds in Antarctica:
https://www.bas.ac.uk/about/antarctica/environmental-protection/wildlife-and-plants-2/removal-of-the-sledge-dogs/

Further research on Antarctic travel – lesson plans included for 11 to 16 year olds:
https://www.coolantarctica.com/schools/lesson_plan_antarctica_travel.php

Learn about Robert Falcon Scott's journey:
https://www.coolantarctica.com/Antarctica%20fact%20file/History/Robert-Falcon-Scott2.php

Watch this clip from CBBC Newsround about Scott's journey to the South Pole:
https://www.bbc.co.uk/newsround/16603842

Learn about the RRS Sir David Attenborough:
https://www.bas.ac.uk/polar-operations/sites-and-facilities/facility/rrs-sir-david-attenborough/

To further your work on careers in STEM, try the following resources:

- Ask children to complete their own future professional profile using the 'My STEM Professional Profile' resource.
- What kind of scientist could I be? **http://findingada.com/wp-content/uploads/delightful-downloads/2015/10/Ada-Lovelace-Day-10-Types-of-Scientist.pdf**
- Top 10 Employability Skills from the STEM Centre:
  https://www.stem.org.uk/resources/elibrary/resource/418157/top-ten-employability-skills
- Book a STEM Ambassador to come into school: **https://www.stem.org.uk/stem-ambassadors**

Cross-curricular

Maths: weights and measures

Design and Technology: design, make and evaluate

PE: develop control and balance; take part in adventurous activity challenges

English: write about a journey undertaken in the Arctic or Antarctica

ICT: presentation of information

Science at home

Can you design (or build) a boat or other vehicle that would be suitable for transporting food in the polar regions?

MY STEM PROFESSIONAL PROFILE

Name:	My job would be:	My job would involve:

The experience and qualifications I would need are:

I would work at:

I would like to be a (insert here) because:

(refer to your own skills and what you enjoy doing)

The challenges I would face in my career would be:

In my career, I would have the opportunity to:

The best thing about my job would be:

From my research, key advice for this job is:

I can find out more from:

PICTURE OF YOU NOW

DRAWING OF YOU DOING YOUR STEM JOB

The National STEM Learning Network
Working together to achieve a world-leading STEM education for all young people across the UK.
www.stem.org.uk