

The Spark

Magazine



PUZZLES, QUIZZES, EXPERIMENTS

**ISSUE
No14**

**ICE COOL
SCIENCE**

**WINTER
STARGAZING**

**CLEVER
CAMOUFLAGE**

**MEET A
GLACIOLOGIST**

With support from the Inspiring Science Fund – a partnership between UK Research and Innovation (UKRI) and Wellcome.



UK Research
and Innovation



GLASGOW
**SCIENCE
CENTRE!**

Inside

This issue



WELCOME

Welcome to the latest instalment of The Spark!

In this winter edition, we will be learning about our seasons, how holidays are celebrated in space and what cool tricks animals use to stay camouflaged. On top of that, this issue is packed with fun puzzles and quizzes to enjoy. Plus, there's some experiments and crafts to keep you busy on a cold winter's day.

We hope you've had a great year and are looking forward to all the exciting scientific discoveries that are just around the corner in 2022!

Happy Holidays!

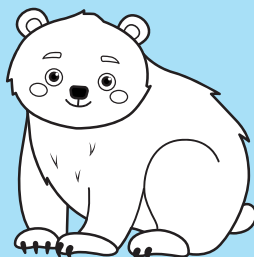
From everyone at Glasgow Science Centre



MINI GAME

Help the Bear!

Help the big bear get back to baby bear! Solve the puzzles on the ice to create a path from 1 to 10.



HINT

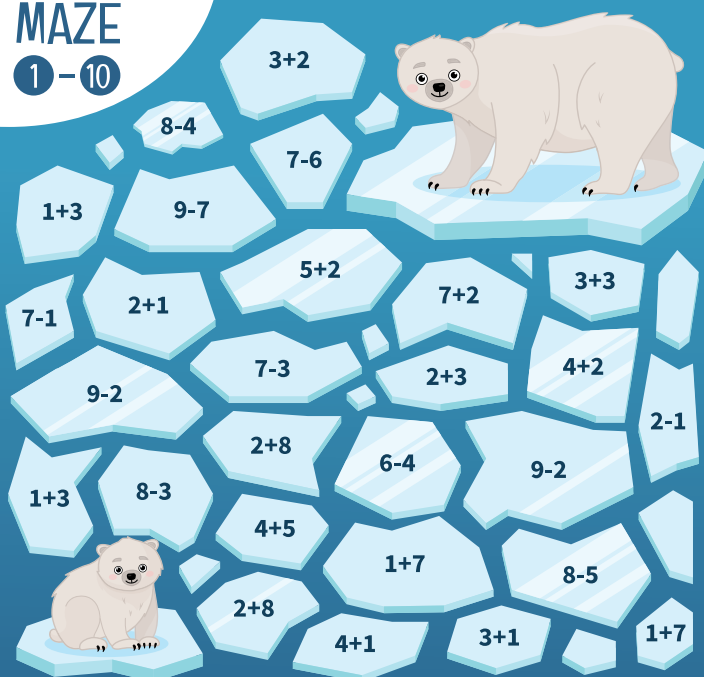
The big bear will only follow the path going from 1 to 10.



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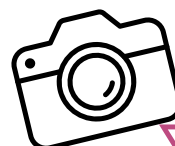
MAZE

1 - 10



Meet a Glaciologist Licensed to Drill

Robert Mulvaney dressed for dinner at an international ice core drilling camp on the Greenland ice cap.



**SHARE
YOUR PICS
WITH US**

If you try any of our activities this issue, please show us how they turned out! Send your favourite pictures to CLDteam@gsc.org.uk or share with us [@TheBothyGSC](https://twitter.com/TheBothyGSC) on Twitter. We'll share a selection of your pictures in the magazine.



FAMILY QUIZ

All questions linked to activities in this issue

Answers on
back page

QUESTIONS

HINT

You may find some answers throughout this magazine or in our #GSCAtHome videos.

- Q1.** What is the coldest temperature ever recorded on Earth?
A. -45.2°C **B.** -64.7°C **C.** -89.2°C
- Q2.** How many seasons are there in one year?
- Q3.** When is the shortest day in 2021?
- Q4.** The Earth's axis is not perfectly vertical but tilted, but by how many degrees?
A. 13.5 degrees **B.** 23.5 degrees **C.** 33.5 degrees **D.** 44.4 degrees
- Q5.** What is the name of the star that makes up the Orion constellation's left shoulder?
- Q6.** **TRUE** or **FALSE:** The freezing point of all liquids is the same?
- Q7.** Is the Earth closer to the sun in our winter or summer?
- Q8.** What is the name given to the shape of an igloo?
- Q9.** Orion's dog has its own constellation, but what is his dog's name?
A. Harry **B.** Hermione **C.** Ronald **D.** Sirius
- Q10.** Purple fireworks are made by mixing copper and which other metal compound?
- Q11.** What is camouflage?
- Q12.** How long did it take to bake a cookie in space?
- Q13.** What is heavier? Hot air or cold air?
- Q14.** In what year was Hanukkah celebrated in space for the first time?
- Q15.** **TRUE** or **FALSE:** A polar bear's skin is black?
- Q16.** What temperature can fireworks reach?
A. 200°C **B.** 600°C **C.** 1000°C
- Q17.** **TRUE** or **FALSE:** Every snowflake is the exact same size and shape?
- Q18.** How many carrots are thrown away during winter in the UK?
A. 4 million **B.** 5 million **C.** 9 million **D.** 12 million
- Q19.** What is the estimated percentage of the population that are 'supertasters'?
A. 20% **B.** 25% **C.** 30% **D.** 40%
- Q20.** Which element is used to make a firework burn orange?
A. Iron **B.** Calcium **C.** Lead

Our Planet

ACTIVITY

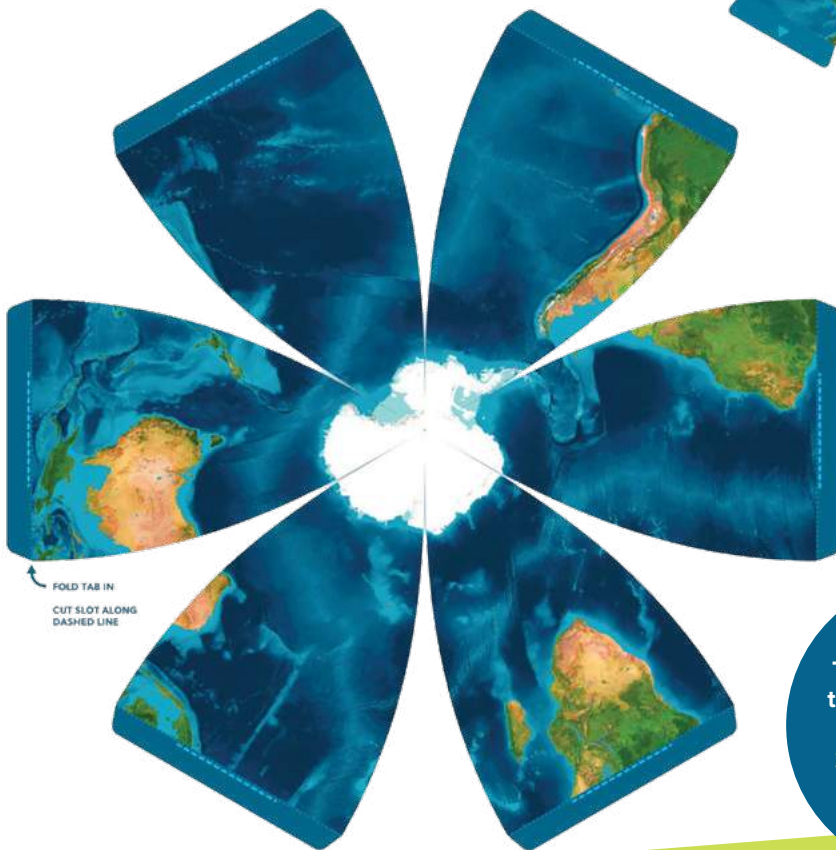
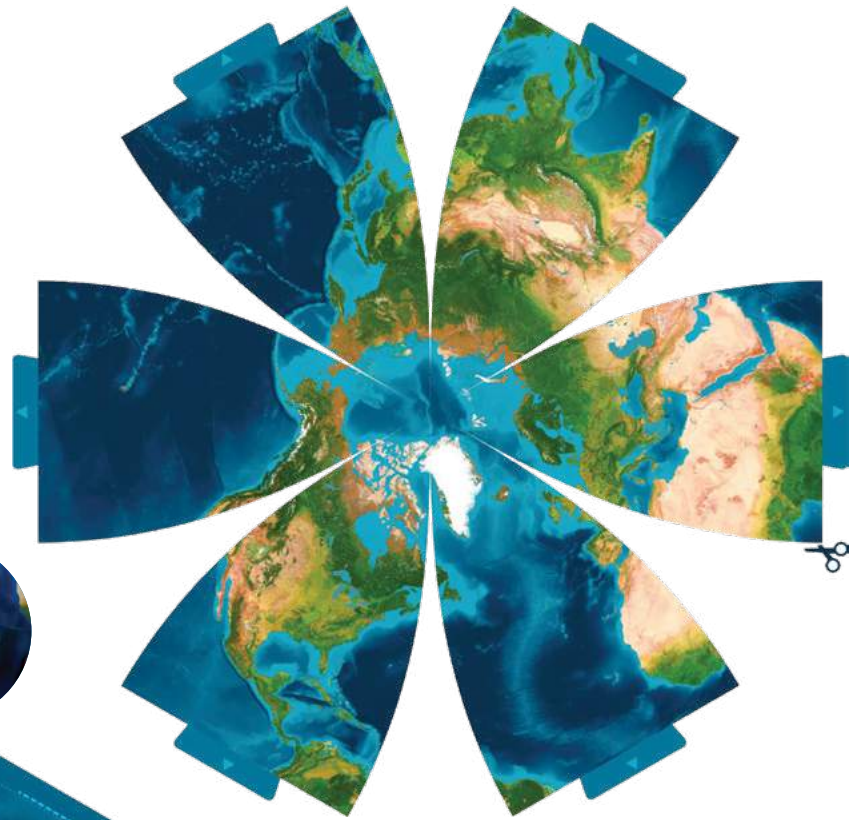
Cut out and keep your own model Earth

You will need:

scissors, glue and a ruler.

Make sure you have adult supervision before starting.

1. Cut out the two 'flower' shapes.
2. Curve the petals down and tape the edges of the petals together on the inside surface.
3. Glue both halves of your globe together. Ensure the continents line up otherwise the globe won't be accurate.



The Earth moves about 1 kilometre per second faster around the sun in winter, making it about **five days shorter than summer.**

The Earth is closer to the sun in winter than in summer - **3.1 million miles closer!**

Earth's average global temperature is around **16°C**



Use your globe and a lamp to create your own model of the Earth's rotation around the sun. Hold your planet and spin it slowly while you move around the lamp, in an orbit.

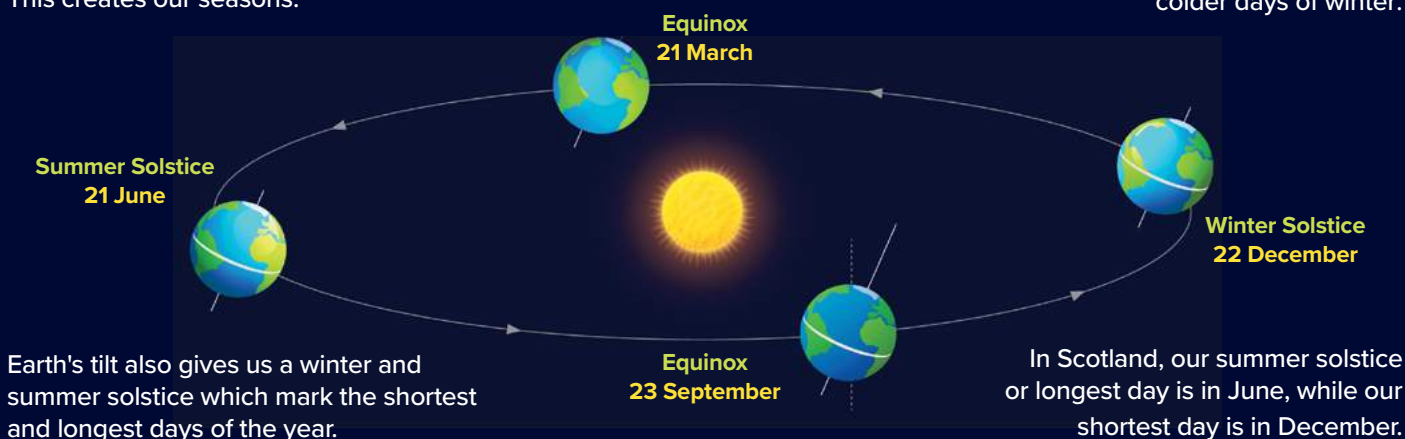
Season's Greetings

Earth's rotation

Have you ever wondered why we have different seasons?
Or why some countries have summer in December, when we're having winter?

Earth rotates around our sun at an angle, 23.5 degrees off vertical. We are tilted towards or away from the sun at different times of year. This creates our seasons.

When the northern hemisphere is tilted towards the sun, days are longer and warmer. But while we have summer, the southern hemisphere is tilted away and has the shorter, colder days of winter.



It's always cold here!

People who live in the northern hemisphere are more likely to have colder winters than those in the south.



Scientists think this is because there are much larger areas of land closer to the cold, polar region in the northern hemisphere.

Whereas the southern hemisphere is surrounded by 20% more water, which keeps it warmer as oceans store and conduct heat better than land.

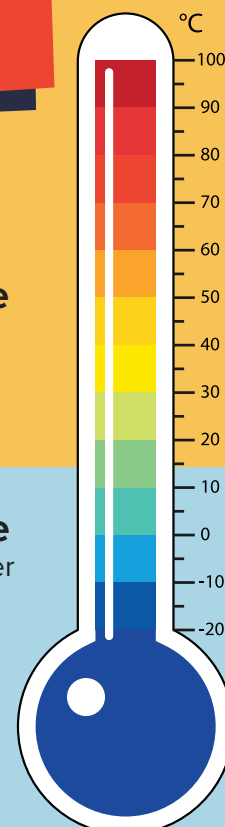
Temperature Check

The **10 warmest years** on record have occurred since 2005.

The **hottest temperature** ever recorded in the UK was 38.7°C at Cambridge University Botanic Gardens in 2019.

The **coldest temperature** ever recorded during a UK winter was -27.2°C.

The **world record** for the coldest temperature ever recorded was -89.2°C at the Vostok station in Antarctica in 1983.



Constellation Creation

Winter is a great time for the whole family to go stargazing.

This constellation is Orion.

Look towards the southern sky to see if you can find it.

Orion is a great starting point for star gazing because it has some very distinctive features.

The left shoulder of Orion is the star 'Betelgeuse' which is a red supergiant star.

One of the easiest parts to spot are the three bright stars known as Orion's Belt. They sit close together and form a straight line in the middle of the constellation.

Four stars in an hourglass shape, pinched at his belt, make his shoulders and tunic.



Orion the warrior

In ancient Greek stories, Orion was a super strong warrior, shown here with his sword and shield.



What other things can you spot in the night sky?

Following Orion through the sky is his dog Sirius! Sirius is easy to spot as it's the brightest star in the night sky!



Can you see him when you look at the stars?

Do you see anything different?

Why not join the dots and draw your own constellation using the stars?



Out of this world holidays



1968

The first people to spend Christmas in space were the Apollo 8 astronauts in 1968.



1974

The Skylab team made the first Christmas tree in space, using food canisters and coloured stickers, topped with a cardboard comet.



2008

Astronauts Michael Fincke and Sandra Magnus in 2008 proudly showing off their decorated cookies, a festive tradition on the ISS.



1993

Hanukkah was first celebrated in space in 1993 by Jeffrey Hoffman. The festival began on the evening of 9 December after Jeffery had finished his third spacewalk.



How many scientists does it take to bake a cookie?

In November 2019, an oven was delivered to the ISS so that they could bake cookies for **science**.



This experiment was done to help plan for long haul space flights. The space cookies took 120 minutes to bake! How long would it take to bake a cookie in your oven?

Traditional ovens need gravity, without it, heat wouldn't rise, and the air wouldn't move to cook the food.



The cookie dough was sent to space in individual cooking pouches, specially made for the zero gravity oven.



Sadly, they didn't get to eat any of the cookies, they were sent back to Earth for research and analysis.

ACTIVITY

Ice Ice Maybe?

Explore the freezing points of liquids in this DIY experiment.

The freezing point is where a liquid becomes a solid – or freezes. But do all liquids have the same freezing point? Let's investigate!

What will you need?

An ice cube tray, different liquids, a timer and your freezer

1. Fill your ice cube tray with a different liquid in each section.
2. Make your hypothesis. What do you think will happen?
3. Place the tray in your freezer and set a timer for 1 hour.
4. Check your experiment every hour.

Mark your findings on the table below.

What is a 'hypothesis'?

It's a prediction about what you think will happen in your experiment, based on things you already know.

Which liquid do you think will freeze first?



TOP TIP

If two or more of your liquids look the same, try colouring them with food colouring to help keep track of which is which. Remember to note this on your table too.

My hypothesis is:

Liquid	Hour 1	Hour 2	Hour 3	Hour 4
Example: Cola	No change	Slushy	Almost frozen	Frozen

What did you discover?

Write a few sentences about what happened during your investigation.

Which liquid froze first? Is it what you expected?

Which liquid froze last? Is it what you expected?

How it works?

Different substances freeze at different temperatures because the molecules that make them up are different.

Water freezes at 0°C. It's made from molecules of hydrogen (H) and oxygen (O) that stick together as water cools to form a solid structure - ice.

If you add salt or sugar to water, it becomes harder to form ice. Its freezing point becomes lower than 0°C.

I'M A... GLACIOLOGIST

Meet Dr. Robert Mulvaney

I work as a Glaciologist in Antarctica, where I have two roles. I drill ice cores from deep in the ice sheet which I bring back to the chemistry laboratory in Cambridge. Measurements on the ice reveal how the climate, and the atmosphere, have changed over many thousands of years. I also use radar to find the thickness of the ice sheet, and to look at the geography of the bedrock beneath the ice.

While working in Antarctica, I live in a small 2-person tent, and spend a lot of time working outside. People assume that this must be appallingly cold and uncomfortable, but in practice, if properly dressed, and we take care of ourselves and our colleagues, then there is enjoyment to be had in overcoming the conditions. I usually work in small teams of around six people, in remote locations hundreds of kilometres from our large research stations. We develop a strong reliance on each other, and I find that the friendships that develop can last a lifetime.

As a teenager, I received a book entitled "Great True Adventures in Ice and Snow", in which I read about the early polar explorers in the Arctic and Antarctic, so I would pick out Scott and Shackleton as intrepid explorers and inspiring leaders. (Robert Falcon Scott and Ernest Shackleton were Antarctic Explorers in 1901).



Cool Science

Igloos keep you warm in the coldest of conditions, but how do they work?

FUN FACTS

The shape of an igloo is called a 'catenoid'. It's a very strong shape.

It can be as cold as -40°C outside, while the igloo stays a cosy 16°C inside!

Igloo Facts

Igloos are built with compressed snow, which has amazing insulating properties. Snow is filled with loads of miniature air pockets which help trap the heat inside.

Cold air is heavy. It falls and collects on the lower level. Warm air rises and stays in the parts of the igloo people use the most, keeping them snug and warm.

Like air, hot water will also rise, and cold water will fall. Try our experiment below and see for yourself.

ACTIVITY - Water experiment

Make sure you have adult supervision before starting.

What will you need?

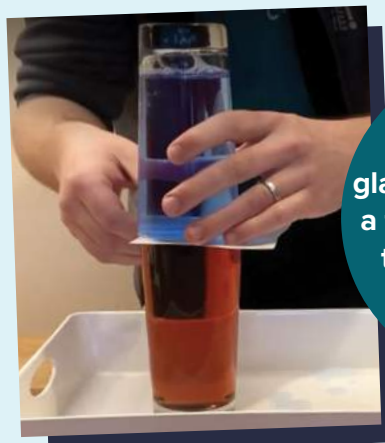
2 glasses, food colouring (two different colours) and a piece of card.

You may wish to do this over a tray or sink

1. Fill one glass to the brim with cold water, add in a few drops of blue food colouring and give it a stir.
2. Fill the other glass to the brim with warm water, add in a few drops of red food colouring and give it a stir.
3. Pop a piece of card over the blue cold glass and tap the card a little to create a seal.
4. Hold onto the card and blue glass, carefully turn it upside down and place it on top of the red warm glass.
5. Slowly remove the card in-between while balancing the glasses. What happens?

Try this experiment again, but this time, try putting the warm water on top.... you might be surprised at what happens.

Be careful when handling the warm water, ask an adult for help.



Flipping the glasses can be tricky, a few practices over the sink might be needed!

ACTIVITY

Ice Fishing Challenge

Challenge your friends and family in this tricky game during dinner!

Make sure you have adult supervision before starting.

What will you need?

A bowl of cold water, some ice cubes, a length of wool and salt (this is your secret ingredient, don't tell anyone).

Place the ice cubes in the bowl of water and put it on a table. Give everyone a piece of wool and ask them to try and fish out an ice cube.

The only rule is they can't touch the ice cube.

Your friends may try to tie a loop in the string to pull it out, but this will be quite tricky. When they give up, show them how to do it using the instructions below.

TOP SECRET

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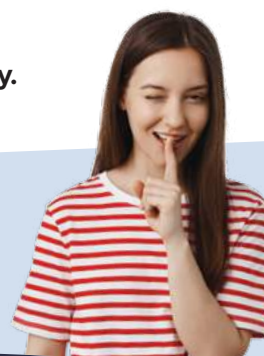
Solution

Place the wool with one end on the ice cube and hold on to the other. Grab the salt shaker and sprinkle lots of salt onto the ice cube. Wait for a minute and lift the wool up. The ice cube will be stuck to the wool!

How does it work?

When the salt touches the ice, it causes the ice to melt a little and quickly refreeze around the string. This causes the ice to stick to the string when it is pulled out of the bowl.

Can you think of any other times salt is used to melt ice? Why is this helpful?



Shhhhh

The trick is to have a salt shaker on the table and not to tell anybody about it!

MINI GAME

Can you help this penguin catch their dinner?



Solution on back page



Food Waste

Energy

When we waste food, we also waste all the energy and water it takes to grow, harvest, and transport it. If food goes to landfill and rots, it produces methane—a greenhouse gas.

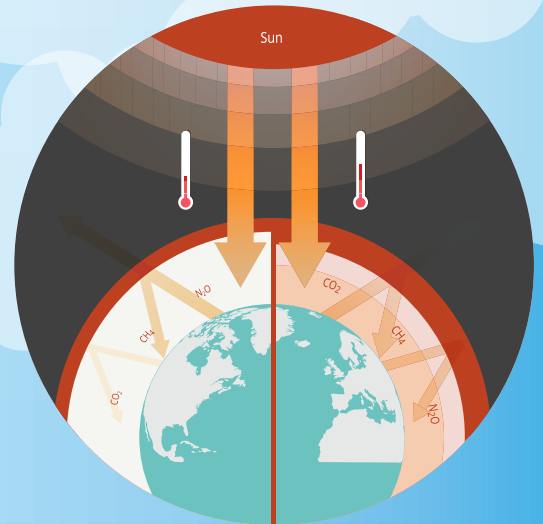
Throw out less

Greenhouse gases, such as methane and carbon dioxide, contribute to climate change.

By throwing out less we can help reduce the greenhouse gases in our atmosphere

Our atmosphere

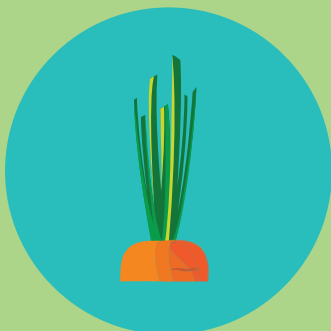
Plants can also help reduce the carbon dioxide from our atmosphere.



The more greenhouse gases we have in our atmosphere, the more heat gets trapped from the sun and the hotter our planet gets. This contributes to climate change.

ACTIVITY - Regrow your carrots

Instead of throwing away the tops of your carrots, plant them and watch them grow green leafy tops.



Step 1:

Carefully cut off the top of your carrots.



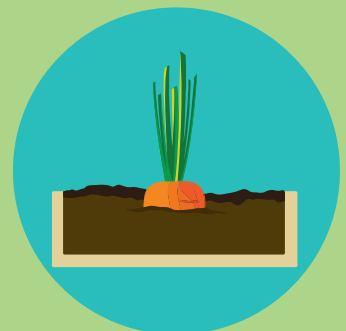
Step 2:

Fill a bowl with enough water to cover the carrot tops.



Step 3:

Place in a windowsill and change water every day.



Step 4:

After a few weeks, transfer your plant to a pot of soil.

Keep your plant in a warm area indoors and use the leaves as a garnish, in salads or sauces. Make sure to wash them before using them in food.

Do you hate Brussels sprouts?

You might have supertaster genes!

It is estimated that about 20% of humans are "supertasters" and have more tastebuds.

This can make you sensitive to bitter flavours in foods like broccoli and Brussels sprouts.



Take the supertaster test!



Use a cotton bud to 'paint' the tip of your tongue blue with food colouring.



The blue will stain most of your tongue except for the papillae which house your taste buds. The papillae are the prominent pink dots.



Take a picture of your tongue and compare it with your friends.



Supertasters have lots of pink dots because they have double the number of papillae compared to non-tasters.



Sensitivity to bitter tastes can change with age, with children being more sensitive to bitter taste than adults.

Don't over do the blue colouring, it could make your poop green if you use too much!



Winter Wildlife



Animals that live in polar regions are often perfectly adapted to their environment.

The polar bear is a great example!
Polar bear fur is hollow to help trap air and keep them warm.

Under all their fur their skin is black.
This helps to absorb the heat from the sun.

Their coat is double layered which helps to insulate against Arctic winds.

Their fur is so good at keeping them warm that polar bears can sometimes overheat and will roll around in the snow to cool down.



COOL FACT

Polar bear fur isn't white. It contains no white pigment and is actually clear. This scatters the light making it appear white.

Clever Camouflage

Camouflage is something that animals, plants and sometimes even humans use to help them hide in different environments.

They use different colours, patterns or shapes to match their surroundings or hide amongst them.

For most of the year these animals have brown or grey coats. This makes it difficult for predators to spot them against the rocks and plants.

When winter comes and their surroundings change, this dark coat isn't effective anymore, so something amazing happens! Their coats change to a brilliant white which camouflages them against the newly fallen Arctic snow.



Arctic Hare (winter)



Arctic Hare (summer)



Willow Ptarmigan (winter)



Willow Ptarmigan (summer)

Happy New Year!

Fireworks have been used in festivals and celebrations for thousands of years, but how do they work and how do they get their fantastical colours?

Fireworks are a brilliant piece of chemistry! Chemical reactions make their loud explosions but also their bright colours. The colours come from burning chemical compounds called metal salts, but these salts aren't like regular table salt. A salt in chemistry is something that contains both metal and non-metal atoms.



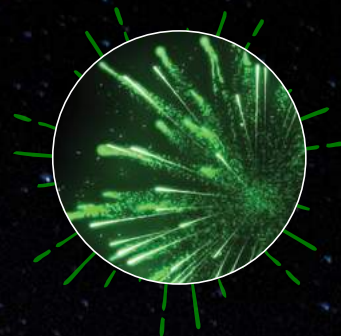
Red fireworks get their colour by burning **STRONTIUM**



Orange fireworks get their colour from **CALCIUM**



Yellow fireworks get their colour from **SODIUM**



Green fireworks burn **BARIUM** for their colour



Bright white fireworks get their colour from **MAGNESIUM**



Blue fireworks burn using **COPPER**

Fireworks reach super high temperatures around **1,000°C!**

The biggest ever fireworks display consisted of **810,904** fireworks and lasted for over an hour.

The loud bangs in fireworks come from the use of aluminium powder.

Purple fireworks are made by mixing the chemicals for blue and red together.

Which chemicals are needed?

ABOUT US

Glasgow Science Centre is a 5-star visitor attraction located beside the River Clyde. We are home to hundreds of interactive exhibits where you can discover how the world works.

Glasgow Science Centre is a registered Scottish charity SC030809.

For more information and bookings, visit: glasgowsciencecentre.org

QUIZ ANSWERS



- Q1.** C) -89.2°C (Recorded at Vostok station in Antarctica in 1983.)
- Q2.** There are four seasons - spring, summer, autumn and winter.
- Q3.** The shortest day of 2021 is the 22nd of December, also known as the winter equinox.
- Q4.** B) 23.5 degrees. This tilt is responsible for our changing seasons.
- Q5.** Betelgeuse. The star making the other shoulder is named Bellatrix.
- Q6.** FALSE. Different liquids will have different freezing points depending on their chemical composition.
- Q7.** Winter. Earth's orbit is elliptical or slightly oval shaped, therefore it's closer to the sun at some places and farther away at others.
- Q8.** A catenoid. Igloos are built using individual blocks of compacted snow arranged in an upwards spiral creating their signature domed shape.
- Q9.** D) Sirius is Orion's dog and it's also the name of the brightest star in the night sky.
- Q10.** Strontium. Copper gives off blue light and strontium gives off red light. Both mixed together create purple.
- Q11.** Camouflage is the way animals (and sometimes humans) use colour and pattern to blend in with their surroundings.
- Q12.** It took 110-120 minutes. On Earth you could cook four batches of cookies in the same amount of time.
- Q13.** Warm air is lighter than cold air because it has more heat energy, which increases the distance between the molecules. This decreases the density, which makes it lighter.
- Q14.** It was celebrated in 1993 by NASA astronaut Jeffrey Hoffman while on board the space shuttle Endeavour.
- Q15.** TRUE. This allows the bear to absorb more heat.
- Q16.** C) $1,000^{\circ}\text{C}$. This is the same as the melting point of copper.
- Q17.** FALSE. All snowflakes are different due to their unique path through the sky as they fall.
- Q18.** C) 9 million carrots are wasted every year and thrown in the bin.
- Q19.** A) 20%. One in five of us might have supertaster genes.
- Q20.** B) Calcium makes orange fireworks.

PUZZLE SOLUTIONS

Help the Bear!

Help the big bear get back to baby bear! Solve the puzzles on the ice to create a path from 1 to 10.

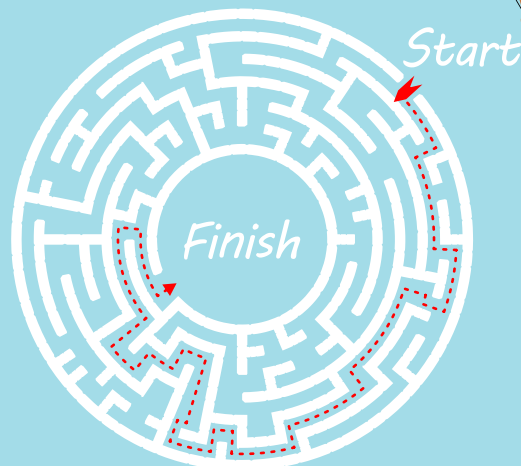


MAZE

1-10



Can you help this penguin catch their dinner?



WE WANT YOUR FEEDBACK

We would love to hear what you think!

We hope you liked this issue, but if you didn't, what could we change? What other things would you like to see? What topics are you most interested in?

You can send feedback and pictures to CLDteam@GSC.org.uk or message us on Twitter @TheBothyGSC



KEEP IN TOUCH



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