

The Spark

Magazine

PUZZLES, QUIZZES, EXPERIMENTS

ISSUE
No22

WHAT IS

WINTER?

MAKE YOUR OWN

FAKE SNOW

COLD WEATHER ANIMALS

HOW DO THEY STAY WARM?

INVESTIGATE

HOW PENGUINS STAY DRY

MEET A

**SCIENTIFIC PROJECT
MANAGER**



GLASGOW
**SCIENCE
CENTRE!**
Registered Scottish Charity: SC030809

Inside

This issue



HELLO!

Snow way! It's winter already?

Welcome to another brrr-illiant issue of the Spark magazine crammed full of creative and curious activities, puzzles, quizzes and facts. In this edition, we're exploring all things winter. We'll be finding out more about animals that live in cold habitats, and answering the question 'Why is snow white?'

Plus, we'll meet a scientist who is working on technology to help predict events like avalanches, and you'll be amazed by cool optical illusions and making your own 'instant ice'!

We hope you enjoy exploring and experimenting with the Spark magazine.

**Best wishes and happy holidays,
Glasgow Science Centre**



SHARE YOUR PICS WITH US

If you try any of our activities, please show us how they turned out! Send your favourite pictures to CLDteam@gsc.org.uk or share with us @TheBothyGSC on Twitter.

MINI PUZZLE

Polar Puzzle!

Can you find and colour in all the polar bears hidden in the image below? How many can you count?



Meet a Scientific Project Manager



Dr Mark Hart,
who works at the Scottish Association
for Marine Science, on page 11!



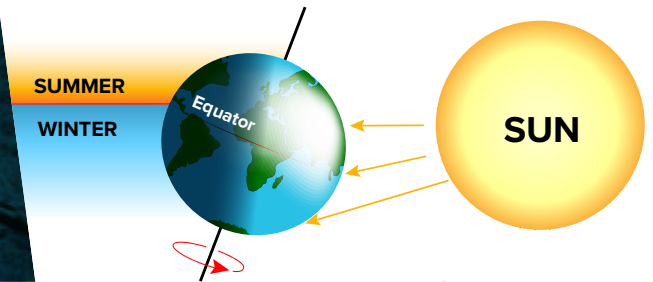
Wondering about winter?

What is winter?

Winter happens at different times of year for different parts of Earth, and sometimes not at all!

During our winter, our hemisphere of Earth is tilted away from the Sun and so gets fewer hours of sunlight per day. Less sunlight means that the temperature doesn't get very high, and we experience colder days.

Earth's seasons



When is winter?

Here in the northern hemisphere, winter starts in December and continues into the new year. In the southern hemisphere, winter starts in the middle of June.

In the UK, we have two different start and end dates for winter. Meteorological winter officially starts on 1 December and ends on 1 March. This is the same every year and is helpful for comparing our weather and climate year to year. In 2023, astronomical winter starts on 22 December and ends on 20 March 2024. Astronomical winter is calculated depending on where Earth is in its orbit around the Sun.

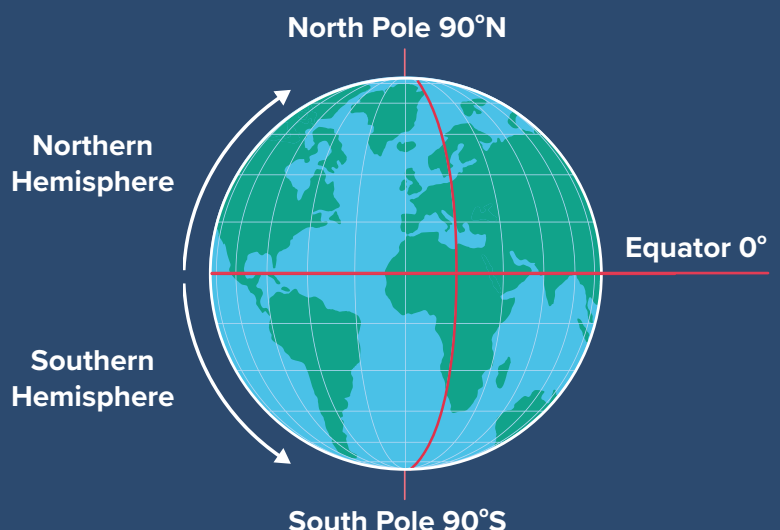
During northern winter, the north pole of Earth is tilted away from the Sun. This causes a polar night which lasts six months, with the sun sinking below the horizon in September and not rising again until March!

DID YOU KNOW?

The shortest day in the northern hemisphere happens every year either on 21 or 22 of December. We call this the northern winter solstice.

Does everywhere have winter?

There is an imaginary line around the Earth that splits the northern and southern hemispheres. This is called the equator. Countries near the equator do not experience winter like we do in the UK. The climate near the equator stays warm all year round, and instead of winter they have a wet or rainy season, and a dry season.



Keeping warm in cold habitats

Animals living in cold environments, like the Arctic and Antarctic, have evolved to stay warm in freezing temperatures. One of the ways these animals keep warm is by using insulators.

Insulators are materials which do not allow heat to move through them easily. They help to prevent heat loss!



Marine mammals

Whales and seals use an insulator called blubber. Blubber is a thick layer of fat under their skin. Weddell seals, who live in Antarctica, have blubber which can be up to 5cm thick, and can make up 240kg of their 400-600kg weight!

Polar bears

They are the biggest species of bear and have a very thick layer of transparent fur as well as a layer of blubber. They also have black skin under their fur which helps absorb heat from the sun and keeps them warm in the Arctic.



Snowy owls

Their body feathers are much thicker than their wing feathers, which helps to keep their bodies warm. These owls also have long feathers on their legs and feet to keep them covered and protected from cold Arctic winds.

Emperor penguins

On top of blubber, these Antarctic birds have a thick layer of waterproof feathers to stop their skin getting wet when they are swimming for food. These insulators also provide excellent protection against freezing blizzard winds.



Allen's Rule

Animals living in cold polar regions often have big bodies compared to their heads and limbs. Having smaller heads and limbs means there is less surface area for heat to escape through. For example, penguins have small heads and flippers, while polar bears have small ears and tails!



Polar Bear Fur Experiment

ACTIVITY

Polar bear fur is made of two different types of hair – one rough and one soft. The rough hair is waterproof and works like a raincoat to keep the polar bear's skin dry. The soft hair acts like a nice woolly jumper, keeping heat close to their body. By combining this multi-functional fur, and a layer of blubber under their skin, polar bears are so well insulated that they bear-ly show up on a thermal camera!

Try the experiment below to feel how this incredible insulation works.

What will you need?

- A big bowl of cold water
- Ice cubes
- A timer or stopwatch
- A kitchen glove (this will be your rough fur)
- A pair of woolly gloves (this will be your soft fur)
- Other materials to test as insulators
- An adult's supervision



It is important not to keep your hand in the cold water for too long – take your hand out of the water as soon as it feels uncomfortable.

What to do

Step 1. Fill the bowl with cold water and add some ice cubes to create cold, icy water.

Step 2. Dip your bare hand into the cold water and ask a friend to time how long you can keep your hand in for. It's going to feel chilly! Remove your hand as soon as it feels uncomfortable.

Step 3. Dry your hand and let it warm up again. Put on one of the woolly gloves.

Step 4. Dip your gloved hand into the bowl and ask a friend to time you again. How long does it take to feel the cold?

Step 5. Put your wet glove away to dry. Dry your hand and let it warm up again. Put on the dry woolly glove, and put the kitchen glove on top.

Step 6. Put your double gloved hand in the cold water. How long does it take to feel the cold now?



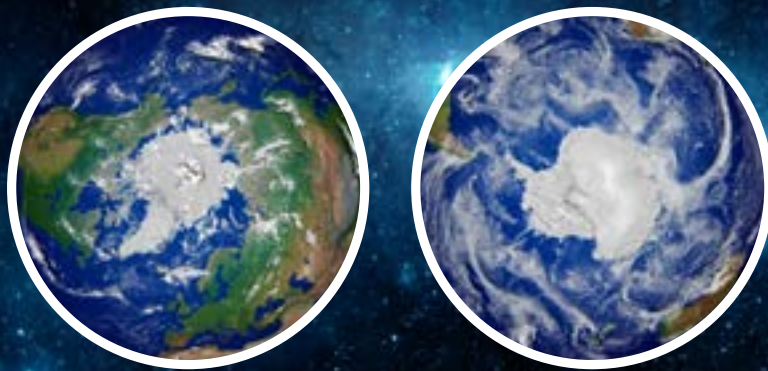
You can also experiment with other materials inside your gloves, like cotton wool.



Ice. It's cool.

What is ice?

Ice is water that has been cooled below its freezing point of 0°C . Water molecules arrange themselves into a crystal structure at this temperature. This turns the water from a liquid into a solid.



Where do we find ice?

There is a lot of ice at the North and South Poles, as these places get very little direct sunlight to warm them. We can make ice at home by putting water in a freezer and cooling it to below 0°C , or outside if it's cold enough!

Frozen floaters

Icebergs are chunks of ice that have broken off glaciers and floated into the ocean. Most of an iceberg is under water, which is where we get the phrase 'tip of the iceberg' from – we can only see a small amount of what's actually there at the surface. An iceberg was famously responsible for the sinking of the Titanic cruise ship in 1912. Icebergs can last for up to 3000 years!



What can we use ice for?

You've probably had ice in your drink to keep it cool during the summer. Perhaps you enjoy an ice cream or a slushy drink? Some people like to make ice sculptures. We can also use ice to store and preserve food. Freezing food makes it last longer by stopping it from going rotten.

What we call 'dry ice' doesn't contain any water. It's the solid form of carbon dioxide and is very cold at -78.5°C !



Instant Ice. It's SUPER cool.



What is supercooling?

Water freezes when it gets to a temperature of 0°C , but did you know it can also be a liquid below 0°C ? Liquid water in this state is called 'supercool'.

Liquid water normally freezes at 0°C because it contains impurities such as dust, or chemicals to make the water safe to drink. These impurities allow the liquid water molecules to begin aligning into crystal-like structures, forming ice.

When water contains no impurities, this makes it more difficult to form ice crystals and freeze. This type of water can be 'supercooled'. For supercooled liquid water to turn into ice, a sharp knock on a surface, or adding an impurity, can cause the liquid water molecules to change into solid ice.

Try out our supercool experiment below!

What will you need?

- Sealed plastic bottle of distilled water
- Freezer
- Table, floor, or another hard surface
- An adult's supervision

What to do

Step 1. Place an unopened bottle of distilled water in the freezer.

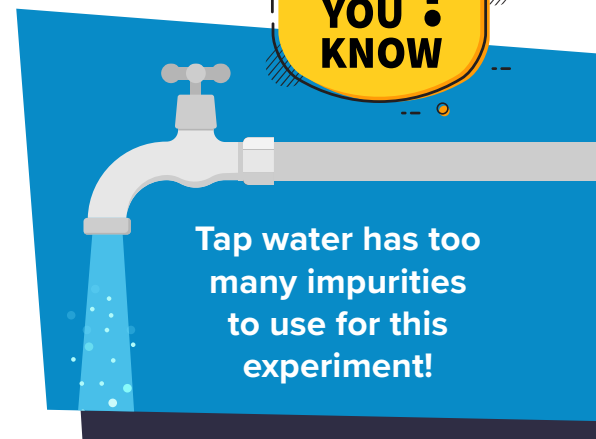
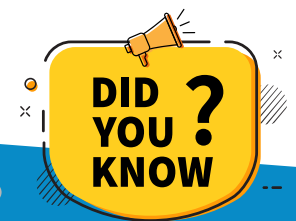
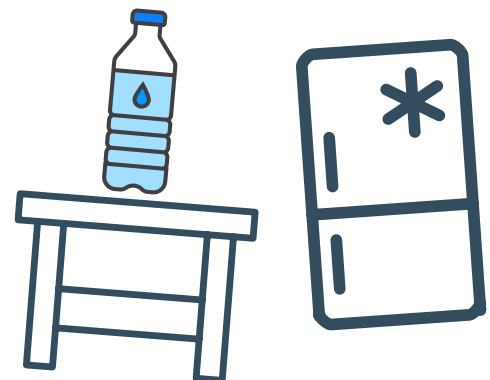
Step 2. Leave it in the freezer for 3-4 hours.

Step 3. **Very carefully** take the water out of the freezer.

Step 4. Hit the bottle off a hard surface and watch the ice form before your eyes!

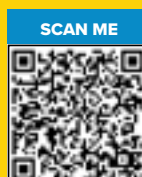


You can try this experiment multiple times with the same bottle! Just let the water melt and try again.



Tap water has too many impurities to use for this experiment!

Watch the Supercool Water video on the #GSCAtHome YouTube page



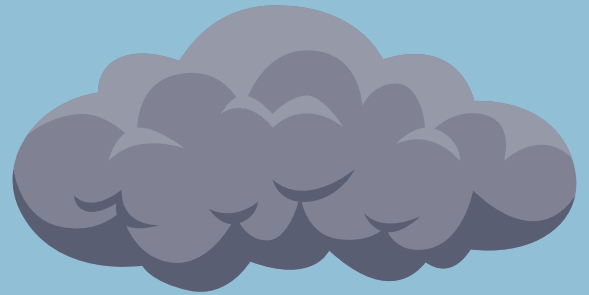
What is snow?



When we see snow, we are actually seeing tiny ice crystals falling to Earth. Snow can be made of both single ice crystals and clumps of ice crystals.

When does it happen?

Snow is formed high in the clouds from water vapour. If a cloud is cold enough, around 0°C or lower, the water vapour freezes to form ice crystals. The ice crystals can stay up in the clouds, or, if they are heavy enough, they can fall to the ground.



However, the temperature in the air doesn't need to be freezing for snow to fall. If the air temperature is around 6°C , and rain is falling consistently, the rain can lower the air temperature enough to allow snow to form. If the air is too warm, the snow could melt before it reaches the ground. This is what leads to a mixture of raindrops and snow, also known as sleet.

Are all snowflakes unique?

When ice crystals join together, they form snowflakes. One snowflake can contain as many as 100 ice crystals. The way they join together gives each snowflake a unique design. While most snowflakes have six points, there are different shapes of snowflake, including the types you can see below!



NEEDLE



STAR/DENDRITE



PLATE



**COLUMN
CAPPED WITH PLATES**



What's the best snow for building a snowperson?



The best conditions for building snowpeople are slightly moist air with a temperature just above 0°C . This allows falling snowflakes to melt a little and freeze back together, which will produce bigger flakes. The perfect snow for building a snowperson forms a snowball easily in your hands and keeps its shape when you throw it.

DIY Fake Snow

It doesn't snow all that often in Scotland – so make your own snowperson using fake snow!

What will you need?

- 200g bicarbonate of soda
- 2 or 3 tablespoons of white hair conditioner
- Bowl or plastic container
- Spoon for mixing (or hands!)
- Small plate
- An adult's supervision

Add decorations to your snowperson using twigs, pebbles, felt, ribbon – whatever you can find!

TOP TIP



Snow too crumbly? Add more hair conditioner.

Too soft? Add more bicarbonate of soda.

What to do

Step 1. Add bicarbonate of soda & hair conditioner to the bowl.

Step 2. Mix it together until you can roll your 'snow' into a ball.

Step 3. Pour some loose bicarbonate of soda onto a tray or plate. Make a snowperson and create your own winter wonderland.



How do penguins stay dry?



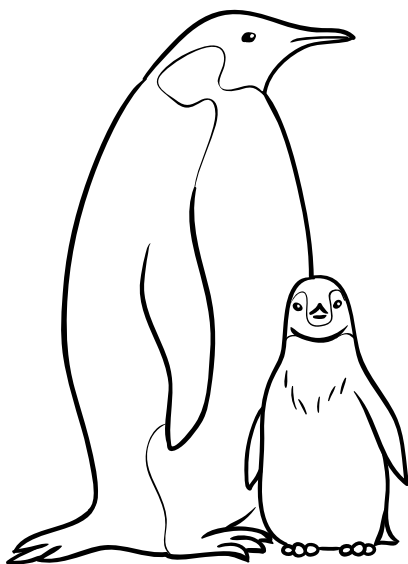
Penguins have a thick layer of overlapping feathers covering their bodies. While the outer edge of each feather is waterproof, the centre is fluffy and soft to help keep them warm. Their feathers are also covered in an oily coating from their preen gland, which helps to make them waterproof.

What to do

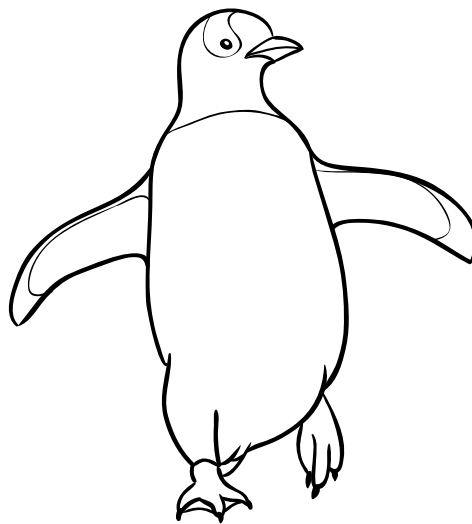
Colour in the penguins using wax crayons. Make sure to colour them in completely with a thick layer of crayon. What happens when you drip water onto the drawings?

What is happening?

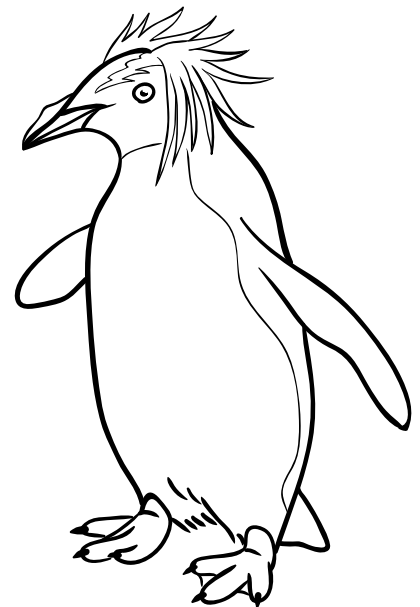
The wax in the crayon acts like the oily coating on the penguin's feathers. It stops the water being absorbed by the magazine paper, making it waterproof!



Emperor penguin



Gentoo penguin



Rockhopper penguin

Penguin Facts

There are at least **18** different species of penguin.

Not all penguins live in **Antarctica**. Most penguins live in the **southern hemisphere** but some are found at the **equator** on the **Galapagos islands** where it's warm all year round!

Many penguin species are threatened by climate change and the fishing industry.

Smallest species: Blue penguin **Largest species:** Emperor penguin

Height: 30-33 cm

Height: 110 cm

Weight: 1.2kg-1.3kg

Weight: 35kg



Meet a Scientific Project Manager



Dr Mark Hart from the Scottish Association for Marine Science (SAMS)

At SAMS, we are developing technology that allows people to analyse snow, sea-ice and freshwater ice. This helps us to understand the impact of global warming in the polar regions, and also to understand and forecast the conditions which might lead to events such as avalanches on mountains.

What is your favourite thing about your job?

The improvement in the equipment we are developing, and seeing this technology contributing to better knowledge and understanding in whichever environment it is being used. I also visited the Arctic a few years ago on a research cruise which was amazing.

What were you like at a young age?

I was quiet and shy but liked to play sport, and I liked to joke around and make people laugh. I enjoyed school, especially biology, history and chemistry.

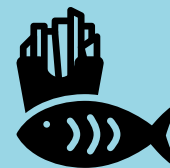
What inspired you?

For science, I think it was some of the amazing discoveries that have happened not that long ago, like the discovery of the structure of DNA or some of the recent space exploration and images of distant stars and planets. I was always fascinated by the Voyager spacecraft launched by NASA when I was young.

For non-scientific 'heroes', it was Kenny Dalglish who is a famous Scottish footballer!



My hobbies are golf and mountain biking



My favourite food is fish and chips!



Icy Problems

When the temperature drops and there's ice on the ground, it can make our pavements and roads very slippery. We need to be careful not to slip and fall!

When things turn icy, you might see vehicles called gritters out and about. They spread salt on the roads and pavements. Salty water needs a lower temperature than 0°C to turn to ice. This means it's less likely that ice will form on the ground if the water is salty.

In Scotland, some of our gritters have funny names, like '**Gritty Bang Bang**' and '**Robert Brrrns**'.



Why is snow white?

Snow is made up of lots of tiny clear ice crystals, called snowflakes, which are formed from water.

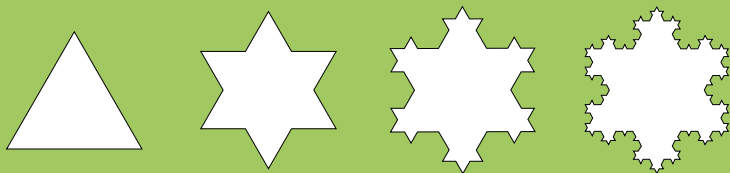
When sunlight hits snowflakes, it gets bounced between them and scattered. Sunlight contains all the colours of the rainbow. When these colours are seen together, they appear as white.



Sensational Snowflakes

Snowflakes start life as crystals of ice that form their distinctive shape as they flutter down from the sky. Their shape depends on the temperature of the air they fall through. This is why no two snowflakes are the same.

When we talk about the complex patterns seen in snowflakes we often use the words 'fractal' and 'symmetry'.



A fractal snowflake forming with a repeating pattern of triangles.

A **fractal** is a **pattern or shape** which **repeats forever**. In **snowflakes**, the pattern will **begin in the middle and grow outwards**, repeating the same pattern over and over again. As the **pattern is repeated**, it gets **smaller and more detailed**, giving each snowflake its own **unique, complex shape**.

If a shape has **two matching halves** we describe it as **having symmetry**.



Symmetrical snowflakes

Hidden Dimensions!

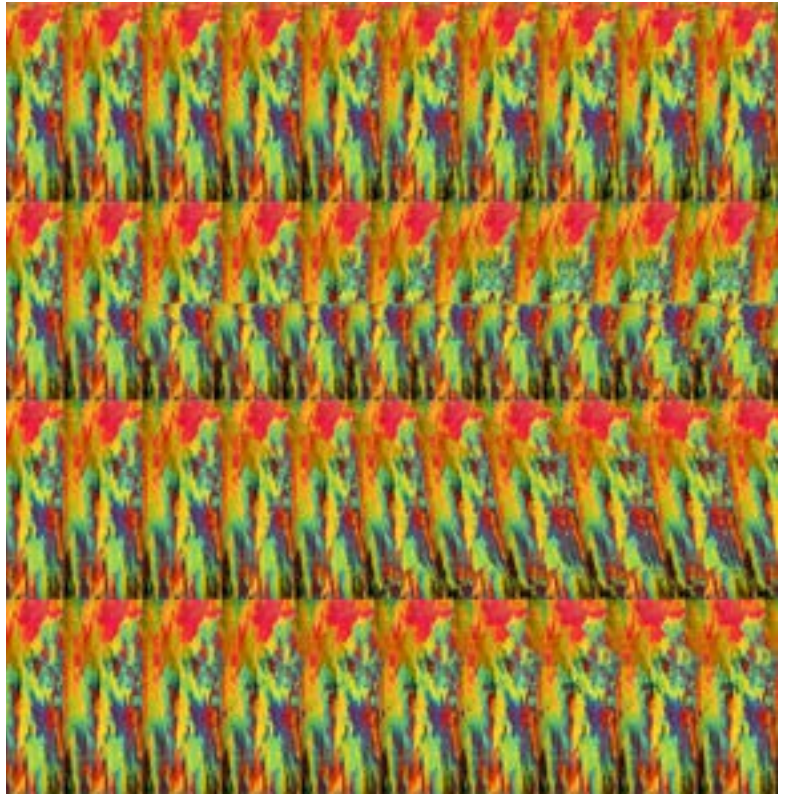
1

An autostereogram is a flat 2-dimensional (2D) image that can create the illusion of a 3-dimensional (3D) object. These are sometimes called 'magic eye pictures'.

How do autostereograms work?

Our eyes are spaced slightly apart from each other. This means that each of our eyes sees an object from a slightly different point of view. If you stare at an object and open and close each eye in turn, you'll notice that the object seems to jump back and forth. Our brains can put these two different views together and we recognise the object as 3D.

Autostereograms create the illusion of a 3D object by merging 2 images. One is a repeating colourful pattern, the other is what will become the 3D illusion. Our brains can put together the different views from each eye to create the illusion that we're seeing a 3D object



How to view an autostereogram:

Step 1. Hold the image as close to your face as possible.

Step 2. Don't focus on the image. Try and look through the image. Imagine you're trying to look at an object in the distance beyond the image.

Step 3. Slowly move the image away from your face. Try to keep your eyes from focussing on the image. Keep trying to look through the image.

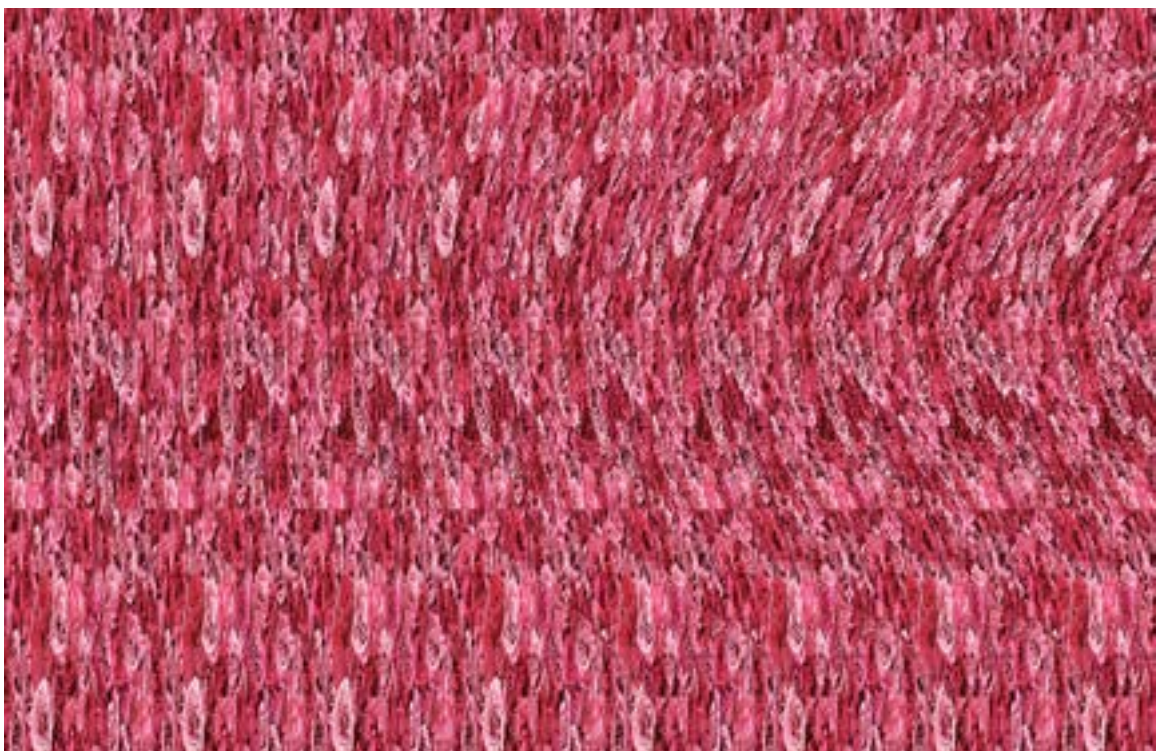
Step 4. At the right distance, a 3D image should appear!



TOP TIP

If you focus your eyes on the image at any point, start from step 1 again. Have patience! It can take a few tries to see the 3D image. The more you practice, the easier it is to see the 3D images.

2



BRIGHT SPARKS!

Are you a bright spark? Test your knowledge with our tricky questions! Check your answers on the back page.

What is the perfect air temperature for building a snowperson?

- ☐ A) 6°C
- ☐ B) Below 0°C
- ☐ C) Just above 0°C

1

2. What are fractals?

- ☐ A) Symmetrical patterns
- ☐ B) Repeating patterns
- ☐ C) Pretty patterns

2

What is blubber?

- ☐ A) A thin layer of fat
- ☐ B) A thick layer of fur
- ☐ C) A thick layer of fat

3

What do we call a night that lasts longer than 24 hours?

- ☐ A) Arctic night
- ☐ B) Winter night
- ☐ C) Polar night

4

There are at least 18 different species of penguin.

- ☐ True
- ☐ False

5

How many years can an iceberg last for?

- ☐ A) 3000 years
- ☐ B) 300 years
- ☐ C) 30 years

6

What colour is a polar bear's skin?

- ☐ A) White
- ☐ B) Black
- ☐ C) Pink

7

How many points does a snowflake have?

- ☐ A) 3
- ☐ B) 6
- ☐ C) 10

8

What is the name of the largest species of penguin?

- ☐ A) Rockhopper
- ☐ B) Adélie
- ☐ C) Emperor

9

How many seasons do countries near the equator have?

- ☐ A) 2
- ☐ B) 3
- ☐ C) 4

10

When does meteorological winter start in the northern hemisphere?

- ☐ A) 1 December
- ☐ B) 22 December
- ☐ C) 1 June

11

What is 'dry ice' made of?

- ☐ A) Solid water
- ☐ B) Solid carbon dioxide
- ☐ C) Solid hydrogen

12

Insulators are materials which allow heat to move through them easily.

- ☐ True
- ☐ False

13

What is an 'autostereogram'?

- ☐ A) A stereo which plays music automatically.
- ☐ B) A 3D image which can create the optical illusion of a 2D object.
- ☐ C) A 2D image which can create the optical illusion of a 3D object.

14

Where do Polar bears live?

- ☐ A) Antarctic
- ☐ B) Sahara Desert
- ☐ C) Arctic

15

Every snowflake is unique.

- ☐ True
- ☐ False

16

What do we call water which is still a liquid below 0°C?

- ☐ A) Supercooled
- ☐ B) Ubercooled
- ☐ C) Undercooled

17

How many types of hair does a Polar bear have?

- ☐ A) 1
- ☐ B) 2
- ☐ C) 3

18

Salty water needs a temperature lower than 0°C to freeze.

- ☐ True
- ☐ False

19

What are snowflakes made of?

- ☐ A) Cotton wool
- ☐ B) Ice crystals
- ☐ C) Paper

20

Answers on
back page

I scored

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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

Bright Spark QUIZ ANSWERS



- Q1. C** The best snow for building a snowperson is just above 0°C.
- Q2. B** Fractals are patterns or shapes which repeat forever.
- Q3. C** Blubber is a thick layer of fat found under some animals skins, like the Weddell seal.
- Q4. C** Polar nights last 6 months!
- Q5. True** At least 18 different species of penguin exist.
- Q6. A** Icebergs can last up to 3000 years.
- Q7. B** Polar bear skin is black to help them absorb heat from the Sun.
- Q8. B** Most snowflakes have 6 points and 6 sides.
- Q9. C** The Emperor penguin is the largest species of penguin. They can be as tall as 110cm!
- Q10. A** Countries near the equator have 2 seasons: a wet or rainy season, and a dry season.
- Q11. A** Meteorological winter in the northern hemisphere starts on 1 December and ends on 1 March.
- Q12. B** Names can be deceiving! Dry ice doesn't contain any water.
- Q13. False** Insulators are materials which don't allow heat to move through them easily.
- Q14. C** Autostereograms create the optical illusion of a 3D object within a 2D image.
- Q15. C** Polar bears live in the Arctic in the northern hemisphere.
- Q16. True** Every single snowflake which has ever formed is unique!
- Q17. A** Supercooled water contains very few impurities so it's harder for ice to form at 0°C.
- Q18. B** Polar bears have 2 types of fur – one rough to keep them waterproof, and one soft to keep them warm.
- Q19. True** Ice is less likely to form at 0°C if water is salty.
- Q20. B** Snowflakes are made of ice crystals.

PUZZLE SOLUTIONS

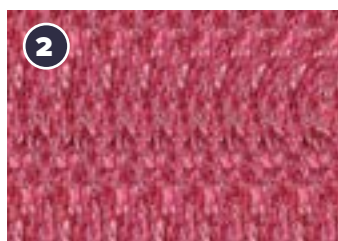
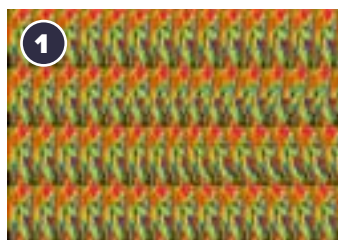


Polar Puzzle!

There were 7 polar bears.



Hidden Dimensions!



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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GLASGOW
**SCIENCE
CENTRE!**

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