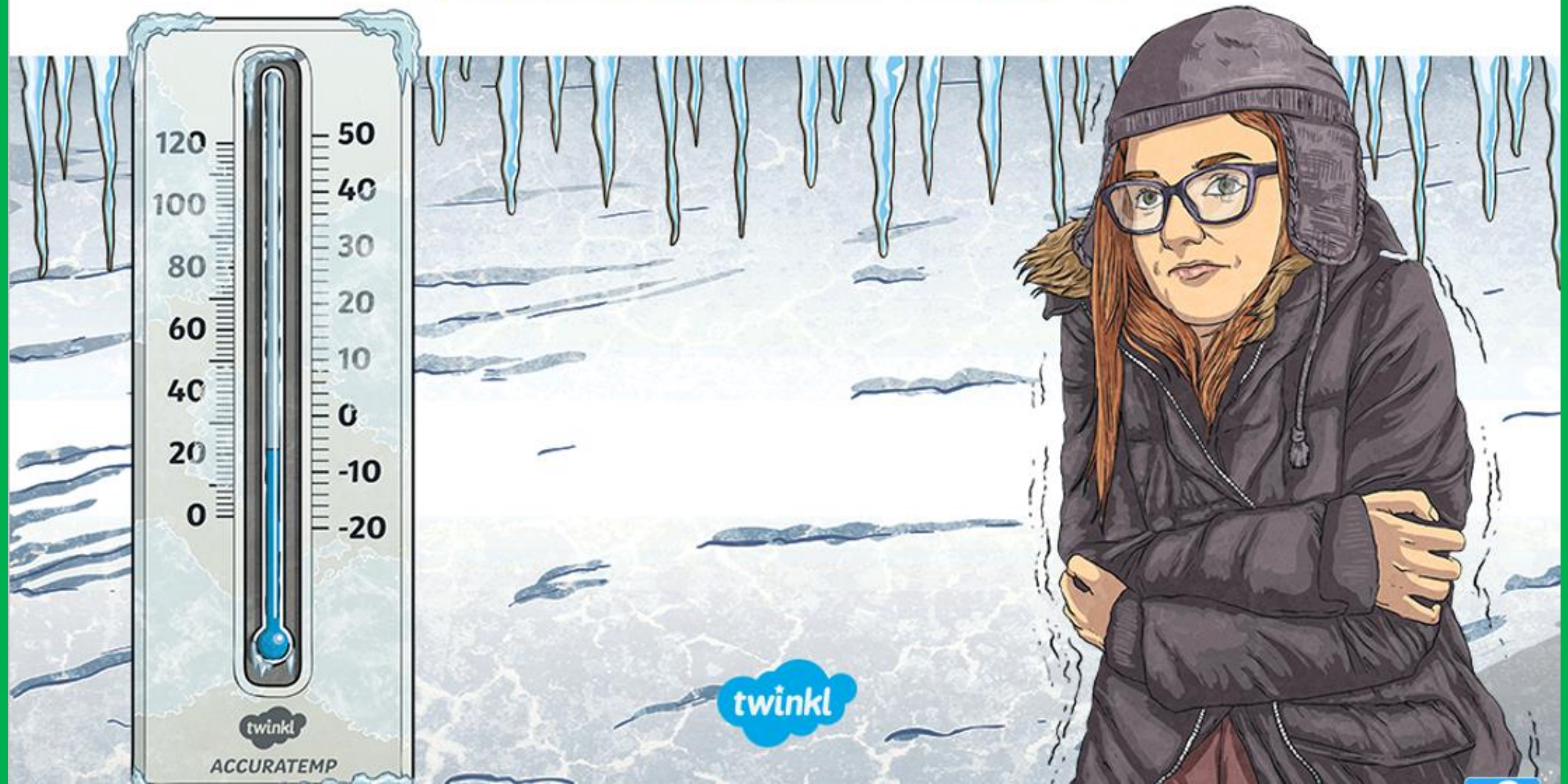
Scientists and Inventors

Lesson 5: Absolute Zero

Thursday 11th February

Absolute Zero



Aim

- I can explain what Lord Kelvin called ‘absolute zero’.
- I can accurately use a thermometer.

Success Criteria

- I can describe Lord Kelvin’s life and work.
- I can make a model to demonstrate how particles behave at absolute zero.
- I can use a thermometer to read and show temperatures.

Searching for Absolute Zero

How cold can it get?

This is a question that had puzzled scientists for hundreds of years in the 17th, 18th and 19th centuries. They wondered if there was a limit to how cold things could possibly get.

Many scientists joined in the race to find **'absolute zero'** – the lowest temperature possible.

Ideas ranged from French physicist Guillaume Amontons' suggestion of -240°C, to English scientist John Dalton's proposal of -3000°C.

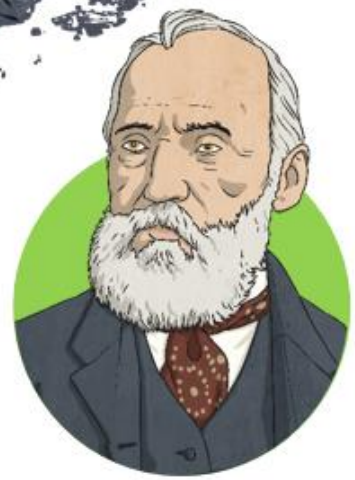
It was not until 1848 that the question was finally answered and Lord Kelvin discovered the coldest possible temperature, the absolute zero.

Lord Kelvin

Lord Kelvin was born in Ireland in 1824. He was named William Thomson, but he became better known as Lord Kelvin in later life.

When Thomson was eight, his father moved to Glasgow in Scotland to teach at the University of Glasgow.

At the age of ten, Thomson passed the entrance exams for the university and began studying there. Although he was very young, he kept up with the other students and studied complex ideas.

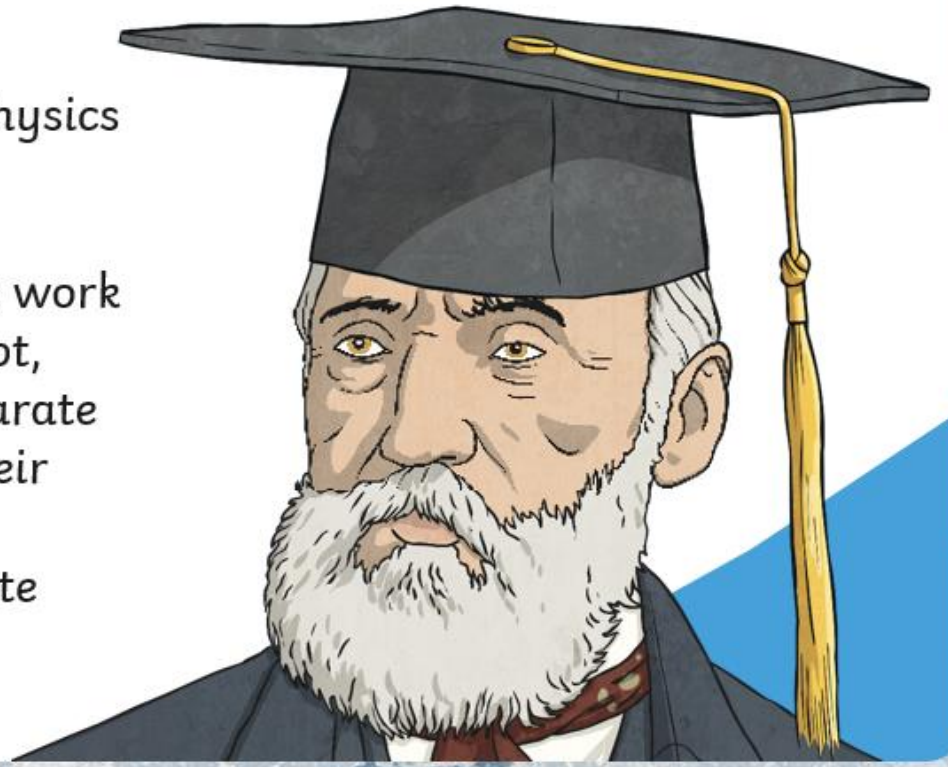


Lord Kelvin

In 1841, he attended Cambridge University and in 1846, he went back to the University of Glasgow, this time as professor of natural sciences. He held this post for over fifty years!

While there, he created the first physics laboratory in Britain .

Thomson became interested in the work of James Joules and Nicolas Carnot, who had both published their separate research into heat and energy. Their ideas led Thomson to develop his temperature scale and find absolute zero.



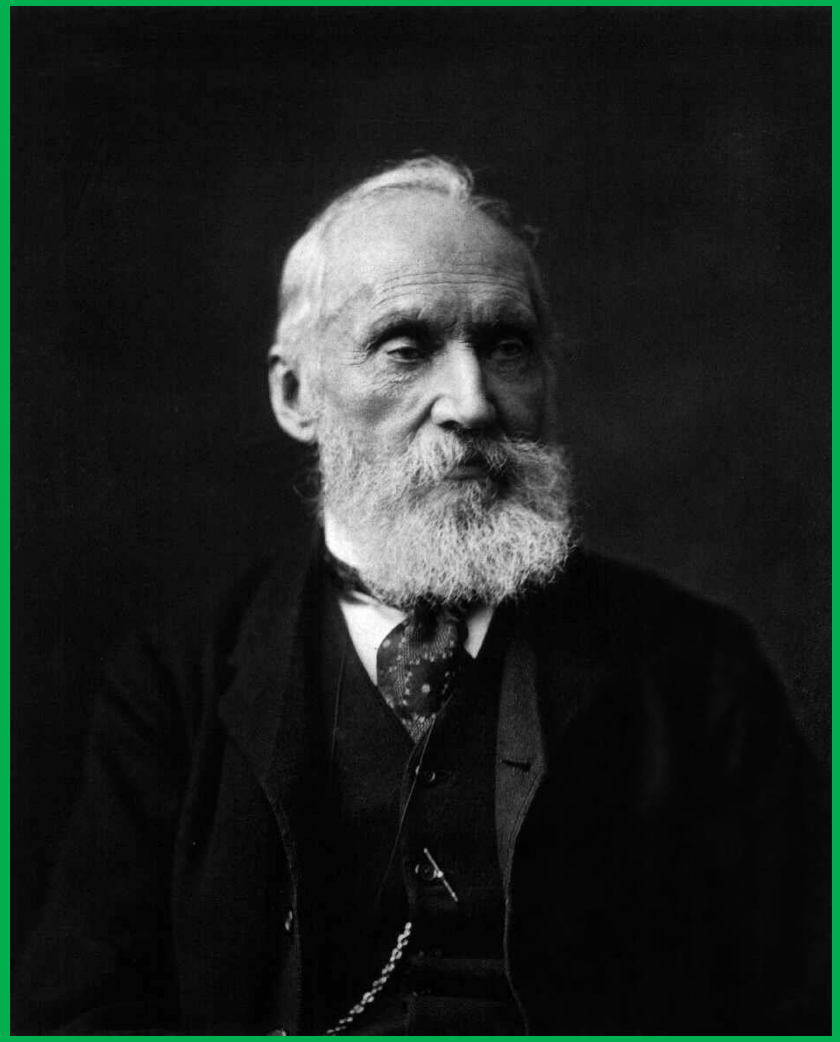
Lord Kelvin

In recognition of his discovery, Thomson was made a Lord in 1892. He was named Lord Kelvin after the River Kelvin, which flowed near his lab in Glasgow.

He worked on many other inventions, including supervising the laying of the first telegraph cables under the Atlantic in the 1850s and 1860s. He also developed a sailor's compass and invented several electrical devices. His house in Glasgow was the first to be lit by electric light.

The Hunterian Museum at Glasgow University has a permanent exhibition of Kelvin's life and work.

Task 1: Write 3 key facts about Lord Kelvin's life.



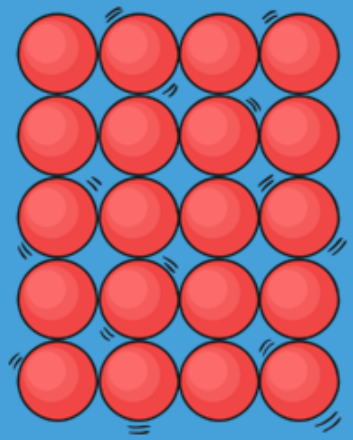
Absolute Zero

Lord Kelvin developed a temperature scale called the Kelvin scale. His research into heat and energy allowed him to determine the temperature of absolute zero.

This is the coldest possible temperature. He found that it was **-273.15°C**

At this temperature, all the particles in a material would almost stop moving completely.

At the moment, scientists do not have the ability to cool materials down to absolute zero, although a method called laser cooling can produce temperatures extremely close to absolute zero.



At these temperatures, some materials develop unusual properties, such as superconductivity, which is where a material becomes a special type of electrical conductor.

The lowest natural temperature ever recorded is around -272°C, in the Boomerang Nebula, a star system about 5000 light years away from Earth.

Watch the video clip to find out how particles change when the temperature changes.

https://www.youtube.com/watch?v=GVRTa0JopuE

Task 1: You will need some marbles or any small round object and a tray. Follow the instructions below. You can either print the activity or draw the 4 boxes on your page.

Make a model to demonstrate how particles behave at absolute zero.

1)Use marbles (or any round shaped objects) to demonstrate how the particles in water behave as they change from a gas to a liquid, then to a solid, and how they would behave when cooled down to absolute zero. You will need some marbles and a tray. Firstly, position the marbles in the tray as if they were the particles in water vapour, a gas. The marbles should be spread out all over the tray. Move the tray so that the marbles roll all over it and move a lot. This is how the particles in a gas behave. Draw a picture or take a photo of your demonstration of the particles in a gas, like water vapour.

1)

2) Imagine the temperature gets lower and cools down. Position the particles so that they are all grouped at one end of the tray. Move the tray so that the marbles still roll all around, but stay at the end of the tray. This is how the particles in a liquid behave. Draw a picture or take a photo of your demonstration of the particles in a liquid, like water.

2)

3) The temperature falls even lower, and the water cools down even further. Position your marbles in rows at one end of your tray. Move the tray so that the marbles shake from side to side but stay in their rows. This is how the particles in a solid behave. Draw a picture or take a photo of your demonstration of the particles in a solid, like ice.

3)

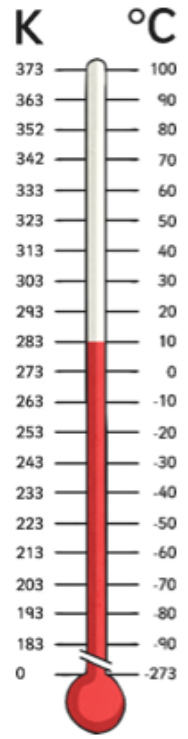
4) Now, the temperature falls much lower, as low as absolute zero! Try to move the tray very gently, so that the marbles hardly move at all. This is what happens to the particles in a material as they are cooled down towards absolute zero. Draw a picture or take a photo of your demonstration of the particles in a material at absolute zero.

4)

Scales of Temperature

Lord Kelvin created a new temperature scale to show absolute zero. It is called the Kelvin Scale, and it is measured in kelvins, not degrees Celsius.

This thermometer shows Kelvin's scale next to the more familiar Celsius scale.



You can use the Celsius scale to convert temperatures to the Kelvin scale.

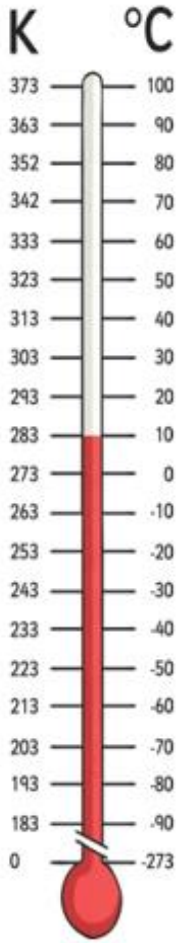
Look at -273°C on the Celsius side. Now, follow the line across the thermometer to the Kelvin side. You can see it shows zero.

Can you convert the temperatures on your **Scales of Temperature Activity Sheet** using both sides of the thermometer?

So -273°C is the same as 0 Kelvin.

Task 3: Use a thermometer to show temperatures.

Use the thermometer to answer the questions about the Kelvin scale of temperature.



Use the image of the thermometer to convert these temperatures to Kelvin.

Boiling point of water: 100°C or _____ Kelvin

Freezing point of water: 0°C or _____ Kelvin

Answers:

Boiling point of water:	100°C or 373 Kelvin
Freezing point of water:	0°C or 273 Kelvin

Well Done Year 4!