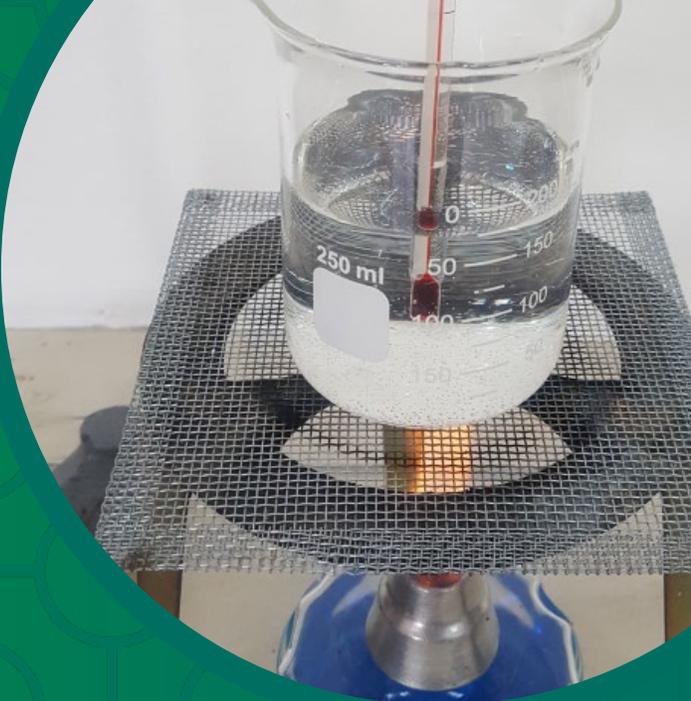




11–14 years

Boiling point: a surprising measurement!

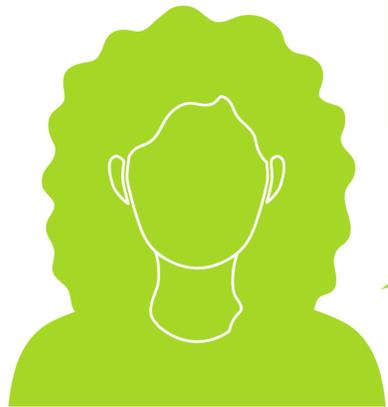




The problem

Lydia carried out an experiment to measure the boiling point of water. She heated some water, in a beaker, with a Bunsen burner. When the water started to boil, she added a thermometer and took the reading. The temperature was 102°C .

Lydia was surprised.



Lydia

What a surprise!

I was not expecting to measure the boiling point of water as 102°C .

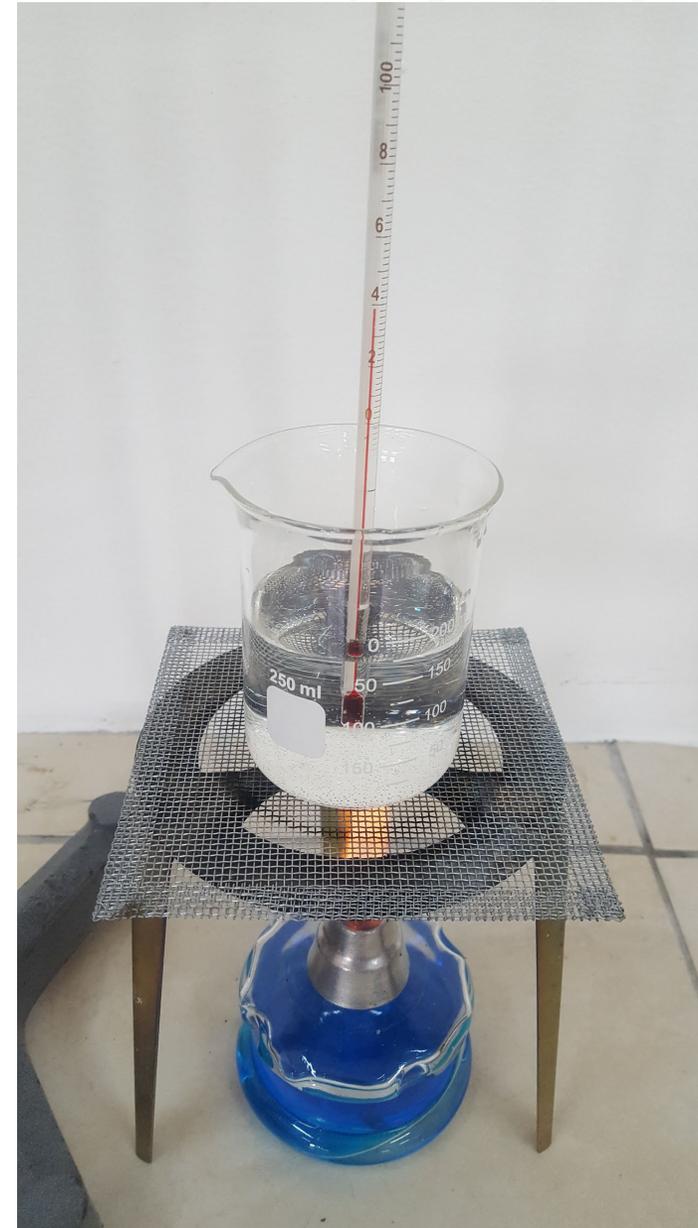


Image ©: Shutterstock/fen deneym



Why might that be?

Lydia's classmates made some suggestions as to why the reading was not 100°C as she was expecting.

What a surprise!
I have measured
the boiling point of
water as 102°C .

It was warm in the
science lab today and
this has added to the
temperature reading.

The thermometer
was inaccurate.

The thermometer was
touching the beaker,
which was hotter than
the water.

The water was not
pure, and the
impurities changed
the boiling point.

Lydia has
taken the
reading
incorrectly.

The thermometer
had **not** been left
long enough in the
water.

The
thermometer
was left **too**
long in the
water.

Lydia

Sam

Uri

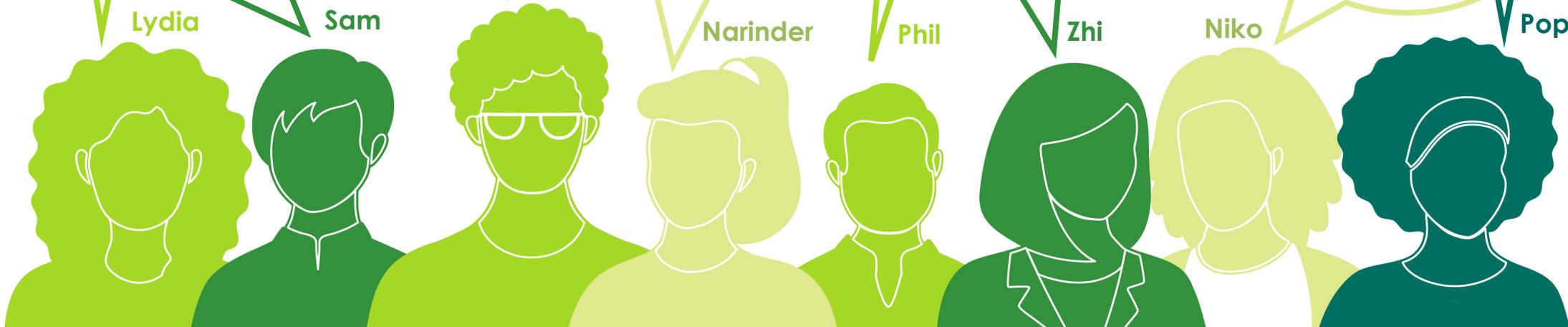
Narinder

Phil

Zhi

Niko

Poppy



Activity 1: table sort



In a small group, discuss the suggestions Lydia's friends made. Arrange the suggestions into two categories, possible (plausible) explanations and unreasonable ones.

Possible explanations	Unreasonable explanations



Activity 2: test it out

For each reasonable (plausible) explanation, describe what further experiment you would do to decide whether it might be correct or not. Explain how that experiment would help you decide if the suggestion was correct.

Lydia has taken the reading incorrectly.

Reasonable explanation

Lydia misread the thermometer.

How to test this explanation:

Get several members of the class to take the reading themselves.

How would this help to decide if the suggestion was correct?

If they agree that the thermometer reads 102°C , then you can rule out Narinder's suggestion as a possible explanation. If the other students take the reading to be 100°C , then you could conclude that Narinder's was the correct explanation.

Narinder



Activity 3: your ideas



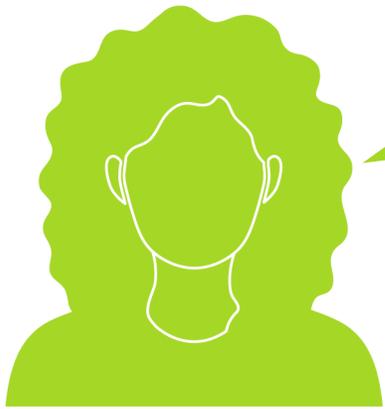
You may be able to suggest a different explanation for the reading.
If you can, write it down and discuss the idea with your group.

A large, empty, light green speech bubble shape with a dark green outline. The bubble is oriented horizontally, with the tail pointing towards the bottom-left corner. It is intended for the user to write their idea in.

Discussion of answers

This activity is designed to help develop critical thinking (evaluation) skills. You are asked to make judgments about the suggestions based on scientific reasoning.

Without being there at the time we can't say for sure why the thermometer reading taken was 102°C . However, we can form opinions about how likely each explanation is. We can also suggest experiments to test the suggestions.



Lydia

What a surprise!

I was not expecting to measure the boiling point of water as 102°C .

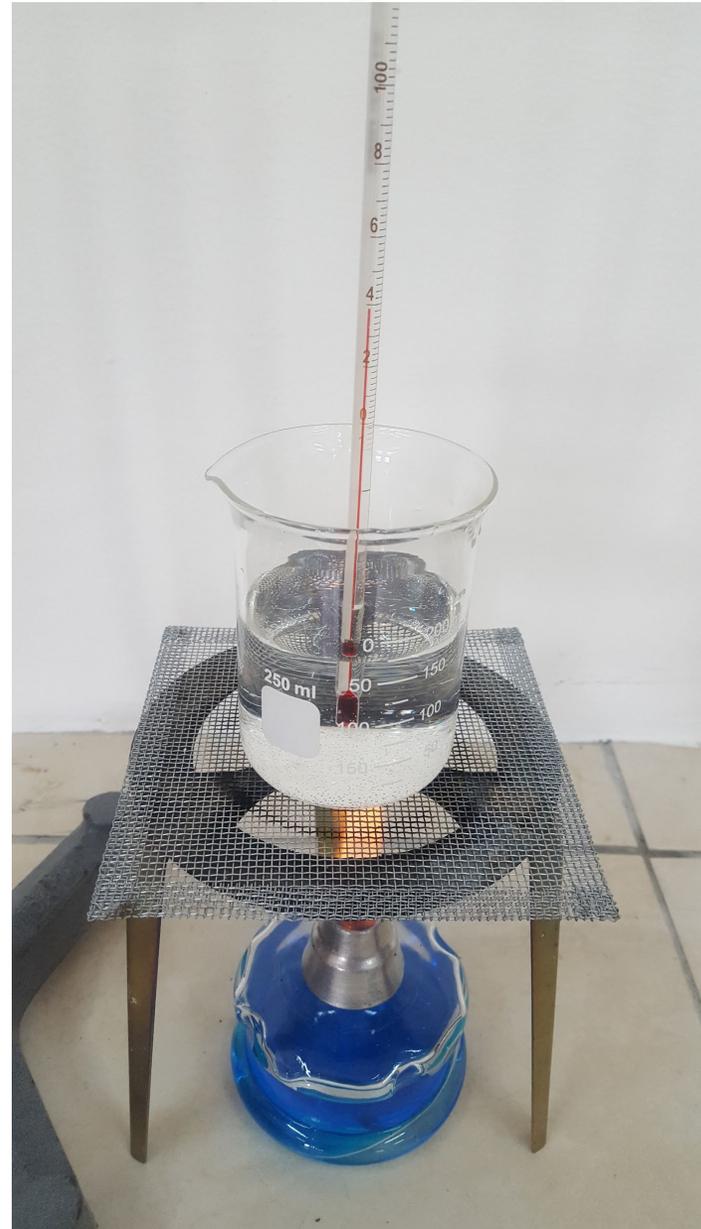
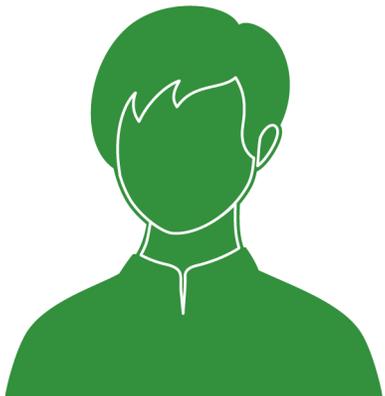


Image ©: Shutterstock/fen deneyim



Discussion of answers

The water was not pure, and the impurities changed the boiling point.



Sam

This seems a reasonable suggestion. Impurities would raise the boiling point of water. That is why salt is often added to boiling vegetables. However, it is unlikely that the typical amounts of impurities in normal tap water would change the boiling point by as much as two degrees.

To test this idea, you could do the experiment using distilled water after carefully washing and rinsing the beaker.



Discussion of answers

The thermometer was inaccurate.



Phil

This is the most likely explanation. It is tempting to believe that all apparatus is accurate. This is not the case. Different thermometers can be more, or less, accurate. Some thermometers are manufactured to be more accurate than others.

To test this idea, you could put several different thermometers into the water and take readings from them all.



Discussion of answers

The thermometer had not been left long enough in the water.



This is not very likely. If the thermometer had not been in the water long enough, it would still be warming up and would be likely to read less than 100°C.

To test this explanation, you could leave the thermometer in the water and take readings every 30 seconds to see if it changed.



Discussion of answers

The thermometer was touching the beaker which was hotter than the water.



This is a sensible suggestion. The beaker would be hotter than the water because heat energy is flowing from the flame to the beaker then from the beaker into the water, to keep the water boiling. Flame, beaker, water is the order in decreasing temperature.

To test this suggestion, you could repeat the experiment, this time holding the thermometer off the bottom of the beaker.



Discussion of answers

It was warm in the science lab today and this has added to the temperature reading.



The temperature of the room should not affect the boiling point of the water.

However, if the room was warm that might be because it was a fine day associated with high atmospheric pressure.

Boiling points can be affected by air pressure. For example, they tend to decrease high up a mountain where the air pressure is low.

The boiling point of water could vary by as much as one degree either side of 100°C depending on whether the air pressure is high or low.



Discussion of answers

The thermometer was left too long in the water.



The water should boil at 100°C, no matter how long you heat it or how vigorously it boils.



Activity 4: create your own!

Devise your own concept cartoon about another surprising experimental result.

