

Investigating



Communicating



Knowledge and understanding



An experimental investigation: How is the solubility of a common substance in water affected by the temperature of the water?

## Learning outcomes in focus

**Students should be able to:**

**NS3 design, plan and conduct investigations;** explain how accuracy, fairness, safety and selection of suitable equipment have been considered

**NS4 produce and select data** (qualitatively/quantitatively), **critically analyse data to identify patterns and relationships**, identify anomalous observations, **draw and justify conclusions**

**CW6 investigate the properties of different materials including solubilities**, conductivity, melting points and boiling points

## Learning intentions

**We are learning to:**

- design, plan and conduct an investigation
- produce quantitative data in relation to solubility
- investigate the effect of temperature on solubility
- identify relationships between solubility and temperature
- use results to draw valid conclusions

## Teaching and learning context

The First Year mixed ability students have designed, planned and conducted experiments on states of matter, solutions and separating

mixtures with teacher guidance. This the first time the students have designed, planned and conducted their own investigation. The students have used PHET to investigate solubility, concentration and saturation. The students have through investigations and "The Simpsons scientific method" worksheets engaged with variables and controls.

## Task

Investigate the following question **How is the solubility of a common substance in water affected by the temperature of the water?**  
Represent your work in a poster

## Success Criteria

- SC1:** pose a testable hypothesis.
- SC2:** list appropriate variables.
- SC3:** select and list appropriate apparatus.
- SC4:** outline my method.
- SC5:** produce a labelled diagram.
- SC6:** produce quantitative data with appropriate units.
- SC7:** state a valid conclusion based on results.
- SC8:** state safety precautions taken in conducting their investigation.
- SC9:** review my investigation design, referring to errors, extensions and/or improvements.

## How is the solubility of a common substance in water affected by the temperature of the water?: Example 1

P2

### Observing Solubility of household substances at different temperatures

conclusion-The higher the temperature then the more Mass is needed to saturate. The Lower the temperature the less Mass is to saturate.

Errors: In The fourth test we had the Water at a higher temperature than our 3rd test and the mass decreased but our tests showed that a higher temperature uses more mass to saturate. we made the same error on the salt on the 6th test

Image of Finished Project

### Observing Solubility at household substances at different temperatures

Apparatus: 12 glasses, sugar, Bisto, veg oil, instant coffee, teaspoon, flask, beaker, and a mixing spoon, water at 0°C, 50°C, 100°C

Method:

- Get 12 glasses
- Get your Bisto, sugar, veg oil and instant coffee
- Take a heaped teaspoon of each and put them in the glasses
- Add the zero degree water into the sugar, Bisto, veg oil and instant coffee record your observations.
- Heat the water and see if there any changes
- Repeat the same procedure for the 50°C and 100°C water
- Record observations

Independent variable: Volume of water and weight of household substances

Independent variable: Measuring the solution for 10ccs

### Improved Method

- I measured 50g of sugar in a beaker
- I measured 80ml of cold water in a beaker cooled by ice
- I then measured the temperature of the water
- I then added sugar (in small amounts) into the water until it was saturated so it wouldn't dissolve anymore sugar
- Then I measured the mass of the sugar and wrote my results down
- I repeated this with lots of different temperatures
- I graph all my results on excel

Hypothesis: I think at the end of this experiment I will know that a higher temperature will take more mass to saturate and a lower temperature will take less mass to saturate.

Temperature	mass	Temperature	mass
0°C	4.2g	10°C	8.6g
5°C	4g	16°C	1.2g
25°C	11.3g	12°C	6.3g
23°C	17.2g	64°C	14.2g
69°C	15.2g	83°C	26.2g
37°C	5.5g	100°C	72.6g
		30°C	14.8g
		51°C	21.2g

Sugar      Coffee      Salt

Temperature      mass

100°C      0.2g

76°C      It can't be saturated

Extensions

I could've been much more precise when stirring the water. I could have measured the water exactly.

Apparatus

Safety: we were safe when boiling the Kettle. We had a adult v us.

**SC1:** Poses testable hypothesis which shows student has considered Mass, Temp and Saturation of solution.

**SC2:** Appropriate variables identified and correctly manipulated, however, inaccurately labelled.

**SC3:** Listed apparatus.

**SC4:** Method outlined.

**SC5:** Equipment drawn and photo included.

**SC6:** Quantitative data produced with correct units and displayed in table and graphical form.

**SC7:** Valid conclusion based on results.

**SC8:** Not enough consideration of safety precautions.

**SC9:** Planned reviewed and redesigned improvements identified.

Overall judgement: In Line With Expectations



How is the solubility of a common substance in water affected by the temperature of the water?: Example 1

P3

Observing Solubility of household Substances at different temperatures

Temperature (degrees celcius)	Mass (grams)
5	1
20	2
35	6
50	4
70	16
85	18

conclusion-The higher the temperature then the more mass is needed to saturate. The lower the temperature the less mass is to saturate.

Temperature degrees cellius	Mass(grams)
5	2
10	6
20	9
30	15
50	22
65	15
85	28
100	30

Errors: In The fourth test we had the water at a higher temperature than our 3rd test and the mass decreased but our tests showed that a higher temperature uses more mass to saturate. we made the same error on the salt on the 6th test

Image of finished project

**SC6:** Quantitative data produced with correct units and displayed in table and graphical form.

**SC7:** Valid conclusion based on results.

**SC5:** Equipment drawn and photo included.



How is the solubility of a common substance in water affected by the temperature of the water?: Example 1

P4

**Observing Solubility at household substances at different temperatures**

**Apparatus:** 12 glasses, sugar, Bisto, Veg oil, instant coffee, teaspoon, 3 flasks, beaker, and a measuring spoon, water at 0°C, 50°C & 100°C

**Method:**

- Get 12 glasses
- Get your Bisto, sugar, veg. oil and instant coffee
- Take a heaped teaspoon of each and put them in the glasses
- Add the zero degree water into the sugar, Bisto, veg. oil and instant coffee record your observations.
- Mix the ~~water~~<sup>solutions</sup> and see if there any changes
- Repeat the same procedure for the 50°C and 100°C water
- Record observations

**Dependent variable:** Volume of water and weight of household substances

**Independent variable:** Mixing the solution for 10 secs

**Improved Method**

- I measured 50g of sugar in a beaker
- I measured 80ml of cold water in a beaker cooled by ice
- I then measured the temperature of the water
- I then added sugar (in small amounts) into the water until it was saturated so it wouldn't dissolve anymore sugar
- Then I measured the mass of the sugar and wrote my results down
- I repeated this with lots of different temperatures
- I graft all my results on excel

Hypo

Temper  
51°C  
5°C  
20°C  
83°C  
69°C  
37°C

Su

**SC3:** Listed apparatus.

**SC4:** Method outlined.

**SC2:** Appropriate variables identified and correctly manipulated, however, inaccurately labelled.

**SC9:** Planned reviewed and redesigned improvements identified.

How is the solubility of a common substance in water affected by the temperature of the water?: Example 1

P5

**Safety:** we were safe when boiling the kettle. We had a adult with us.

**Extensions**

I could've been much more precise when stirring the water. I could have measured the water exactly.

**Apparatus**

12 Glasses      Sugar      salt      3 Test tubes

8 Beakers      Mixing spoon      kettle

Water at 0°, 50°, 100°

**Hypothesis:** I think at the end of this experiment I will know that a higher temperature will take more mass to saturate. And a lower temperature will take less mass to saturate.

temperature	mass	temperature	mass
51°C	4.2g	18°C	8.6g
5°C	1g	8°C	1.7g
20°C	1.3g	12°C	6.3g
83°C	17.7g	64°C	14.2g
69°C	15.2g	83°C	26.3g
37°C	5.5g	100°C	78.6g
		32°C	14.8g
		51°C	21.2g

Sugar      coffee      Salt

temperature	mass
18°C	0.2g
76°C	It can't be saturated

**SC8:** Not enough consideration of safety precautions.

**SC5:** Equipment drawn and photo included.

**SC1:** Poses testable hypothesis which shows student has considered Mass, Temp and Saturation of solution.

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