

Controlled variable investigation: Find the mistakes – answers

Education in Chemistry

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Use this activity alongside the tips in the *Education in Chemistry* article, [How to teach controlled variable investigations at 11–14](#). Mistakes are highlighted in yellow below; corrections are in red.

A student is investigating how long sugar takes to dissolve in water. They have written up their work, but unfortunately there are a few mistakes.

a) Identify the mistakes in the investigation below and correct them.

How does changing the type of sugar used affect the time it takes to dissolve?

Independent variable: The time that is taken for all of the sugar to dissolve.

- This is the dependent variable.

Dependent variable: If we use caster sugar or icing sugar, the type of sugar.

- This is the independent variable.

Control variables: The mass of sugar used; the temperature of the water; the amount of water.

- 'amount of water' should be **volume** of water.
- Could also include the solvent, the surface area of sugar (granules or lumps), stirring speed, etc.

Method:

- Use a spoon to measure out 5 g of the sugar.
 - Inappropriate apparatus, a mass balance would be needed.
- Use a 100 cm³ measuring cylinder to measure 20 cm of water. Ensure the water is at exactly 27.00°C.
 - 100 cm³ is probably a bit on the large side for the given volume.
 - 20 cm should be 20 cm³.
 - 27.00°C: This resolution not likely with the equipment available; doesn't indicate how we would achieve this; as long as temperature is constant, we don't need a particular temperature.
- Put the water into a beaker and then add the sugar, stir it until it dissolves.
- When the sugar is added, start the timer and record the time (m) it takes to dissolve.
 - Incorrect abbreviation: (m) is metres, not minutes.
- Repeat with different types of sugar.
- Repeat each sugar three times to make sure it is a fair test.
 - Repeating is not what makes it a fair test: repeating it means you can get an accurate mean average value; the control variables make it a fair test.

Results:

Type of sugar	Time it takes for sugar to dissolve			
	Test 1	Test 2	Test 3	Average
Caster	1m 4s	15s	1m 20s	53s
Icing	23s	31s	42s	32s
Demerara	2m 15s	2m 2s	1m 59s	2m 5s

- Time it takes heading is missing units: (seconds)
- A mix of units is used in table, they should all be seconds.
- Average for caster sugar includes test 2 which is anomalous – average should be 72s, not 53s.

b) Extension: What else could be added to the method to improve it?

Improvement to the method could include:

- the number of times it was stirred
- was it manual or automatic stirring?
- how was the end point determined?
- the size of the beaker used
- safety: eg, how will you stop the beaker falling over?