# Controlled variable investigation: Find the mistakes – answers

***Education in Chemistry***May 2021
[rsc.li/3tYSiZP](https://rsc.li/3tYSiZP)

Use this activity alongside the tips in the *Education in Chemistry* article, [How to teach controlled variable investigations at 11–14](https://rsc.li/3tYSiZP). 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.

1. 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:

1. Use a spoon to measure out 5 g of the sugar.
	* Inappropriate apparatus, a mass balance would be needed.
2. 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.
3. Put the water into a beaker and then add the sugar, stir it until it dissolves.
4. When the sugar is added, start the timer and record the time (m) it takes to dissolve.
	* Incorrect abbreviation: (m) is metres, not minutes.
5. Repeat with different types of sugar.
6. 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 incudes test 2 which is anomalous – average should be 72s, not 53s.
1. **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 the stop the beaker falling over?