

## Bob's Sugar Experiments

Bob likes sugar in his tea. He decided to investigate how quickly sugar dissolves. He discovered that it was too difficult to do his experiments in tea, so he used water instead.

### Experiment 1

Bob decided to look at how long it took for different sugars to dissolve.

He added 1 level teaspoonful of sugar to 50cm<sup>3</sup> of water, stirred all the time, and timed how long it took for the sugar to dissolve.

He also made sure that he measured the temperature of the water.

Bob tested each type of sugar three times.



- Write down the best apparatus that Bob could use to measure:
  - The volume of water
  - The time taken to dissolve
  - The temperature of the water
- Bob used a level teaspoonful each time to make it a fair test.
  - What else did Bob do to make it a fair test?
  - Suggest a more accurate way that Bob could measure out his sugar.
- Bob wasn't terribly good at making tables for his results, so he recorded them as lists. A copy of part of Bob's exercise book is shown below.

<u>Results</u>			
	<u>Experiment 1</u>	<u>Experiment 2</u>	<u>Experiment 3</u>
	Icing sugar took 27 secs	Caster ..... 27 sec	GS took 52 s
	Caster sugar took 29 secs	Icing ..... 23 sec	IS = 25 s
	Granulated sugar took 56 secs	Granulated ... 54 s	CS ..... 37 s

- Bob used three different units to record the times. These were sec, secs, and s. Only one of these units is correct. Which one?
  - Bob got bored writing out the names of each sugar, so he used shorter names. Suggest a problem that Bob might have later if he does this.
4. Bob's teacher helped him to make a table for his results. It looked like this:

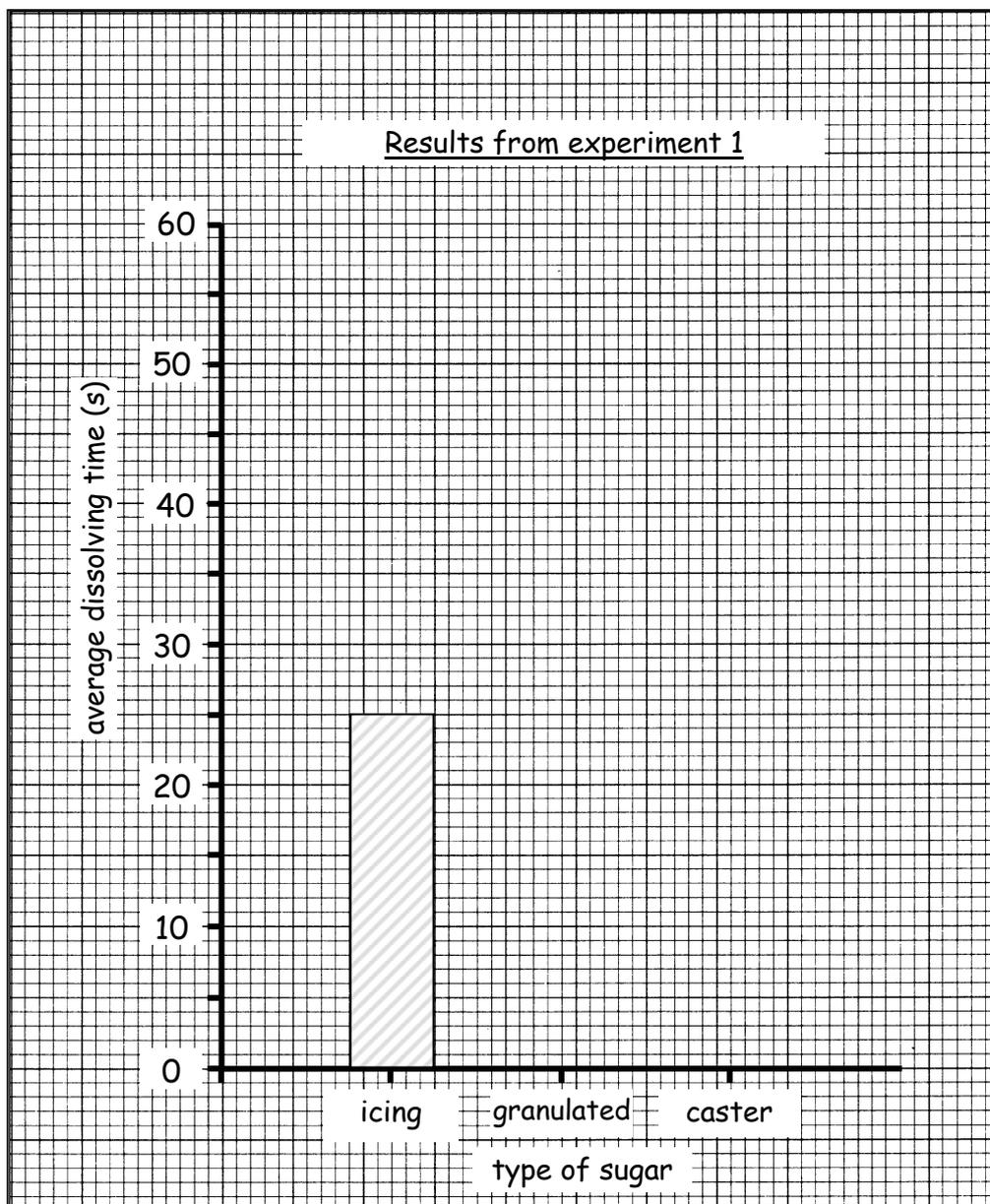
Type of sugar	Dissolving time			Average dissolving time
	Experiment 1	Experiment 2	Experiment 3	
Icing sugar				
Granulated sugar				
Caster sugar				

- Copy the table into your book. Use a pencil and ruler to draw the table lines.
- Put the correct unit of time in two of the headings. Put brackets around the unit.
- Write Bob's results into your table. As you have put the units in the headings, don't repeat them in the main part of the table – just write in the numbers.

5. Bob needed to work out the average dissolving times for each of his sugars. He wrote down his working out for icing sugar like this:

$$\begin{aligned}\text{average dissolving time} &= (27 + 23 + 25) \div 3 \\ &= 75 \div 3 \\ &= \underline{25 \text{ s}}\end{aligned}$$

- a) Work out the average dissolving times for the other two sugars. Show all your working out.
- b) Write all three average dissolving times into your table.
6. Bob decided to draw a bar chart of the average times. A copy of Bob's graph is shown below (but only icing sugar has been plotted so far).



**On graph paper**, draw a graph of the average dissolving times. Make sure that you:

- Use a sharp pencil and a ruler
- Label both axes, including the unit of time, and give your graph a title
- Plot each bar carefully so that the top of the bar is at the correct height

7. Look at your table and graph. What do they tell you about the way that the three different sugars dissolve in water? Write a short paragraph about what the results show you.
8. When Bob looked at the three sugars, he saw that icing sugar was made of very fine powder, granulated sugar was made of quite large crystals, and caster sugar was in between in size.

Look again at the results. What else can you say about sugar dissolving in water?

## Experiment 2

Bob decided to look at the dissolving times of sugar at different temperatures. He decided to use just one type of sugar in these experiments.

9. Suggest why Bob decided just to use one type of sugar in these experiments.

Bob added 1 level teaspoonful of granulated sugar to 50cm<sup>3</sup> of water, stirred continually, and timed how long it took for the sugar to dissolve. He also made sure that he measured the temperature of the water. Bob tried three different temperatures.

A copy of part of Bob's exercise book is shown below.

<u>Results</u>
<u>Temperature experiment</u>
26°C took 55 secs to dissolve
37C ..... 47 s
49° took 31 sec

10. a) Apart from not drawing a table before he started, Bob made at least three mistakes when he wrote down his results. What were these mistakes?
  - b) In your book, make a suitable table of Bob's results. Remember to:
    - Make the first column the factor (thing) that Bob changed, in this case **temperature**
    - Make the second column the factor that Bob measured as a result, in this case **time**
    - Draw all table lines with a pencil and ruler
    - Put units in the headings
    - Write the numbers only in the main part of the table
  - c) It is usually better to put results into a table, rather than doing lists like Bob did. Write down some reasons why tables are usually better than lists.
11. Look back at what you have done so far. Write down what you must remember to do when:
  - a) You are writing down your results
  - b) Doing maths, such as working out average times
  - c) Drawing a graph

12. Draw a line graph of Bob's results.  
You should put temperature along the bottom, and time up the side. Remember to:
- Use a sharp pencil and a ruler
  - Use as much of the graph paper as possible
  - Draw "tick marks" on the axes and number each tick mark
  - Label each axis with the measurement and its unit
  - Give the graph a title
  - Draw a smooth curve with a pencil
13. Look at your graph. What does it tell you about sugar dissolving in water?  
Write a short paragraph about what the results show you.

### Experiment 3

Bob decided to do one last experiment involving different temperatures **and** types of sugar. He used 1 level teaspoonful of sugar in 50cm<sup>3</sup> of water each time. As usual, he stirred continually and timed how long it took for the sugar to dissolve. He also recorded the water temperature.

Bob made three tables to show his results. These are shown below.

Icing sugar	
Temperature of water (°C)	Dissolving time (s)
24	27
34	21
46	16

Caster sugar	
Temperature of water (°C)	Dissolving time (s)
25	29
33	24
47	17

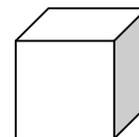
Granulated sugar	
Temperature of water (°C)	Dissolving time (s)
26	56
37	47
49	31

14. Bob has made three tables to show his results. Make just one table to show all the results together. Put Bob's results into your table.
15. Bob tried to get three identical temperatures for each sugar. Suggest three temperatures he might have been aiming for.
16. Draw **one** line graph of Bob's results. You should:
- put temperature along the bottom, and time up the side.
  - draw three separate lines to show the results from each sugar
  - write the name of each sugar against its line (or make a key).
- Do not** use colours for each line.
17. Look back at all Bob's results.
- Write a paragraph to describe what he has found out about sugar dissolving in water.
  - Are any results **anomalous** (do they look "funny" or in the wrong place)?  
If you find any anomalous results, write them down. Explain why they are anomalous.
18. Look back at all Bob's methods.
- Write a paragraph to describe the good points about his methods.
  - Write a paragraph to describe the bad points about his methods.
  - Explain how **you** would improve his experiments.

## Bobbie's Jelly Experiments

Bobbie likes jelly for tea. She decided to investigate how to dissolve jelly quickly in water.

1. A jelly cube is 2cm wide, 2cm high, and 2cm deep.  
Work out its surface area in  $\text{cm}^2$ . Show all your working out.



2. Bobbie decided to try cutting up jelly cubes.
- a) First, she cut a jelly cube in half.  
This gave her two pieces of jelly, each 1cm wide, 2cm high, and 2cm deep.
- i) Work out the surface area of each piece in  $\text{cm}^2$ . Show all your working out.  
**Hint:** There are four identical sides and two ends.
- ii) Multiply by two to find the **total** surface area of the two jelly pieces.
- b) Next, she cut a jelly cube into four.  
This gave her four pieces of jelly, each 1cm wide, 1cm high, and 2cm deep.
- i) Work out the surface area of each piece in  $\text{cm}^2$ . Show all your working out.
- ii) Multiply by four to find the **total** surface area of the four jelly pieces.

3. Bobbie now investigated the dissolving times (in seconds) of her jelly cubes.

- a) In your book, make a table with 6 columns, and enough lines for 12 results.  
Use the headings below.

Width	Height	Depth	Number of pieces	Total surface area	Dissolving time
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- b) Write the correct units in brackets into each heading of your table.
- c) Bobbie dissolved one large 2cm x 2cm x 2cm cube in water and timed how long it took. She did this four times. She found that the dissolving times were: 155s, 141s, 150, 134s. Write all this information and results into your table.
- d) Bobbie dissolved two half cubes (each 1cm x 2cm x 2cm) together in water and timed how long they took to dissolve. She did this four times. She found that the dissolving times were: 105s, 101s, 94, 88s. Write all this information and results into your table.
- e) Finally, Bobbie dissolved four quarter cubes (each 1cm x 1cm x 2cm) together in water and timed how long they took to dissolve. She did this four times. The dissolving times were: 65s, 41s, 55, 63s. Write all this information and results into your table.
- f) Write your surface areas from questions 1 and 2 into your table.
4. a) Work out the average dissolving time for dissolving one large jelly cube.  
b) Work out the average dissolving time for dissolving two half jelly cubes.  
c) Work out the average dissolving time for dissolving four quarter jelly cubes.
5. a) Make a table for your answers to question 4.  
b) Draw a bar chart of the **average times** (number of pieces on the bottom, time up the side).  
c) Draw a line graph of **all** the results (surface area along the bottom, time up the side).  
d) Which method of showing the results is most useful (tables, bar chart, or line graph)?