[MATHS PROBLEM]

ESTIMATING VOLUME

Students often struggle with estimations involving volume and capacity, says Colin Foster

In this lesson, students tackle a variety of volume-based estimates.

THE DIFFICULTY

I don't want you to do any calculations yet – I just want your gut feeling about this question. Imagine a bath full of water. Now imagine you were going to drink this water! (Ugh!)

On your whiteboard, write down how many glasses of water you think you would get from one bath full of water.

Students are likely to give wildly different estimates, which is fine. According to the idea of the 'wisdom of crowds', the average of these estimates might be close to the true value, so students could calculate the average of all of their estimates and compare this with their calculated estimates later on.

THE SOLUTION

What information would you need to have if you were going to do an approximate calculation for this problem?

Students will likely ask about the size of the glass and the dimensions of the bath. You don't need to tell them these values though, because they should have enough experience from their lives to give reasonable values for these things.

Even if their home only has a shower and no bathtub, they will still know what a bathtub is.

Look out for students worrying too much about precision. If some students take a glass to be 200 ml and others 300 ml, it won't matter, as we are just doing an estimate. Students often find it hard to allow themselves this kind of latitude in a mathematics lesson!

Similarly, baths vary in size, but we are just looking for an order-of-magnitude estimate, so this doesn't matter. It might help when estimating to note that a person can usually (almost) fit inside a bath.

Taking a standard bathtub as 170 cm by 70 cm by 60 cm gives an approximate capacity of 714 litres. Dividing this value by 250 ml gives an answer of about 3000 glasses. Was this close to the average of the estimates that students gave earlier?

What other volume estimation questions can you pose?

Students might consider how many glasses of water or baths they could fill from a swimming pool, or how long a shower would have to run to fill a bath or a swimming pool. The exact question doesn't matter, because all of these questions provide opportunities to work on volume estimation.

Checking for understanding

Estimate how long it would take to empty a swimming pool using a standard 14-litre bucket.

Taking a swimming pool as being 25 m by 15 m by 1.5 m gives a volume of about 500 m^3, which is 500 000 litres. Dividing, we find that this would correspond to about 40 000 buckets.

Depending on how far you have to take each bucket to empty it, we could allow, say, 1 minute per bucket. This would give 40 000 minutes – or, working 24 hours a day, about a month of exhausting work!

Colin Foster (**@colinfoster77**) is a Professor of Mathematics Education in the Department of Mathematics Education at Loughborough University. He has written many books and articles for mathematics teachers. **foster77.co.uk**, **blog.foster77.co.uk**