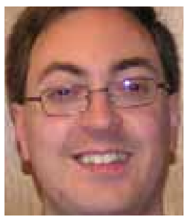
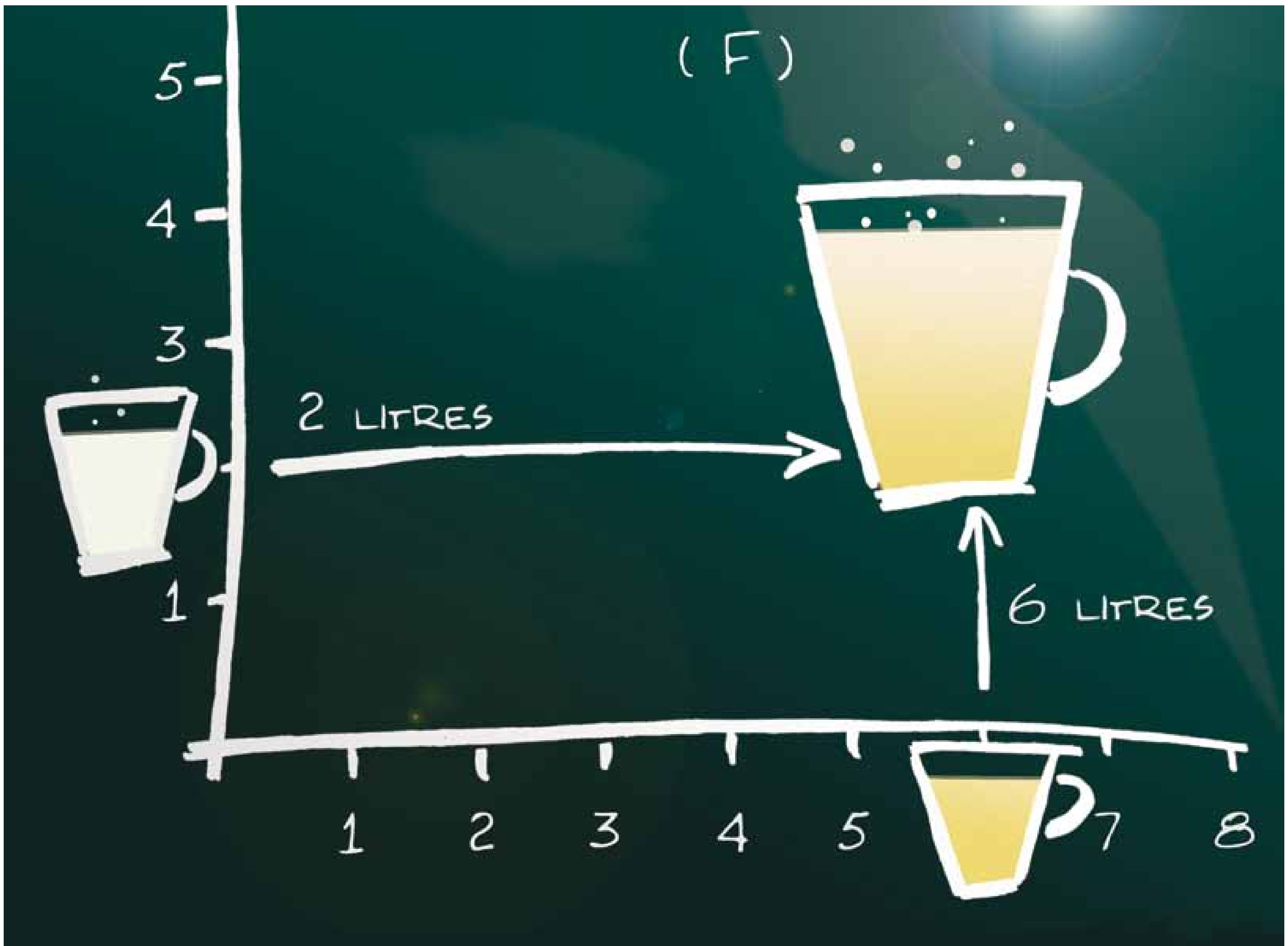


Maths teacher **Colin Foster** finds a glass of fizzy orange can help students get to grips with the tricky topic of ratio



Make maths sparkle

MANY PUPILS can write a statement like 3:4 = 6:8, but struggle to explain the meaning of the equals sign in between the two ratios.

In what sense are the two sides equal? What is it that is the same about them? I have found that challenging pupils over this can create a lot of difficulty and commotion in an otherwise dull and routine lesson of exercises, and therefore I am often tempted to do it!

Aside from being mischievous, I am uneasy about pupils writing "squiggles" on the page that hold very little meaning for them, their only reward being a teacher's "ticks" and approval.

So I ask the question.

Pupil: "They're the same ratio?"
Teacher: "But what does that mean?"
Pupil: "You times that one by two, so you times that one by two."
Teacher: "So they're twice as big? How does that make them the same?"
Pupil: "It's because they're both twice as big."
Teacher: "Could I add seven to them both? Would that be okay?"
Pupil: "No, you're not allowed to add, only times."
Teacher: "Who says?"
Pupil: "You did!"

I don't believe that an inability to express an understanding in words necessarily means that there is no understanding, but it does concern me that pupils can be trained to produce pages of "6:10 = 3:5", by following second-hand rules, with very little sense that what they are writing is meaningful or useful to anyone. The most worrying aspect is that this is so often considered normal and reasonable in mathematics lessons, by both pupils and teachers.

So I am always on the lookout for ways of talking about tricky terms like "ratio" that do not rely on vain repetition of the technical word, but instead use non-jargon that everyone can understand.

I have found "taste" to be an excellent way to talk about ratio, and the activity below calls on pupils to use their sensory imaginations. It is not offered as a contrived "real life context", but simply to facilitate discussion about quantities and their comparison.

"Let's suppose it's summer, we're thirsty and we all want something to drink. You can buy fizzy orange, but it tastes much better if you make it up yourself from real orange juice and lemonade. If we all want a decent drink, can you estimate how much you would suggest we make?" The teacher can improvise based on whatever figure is agreed upon – say 14 litres.

"Let's suppose we use 10 litres of orange juice and four litres of lemonade. Suppose another time there are more people and we decide we need 16 litres of drink. And we use 11 litres of orange and 5 litres of lemonade."

	A	B
Orange	10	11
Lemonade	4	5

"Will these mixtures taste the same or different?"

I have used this opening many times now, and have never known it to fail to lead to a very profitable discussion. There is never total agreement. Sometimes there are a few saying that "A" and "B" will not taste the same (once it was a lone voice the other way), but there is always a lot of debate, in which I see my role as making sure that the pupils have their say and that nothing is rejected for non-mathematical reasons – asking for clarification of what is said, making differences of conclusion or argument explicit, and encouraging learners to try to "convince" one another. It doesn't work if the teacher has too fixed a plan of how the discussion ought to develop, but it is worth thinking through in advance some of the possibilities that might arise, so that you are aware of the choices that you might make.

- In the above case, for example, if a pupil starts talking about five oranges to two lemonades, I would usually write that up as example "C" – typically we would get up to about "H" during a 10-minute discussion. (I would not be asking pupils deliberately to "think of another one", but it is hard to discuss for long without somebody saying, "say you had..."). This way, it is easy to clarify differences of opinion without making any judgement as the teacher: "So Sarah's saying that 'A' and 'C' would taste the same but Rikesh is saying that 'B' and 'C' would be the same and different from 'A'."
- If people are certain that two drinks would taste different, then it is possible to push for which would be "orangier" and which "lemonadier" – pupils always laugh at these words. Asking pupils to place the various mixtures in order of "orangeyness", justifying their positions, can be informative.
- If mixtures are declared to be of the same taste, then you can ask for more mixtures that would also taste the same. It can prove useful to consider the effect of mixing two supposedly identically tasting drinks – common sense will say that the result ought not to taste different!
- Don't allow easy resolutions. For example: "B will be more orangey than A because it's got more orange in it." "But it's got more lemonade in it too!"
- Linear thinking (for example, if it has six more oranges than lemonades it will taste the same, no matter how many oranges there are) can sometimes be disturbed by extending the pattern to cases such as 106: 100, since mixtures like these are virtually 50:50. "Can you think of an example that might persuade Alex that those ones won't always be the same?" (Another example that ought to give pause for thought is 6:0. This can go by stages: "9:3 – still the same? 8:2 – still the same? 7:1 – still the same? What now?!") The idea that six oranges can have a bigger or smaller effect, depending on how many you've already got, is one that is hard for learners to appreciate when they are simply told it by someone else (whether teacher or peer), but as they begin to express it for themselves it may start to become plausible. Sometimes someone refers to the difference between tipping one millilitre of cyanide into the sea or into someone's tea!

Paint may seem to be a similar context for ratio. I have found red and white to be a much easier mixture for discussion than blue and white, simply because of the availability of the word "pink".

However, the taste aspect of the fizzy orange, as opposed to merely vision with paint, seems to lend something helpful and make the discussion that bit more concrete.

Fizzy orange is far more helpful than a simple cordial-water mixture, since both components have properties that can be referred to: water as a solvent is too neutral to be easy to talk about in this task. SecEd

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