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Title: Alphabet soup

I am learning about the language of mathematics, and how to record in symbols instead of words

Prerequisite Knowledge

The equals sign acts as a balance, rather than an instruction to combine numbers
Students should have worked extensively with unknowns. For example, sentences like
$\square + 5 = 32$, or $\square + \bigcirc = 10$
Students should have been introduced to letters in a number of situations. For example, as abbreviations in formulae like $A = b \times h$, or as an some unknown number on which we operate, as in the general terms of patterns

Using Representations Of Numbers

Read out a number of sentences like ‘five plus three equals eight’, ‘the difference between ten and seven is three’, ‘half of twelve equals six’, ‘twenty divided by four equals five. In each case get the students to write the sentences with symbols, then get them to check that their sentence is the same as the person’s next to them. Gather feedback after this, and invite some students to write their sentence on the board. Be aware that this activity is likely to throw up different recording strategies. For example, some students may decide to write an addition for ‘the difference between ten and seven is three’. While the sentence can be mathematically correct, this is not an accurate recording of what was said. Likewise, some students may write $20 \div 4 = 5$, and others $\frac{20}{4} = 5$ for ‘twenty divided by four equals five’, both of which are appropriate but are alternate recording strategies. (In this case if students have not introduced the latter recording it should be introduced and discussed by you.) Make sure that once what you consider is the correct sentence is written that you ask ‘does anyone have a different sentence?’ to ensure that any misconceptions are brought to light so they can be addressed.
Other useful sentences to introduce (depending on the stage of the group) involve the use of multiple operations and the use of brackets. For example, ‘sixteen minus two plus nine equals twenty three’, and ‘three plus one times four equals seven’.
With such problems students can be challenged to decide if they are true or false, with the two ‘opposing teams’ split and justifying their reasoning to the other team. (At this stage, discussion should be used as a means of resolving any misconceptions).

Using Number Properties

Give the standard algebra introductory problem (listed below):	*The algebra*
Think of a number (any number) and write it down	n
Add 4 to it	$n + 4$
Double it	$2(n + 4)$ or $2n + 8$ or $n + 4 + n + 4$
Subtract the number you started with	$n + 8$
Add 2	$n + 10$
Subtract the number you started with again	10
Subtract five	5
Square your number (multiply it by itself)	25
What is your answer? (ask a number of students)	

At this stage, ask ‘why does this work?’ Write the list of the instructions on the board. Set a challenge for people to work in groups to try to establish why (everyone?) got the same answer. After 5 minutes, if students are still working, start taking feedback about what people have been trying, and the reasons they think it works. If students do not come up with an explanation, introduce them to the idea of recording (some number) as the letter *n*, and set them to work again and see if they can use this idea to work out how it works. If an explanation is still not forthcoming, take the students through the logic/algebra statements that would show what happens to the number *n* on the right hand side above. Be aware that the notation for describing $n + 4$ doubled is not likely to have been established as yet (and could form a topic of discussion on its own).
Once understood, students can work on developing their own problem

Generalising From Number

Provide students with a series of oral statements that students are to write with symbols, starting from the idea that the letter *n* can be used to mean ‘a number’ or ‘some number’. For example: ‘one more than a number’, ‘double a number’, three less than a number’, halve a number’, ‘add a number to itself’, ‘double a number then add one’, ‘add one to a number then double it’, ‘one number added to another number’.
Statements like the last one can be experimented upon with numbers to help introduce the need for brackets. One useful discussion to have at this time is how we talk about similar sentences that give different answers. For example, three, plus one times four. In this sentence the comma, or pause is indicating that we mean that it is only the one that is multiplied by four, whereas in ‘three plus one, time four’ indicates the emphasis is on adding the 3 and 1 first. This is obviously shown much better with symbols, where we can use brackets (and the conventions of operation order) to show what we mean.