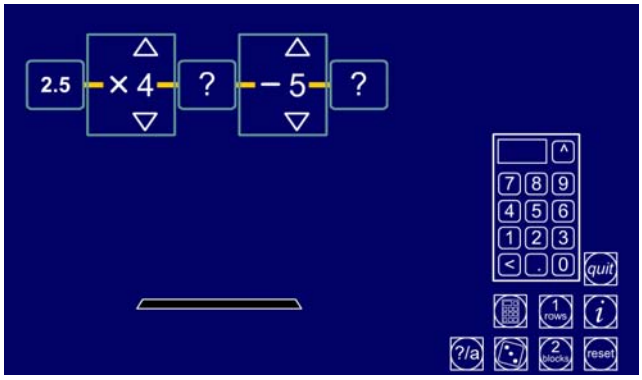
Can I solve multi-step problems that involve using inverse operations and explain my method?

Teaching activity using Function blocks ITP

- Click on the number of blocks button until it shows two blocks.
- Reveal the function in each block by clicking on the yellow arrow. Click on the dice button until the two functions are interesting (e.g. a combination of different operations).
- Click on the calculator button. You can now enter a decimal number such as 2.5 by typing it onto the calculator keys then pressing the ^ key. Drag the number card produced into the start box.

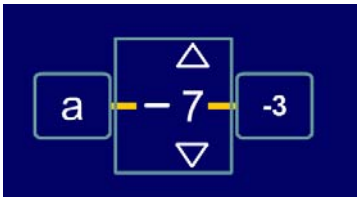


Q: Two operations are carried out on this start number. What number will be the final output? Talk with a partner.

Take feedback from one pair. Ask others whether they agreed.

Produce different functions using the dice button and ask children to find the output number each time.

- Reset the ITP. Choose one block. Enter an input number of your choice without the children seeing. Once the start number has been inputted, click on the box to hide it. Click on the **?/a** button to show the letter **a** rather than **?**.
- Reveal the function by clicking on the yellow arrow. Click on the dice button to select a different random function.
- Reveal the output number.



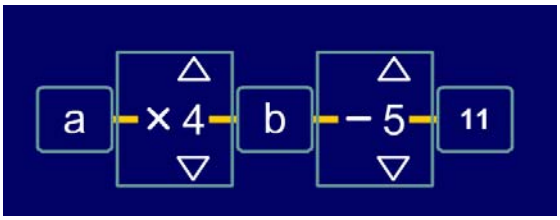
Q: What must be the input number? How do you know?

Establish that you need to carry out the inverse operation on the output number to find the input number. For example, if **a** – 7 = –3 then using the inverse operation gives –3 + 7 = **a**, that is, **a** = 4.

- Click on the input box to reveal the number, to check children's suggestions.

Repeat for other functions and other input numbers.

- Then select two function boxes and reveal both functions and the final output:



*Q: Do you know straightaway what number **a** represents? What do we need to find first?*

Establish that it is not possible to find **a** straightaway. Instead, you need to work backwards using inverse operations to find **b** and then to continue to work backwards to find **a**.

Ask individual children to find both unknown numbers, and then to explain to a talk partner what they have found and to explain their reasoning.

*Q: Who can explain their method for finding the unknown input number represented by **a**?*

Ensure that children are able to explain that they are using inverse operations. In the example above, for example, children might explain that the inverse operation for –5 is +5, so working backwards gives **b** = 11 + 5, that is, **b** = 16. Once **b** is known, then you can use the inverse operation for × 4, in other words ÷ 4 to find **a**. Thus **a** = 16 ÷ 4 = 4.

Once children have established an answer for **a**, ask them to check by working through the function blocks in the correct order that this would give them the required output of 11.

Repeat with two different functions and a different input number.

Then explain that children are going to work in pairs to create function machine examples to give to each other. Explain that each child is going to create an example with two function blocks. They should choose an input number and the two operations and record the output in a similar way to the ITP.

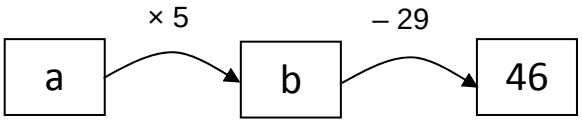
Once they have completed their double function block, they should swap with their partner but instead of writing the input and the middle number, they should write **a** and **b**, as in the ITP. Their partner should then work out the missing numbers, using inverse operations, before they both compare solutions.

Plenary

Explain that children are going to look at a problem and use what they have learned this lesson to help them solve it. Tell children the problem: *I think of a number. I multiply it by 5 then subtract 29. I get the answer 46. What was my number?*

Q: How is this problem related to the function blocks we have been learning about?

Establish that, if you call the unknown number **a** it is possible to draw out a double function block that illustrates the problem. Ask children, in pairs, to draw out the double function block.



Q: How can you find the numbers a and b? Work with a partner explaining your method.

Take feedback. Establish that b – 29 = 46, so, using the inverse operation, b = 46 + 29, that is, b = 75. This tells us that a × 5 = 75, so, using the inverse operation, a = 75 ÷ 5, that is a = 15.

Check this answer together by entering the input number 15 and seeing the functions through in order, in other words working out 15 × 5 and then subtracting 29 from the answer.

Repeat with a similar problem.