Number

This document is part of a set that forms the subject knowledge content audit for Key Stage 1 and Key Stage 2 maths. Each document contains: audit questions with tick boxes that you can select to show how confident you are (1 = not at all confident, 2 = not very confident, 3 = fairly confident, 4 = very confident), exemplifications; explanations; and further support links. At the end of each document, there is space to type notes to capture your learning and implications for practice. The document can then be saved for your records.

Question 6

How confident are you that you understand and can support children to recognise the structure of the place value system, linking to concepts including decimals and negative numbers?

1 ☐   2 ☐   3 ☐   4 ☐

How would you respond …?

a. **What potential errors or misconceptions could occur when ordering the numbers?**

   For each of these, put these numbers in order, from smallest to largest:

   3.3, 3.03, 3.33, 3.303, 3.033

   5,834, 61.8 multiplied by 100, one tenth of 45,813
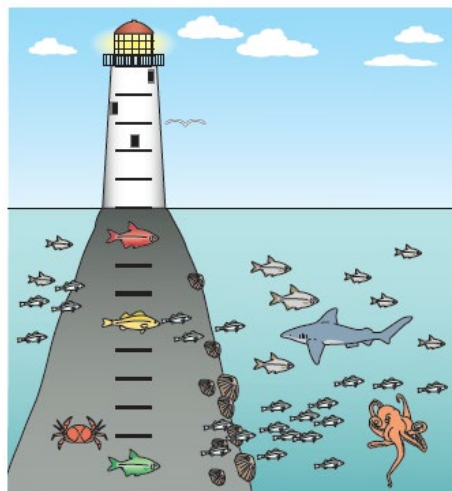
   0.034, 3.6 divided by 100, ten times 0.0033

   -4.4, -4.44, -4.04, -4.404

b. **The sea level is usually at zero. A child has been told that the red fish is at -5m (5 metres below sea level) and asked where the yellow fish is.**

   'The yellow fish is at -2m.'

   What strategy would you use to develop this child's understanding of negative numbers?

Responses

Note your responses to the questions here before you engage with the rest of this section:

a. With the first set of numbers, children need to have a good understanding of the value of each of the digits in the decimal number, as the same digit is repeated in different positions. Some children may think that the more digits there are, the greater the number. All the numbers have the same number of ones, so children will need to compare the tenths digits and then the hundredths and thousandths. There are also a different number of digits in each number so children will need to understand that 3.303 is greater than 3.3 as there are 3 thousandths more.

> **Answer: 3.03, 3.033, 3.3, 3.303, 3.33**

The second and third sets require children to multiply or divide the numbers, using their understanding of the place value system and base ten, before comparing. When multiplying or dividing, children need to ensure they keep the digits in the same order and write the new number carefully.

> **Answer: 4581.3, 5834, 6180**

> **Answer: 0.033, 0.034, 0.36**

The final set of numbers uses negatives. This can be an area of difficulty as children may apply their understanding of positive integers to negative ones and order the numbers without taking into consideration the fact that they are negative. To support this, children could place the numbers on a number line and look at their relative positions.

> **Answer: -4.44, -4.404, -4.4, -4.04**

b. The yellow fish is at -20m. If a child gave an answer of -2m, they have read that the red fish is at -5m, but has not understood the position of this.in relation to 0 being at sea level, or that the marks are in intervals of 5m. Instead, they have counted that the fish is 3 lower so have subtracted 3 from 5, to find an answer of -2m.

To support this learner, focus attention on the position of 0 and the red fish in relation to this (5 below zero). Make sure they can visualise the numbers; they may wish to mark them on and create their own number line to support them.

Decimals and negative numbers

In the previous question, **unitising** was introduced; it looked at step counting and the base ten nature of our place value system, with a focus on whole numbers. This section will continue the exploration of the place value system and the role of unitising within it, with a focus on decimals. In addition, it will explore the introduction of negative numbers, their position within our number system and how they are used within a coordinate and graphing context.

Progression through the curriculum

Unitising and decimals

Children should be familiar with counting in tens, hundreds or thousands and understand the relationship between these; for example knowing that 1 hundred is ten times bigger than 1 ten or that 1 hundred is the same as 100 ones. Draw attention to the fact that ten is a tenth the size of a hundred. This will enable children to build an understanding of decimal numbers.

1,000s	100s	10s	1s
1			
	1		
		1	
			1

ten times smaller	ten times smaller	ten times smaller
→	→	→
one tenth the size	one tenth the size	one tenth the size

One common misconception is that a decimal number is a negative number. A tenth is part of a whole. Clearly demonstrating that the whole is divided into ten equal parts, and one of these parts is a tenth, will support children to make the link that a tenth is ten times smaller than a whole. When counting decimals, unitising language should be used, *'One tenth, two tenths, three tenths.'* This will be important for children when applying known additive strategies to numbers with tenths.

Introduce the decimal point to allow children to write the numbers being represented. Children should work with numbers where the ones digit is greater than one, to build an understanding of the composition of different numbers. For example, *'Three point two is composed of three ones and two tenths, which is equivalent to 32 tenths. It can be written as 3.2.'*

Negative numbers and coordinates

Children will experience negative numbers when working with coordinates or graphs. They will need to review their knowledge of plotting positive coordinates and expressing them in coordinate notation, for example (4,2), with attention being drawn to the *x* and *y* axes.
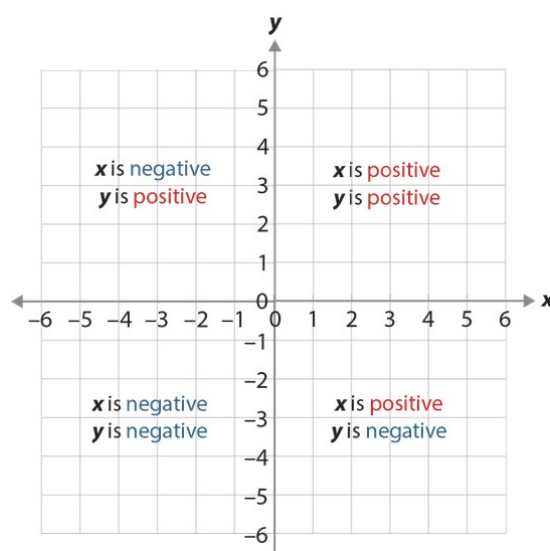
Extend one of the lines to include negative numbers so children can discuss how the extended line links with their understanding of the number line: the points above 0 being positive and those below 0 being negative. After lots of experience reading, plotting and exploring coordinates, children should be encouraged to look for generalisations that reinforce their understanding, such as, *'When the y coordinate is negative, the point is positioned below the x-axis.'*

By extending one line at a time, children will have the opportunity to explore the coordinates within this quadrant and build their understanding, before moving onto the next quadrant. Children should be able to summarise the properties of each quadrant.

Common errors in this area may include:

- children saying 2.135m is longer than 2.34m, as they believe the number is larger if it has more digits
- writing negative numbers in the reverse order on the number line, applying their knowledge of positive integers, e.g. -1, -2, -3, 0, 1, 2, 3
- using incorrect language – minus one, rather than negative one
- confusing the coordinates when working within four quadrants.

What to look for

Can a child:
- decompose decimal numbers, showing an understanding of the value of each digit?
- use the correct notation for writing amounts of money?
- convert between units of measure, using unitising to show equivalence?
- confidently describe and position positive and negative numbers on a number line?

Links to supporting materials:

NCETM Primary Professional Development materials, Spine 1: Number, Addition and Subtraction:
- Topic 1.23: Composition and calculation: tenths
- Topic 1.24: Composition and calculation: hundredths and thousandths
- Topic 1.27: Negative numbers: counting, comparing and calculating

Key learning from support material and self-study:

What I will focus on developing in my classroom practice: