Core concept 1.1: Place value, estimation and rounding

This document is part of a set that forms the subject knowledge content audit for Key Stage 3 maths. The audit is based on the NCETM Secondary Professional Development materials and there is one document for each of the 17 core concepts. Each document contains audit questions with check boxes 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 and explanations, and further support links. At the end of each document there is space to type reflections, targets and notes. The document can then be saved for your records.

1.1.1 Understand the value of digits in decimals, measure and integers

How confident are you that you can explain, using representations if appropriate, the place value of integers and decimals including using exponent and fractional representations for the column headings?

1 ☐ **2** ☐ **3** ☐ **4** ☐

How confident are you that you can explain how to order and compare numbers using inequality notation?

1 ☐ **2** ☐ **3** ☐ **4** ☐

Understanding place value is a fundamental skill and at the heart of a strong sense of number. Students need to be able to correctly say any number and understand where it fits in the number system (i.e., in an ordered list of numbers and on a number line). The focus in this set of key ideas is understanding the structure of the system (that each column value is a power of ten and that multiplying or dividing by ten shifts digits from one column to the adjacent one).

For example, students should be able to reason that in the number 4.763:

- the value of the digit 4 is four ones
- the value of the digit 7 is seven tenths
- the value of the digit 6 is six hundredths
- the value of the digit 3 is three thousandths

and that the number can be represented like this:

1	10^{-1}	10^{-2}	10^{-3}
1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
4.	**7**	**6**	**3**

Dienes, place value counters, the Gattengo chart, place-value charts and single number lines are all common representations used in schools for place value.

Students should be able to order sets of numbers such as 9, 7.5, –4, –11, 11.2, 7, 6.81 by first comparing the digits with the greatest place value.

Students should also be able to select the correct symbol to complete number sentences, e.g. $-4 > -5$ and $2.03 < 2.1$.

Further support links

- NRICH: Learn about Number Bases: https://nrich.maths.org/1368
- NCETM Secondary Professional Development materials: 1.1 Place value, estimation and rounding, pages 6–9
- NCETM: Using mathematical representations at KS3: Single number lines, Dienes and place value counters, The Gattegno chart (structure of the number system page 3), Place Value Charts

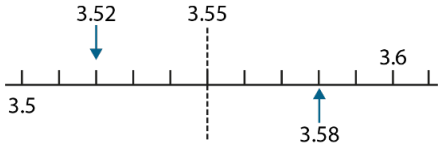
1.1.2 Round numbers to a required number of decimal places

How confident are you that you can explain how to round numbers to a required number of decimal places?

1 ☐ 2 ☐ 3 ☐ 4 ☐

Students need to understand why rounding is necessary and that it is a valuable tool for estimating number to varying degrees of accuracy. Rounding to a number of decimal places is particularly useful when working with measures in real-life contexts. For example, an important awareness is that rounding to two decimal places involves choosing between two numbers; one that is just greater than it and one that is just less than it, both of which have two decimal places. Memorising and applying a procedure for rounding a number to a specified number of decimal places without this overall awareness often results in errors.

A number line can be used to illustrate rounding:



Where 3.52 rounds to 3.5 (to one d.p.) and 3.58 rounds to 3.6 (to one d.p.)

The convention is that we round up when there is no definitive 'closer number' and the general rule is that we 'round up' towards positive infinity for consistency reasons.

Further support links

- NCETM: Mathematical representations: Single number lines, pages 7–9

1.1.3 Round numbers to a required number of significant figures

How confident are you that you can explain the meaning of 'significant figures'?

1 ☐ 2 ☐ 3 ☐ 4 ☐

How confident are you that you can explain how to round both integers and decimals to a required number of significant figures?

1 ☐ 2 ☐ 3 ☐ 4 ☐

It is important for students to develop a strong sense of the size of numbers and be able to use various methods of rounding, especially when giving answers in context.

Rounding large numbers is particularly useful when estimating (for example, crowds at a football match or winnings in a lottery).

Rounding to significant figures is an alternative way of describing rounding to the nearest whole number, nearest 10, nearest 100, one decimal place, two decimal places and so on. If students are fluent at rounding in these ways, then they can see that using significant figures is a convenient way to summarise rounding choices.

The first significant figure in a number is the 'most significant figure'; i.e. the one with the greatest value:

- the first significant figure in 43 702 is the 4 (which has a value of 40 000)
- the significant figure in 0.00451 is the 4 (which has a value of 0.004)
- the second significant figure is the digit to the right of the first

So:

- 43 702 = 40 000 to one significant figure
- 43 702 = 44 000 to two significant figures
- 0.00451 = 0.005 to one significant figure
- 0.0045 = 0.0045 to two significant figures

If rounding to three significant figures:

- 98.765 is written as 98.8
- 4.0003 is written as 4.00
- 27 is written as 27.0

Further support links

- NCETM Secondary Professional Development materials: 1.1 Place value, estimation and rounding, pages 10–17

1.1.4 Estimate calculations by rounding

How confident are you that you understand the accuracy of measurements?

1 ☐ 2 ☐ 3 ☐ 4 ☐

How confident are you that you can explain how to make, interpret and use estimates for calculations?

1 ☐ 2 ☐ 3 ☐ 4 ☐

How confident are you that you understand how to calculate possible errors as inequalities?

1 ☐ 2 ☐ 3 ☐ 4 ☐

Estimation is a key skill that contributes to students' fluency in calculation. Fluency demands that students have strategies for checking the validity of their answers. Students who are proficient in carrying out algorithms, but who have no idea whether the answer to a calculation is sensible or not, are not fully fluent.

No measurement is exact. Every measurement is limited by the accuracy of the equipment used to make it. It is usual to give any measured value to the nearest whole unit or decimal place (e.g., to the nearest division on a scale).

Measurements given to the nearest whole unit may be inaccurate by up to one half of a unit in either direction. For example:

- A length d m is given as 36 m to the nearest metre so $35.5 \leq d < 36.5$
- A volume V cm^3 is given as 240 cm^3 to the nearest 10 cm^3 so $235 \leq V < 245$
- A mass m kg is given as 2.3 kg to the nearest 0.1 kg so $2.25 \leq m < 2.35$

Further support links

- NCETM Secondary Professional Development materials: 1.1 Place value, estimation and rounding, pages 18–21

Notes