Planning to teach place value – Supporting document

This document, which accompanies the ‘Planning to teach place value’ video, offers suggestions to support the process for planning to teach place value.

Part 1 – The big idea

Students need to:

- have a sense of the enormity of large numbers and the miniscule nature of small numbers
- appreciate that there is an infinite number of numbers and that our number system is based on powers of 10
- appreciate how numbers can be ordered in terms of magnitude and be able to position numbers on a number line
- understand that, when rounding a number to a given order of magnitude (i.e. ‘to the nearest 10, 100, 0.1, etc’), they are finding the number that is nearer to that number than any other number of the same order
- appreciate three important aspects of place value, namely scale, position and quantity.

What things typically go wrong?

Common misconceptions include:

- thinking that the decimal point moves, rather than the digits of a number moving into a higher or lower place around a static decimal point
- thinking that number lines only have integers on them
- only attending to the last digit of a number when rounding
- not attending to all of the digits in a number when rounding e.g. rounding 3,654 to the nearest hundred as 700
- multiplying or dividing by 10 by adding or taking away a zero, leading to incorrect calculation like $7.32 \times 10 = 7.320$

Part 2 – Pre-requisites

Expectations from KS2

Key stage	Learning outcome
Upper Key Stage 2	• Read, write, order and compare numbers up to 10000000 and determine the value of each digit • Round any whole number to a required degree of accuracy • Identify the value of each digit in numbers given to three decimal places and multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places

From the DfE Mathematics programmes of study: key stages 1 and 2 (Sept 2013)

Pre-requisite skills

It is important to check the students are secure in their ability to:

- exchange groups of ten when calculating, including bridging powers of 10
- use a number line to position and order numbers
- know the place value column headings and the relationships between the columns
- be able to partition a number.

Part 3 – Key teaching aspects

Key message

Students need to be aware of the general structure of the base 10 place value system and that this is structured around powers of 10. Students should:

- appreciate how numbers can be scaled up or down by powers of 10 (scaling)
- appreciate how numbers can be positioned in relation to other numbers (position)
- have a sense of the size of any number (quantity).

KS3 Expectations

Students should be taught to:

- understand and use place value for decimals, measures and integers of any size
- order positive and negative integers, decimals and fractions; use the number line as a model for ordering of the real numbers; use the symbols =, ≠, <, >, ≤, ≥
- round numbers and measures to an appropriate degree of accuracy (for example, to a number of decimal places or significant figures)
- use approximation through rounding to estimate answers and calculate possible resulting errors expressed using inequality notation $a < x \leq b$
- appreciate the infinite nature of the sets of integers, real and rational numbers

From the DfE Mathematics programmes of study: key stage 3 (Sept 2013)

Key language

Students should be expected to use correct mathematical language and answer in full sentences.

Key vocabulary includes:

- Value
- Round
- Estimate
- Power
- Decimal
- Significant figures
- Digit and number (not confusing the two)

Key skills

Students need to be able to:

- round numbers to a stated degree of accuracy using a number line to support their reasoning
- make sensible estimates when calculating to help them check answers and support their reasoning.

Key representations

- The number line to support positional understanding of place value
- Dienes or base 10 apparatus as a representation of quantity
- Maps as a contextual representation of scale
- Place value charts to support understanding of the multiplicative relationship between the column headings.

Digital representations of these and other tools can be found at mathsbot.com

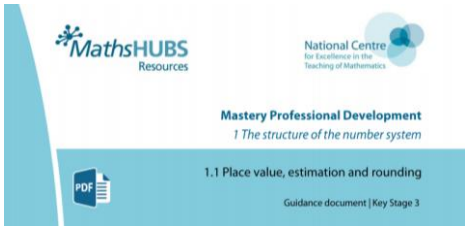
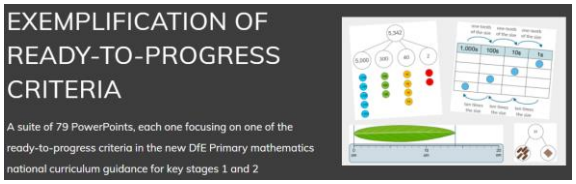
Part 4 – Why this is important

How will this support future learning?

A deep understanding of place value supports future learning in the following areas:

- Limits of accuracy
- Upper and lower bounds
- Standard form
- Calculating with decimals
- Recurring decimal fraction conversion
- Conversion between metric and imperial measure

Useful links

	NCETM Secondary Mastery Assessment materials https://www.ncetm.org.uk/classroom-resources/assessment-materials-secondary/ In particular, activities on pages 5-8 are related to place value, ordering, and rounding
NRICH	A collection of short problems related to place value, integers, ordering and rounding https://nrich.maths.org/9255 Some longer problems related to place value, integers, ordering and rounding https://nrich.maths.org/8703
OPEN MIDDLE	Particular examples related to place value, ordering, and rounding include: www.openmiddle.com/greatest-difference-of-two-decimal-numbers/ www.openmiddle.com/subtracting-decimals-to-make-them-as-close-to-one-as-possible/
	NCETM Mastery Professional Development Materials (1.1. Place value, estimation and rounding) https://www.ncetm.org.uk/media/ounhep23/ncetm_ks3_cc_1_1.pdf
	NCETM Exemplification of ready-to-progress criteria (Number and place value) www.ncetm.org.uk/classroom-resources/exemplification-of-ready-to-progress-criteria/
Department for Education **Mathematics programmes of study: key stage 3** **National curriculum in England**	DfE Mathematics programmes of study www.gov.uk/government/publications/national-curriculum-in-england-mathematics-programmes-of-study
MathsBot.com Tools for Maths Teachers	A collection of manipulatives including Dienes blocks can be found here: https://mathsbot.com/#Manipulatives