Level 5 Bring on the Maths

Teacher Notes

Contents

Ideas for use

All 'Bring on the Maths' activities have been designed to support interactive whole-class work through a visually striking presentation of key concepts that encourages learners to think deeply about the mathematics of a situation. However, they are flexible in their nature and can be used to encourage group work, paired work, self assessment or peer assessment, and can also be used as homework.

All the activities can be used either electronically or as a paper-based activity. Depending on the type of activity it might be particularly beneficial to use the two together: the paper version might be cut up into twelve cards and used as a matching or sorting activity. This ensures that learners have thinking and discussion time before presenting their solution. Whatever format is used, it is essential that all answers are justified: the careful targeting of misconceptions in many of the activities creates real opportunities to further the learning.

More details on these ideas can be found at **www.kangaroomaths.com**

Using and Applying

Due to the rich nature of all 'Bring on the Maths' activities and associated discussions, there are no activities specifically written for each of the 'Using and Applying' criteria:

- Identify and obtain necessary information to carry through a task and solve mathematical problems
- Check results, considering whether these are reasonable
- Solve word problems and investigations from a range of contexts
- Show understanding of situations by describing them mathematically using symbols, words and diagrams
- Draw simple conclusions of their own and give an explanation of their reasoning

It is intended that the key processes of representing, analysing, reasoning, interpreting, communicating and reflecting are embedded through the activities.

Numbers and the Number System

Activity: **Multiplying and dividing by 10, 100 and 1000**

Anagram: DIGITS

Learning intentions and design philosophy:

To be able to use the understanding of place value to multiply and divide numbers by 10, 100 and 1000 and explain the effect

The activity has been designed not to just explore the effect of multiplying and dividing numbers – whole and decimals – by 10, 100 and 1000, but also to challenge learners to explain the effect. Cells 4, 6 and 10 explore this in more detail. Cell 1 illustrates the method of 'adding a zero', that might have been used by learners at levels 3 and 4, no longer applies with decimals. Learners might need empty place value cards to support this activity – especially cells 7, 8 and 9.

Further ideas:

Find the correct answers to cells 1, 5, 6, 9, 10, 11 and 12.

Draw 5 columns on the board (hundreds, tens, units, tenths and hundredths). Put the digits 3, 6 and 7 and a decimal point on four pieces of card. Ask 4 learners to hold the cards and position themselves in the correct places for cell 1. Now multiply by 10: the digits should move but the decimal point stays still. Repeat for other cells emphasising that the learner holding the decimal point never moves!

Activity: **Rounding decimals**

Anagram: CLAVIUS

Learning intentions and design philosophy:

To be able to round decimals to the nearest decimal place

The activity has been designed to emphasise the facts that decimals are rounded up if the next digit is 5 or more, and that 'to 3dp' means 3 places **after** the decimal point not just 3 digits.

Further ideas:

Ask the learners to find a decimal that could be rounded to the answers in cells 2, 5, 10 and 12.

Ask the learners to research more about Christopher Clavius and other mathematicians who were influential in the development of decimal notation and prepare a presentation to the class.

Activity: **Ordering negative numbers**

Anagram: Cells placed in order from 1 to 12

Learning intentions and design philosophy:

To be able to order negative numbers in context

The activity uses the context of temperature to avoid 'greater than' and 'less than' but asks the learners to consider which temperature is the coldest. A vertical number line might be helpful to support learners with this activity; in particular, cells 8 and 9.

Further ideas:

Pick two cells at random and ask learners to find the difference between the two temperatures.

Ask learners to research other temperatures from around the world and design their own puzzle.

Activity: **Number patterns and relationships**

Anagram: DIFFERENCE

Learning intentions and design philosophy:

To be able to recognise and use number patterns and relationships

The activity encourages learners to spot patterns in sequences by analysing the difference between consecutive terms. Learners may incorrectly think that cell 7 is paired with cell 1 by simply adding '3' to the '7' in 5.7.

Further ideas:

Find a sequence that has a next term as i) cell 4 and ii) cell 7.

Ask learners to give you examples of other sequences that have as a next term each of cells 2, 5, 6, 10 and 11.

Activity: **Equivalence between fractions**

Solution: NUMERATOR

Learning intentions and design philosophy:

To be able to use equivalence between fractions

The missing number is 8. Cell 12 emphasises to learners that multiplicative relationships are key to finding equivalent fractions and not simply adding/subtracting numbers from the numerator and denominator.

Further ideas:

Ask learners how they would change cells 1, 6 and 12 to make '8' the missing number.

Ask learners to design a similar puzzle but with the missing number as '6'.

Ask learners to research who was the first person to use the term 'denominator'.

Activity: **Ordering fractions and decimals**

Solution: Cells placed in order from 1 to 12

Learning intentions and design philosophy:

To be able to order fractions and decimals

A number line from 0 to 1 with tenths marked might be helpful to support learners with this activity. Cells 1, 2 and 4 emphasise to learners that, for unit fractions, the larger the denominator the smaller the fraction. Learners might also think (incorrectly) that 1/3 is equivalent to 0.3 (cells 3 and 4) and 2/3 is equivalent to 0.6 (cells 8 and 9).

Further ideas:

Solve the problem by writing all the cells as i) equivalent fractions, or ii) decimal fractions.

Pick two cells and ask learners to give another i) fraction and ii) decimal fraction that lies between the two numbers.

Activity: **Simplifying fractions**

Solution: CANCELLING

Learning intentions and design philosophy:

To be able to reduce a fraction to its simplest from by cancelling common factors

The activity has been designed to emphasise the fact that simplifying fractions requires learners to find common factors. Cells 2 and 11 emphasise that learners can not simply halve the two numbers to simplify a fraction.

Further ideas:

Ask learners to give 5 other fractions that could be simplified to cells 3, 6, 8 and 9.

Ask learners to place cells 3, 5, 6, 8 and 9 in order from smallest to largest.

Activity: **Simplifying ratios**

Solution: FACTOR

Learning intentions and design philosophy:

To be able to understand simple ratio

The activity emphasises that simplifying ratio relies on multiplicative relationships rather than simply adding/subtracting numbers; e.g. learners might incorrectly want to match cell 1 with 3 and cell 4 with 8.

Further ideas:

Ask learners to find equivalent ratios for cells 1, 4, 6, 7, 9 and 11.

Calculating

Activity: **Order of operations**

Anagram: BRACKETS

Learning intentions and design philosophy:

To be able to calculate using the order of operations and brackets

The activity has been designed to emphasise the order of brackets, multiplication/division and addition/subtraction when performing calculations, rather than simply doing the operation in the order. For example, learners might think incorrectly that the answer to cell 4 is '30' as '3+7=10', '10 x 3 = 30' and the answer to cell 7 is '24' because '5-4=1', '1x24=24'.

Further ideas:

Ask learners for the correct answers to cells 1, 2, 7 and 11.

Write 4 □ 2 □ 6 □ 3 = 24 on the board. Ask the learners to insert any of the four operations and brackets to make as many different answers as possible.

Write 4 □ 2 □ 6 □ 3 on the board. Ask the learners to insert any of the four operations and brackets to give the answers i) 15, ii) 9, iii) 24, iv) 8, v) 4, vi) 39, and vii) 36

Ask learners to design a similar puzzle but with a solution of '30'

Activity: **Fractions and percentages of quantities**

Anagram: Cells placed in order from 1 to 12

Learning intentions and design philosophy:

To be able to calculate fractions and percentages of quantities, using a calculator where appropriate

The activity has been designed such that all cells can be solved using a non-calculator method in a reasonably straightforward manner. Ensure that learners can **definitely** solve cells 1, 3, 5, 6, 7, 8 , 9 and 12 without a calculator.

Further ideas:

Ask learners to list fractions and percentages that they can use without a calculator.

Explore how you would solve cell 9 using a i) non-calculator, and ii) calculator method

Activity: **Multiplying and dividing**

Anagram: Cells placed in order from 1 to 12

Learning intentions and design philosophy:

*To be able to understand and use an appropriate **non-calculator** method for multiplying and dividing any three digit number by any two digit number*

The teacher will need to decide if the aim of the activity is for the learners to be efficient and accurate with their preferred method or for learners to use only certain methods (possibly in line with a school calculation policy)

Further ideas:

Repeat the activity but ask learners to estimate the answers (if they have not already done so!)

Give the learners some incorrect methods for multiplying and dividing numbers and ask them to spot the mistakes.

Ask the learners to write instructions for their method to help someone who can't multiply and divide any three digit number by any two digit number.

Activity: **Working with negative numbers**

Anagram: WIDMANN (there are alternative spellings to his name, though this seems the most common one)

Learning intentions and design philosophy:

To be able to solve simple problems involving adding and subtracting negative numbers in context

The activity has been designed to use the contexts of temperature, money and scoring and also challenge some of the big ideas that might have worked for earlier levels but no longer holds true; e.g. cells 2 and 8. Learners might find an empty number line useful to support this activity.

Further ideas:

Ask learners to develop their own problems involving negative numbers using the contexts of temperature, money and scoring.

Activity: **Solving simple ratio problems**

Anagram: REASON

Learning intentions and design philosophy:

To be able to solve simple problems involving ratio and direct proportion

The activity has been designed to ensure learners respect the order of a ratio; i.e. which number relates to the largest or smallest amount, and also that the quantity has to be divided up into the total number of parts not just the parts you are interested in. For example, learners might match incorrectly cells 3, 6 and 9 as they simply divide £60 by the 5 parts to give £12.

Further ideas:

For each of the cells 2, 5, 7, 8, 9 and 12, ask learners to find a matching triple; i.e. a ratio, a quantity and an amount.

Ask learners to research the other word that is sometimes the translation of Latin 'ratio'

Activity: **Approximating and checking**

Anagram: MAGNITUDE

Learning intentions and design philosophy:

To be able to apply inverse operations and approximate to check answers to problems are of the correct magnitude

The activity has a twist as it is asking learners to find the cells that are **definitely wrong**. It is important that the learners focus on trying to check the reasonableness of the answer rather than trying to calculate the problems. Learners should be justifying why the cell is correct/incorrect rather than just saying because it is; e.g. in cell 1 you can't just add 75 on to 3.45 because there are not 100 minutes in one hour, and cell 5 is approximately equal to 30 x 30 = 900

Further ideas:

Find the correct answers to cells 1, 2, 3, 5, 6, 8, 9, 11 and 12.

Ask learners to make some of their own approximation problems – some correct and some incorrect.

Algebra

Activity: **Simplifying expressions**

Anagram: (al-) Khwarizmi (there are alternative spellings to his name, though this seems the most common one)

Learning intentions and design philosophy:

To be able to construct expressions using symbolic form

The activity has been designed to explore collecting like terms, multiplying a single term over a bracket (cells 4, 6 and 9) and the difference between 2x and x^2 (cell 2).

Further ideas:

Ask learners for the correct answers for cells 4 and 6.

Ask learners to give 5 other ways of making 6x+3y by collecting like terms and/or using brackets

Ask the learners to research more about the origins of Algebra.

Have some fun with Algebra! Explore the 'enrichment' section of 'Kenny's pouch' at **www.kangaroomaths.com**

Activity: **Substituting into simple formulae**

Anagram: SUBSTITUTE

Learning intentions and design philosophy:

To be able to use simple formulae involving one or two operations

The activity ensures learners can substitute values correctly into formulae expressed algebraically; e.g. cell 5 means 'a times b' rather than just literally substituting '2' and '5' into 'ab' to incorrectly give '25'. Cell 11 explores the order of expressions: learners might think the cell is correct as '2x5=10', '10^2=100','100/4=25', but it is only the 'b' that is being squared to give the correct answer of '12.5'.

Further ideas:

Change the output to 36. For each cell, what values must a, b and c take to make the cell correct?

Activity: **Coordinates in four quadrants**

Solution: DESCARTES

Learning intentions and design philosophy:

To be able to use and interpret coordinates in all four quadrants

The activity primarily emphasises the order of the numbers in the co-ordinate pair; in particular, cells 3, 6 and 9. Also, the activity begins to explore interpreting coordinates by starting to look at the equations of lines in cells 4 and 11. This is explored further in level 6.

Further ideas:

Find the correct coordinates for cell 3.

Pick random points and ask the learners to give you the correct coordinates.

Give the learners a blank grid and ask them to point to coordinate that i) has both numbers negative, ii) only x negative, iii) only y negative, iv) x greater than y, and v) x equal to y, etc.

Ask the learners to give you 5 other coordinates on the line i) y=3, ii) x=-2

What line would the points (4,3), (4.-1), (4,0) and (4,5) be on?

Ask the learners to research more about Rene Descartes and the origins of coordinates. Prepare a presentation for the class.

Shape, Space and Measures

Activity: **Rotational symmetry**

Anagram: PLATO

Learning intentions and design philosophy:

To be able to identify all the symmetries of shapes

Learners may need to cut out the shapes to explore the rotational symmetry properties.

Further ideas:

Find the rotational symmetry of cells 1, 3, 5, 6, 8, 10 and 12.

Find the line symmetry of all the cells.

Can a shape have an order of rotational symmetry greater than/less than the number of lines of symmetry?

Using cell 9, how many squares are needed to be coloured in to give it a i) horizontal line of symmetry, ii) vertical line of symmetry?

Ask the learners to research more about Plato and Euclid. Prepare a presentation for the class.

Activity: **Using angle facts**

Anagram: FRISIUS

Learning intentions and design philosophy:

To be able to use the angle sum of a triangle and that of angles at a point

The missing angle is 50˚. As well as the two angle facts, the activity is also designed to explore the learners' understanding of the notation of an isosceles triangle to indicate which sides (and hence angles) are equal; e.g. cell 6 and 8.

Further ideas:

Find the correct answer for cells 2, 3, 4, 8 and 9.

If the missing angle is 65˚, what angles would need to be changed in the cells?

Prove the angle sum of a triangle is 180˚.

Ask the learners to research more about Frisius and the origins of angle notation and facts. Prepare a presentation for the class.

Activity: **Reflecting shapes**

Anagram: DISTANCES

Learning intentions and design philosophy:

To be able to transform shapes using reflection

The activity is primarily designed to explore the learners' understanding of oblique reflections: cells 5, 6 , 11 and 12. The key word also stresses the importance of distance from the reflection line. Learners may need mirrors and/or tracing paper to support this activity.

Further ideas:

Complete the correct reflections for cells 3, 4 and 11.

Reflect other shapes in oblique lines.

Activity: **Measuring and drawing**

Anagram: ACCURACY

Learning intentions and design philosophy:

To be able to measure and draw angles to the nearest degree

The activity is primarily designed to see if learners can use a protractor correctly; i.e. reading the correct scale. For example, cells 1 and 2 might look very similar if they use the wrong scale on the protractor! Encourage learners to think about the type of angle they are intending to draw; i.e. acute, obtuse, etc. Learners need to understand the standard triangle notation used in cells 1 to 4: a diagram might be need for support.

Further ideas:

Can you always draw a triangle knowing 2 sides and an angle?

Draw angles greater than 180°.

Activity: **Interpreting scales**

Anagram: MEASURING

Learning intentions and design philosophy:

To be able to read and interpret scales, explaining what each labelled division represents

The activity is designed to emphasise to learners that it is essential to work out the value of the labelled divisions in order to read scales correctly. The activity is not interested in the reading the scales in cells 6 and 11. Learners might incorrectly pair cell 6 with 12 forgetting 1000g=1kg and cell 7 with 5 as they divide the one metre into the four marks (including the end points) rather than the three divisions.

Further ideas:

Draw a scale that would work for cells 7 and 12.

Ask the learners to write instructions for a friend explaining how to work out the value of labelled divisions.

Activity: **Converting units**

Anagram: METRE

Learning intentions and design philosophy:

To be able to solve problems involving the conversion of units and make sensible estimates of everyday situations

The activity is designed to challenge the understanding of which units are linked by '×100' and which by '×1000'; e.g. cells 3, 4 and 10. Cell 2 is a useful approximation to help with cell 9.

Further ideas:

Ask the learners to explore items that are one pint, one litre, one kg, one mile, etc. Make a classroom display.

Take the learners for a 1km walk and a 1 mile walk to see which is longer.

Activity: **Area and perimeter**

Anagram: OBLONG

Learning intentions and design philosophy:

To be able to understand and use the formula for the area of a rectangle and distinguish area from perimeter

The activity is designed such that learners have to use the formula for the area of a rectangle and perimeter to solve the problems. For example, learners might incorrectly pair cell 2 with cell 9 as they forget that adding the length and the width will only be half way around a rectangle. Learners may also get confused with remembering to multiply to find the area but adding to find the perimeter. The key word being 'oblong' can be used to provide the information that an oblong is a rectangle that is not a square. The word oblong is derived from the Latin '*oblongus*' meaning 'longish'.

Further ideas:

Complete cells 2, 6 and 8 correctly.

If the number in the cells 9, 10 and 12 equalled the area of a rectangle, ask learners to find the dimensions of the rectangle.

If the number in the cells 9, 10 and 12 equalled the perimeter of a rectangle, ask learners to find the dimensions of the rectangle.

Ask the learners to find a rectangle with this property: area = perimeter.

Ask the learners to give you 5 rectangles with the property that the perimeter is less than the area.

Ask the learners to give you 5 rectangles with the property that the perimeter is greater than the area.

Handling Data

Activity: **Asking questions**

Anagram: COLLECT

Learning intentions and design philosophy:

To be able to design and ask appropriate questions

The activity is designed to emphasise to learners the importance of carefully planned questions in order to aid the efficient collection of data. This includes ensuring questions have options (e.g. cell 1), that options cover all possibilities (e.g. cells 2 and 3) and that questions are not biased (e.g. cell 12).

Further ideas:

Use some of the questions, for example cell 1, with the class to illustrate some of the problems in collecting data.

Ask the learners to use the questions to collect data.

Activity: **Using equally likely outcomes in probability**

Anagram: OUTCOMES

Learning intentions and design philosophy:

To be able to solve problems based on equally likely outcomes

The activity is designed to emphasise the fact that knowing the **number** of outcomes only helps directly in finding the probability if those outcomes are equally likely. Learners will need to be familiar with the notation, P(event), and cells 10 and 11 start working towards a basic understanding of experimental probability.

Further ideas:

Discuss how learners would change spinners A and B to make cells 4, 5, 7 and 8 correct.

Make the spinners and experiment to compare experimental with theoretical results.

Activity: **Using the probability scale**

Anagram: LAPLACE

Learning intentions and design philosophy:

To be able to understand and use the probability scale from 0 to 1

The activity requires learners to find a probability based on equally likely outcomes and then place this correctly on a probability scale. Learners might interpret the 'less than' incorrectly and hence match cell 3 with cell 2. Cell 12 is designed to emphasise the fact that 1 is not a prime number, otherwise it would match with cell 8. Cells 6 and 9 are to combat the misconception that 'impossible' is represented by the upper end of the probability scale.

Further ideas:

Find an event to match the scales in cells 9, 10 and 12.

Ask the learners to research more about Laplace and the origins of probability. Prepare a presentation for the class.

Activity: **Averages and the range**

Anagram: MIDDLE

Learning intentions and design philosophy:

To be able to understand and use the mean of discrete data and compare two simple distributions, using the range and one of mode, median and mean

The activity is designed to consolidate the differences between calculating the range, mean, mode and median of a set of data. Learners might incorrectly pair cell 2 or 3 with cell 8, and cell 6 with cell 4 because they forget that the numbers must be in order before finding the median.

Further ideas:

Find the range, mean, mode and median for cell 2.

Ask the learners to find a set of data that satisfies the conditions in each of the cells 4, 8, 9, 10 and 11.

Ask the learners to invent ways, songs, etc. to remember how to find range, mean, mode and median of a set of data.

Activity: **Experimenting with probability**

Anagram: EXPERIMENT

Learning intentions and design philosophy:

To be able to understand that different outcomes may result from repeating an experiment

The activity is designed to challenge learners' understanding of the difference between theoretical and experimental probability; e.g. cells 1, 3, 6, 7, 8 and 11 explore theoretical probability and cells 4, 5, 9 and 12 explore experimental probability. Both cells 2 and 10 are incorrect because the balls are replaced each time.

Further ideas:

Do the activity physically with the class.

Put some different coloured balls in a bag. Pull out one ball at a time, record the colour and then replace the ball. Repeat until a learner thinks they can predict the number of different coloured balls in the bag.

Investigate the National Lottery: do learners think 1, 2 , 3 , 4 , 5 , 6 is possible? What patterns have occurred? Are there such things as 'lucky numbers'? Other ideas can be found in the National Lottery project within the 'enrichment' section of 'Kenny's Pouch' on **www.kangaroomaths.com**

Activity: **Interpreting pie charts**

Anagram: PLAYFAIR

Learning intentions and design philosophy:

To be able to interpret pie charts and draw conclusions

The activity has been designed such that some of the cells are focused on proportions (same reasoning for each pie chart) and some of the cells are focused on specific numbers (different total number for the two pie charts); e.g. the reason why cell 3 is correct but cell 4 is incorrect. Learners might think cells 8, 11 and 12 are correct because they are using the wrong total number.

Further ideas:

Find the correct answers to cells 4, 8, 11 and 12.

Change the total numbers to the pie charts: which cells would still be correct and which ones would need to be changed?

Ask the learners to research more about William Playfair and the origins of pie charts. What other statistical diagram did he invent? Prepare a presentation for the class.

Activity: **Constructing and using a line graph**

Anagram: CONVERSION

Learning intentions and design philosophy:

To be able to create and interpret line graphs

This activity has been designed to use the context of a conversion graph to illustrate how a line graph can be used to find intermediate values. Learners will need to draw the line graph to find the matching pairs and not use a unitary method.

Further ideas:

Find the correct conversions for cells 5 and 9.

Draw conversion graphs for other currency rates.