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| **Maths tea party** | | |
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| Solving maths problems to get ready for a tea party, e.g. to celebrate the coronation of King Charles III | | |
| **Subject(s):** Maths  **Approx time:** 45-60 minutes |  | **Key words / Topics:**   * Possibilities * Row * Column * Rotation * Symmetry * Equation/expression |
| **Stay safe**  Whether you are a scientist researching a new medicine or an engineer solving climate change, safety always comes first. An adult must always be around and supervising when doing this activity. You are responsible for:    • ensuring that any equipment used for this activity is in good working condition  • behaving sensibly and following any safety instructions so as not to hurt or injure yourself or others    Please note that in the absence of any negligence or other breach of duty by us, this activity is carried out at your own risk. It is important to take extra care at the stages marked with this symbol: ⚠ | | |
| **Suggested Learning Outcomes** |  |  |
| * Pupils can ‘solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions’. * Use pattern and shape to solve problems * Make generalisations and apply them to solve problems | | |
| **Introduction** |  |  |
| This lesson links to a 200-year-old maths puzzle and also to Latin Squares or Euler Squares which form the basis of popular Sudoku puzzles. The aim is to position different coloured items into a square grid so that each row and column contains one of each.  The lesson starts with someone arranging 9 cups, three of each colour, in a 3 by 3 square so that there is only one of each colour in each row and column. The lesson continues by adding a fourth coloured cup and placing all 16 in a 4 by 4 grid. The final stage introduces the idea of different colour and different items for the tea party, the challenge is to arrange red, white and blue sets of cups, saucers and plates into a 3 by 3 grid and then 4 sets, including a teaspoon this time, into a 4 by 4 grid. This time there has to be one of each colour and one of each item in the grids. | | |
| **Purpose of this activity**  The purpose of this activity is to explore problem solving strategies including trial and improvement, pattern spotting and using known strategies to tackle a new problem.  There is also the opportunity to explore rotation and symmetry and to use these as problem solving strategies.  The final slides provide the history of the puzzle and a bit of algebra to explain the problem. | | |
| **Activity** |  | **Teacher notes** |
| **Activity 1: Setting out teacups on a tray**  The challenge is to arrange 3 red, 3 white and 3 blue teacups in a 3×3 grid.  There must be one red, one white and one blue teacup in each row and column.  You could use this context for the problem:  Sam is laying out cups and saucers ready for the tea party.  The cups are being arranged in a square ready for the tea to be poured.  To make the table look as interesting as possible, Sam has decided to try and do it so that there is only one cup of each colour in each row or column.  Can you help Sam to do this?  Looking for patterns  What shapes and patterns can we find in our solutions? |  | **Slides 3 - 7**  This initial activity allows pupils to explore the problem in a simple form.  You may want to print grids and teacups for pupils to use or you could use coloured cubes or counters to position on the grid. Using objects makes it much easier for them to change the position of objects.  Appendix 1 and 3  **Key questions:**  How do you know you have solved the problem?  Did you get it right first time?  What did you do if you didn’t get it right?  Is there more than one way to do it?  Once the pupils have had a go and you have shared the solutions, ask pupils to look for any patterns and shapes that they can see in their solutions. These patterns are shown on Slide 6.  The following slide show that by rotating one solution, the shapes appear in the same places. |
| **Activity 2: A bigger grid**  If we add in some more cups so we have 4 each of red, white, blue and green.  Can we use what we have found out to position these in a 4×4 grid of 16 squares?  **Activity 3:** **Introducing Euler**  This is a chance to find out about Euler and why we are solving these problems.  **Activity 4: Cups, saucers and plates**  Can you arrange these coloured sets of cups, saucers and plates so that there is one of each colour and one of each type in every row and column?  **Cups, saucers, plates and teaspoons!**  Now for a real challenge.  Can you arrange cups, saucers, plates and teaspoons in four colours into a grid of 16 squares?  Remember to use the idea of patterns and shapes to help you.  **Activity 5: Euler and what he started**  This is a bit about the history of these puzzles and problems and gives a sense of how complicated they are.  There is also a little bit of algebra to explain how Euler thought about these grids. |  | **(Slides 8 – 10)**  Arranging the four different colours in the grid is a challenge but if pupils see the diagonal line in the previous grid, they can be encouraged to use that as a starting point for the larger grid.  **Appendix 2**  The solution is given with the shapes highlighted.  You might decide to use this to show that the problem gets much harder the bigger the grid.  **(Slide 11)**  We take a break from the problems to introduce Euler before changing the problem to make it more like the problem that Euler worked on which is introduced after the next activity.  **(Slides 12 – 16)**  This development of the problem to include different items in the different colours brings the activity closer to the problem that Euler worked on in the 18th Century.  Again, draw attention to the patterns in the initial problem as these will support them as they solve this new puzzle.  This final challenge is a challenge!  The diagonals are a good starting point and there are shapes again within the solutions but the one in the presentation focuses on rectangles rather than triangles.  **(Slides 17 – 19)**  The last slides introduce The Officer Problem which Euler investigated. The theory he came up with is explained and this includes a little algebra.  In finding out just how long it has taken to prove that Euler was wrong and to work out the solution for a grid, hopefully pupils can see that they are engaging with **real** maths that has occupied the minds of many for a very long time.  **Slide 20** gives an example of a Sudoku puzzle which is based on these Latin or Euler squares. |
| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| * Teachers can add some teacups onto the 3 x 3 grid in advance to start learners off. |  | * The 4 x 4 grids are much more challenging as there are so many possibilities. |
| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| * 3 x 3 grids * 4 x 4 grids * 4 colours of counters * Images of cups, saucers, plates, spoons in 4 different colours |  | Maths tea party presentation  icon-doc Maths tea party worksheet |
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| **Additional websites** |  |  |
| * NRICH has a related activity <https://nrich.maths.org/7397/note> * Any website offering Sudoku problems | | |
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| **The Engineering Context** |
| * The power of technology to solve problems. It was almost 200 years before mathematicians were able to prove that Euler was wrong and it took a computer to help them as the task was so great. |

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| **Curriculum links** | |
| **England**  From the aims of the National Curriculum  The national curriculum for mathematics aims to ensure that all pupils:   * become fluent in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately. * reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language * can solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions   Year 5 Geometry – Position and direction   * identify, describe and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed   Year 6 Algebra   * use simple formulae | **Northern Ireland Curriculum**  Processes in mathematics  Making and monitoring decisions   * Plan and organize their work, learning to work systematically * Develop a range of strategies for problem-solving, looking for ways to overcome difficulties   Communicating mathematically   * Compare their ideas and methods of working with others * Present information and results clearly   Mathematical reasoning   * Recognize general patterns and relationships and make predictions about them |
| **Scotland: Curriculum for Excellence**  My learning in mathematics enables me to:   * engage with more abstract mathematical concepts and develop important new kinds of thinking * understand the application of mathematics, its impact on our society past and present, and its potential for the future * apply skills and understanding creatively and logically to solve problems, within a variety of contexts * appreciate how the imaginative and effective use of technologies can enhance the development of skills and concepts.   I have worked with others to research a famous mathematician and the work they are known for, or investigated a mathematical topic, and have prepared and delivered a short presentation. **MTH 3-12a** | **Wales: National Curriculum**  Developing numerical reasoning  Represent and communicate   * Recognize, and generalize in words, patterns that arise in numerical, spatial or practical situations * Visualize and describe shapes, movements and transformations   Review   * Draw conclusions from data and recognize that some conclusions may be misleading or uncertain |
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| **Assessment opportunities** | | |
| * Systematic approaches to problem solving * Recognising shapes in different orientations * Recognising rotation and similarity * Understanding of an algebraic expression | | |
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