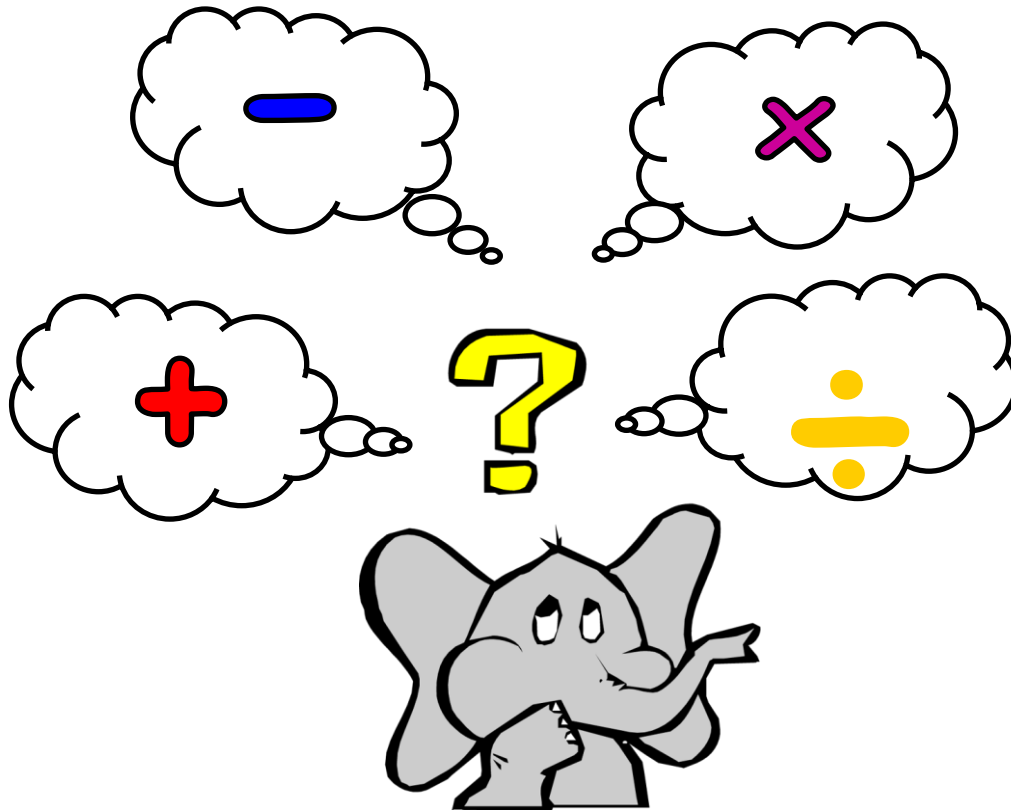# Supporting your child in mathematics

A Guide to Calculation Strategies for Parents

Herne Junior School
2017

Herne
Junior School

Introduction

Maths results at Herne are Outstanding. In 2017, 90% of Year 6 children achieved the expected level of attainment in their SATs (15% more than the national average!)

Our success is based on focussing on a consistent approach to calculations across the school, regular and engaging opportunities to solve problems, Maths challenges and real-life applications of Maths skills as well as high parental engagement in pupil learning in Maths.

The New Mathematics Curriculum is much more strenuous and demanding than ever before. There is now a bigger focus on children learning more formal methods of calculation. Children will learn a range of formal and informal methods throughout the school to develop their understanding and fluency before moving onto the more traditional, shorter methods of calculation.

As children go through the school they will see the methods they use move towards the formal method. It is important that each child is secure with each method before they move onto the next stage.

Your child may be a child who is confident when using large numbers or they may be more confident when using small numbers. We use the same methods regardless of the size of the numbers, so please practice these methods with numbers your child feels are manageable.

This booklet is designed to support your child's mathematic work in the classroom. It will show you some of the methods that we are encouraging the children to use in class, so that you can reinforce these at home.

If you have any specific questions about your child's work in maths at school or at home, please do not hesitate to contact your child's class teacher.

Year 3 to Year 6

Years 3 to 6 build on the understanding of the number system and the mental calculations taught in Reception to Year 2.

Children develop their understanding of mathematics at different rates. Some children are intuitive mathematicians and are confident and quick when using numbers. We recognise the importance of introducing the appropriate challenge to children so they are motivated and successful, **no matter what stage of development they have reached.** This booklet suggests a specific year group for each calculation, but some more confident children will be working on the next stage of the calculation in order to further challenge them. Children who are less confident need more support and encouragement, so that they can make progress and build on what they already know.

Innovation Cross-curricula Discovery Exploration Energetic Lifelong Risky Learning Adventurous

"Very good progress in mathematics is the result of effective teaching and opportunities for pupils to solve problems, undertake investigations and apply their mathematical skills to real life."
Ofsted 2013

Progression in teaching addition

Key Vocabulary

add   and   count on
addition   plus
more   sum   total
altogether   increase

Year 2

In Year 2, the children are taught to use the Dienes system. This enables the children to see a visual and kinesthetic method before moving onto formal written strategies.

```
      T  U
      ||  |||

      |   ||
   +
      3  5
```

As children progress, some are introduced to partitioning. As more digits are used and calculations become more complex, most children will begin to find vertical layout a better way of tackling addition. It is really important that children understand place value before moving onto vertical addition.

E.g. 36 + 53 ⟶ = (30 + 6) plus (50 + 3)
= (30 + 50) + (6 + 3)
= 80 + 9
= 89

Stage 1 –KS1 and into Year 3

During Year 2 children will have used the Dienes system. This enables the children to see a visual and kinesthetic method before moving onto formal written strategies.

```
      T  U
     ||  |||
      |   ||
  +  _____
     3   5
     _____
```

Partitioning can be used as a mental arithmetic strategy- beginning of Year 3 onwards

E.g. 36 + 53 ⟶ = (30 + 6) plus (50 + 3)
                 = (30 + 50) + (6 + 3)
                 = 80 + 9
                 = 89

As more digits are used and calculations become more complex, most children will begin to find vertical layout a better way of tackling addition. It is really important that children understand place value before moving onto vertical addition.

Stage 2 – Recommended for mid-way through Year 3 and into Year 4
Vertical addition (no exchange)

```
      T U                    H T U
      2 4                    1 2 5
  +   3 3                +   1 3 3
      5 7                    2 5 8
```

Stage 3 – Recommended for Year 4
Vertical addition (with exchange)

E.g. 48 + 36   E.g. 587 + 47

```
      T U                        Th H  T  U
      4 8                            5  8  7
  +   3 6                     +      4  7  5
      8 4                            1 0 6  2
      1                                1  1
```

Stage 4 – Recommended for Year 5 and 6.
Vertical addition with decimals

E.g.   346.13 + 173.27

$$
\begin{array}{r}
H \quad T \quad U \quad . \quad \frac{1}{10} \quad \frac{1}{100} \\
+ \quad 3 \quad 4 \quad 6 \quad . \quad 1 \quad 3 \\
\underline{1 \quad 7 \quad 3 \quad . \quad 2 \quad 7} \\
\underline{5 \quad 1 \quad 9 \quad . \quad 4 \quad 0}
\end{array}
$$

1   1

E.g.   26 . 48 + 5.375

$$
\begin{array}{r}
T \quad U \quad . \quad \frac{1}{10} \quad \frac{1}{100} \quad \frac{1}{1000} \\
+ \quad 2 \quad 6 \quad . \quad 4 \quad 8 \quad 0 \\
\underline{5 \quad . \quad 3 \quad 7 \quad 5} \\
\underline{3 \quad 1 \quad . \quad 8 \quad 5 \quad 5}
\end{array}
$$

1   1

The children must include a place holder.

None of these calculation strategies are static and pupils can use any method as they move up through the school. The year groups shown are a guide to when the pupils will be specifically taught this method.

Progression in teaching subtraction

Key Vocabulary

count back   take away
fewer   subtract
less   minus
difference between

Subtraction calculations are initially presented horizontally to the children. As in addition, partitioning is a key skill.

Year 2
In Year 2, to coincide with using the Dienes method for addition, children are taught to use this method for subtraction.

Eg. 32-11=

```
        T    U
       |||   ||
     -  |    |
        2    1
```

So 32-11 = 21

Year 3
Once children are confident with the Dienes method they will be introduced to vertical subtraction without exchanging.
 Eg 48-26=

```
        T    U
        4    8
        2    6
        2    2
```

So: 48 – 26 = 22

<u>Stage 4 – Recommended for Year 4</u>
<u>Vertical subtraction with exchange</u>

E.g. 4̶3̶ – 27

$$\begin{array}{r} \text{T U} \\ {}^{3}4\,{}^{1}3 \\ -\;2\,7 \\ \hline 1\,6 \end{array}$$

<u>So</u> 43 – 27 = 16

E.g. 3007 – 2964

$$\begin{array}{r} \text{Th H T U} \\ {}^{2}3̶\;{}^{1}0̶{}^{9}\;{}^{1}0\;7 \\ -\quad\;\;\;\;\; \\ 2\;\;9\;\;6\;\;4 \\ \hline 0\;\;0\;\;4\;\;3 \end{array}$$

<u>So</u> 3007 – 2964 = 43

<u>Stage 5 – Recommended for Year 5 and Year 6</u>
<u>Vertical subtraction with decimals</u>

E.g.
$$\begin{array}{r} -\;£\,{}^{3}4̶\,{}^{1}6\,.\,{}^{0}1̶\,{}^{1}2 \\ £\,3\,7\,.\,0\,8 \\ \hline £\;\;\,9\,.\,0\,4 \end{array}$$

<u>So</u> £46.12 – £37.08 = £9.04

E.g.

$$\begin{array}{r} \text{H T U}\,.\;\;\;\tfrac{1}{10}\;\;\;\tfrac{1}{100}\;\;\;\tfrac{1}{1000} \\[4pt] 7\;{}^{5}6̶\,{}^{2}3\,.\,{}^{1}2\,{}^{1}0̶\,{}^{1}0 \\ -\qquad 2\;3\,.\,6\;\;7\;\;8 \\ \hline 7\;3\;9\,.\,5\;\;2\;\;2 \end{array}$$
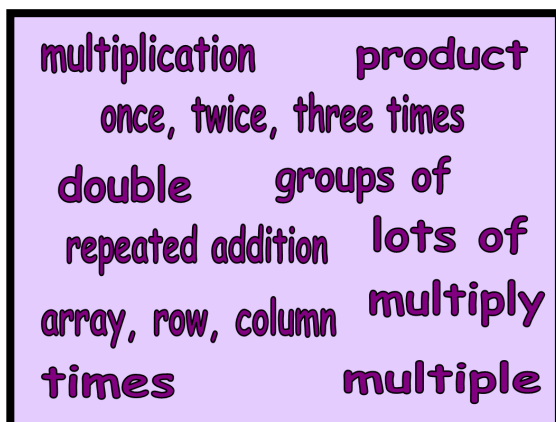
<u>So</u> 763.200 – 23.678 = 739.522

None of these calculation strategies are static and pupils can use any method as they move up through the school. The year groups shown are a guide to when the pupils will be specifically taught this method.

# Progression in teaching multiplication

Key Vocabulary

multiplication   product
once, twice, three times
double   groups of
repeated addition   lots of
array, row, column   multiply
times   multiple

<u>Stage 1 – Recommended for beginning of Year 3</u>

In Key Stage 1, the children are taught to count in 10s, 5s and 2s. Multiplication is commonly introduced in Year 2 and is then built on in Key Stage 2.

In Year 2, continuing on into Year 3, the children will be shown how to use cubes to work out multiplication calculations.

E.g. 3×4
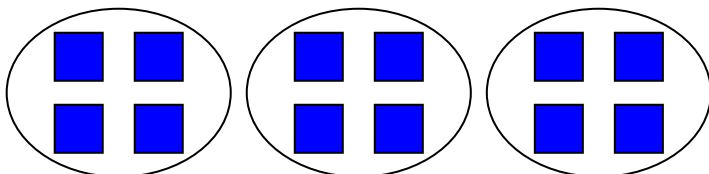
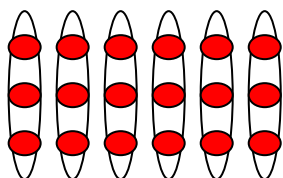The children will also understand multiplication as repeated addition.
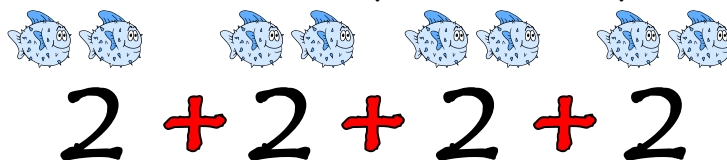
$$2 + 2 + 2 + 2$$

$2 + 2 + 2 + 2 = 8$
$4 \times 2 = 8$
2 multiplied by 4
4 lots of 2

The children should recognise the different ways an array can be expressed. For example, 36 can be expressed as 3 groups of 12 or 12 groups of 3
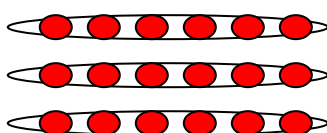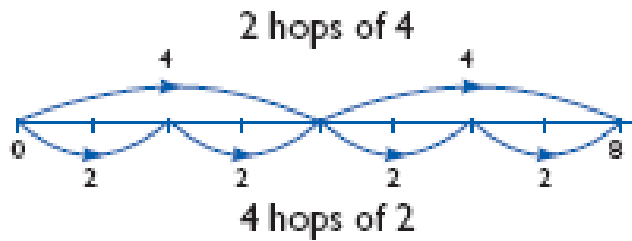
6 groups of 3
$6 \times 3 = 18$

3 groups of 6
$3 \times 6 = 18$

They should also understand how to represent arrays on a number line

2 hops of 4

4 hops of 2

In order to become fluent in the fundamentals of mathematics, children must have a secure understanding of the multiplication tables and corresponding division facts. The sooner the children learn their tables the easier maths will become and the more confident they will be in reasoning mathematically with a range of problems.

Children are now expected to know and quickly recall the multiplication facts up to the 12 times table by the end of Year 4. At Herne we expect our children to have a fluent understanding of these basic facts so that they can readily and efficiently apply them to solve problems. We expect parents to play an active role in the teaching and learning of timetables facts at home.
The sooner the children learn their tables the easier maths will become for them.

It is also important the children can multiply and divide by ten with ease and understand the process. When multiplying by 10 the numbers move 1 place to the left, when multiplying by 100 they move 2 places to the left and so on.

E.g.   43 x 10

H T U

4 3

4 3 0

A zero is put in the units column to keep the place value

E.g. 23 x 100

Th H T U

2 3

2 3 0 0

Two zeros are put in the units column to keep the place value

We avoid saying 'put a zero on the end' as when multiplying a decimal number 23.2 x 10, it would just become 23.20 rather than 232, a fatal misconception!

Stage 2 - Recommended for Year 3

Multiplication using the grid method is taught as a method of organising larger multiplication and involves partitioning.
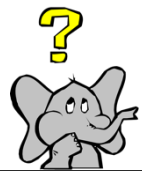

E.g. 13 x 7

×	10	3
7	70	21

So 13 x 7 = 91

```
  T U
+ 7 0
  2 1
  9 1
```

E.g. 23 x 5

×	20	3
5	100	15

```
  H T U
  1 0 0
+   1 5
  1 1 5
```

2 x 5 = 10
So 20 x 5 = 100

So   23 x 5 = 115

E.g. 124 x 7

×	100	20	4
7	700	140	28

```
  H T U
  7 0 0
  1 4 0
+   2 8
  8 6 8
```

7 x 10 = 70
So 7 x 100 = 700

2 x 7 = 14
So 20 x 7 = 140

So   124 x 7 = 868

E.g. 34 x 26

×	30	4
20	600	80
6	180	24

```
  H T U
  6 8 0
+ 1 0 4
  8 8 4
```

2 x 3 = 6
20 x 3 = 60
So 20 x 30 =

6 x 3 = 18
So 6 x 30 = 180

2 x 4 = 8
So 20 x 4 = 80

So 34 x 26 = 884

The children will begin to multiply vertically by 1-digit, which is called short multiplication.

Short multiplication

24×6 becomes

```
      2  4
  ×      6
 ─────────
  1  4  4
      2
```

Answer: 144

342×7 becomes

```
   3  4  2
  ×      7
 ──────────
  2  3  9  4
     2  1
```

Answer: 2394

2741×6 becomes

```
   2  7  4  1
  ×         6
 ─────────────
  1  6  4  4  6
     4  2
```

Answer: 16 446

The children will then move onto multiplying by two or more digits, known as long multiplication.

```
Th  H  T  U
       2  4  3
  ×       3  6
 ──────────────
  1  4₂ 5₁ 8
  7₁ 2  9  0
 ──────────────
  8  7  4  8
```

When using the long multiplication method, you first times by the unit.

e.g. 6 x3, 6 x 40, 6 x 200

Then the children start a new line and put a place holder zero in the units column. The children then times by the tens.
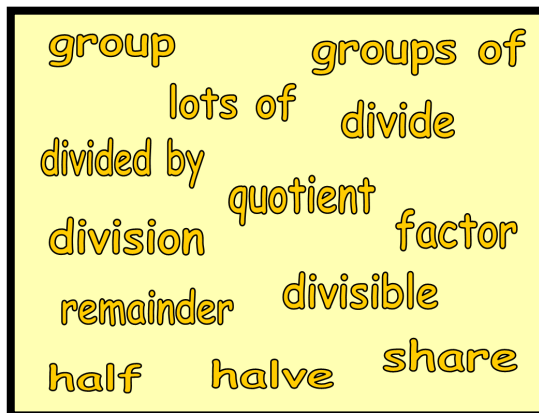
e.g. 30 x 3, 30 x 40, 30 x 200
The children then total the calculations at the end to find the answer.

The children will also learn how to multiply decimals effectively, particularly with money. This is combined with an emphasis on using estimation to check the reliability and accuracy of their answers.

None of these calculation strategies are static and pupils can use any method as they move up through the school. The year groups shown are a guide to when the pupils will be specifically taught this method.

Progression in teaching division

Key Vocabulary

group groups of lots of divide divided by quotient division factor remainder divisible half halve share

Stage 1 – Recommended for Year 3

Division is introduced to the children in Year 2, but even in Year 3 they are still not expected to use formal methods. In both year groups, the emphasis is in using their mental skill and being able to distinguish between the following:
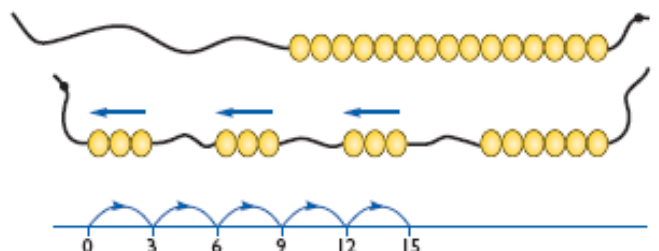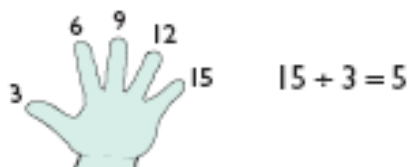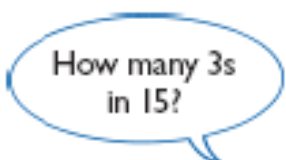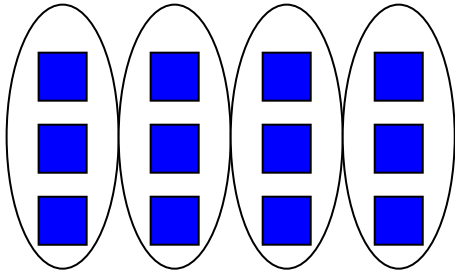
Sharing

12 biscuits shared between 3

12 ÷ 3 = 4

Grouping

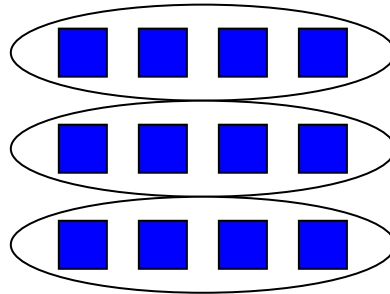How many 3s in 15?

6 9 12 15
3

15 ÷ 3 = 5

0   3   6   9   12   15
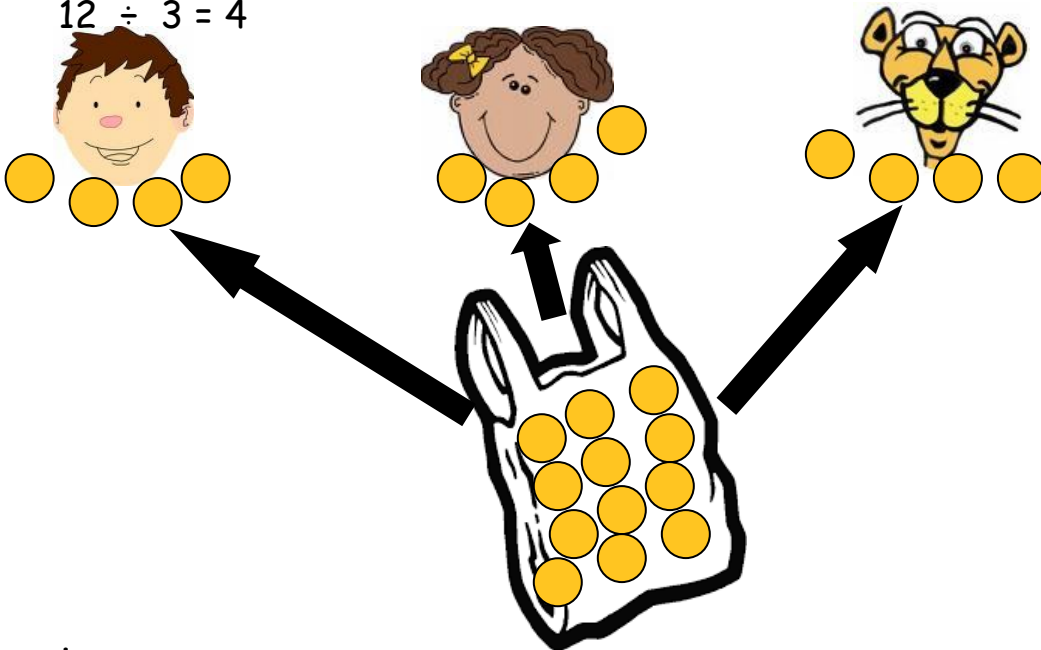
Division can be reinforced using arrays

12 ÷ 3 = 4

12 ÷ 4 = 3

Stage 2 – Recommended for Year 4 Short division method

98 ÷ 7 becomes

```
    1   4
   ┌────────
 7 │ 9   8
      ²
```

Answer: 14

1	7
2	14
4	28
5	35
10	70
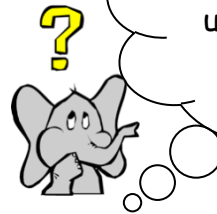
The ready reckoner or jottings are really useful when dividing.

Further examples of short division for use in Year 5 where remainders can be represented in different ways:

432 ÷ 5 becomes

```
        8   6  r2
      ┌────────────
 5    │ 4   3   2
           ³
```

Answer: 86 remainder 2

496 ÷ 11 becomes

```
          4   5  r1
        ┌────────────
 1   1  │ 4   9   6
             ⁵
```

Answer: 45 $\frac{1}{11}$

Stage 3 – Recommended for the end of Year 5 and Year 6
Long division method

$560 \div 24$

```
        23 r8
24 | 5 ¹6 0
      4 8 0
   -  ⁷8¹0
      7 2
         8
```

1	24
2	48
4	96
5	120
10	240
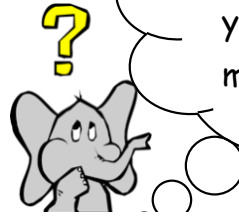
Again, the ready reckoner will support your tables facts to make dividing easier.

So $560 \div 24 = 23r8$

Further examples of long division:

$432 \div 15$ becomes

```
        2  8  r 12
1  5 | 4  3  2
       3  0  0
       1  3  2
       1  2  0
          1  2
```

Answer: 28 remainder 12

$432 \div 15$ becomes

```
        2  8
1  5 | 4  3  2
       3  0  0    15×20
       1  3  2
       1  2  0    15×8
          1  2
```

$\frac{12}{15} = \frac{4}{5}$

Answer: $28 \frac{4}{5}$

$432 \div 15$ becomes

```
        2  8 · 8
1  5 | 4  3  2 · 0
       3  0  ↓
       1  3  2
       1  2  0  ↓
          1  2  0
          1  2  0
                0
```

Answer: 28·8

Answering in Context - Rounding up and rounding down

Presenting children with a real context for their calculations is important for all areas of mathematical investigation. However in division, the nature of the context affects how the calculation may be approached and the necessity to round up or down.

Rounding up

E.g. 132 divided by 7 in the context of:

How many parents are needed to supervise a school trip where one adult is required per seven pupils?

132 ÷ 7 = 18 r 6

<u>So</u> 19 parents would be needed. 18 wouldn't be enough because 6 children would be unsupervised!

Rounding down

E.g. 69 divided by 6 in the context of:

How many complete boxes of eggs can you make with 69 eggs? Each box contains 6 eggs.

69 ÷ 6 = 11 r3

<u>So</u> 11 complete boxes of eggs can be made.

Problem solving

Across the school the pupils are taught various strategies to aid their problem solving, which is key in developing the pupils as independent thinkers and problem solvers.

The first port of call for many of our children is R.U.C.S.A.C. This enables pupils to look at a single or multi step word problem and recognise the different aspects of it.

R   Read the problem carefully,

U   Understand what the question is asking me & underline key information.

C   Choose the appropriate calculation or calculations,

S   Solve the problem using the calculation,

A   Answer the problem,

C   Check your answer using the inverse or another method.

We also encourage the pupils to estimate their answer first to look for obvious mistakes in their own calculations.

Heuristics

The pupils also use heuristics to aid their problem solving. This is essentially a mathematic toolkit, which gives pupils the skills they need to solve a variety of word problems, investigations and day to day problems. This is continued from the Infant School, with a clear progression as the pupils move up through the school. As the children progress through the school, they will learn new problem solving strategies or tools to add to their 'toolkit'.

Yr 3 Act it out
Take on the role of people, things or process in the problem and try to do what they do. It may sometimes be helpful to make use of objects to represent the situation or problem.

Yr 3 Draw a picture
Draw a diagram / model to create a pictorial description of the problem. This helps the child to visualise and understand the problem. Drawing also enables the child to "manipulate" the data.

Yr 3 Use Equipment
Use mathematical equipment to help you solve the problem.

Yr 4 Make a systematic list or make a table
Organise the data such as numbers or type of objects logically into tables or lists. This helps the child identify and spot missing data asked for in the problem. Organised tabulation of data also helps the child perceive trends or patterns in the data.

Yr 4 Look for pattern(s)
Examine the available data for patterns or relationships. Having perceived a pattern, the child can then predict the missing data or answer.

Yr 4 Make a model
Look at the problem, can you use jottings or a model to help you.

Yr 4 Do a calculation.
Look at the end results and work backwards towards the beginning. This strategy can be useful in problems involving a series of steps or computations. It is also useful when the problem gives more data about the end condition and little data about its beginning.

Yr 5 Use trial and improvement
Make an educated guess of the answer and check to see if it is correct. Use the knowledge gained from testing an incorrect guess to improve the next guess. It is important to avoid making wild guesses. Track the guesses made and look for patterns to improve the next guess.

Yr 5 List all the possibilities
Look at the data and write down all the possibilities, then start to cancel out the ones that will not work. This reduces the number of possibilities and makes it easier to explore the problem further.

Yr 5 Jot things down
Read the problem carefully and restate it in the child's own words. This helps the child understand the problem and identify important factors of the problem.

Yr 6 Think about another problem
Make a difficult problem simpler. This can be done by changing complex numbers to simple numbers or by reducing the number of things in the problem. The solution to the simplified problem may help the child solve the original problem.

Year 4 Heuristic problem – Acting it out

Problem 39 | Numbers 1 2 3 | Level A

Twenty nine pupils were waiting in a line to play a game. The teacher chose the first person in the line and then every fourth person in the line after that. How many were chosen?

You, you and you

Year 6 Heuristic problem – Drawing a diagram

Problem 17 | Numbers 1 2 3 | Level C

Mr Johnson wants to wear a three piece outfit to his birthday party. In the wardrobe he has a white shirt and a pale blue shirt. He has a pair of brown trousers, a pair of black trousers and some blue jeans. He has a cashmere coat and a jacket. How many different three piece outfits can he wear?

We hope that this booklet has been helpful. If you have any specific questions relating to your child's progress, please contact your child's class teacher who will be happy to help.

Mrs Elliot-Smith and Mrs Tigwell
Maths Leaders