Upper Key Stage 2

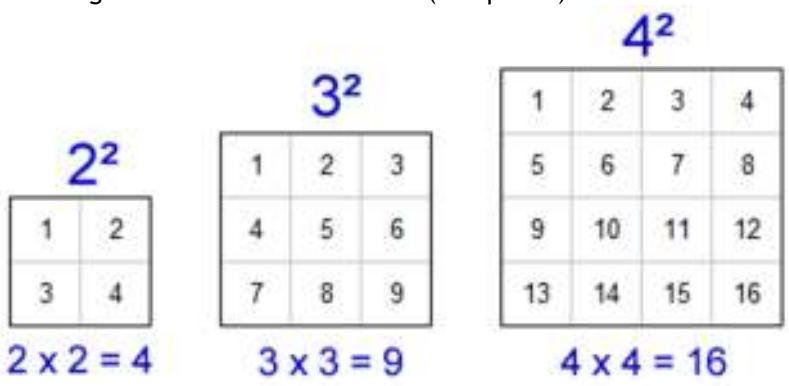
MULTIPLICATION

X

Developing Conceptual Understanding:
CONTEXTUAL – LINGUISTIC – PRACTICAL – CONCRETE

- **Mathematical Vocabulary & Language:**
  Continue to embed and secure the use of the language of multiplication – in particular ensure the children use 'multiple' and 'factor' (see Division) correctly.
  Once these are understood, support the children to apply and reason with these terms through learning about common factors, prime numbers, square / cube numbers and powers.

- **Square and Cube Numbers:**
  In UKS2, time spent on tables knowledge should be consolidating all x and ÷ facts up to 12 x 12, so new learning should focus on learning the sequences, and notation for recording, square and cube numbers.
  Square numbers: any number multiplied by itself, forms a square number.
  [NB the square number is the answer produced, since any number can be squared].
  This is best illustrated by investigating the areas of rectangles – noting what happens when the length and width are the same (ie squares):



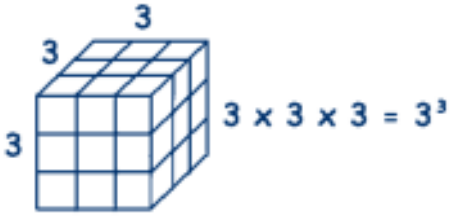
Eg: $4^2 = 4 \times 4 = 16$ So,16 is the square number produced by doing '4 squared'.

Once this concept is understood, square numbers should be learned as a sequence, much like times tables:
$1^2 = 1$, $2^2 = 4$, $3^2 = 9$, $4^2 = 16$, $5^2 = 25$, $6^2 = 36$; $7^2 = 49$, $8^2 = 64$, $9^2 = 81$, $10^2 = 100$, $11^2 = 121$, $12^2 = 144$…..etc

Cube numbers: Any number multiplied by itself three times will produce a cubed number

Eg: $4^3 = 4 \times 4 \times 4 = 64$

This is best illustrated when children understand the 3-Dimensions associated with 3-D Shapes (and the calculation of Volume as length x width x height)
Children don't need to know cubed numbers by heart, but should understand how they are calculated, and be able to reason about them.



In this example, $3^3 = 27$

- **Powers:**
  When learning about squares and cubes, introduce the language of 'powers'.
  "2 squared (2^2)" is the same as "2 to the power of 2"; "2 cubed (2^3)" is "2 to the power of 3" etc.
  The notation (using the power in superscript) should also be taught [x^2; y^3 etc] so it is recognisable.

  Children should recognise and be able to calculate all powers of 10, by applying the rules for multiplying by powers of 10 (especially 10, 100 and 1000):

when we multiply a number by 10, the digits move ONE p.v. column to the LEFT
when we multiply a number by 100, the digits move TWO p.v. columns to the LEFT
when we multiply a number by 1,000, the digits move THREE p.v. columns to the LEFT
when we multiply a number by 10,000, the digits move FOUR p.v. columns to the LEFT
when we multiply a number by 100,000, the digits move FIVE p.v. columns to the LEFT
when we multiply a number by 1,000,000, the digits move SIX p.v. columns to the LEFT

  Children should be able to continue this pattern and use it to reason about large numbers and the decimal system.
  They should be able to use reasoning to deduce that:
  $10^2 = 100$; $10^3 = 1{,}000$; $10^4 = 10{,}000$; $10^5 = 100{,}000$; $10^6 = 1{,}000{,}000$ etc

  They should also practice multiplying and dividing numbers (including those with decimals) by 10, 100, 1000 and must be able to explain what has happened to each digit (ie which direction they moved and by how many places)

  Eg; 25.4 x 100 = 2540

- **Bracket notation:**
  Children should be familiar with the use of brackets to denote parts of an equation that should be performed before carrying out the main calculation:

  Eg: I buy 6 books, each costing £1.99. How much do they cost altogether?

  6 x £1.99 = (6 x £2.00) – (6 x 1p)
  = £12.00 – 6p
  = £11.94

- **B.O.D.M.A.S.**
  The acronym B.O.D.M.A.S. should be taught from Y5 as a way of performing more complex, multi-operation calculations in the mathematically correct order.

B = Brackets	any part of the sum in brackets should be calculated first
O = Orders/Powers	work out any squares,cubes or roots next, before….
D = Division	which must precede….
M = Multiplication	multiply numbers either side of the x sign before doing….
A = Addition	any + and/or
S = Subtraction	- last

  [Note: addition and subtraction can be performed in any order, but must be after all other parts of the calculation have been done]

Eg:	4^2 x (24 ÷ 6) – 10 + 5	
Step 1:	4^2 x 4 – 10 + 5	(Calculate what's in the Brackets, leave the rest alone)
Step 2:	16 x 4 – 10 + 5	(Work out the Power next, leave everything else)
Step 3:	64 - 10 + 5	(There's no ÷, so do the x next, leave the rest)
Step 4:	= 59	(Do all the + and – calculations to find the answer)

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Developing Conceptual Understanding:
PICTORIAL – MENTAL

- **Mental application of tables knowledge:**
  In UKS2, children should know all their times tables facts, so testing of these should be done through applying the facts in context, not merely by speed of recall.

  Eg: (to test 7 x 3) How many vertices would 7 triangles have?

  Continue to apply multiplication by factors to simplify calculations (either mentally or in informal jottings):

  Eg: **12 x 15** = 12 x 3 x 5 = 36 x 5 = Either: i) 36 x 10 ÷ 2 = (half of 360) = 180
  Or: ii) (30 x 5) + (6 x 5) = 150 + 30 = 180

- **'Round and Adjust':**
  A very useful mental strategy (either for mentally doing arithmetic paper questions or as a checking strategy):

  Eg: A book costs £1.99. How much will 6 books cost?
  [See the Brackets section above for a more formal way of recording this sum.]

  Round £1.99 to £2 6 x £2 = £12 Subtract the difference: (6 x 1p) = 6p
  £12.00 – 6p = £11.94

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Abstract Recording:
INFORMAL JOTTINGS

- **Grid Method:**
  As numbers become larger, the grid method starts to become inefficient (it's slow, difficult to set out neatly and easy to introduce place value or addition errors)

  Eg; **124 x 26** { ☐ **NB: Leave two blank squares for H columns!}**

X	☐☐100	☐20	☐4
20	2000	400	80
6	600	120	24
	2600	520	104

2600
+ 520
1 104
3224

The key concept behind the grid method that must be secured, is the correct way to partition large numbers, ready to multiply. Once this is clearly understood, the pupil should be moved on to a quicker, more efficient standard written method (see next section) during Year 5 – which gives them time to secure this method prior to KS2 SATs.

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Abstract Recording:
OUR WRITTEN METHOD

- **Long Multiplication:**

The progression in teaching long multiplication starts with the following:

1 - 'Intermediate/Expanded Method':

Eg; **124 x 26**

```
  1 2 4
X   2 6
-------
    2 4    ( 6 x 4 )
  1 2 0    ( 6 x 20 )
  6 0 0    ( 6 x 100 )
    8 0    ( 20 x 4 )
  4 0 0    ( 20 x 20 )
2 0 0 0    ( 100 x 20 )
  1 1
-------
  3 2 2 4
```

Note how the recording each line of the calculation corresponds to each box of the grid method (compare with the example in the Informal Jottings section above).

2 - 'Short Multiplication by 1 digit numbers':

Eg; **127 x 6**

```
  1 2 7
x     6
  1 4
-------
  7 6 2
```

This method is introduced with Year 4 children who are developmentally ready for it (ie those who are secure with partitioning, grid method, the expanded column method and have accurate times tables recall) whilst still multiplying by single-digit numbers.

In UKS2, develop this method into….

3 - 'Short Multiplication by 2 digit numbers':

Eg; 124 x 26

```
  1 2 4
x   2 6
  1 2
-------
  7 4 4      ( 6 x 124 )

+ 2 4 8 0    ( 20 x 124 )
  1 1
-------
  3 2 2 4
```

Note: The **0** as a place holder (highlighted in blue in the above example) allows the child to simplify this calculation using the factorising concept mentioned in the LKS2 section – ie since 20 x 124 is the same as 2 x 10 x 124, the 0 takes care of the multiplying by 10 element in the answer, enabling the child to simply multiply 124 by 2 and record the digits of this answer in the next place value column to the left).

EXPECTATION:
We aim for all Year 6 children to be secure with this method in good time to practise and prepare for KS2 SATs.