

PROGRESSION THROUGH CALCULATIONS FOR MULTIPLICATION

MENTAL CALCULATIONS

(ongoing)

These are a selection of mental calculation strategies:

Doubling and halving

Applying the knowledge of doubles and halves to known facts.

e.g. 8×4 is double 4×4

Deriving and recalling division facts

Tables should be taught regularly from Y1 onwards, either as part of the mental oral starter or other times as appropriate within the day.

See Renewed Framework objectives for end of year expectation for your year group. Progression will be:

Year 1

- Count on or back in ones, twos, fives and tens and use this knowledge to derive the multiples of 2, 5 and 10 to the tenth multiple

Year 2

- Understand that halving is the inverse of doubling and derive and recall doubles of all numbers to 20, and the corresponding halves
- Derive and recall multiplication facts for the 2, 3, 5 and 10 times-tables and the related division facts; recognise multiples of 2, 3, 5 and 10
- Use knowledge of number facts and operations to estimate and check answers to calculations

Year 3

- Derive and recall multiplication facts for the 2, 3, 4, 5, 8, 10 times-tables and the corresponding division facts; recognise multiples of 2, 5 or 10 up to 1000
- Count in multiples of 50 and 100
- Use knowledge of number operations and corresponding inverses, including doubling and halving, to estimate and check calculations

Year 4

- Derive and recall multiplication facts up to 12×12 , the corresponding division facts and multiples of numbers to 10 up to the tenth multiple
- Count in multiples of 25, 50 and 100

Year 5

- Recall quickly multiplication facts up to 12×12 and use them to multiply pairs of multiples of 10 and 100; derive quickly corresponding division facts
- Identify pairs of factors of two-digit whole numbers and find common multiples (e.g. for 6 and 9)

Year 6

- Use knowledge of place value and multiplication facts to 12×12 to derive related multiplication and division facts involving decimals (e.g. 0.8×7 , $4.8 \div 6$)
- Use knowledge of multiplication facts to derive quickly squares of numbers to 12×12 and the corresponding squares of multiples of 10
- Recognise that prime numbers have only two factors and identify prime numbers less than 100; find the prime factors of two-digit numbers
- Use approximations, inverse operations and tests of divisibility to estimate and check results

Using and applying division facts

Children should be able to utilise their tables knowledge to derive other facts.

e.g. If I know $3 \times 7 = 21$, what else do I know?

$30 \times 7 = 210$, $300 \times 7 = 2100$, $3000 \times 7 = 21\ 000$, $0.3 \times 7 = 2.1$ etc

Use closely related facts already known

$$\begin{aligned} 13 \times 11 &= (13 \times 10) + (13 \times 1) \\ &= 130 + 13 \\ &= 143 \end{aligned}$$

Multiplying by 10 or 100

Knowing that the effect of multiplying by 10 is a shift in the digits one place to the left.

Knowing that the effect of multiplying by 100 is a shift in the digits two places to the left.

Partitioning

$$\begin{aligned} 23 \times 4 &= (20 \times 4) + (3 \times 4) \\ &= 80 + 12 \\ &= 102 \end{aligned}$$

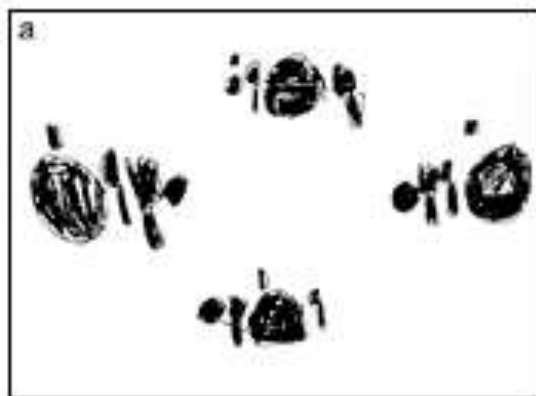
Use of factors

$$8 \times 12 = 8 \times 4 \times 3$$

MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.

Stage 1

Children will experience equal groups of objects and will count in 2s and 10s and begin to count in 5s. They will work on practical problem solving activities involving equal sets or groups.



It is really important at this stage that children experience multiplication in context, ie pairs of socks, egg boxes, fingers and toes etc

Stage 2

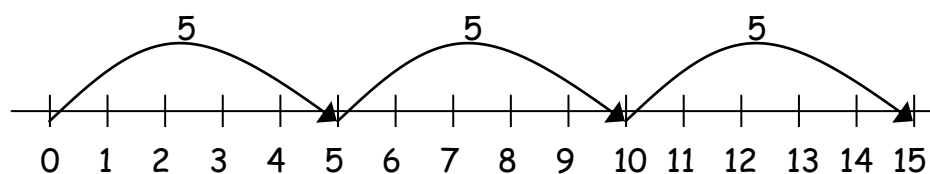
Children will develop their understanding of multiplication and use jottings to support calculation:

- ✓ Repeated addition

3 times 5 is $5 + 5 + 5 = 15$ or 3 lots of 5 or 5×3

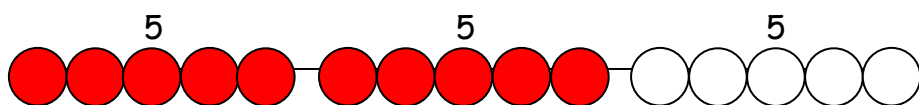
Repeated addition can be shown easily on a number line:

$$5 \times 3 = 5 + 5 + 5$$



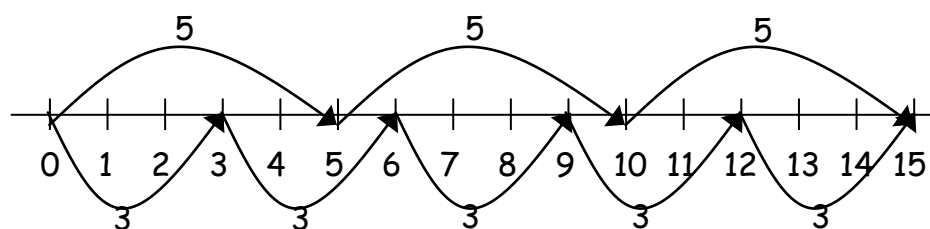
and on a bead bar:

$$5 \times 3 = 5 + 5 + 5$$



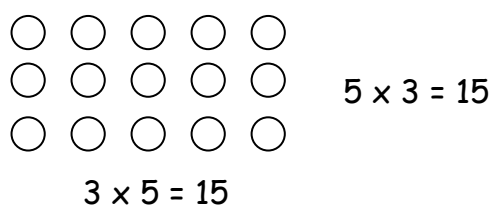
- ✓ Commutativity

Children should know that 3×5 has the same answer as 5×3 . This can also be shown on the number line.



✓ Arrays

Children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method.



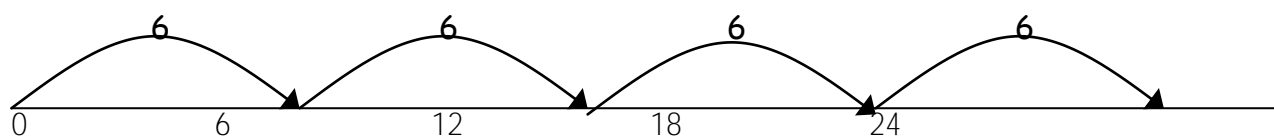
Stage 3

Children will continue to use:

✓ Repeated addition

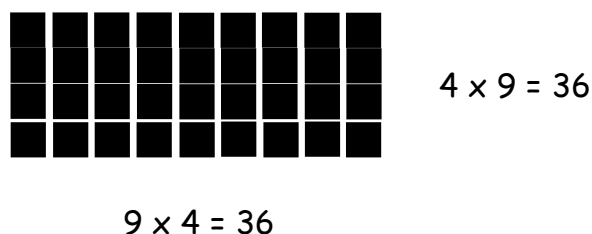
4 times 6 is $6 + 6 + 6 + 6 = 24$ or 4 lots of 6 or 6×4

Children should use number lines or bead bars to support their understanding.



✓ Arrays

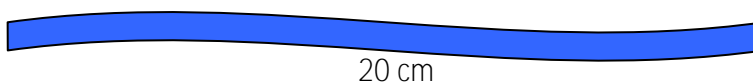
Children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method.



Children will also develop an understanding of

✓ Scaling

e.g. Find a ribbon that is 4 times as long as the blue ribbon



- ✓ Using symbols to stand for unknown numbers to complete equations using inverse operations

$$\square \times 5 = 20$$

$$3 \times \triangle = 18$$

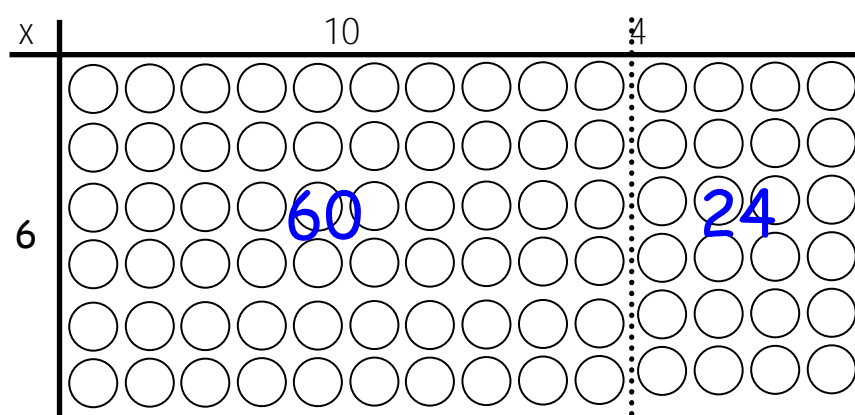
$$\square \times \circ = 32$$

- ✓ Partitioning

$$\begin{aligned} 38 \times 5 &= (30 \times 5) + (8 \times 5) \\ &= 150 + 40 \\ &= 190 \end{aligned}$$

Stage 4

Children will continue to use arrays where appropriate leading into the grid method of multiplication.



$$(6 \times 10) + (6 \times 4)$$

$$60 + 24$$

$$84$$

Grid method

TU x U

(Short multiplication – multiplication by a single digit)

$$23 \times 8$$

Children will approximate first

23×8 is approximately $25 \times 8 = 200$

$$\begin{array}{r} \times \quad 20 \quad 3 \\ 8 \quad \boxed{160} \quad \boxed{24} \end{array}$$

$$160$$

$$\begin{array}{r} + 24 \\ \hline 184 \end{array}$$

Stage 5

Grid method

HTU x U

(Short multiplication – multiplication by a single digit)

$$346 \times 9$$

Children will approximate first

346×9 is approximately $350 \times 10 = 3500$

$$\begin{array}{r} \times \quad 300 \quad 40 \quad 6 \\ 9 \quad \boxed{2700} \quad \boxed{360} \quad \boxed{54} \end{array} = 3114$$

Encourage the children to add up mentally first but then they may need a suitable written method if they cannot add mentally.

TU x TU

(Long multiplication – multiplication by more than a single digit)

$$72 \times 38$$

Children will approximate first

72×38 is approximately $70 \times 40 = 2800$

$$\begin{array}{r} \times \quad 70 \quad 2 \\ 30 \quad \boxed{2100} \quad \boxed{60} \\ 8 \quad \boxed{560} \quad \boxed{16} \end{array} = 2736$$

Encourage the children to add up mentally first but then they may need a suitable written method if they cannot add mentally.

Using similar methods, they will be able to multiply decimals with one decimal place by a single digit number, approximating first. They should know that the decimal points line up under each other.

e.g. 4.9×3

Children will approximate first
 4.9×3 is approximately $5 \times 3 = 15$

$$\begin{array}{r} \times \quad 4 \quad 0.9 \\ 3 \quad \boxed{12} \quad \boxed{2.7} \end{array} = 14.7$$

Stage 6

ThHTU x U
 (Short multiplication – multiplication by a single digit)

4346×8

Children will approximate first
 4346×8 is approximately $4346 \times 10 = 43460$

$$\begin{array}{r} \times \quad 4000 \quad 300 \quad 40 \quad 6 \\ 8 \quad \boxed{32000} \quad \boxed{2400} \quad \boxed{320} \quad \boxed{48} \end{array} \quad \begin{array}{r} 32000 \\ + 2400 \\ + 320 \\ + 48 \\ \hline 34768 \end{array}$$

HTU x TU
 (Long multiplication – multiplication by more than a single digit)

372×24

Children will approximate first
 372×24 is approximately $400 \times 25 = 10000$

$$\begin{array}{r} \times \quad 300 \quad 70 \quad 2 \\ 20 \quad \boxed{6000} \quad \boxed{1400} \quad \boxed{40} \\ 4 \quad \boxed{1200} \quad \boxed{280} \quad \boxed{8} \end{array} \quad \begin{array}{r} 6000 \\ + 1400 \end{array}$$

$$\begin{array}{r}
 + 1200 \\
 + 280 \\
 + 40 \\
 + \underline{8} \\
 \hline
 8928 \\
 \small{1}
 \end{array}$$

Using similar methods, they will be able to multiply decimals with up to two decimal places by a single digit number and then two digit numbers, approximating first. They should know that the decimal points line up under each other.

For example:

$$4.92 \times 3$$

Children will approximate first

4.92×3 is approximately $5 \times 3 = 15$

x	4	0.9	0.02
3	12	2.7	0.06

$$\begin{array}{r}
 12 \\
 + 2.7 \\
 + \underline{0.06} \\
 \hline
 14.76
 \end{array}$$

Stage 7 (updated for new curriculum)

Short Multiplication

24 × 6 becomes

$$\begin{array}{r} 24 \\ \times 6 \\ \hline 144 \\ \hline 2 \end{array}$$

Answer: 144

342 × 7 becomes

$$\begin{array}{r} 342 \\ \times 7 \\ \hline 2394 \\ \hline 21 \end{array}$$

Answer: 2394

2741 × 6 becomes

$$\begin{array}{r} 2741 \\ \times 6 \\ \hline 16446 \\ \hline 42 \end{array}$$

Answer: 16 446

Stage 8 (updated for new curriculum)

Long Multiplication

24 × 16 becomes

$$\begin{array}{r} 2 \\ 24 \\ \times 16 \\ \hline 240 \\ 144 \\ \hline 384 \end{array}$$

Answer: 384

124 × 26 becomes

$$\begin{array}{r} 12 \\ 124 \\ \times 26 \\ \hline 2480 \\ 744 \\ \hline 3224 \\ \hline 11 \end{array}$$

Answer: 3224

124 × 26 becomes

$$\begin{array}{r} 12 \\ 124 \\ \times 26 \\ \hline 744 \\ 2480 \\ \hline 3224 \\ \hline 11 \end{array}$$

Answer: 3224

+ - + - + - + - + - +

By the end of year 6, children will have a range of calculation methods for mental and a preferred written methods. Selection will depend upon the numbers involved.

Children should not be made to go onto the next stage if:

- 1) they are not ready.
- 2) they are not confident.

Children should be encouraged to approximate their answers before calculating.
Children should be encouraged to consider if a mental calculation would be appropriate before using written methods.