

## Figure 1 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.  $8 \times 4$  is double  $4 \times 4$

#### **Using multiplication facts**

**Stage 1**      2 times table  
                  5 times table  
                  10 times table

**Stage 2**      2 times table  
                  3 times table  
                  4 times table  
                  5 times table  
                  6 times table  
                  10 times table

#### **Stage 3**

Derive and recall quickly all multiplication facts up to  $10 \times 10$

#### **Stage 4**

#### **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**

$13 \times 11 = (13 \times 10) + (13 \times 1)$   
           $= 130 + 13$   
           $= 143$

#### **Multiplying by 10 or 100 or 1000**

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

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

Knowing that the effect of multiplying by 1000 is a move in the digits three places to the left.

#### **Partitioning**

$23 \times 4 = (20 \times 4) + (3 \times 4)$   
           $= 80 + 12$   
           $= 102$

#### **Use of factors**

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

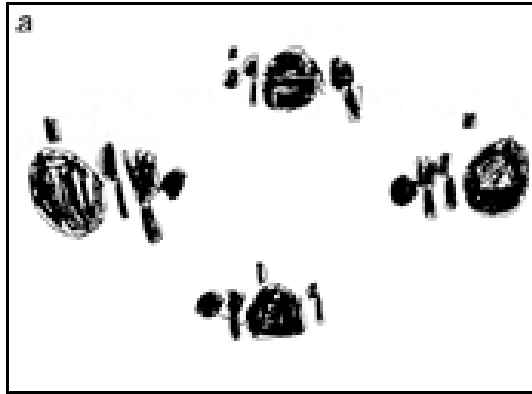
*MANY MENTAL CALCULATION STRATEGIES WILL CONTINUE TO BE USED. THEY ARE NOT REPLACED BY WRITTEN METHODS.*

Children need to be reminded that the decimal point does not move, it's the digits that move into different place values.

THE FOLLOWING ARE METHODS THAT WE EXPECT THE MAJORITY OF CHILDREN TO BE ABLE TO ACHIEVE.

### 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.



Children need visual examples to understand multiplication. Children can group items in a picture or solid items in dishes. When confident with grouping items together, they can then move on to stage 2 by using numbers as well as pictures to link the two together the two stages together

### Stage 2

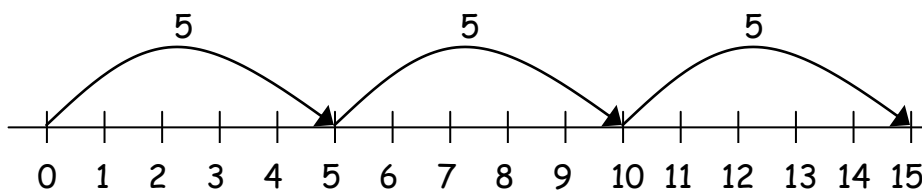
Children will develop their understanding of multiplication and use jottings to support calculation:

#### ✓ Repeated addition

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

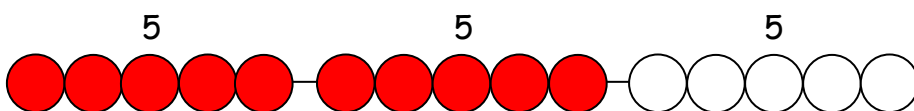
Repeated addition can be shown easily on a number line:

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



and on a bead bar:

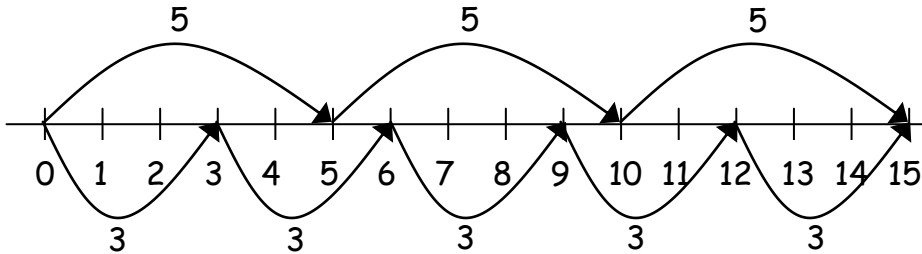
$$5 \times 3 = 5 + 5 + 5$$



### Stage 3

#### ✓ **Commutativity**

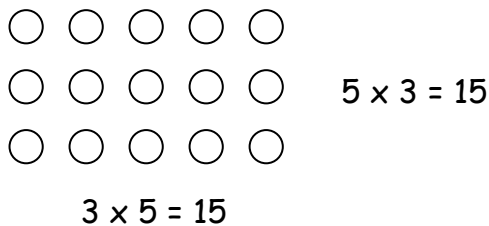
Children should know that  $3 \times 5$  has the same answer as  $5 \times 3$ . This can also be shown on the number line.



### Stage 4

#### ✓ **Arrays**

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

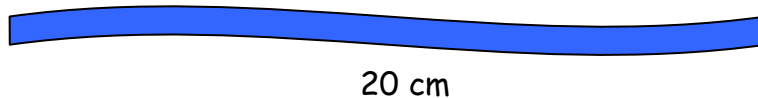
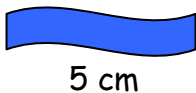


### Stage 5

Children will also develop an understanding of

#### ✓ **Scaling**

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



## Stage 6

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

$$\square \times 5 = 20$$

$$3 \times \triangle = 18$$

$$\square \times 4 = 32$$

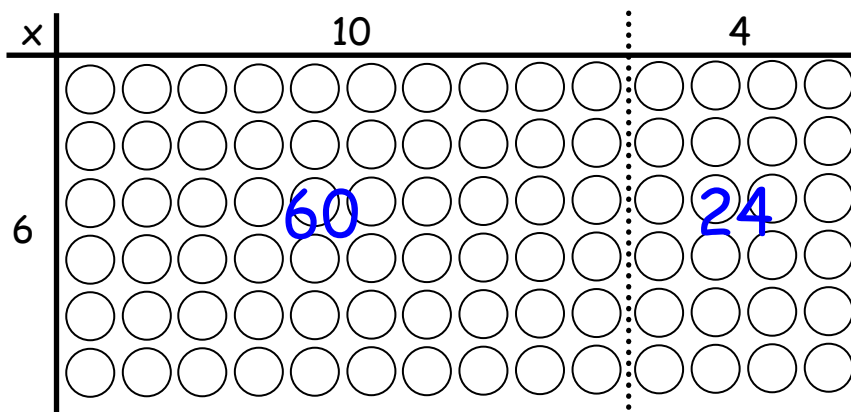
## Stage 7

- ✓ Partitioning

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

## Stage 8

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



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

$$60 + 24$$

$$84$$

This method can be used to visually demonstrate area of shape.

## Stage 9

### Grid method

TU × U

$$23 \times 8$$

Children will approximate first

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

$$\begin{array}{r} \times \quad 20 \quad 3 \\ 8 \quad \boxed{160} \quad \boxed{24} \\ \hline \phantom{\times} \phantom{8} \phantom{\boxed{160}} \phantom{\boxed{24}} \phantom{\hline} 160 \\ + \phantom{\phantom{8} \phantom{\boxed{160}} \phantom{\boxed{24}} \phantom{\hline}} 24 \\ \hline \phantom{\phantom{8} \phantom{\boxed{160}} \phantom{\boxed{24}} \phantom{\hline}} 184 \end{array}$$

### Grid method

HTU × U

$$346 \times 9$$

Children will approximate first

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

$$\begin{array}{r} \times \quad 300 \quad 40 \quad 6 \\ 9 \quad \boxed{2700} \quad \boxed{360} \quad \boxed{54} \\ \hline \phantom{\times} \phantom{9} \phantom{\boxed{2700}} \phantom{\boxed{360}} \phantom{\boxed{54}} \phantom{\hline} 2700 \\ + \phantom{\phantom{9} \phantom{\boxed{2700}} \phantom{\boxed{360}} \phantom{\boxed{54}} \phantom{\hline}} 360 \\ + \phantom{\phantom{9} \phantom{\boxed{2700}} \phantom{\boxed{360}} \phantom{\boxed{54}} \phantom{\hline}} 54 \\ \hline \phantom{\phantom{9} \phantom{\boxed{2700}} \phantom{\boxed{360}} \phantom{\boxed{54}} \phantom{\hline}} 3114 \\ \phantom{\phantom{9} \phantom{\boxed{2700}} \phantom{\boxed{360}} \phantom{\boxed{54}} \phantom{\hline}} \phantom{1} \phantom{1} \end{array}$$

## TU x TU

$72 \times 38$

Children will approximate first

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

x	70	2	
30	2100	60	2100
8	560	16	+ 560
			+ 60
			+ <u>16</u>
			<u>2736</u>
			1

## Grid Method

### HTU x TU

$372 \times 24$

Children will approximate first

$372 \times 24$  is approximately  $400 \times 25 = 10000$

x	300	70	2	
20	6000	1400	40	6000
4	1200	280	8	+ 1400
				+ 1200
				+ 280
				+ 40
				+ <u>8</u>
				<u>8928</u>
				1

## Stage 10

*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.  $4.9 \times 3$

Children will approximate first

$4.9 \times 3$  is approximately  $5 \times 3 = 15$

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

*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

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

$$\begin{array}{r} \times \quad 4 \quad 0.9 \quad 0.02 \\ 3 \quad \boxed{12} \quad \boxed{2.7} \quad \boxed{0.06} \end{array} \qquad \begin{array}{r} 12 \\ + \quad 0.7 \\ + \quad 0.06 \\ \hline 12.76 \end{array}$$

## Stage 11

### Short Multiplication

The next step is to represent the method of recording in a column format, but showing the working. Draw attention to the links with the grid method above.

$$\begin{array}{r} 38 \\ \times \underline{7} \\ \hline 266 \\ 5 \end{array}$$

Children need to understand that the number they are multiplying by, multiplies into each number starting with the lowest place value.

## Stage 12

### Long Multiplication

$56 \times 27$  is approximately  $60 \times 30 = 1800$ .

$$\begin{array}{r} 56 \\ \times \underline{27} \\ \hline 1120 \\ \underline{392} \\ 1512 \\ 1 \end{array}$$

$56 \times 20$   
 $56 \times 7$

- Children need to remember that the number they are multiplying by, multiplies into each number starting with the lowest place value.
- Children start with the tens then move onto the units.
- Children can place a zero in the units place of the tens row but they must be aware that the row is multiply of 10

Children who are already secure with multiplication for  $TU \times U$  and  $TU \times TU$  should have little difficulty in using the same method for  $HTU \times TU$ .

$286 \times 29$  is approximately  $300 \times 30 = 9000$ .

$$\begin{array}{r} 286 \\ \times \underline{29} \\ \hline 5720 \\ \underline{2574} \\ 8294 \\ 1 \end{array}$$

$286 \times 20$   
 $286 \times 9$

This method can be used for decimals by making the numbers being used into whole numbers first by multiplying by 10 and then dividing the answer the answer by 10.

i.e

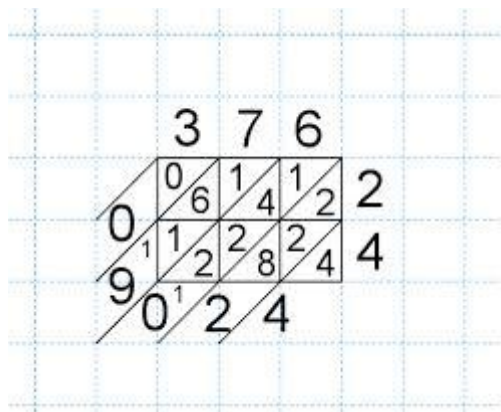
$$8.6 \times 6 = \quad 8.6 \times 10 = 86 \times 6 = 516 \div 10 = 51.6$$

$$\begin{array}{r} 86 \\ \times \underline{6} \\ \hline 516 \\ 3 \end{array}$$



## Stage 12

### Napier's Bones - Chinese Multiplication



If you are multiplying 3 digits by 2 digits you need a 3 by 2 grid which is then split with diagonal lines. Each square represents the numbers on the outside multiplied together. When all the numbers have been multiplied you then add together the numbers in the diagonal lines to give you the answer.

+ - + - + - + - + - +

By the end of all the stages, children will have a range of calculation methods, mental and written. Selection will depend upon the numbers involved.

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

- 1) they are not ready i.e. lack of understanding of place value.
- 2) they are not confident with previous stages