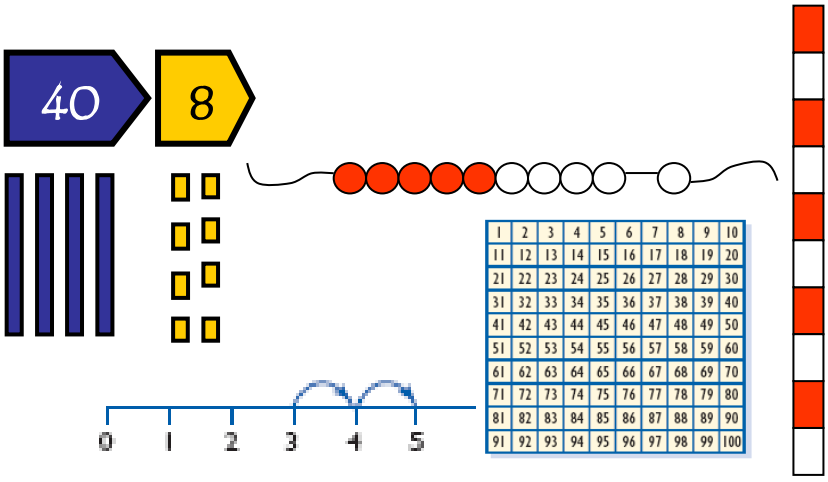
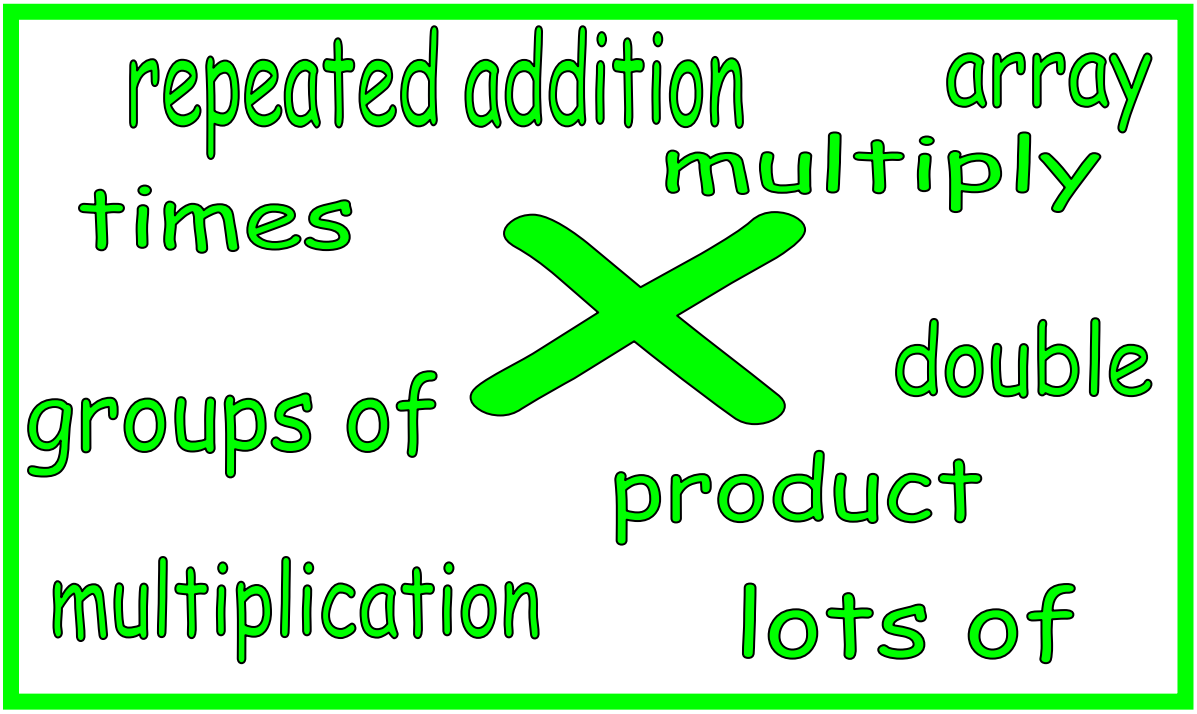
Calculation Policy

Multiplication

Models and Images



Counting apparatus
Place value apparatus
Arrays
100 squares
Number tracks
Numbered number lines
Marked but unnumbered lines
Empty number lines.
Multiplication squares
Counting stick
Bead strings
Models and Images charts
ITPs – Multiplication grid, Number Dials, Multiplication Facts



Counting:

Year R (Early learning goal)

- Children count reliably with numbers from one to 20

Year 1

- count to and across 100, forwards and backwards, beginning with 0 or 1, or from any given number
- count, read and write numbers to 100 in numerals, count in different multiples including 1s, 2s, 5s and 10s

Year 2

- count in steps of 2s, 3s, and 5s from 0, and count in 1s and 10s from any number, forward or backward

Year 3

- count forward and backward in multiples of 1s, 2s, 3s, 4s, 5s, 8s, 10s, 50s, and 100s;
- count up and down in 10ths, 1/4s and 1/2s - recognise that tenths arise from dividing an object into 10 equal parts and in dividing one-digit numbers or quantities by 10

Year 4

- count forward and backward in multiples of 1-10s, 25s, 50s, 100s and 1000s;
- count backwards through zero to include negative numbers;
- count up and down in 10ths, 100ths, 1/4s, and 1/2s - recognise that hundredths arise when dividing an object by a hundred and dividing tenths by ten

Year 5

- count forward or backward in multiples of 1-10s, 25s, 50s, 100s, 250s, 1000s, 10 000s, 100 000s and into negative numbers;
- Count in 10ths, 100ths, 1/4s and 1/2s.

Year 6

- count forward or backward in multiples of 1-10s, 25s, 50s, 100s, 250s, 500s, 1000s, 10 000s, 100 000s and into negative numbers.
- Count in 10ths, 100ths, 1/4s, 1/2s and in decimals such as 0.1s, 0.01s, 0.2s, 0.25s, 0.5s.

Recall of times tables and its associated division facts:

Year 2: 2, 5 and 10

Year 3: 2, 3, 4, 5, 6, 8, 10

Year 4: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Year 5: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Year 6: 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Use the following 100 squares to provide visual aid as children get used to the position of numbers in relation to each other in our number system when counting.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0
4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0
6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0
7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0
8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0
9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10

10	20	30	40	50	60	70	80	90	100
110	120	130	140	150	160	170	180	190	200
210	220	230	240	250	260	270	280	290	300
310	320	330	340	350	360	370	380	390	400
410	420	430	440	450	460	470	480	490	500
510	520	530	540	550	560	570	580	590	600
610	620	630	640	650	660	670	680	690	700
710	720	730	740	750	760	770	780	790	800
810	820	830	840	850	860	870	880	890	900
910	920	930	940	950	960	970	980	990	1000

100	200	300	400	500	600	700	800	900	1000
1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
3100	3200	3300	3400	3500	3600	3700	3800	3900	4000
4100	4200	4300	4400	4500	4600	4700	4800	4900	5000
5100	5200	5300	5400	5500	5600	5700	5800	5900	6000
6100	6200	6300	6400	6500	6600	6700	6800	6900	7000
7100	7200	7300	7400	7500	7600	7700	7800	7900	8000
8100	8200	8300	8400	8500	8600	8700	8800	8900	9000
9100	9200	9300	9400	9500	9600	9700	9800	9900	10000

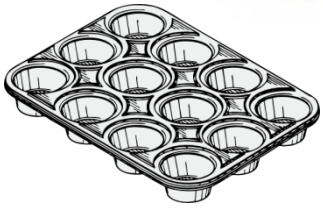
Provide children with opportunities to investigate and discover the patterns on a multiplication square. Allow them to realise the commutative nature of multiplication and how division facts can be derived from known multiplication facts.

X	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	40	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

Reception

Early learning goal:
They solve problems, including doubling, halving and sharing.

Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They should experience practical opportunities to double using a wide variety of equipment, counters, cubes, egg-boxes, ice-cube trays, baking tins etc.



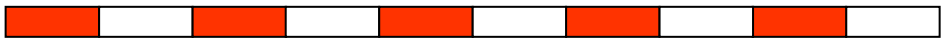
Children develop understanding of doubles using their fingers.

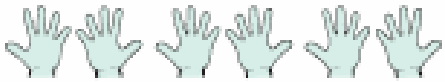
Year 1

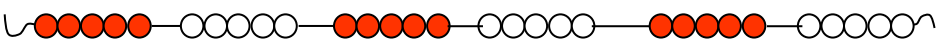
Counting choir
Count in steps of 1s, 2s, 5s and 10s forward and back from 0 and from any of its multiples using the 100 square taking the opportunity to discuss patterns that are recognised.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

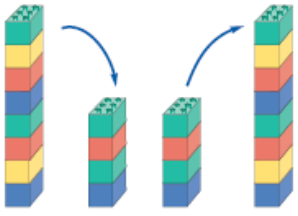
Other resources that aid counting







Know doubles and corresponding halves



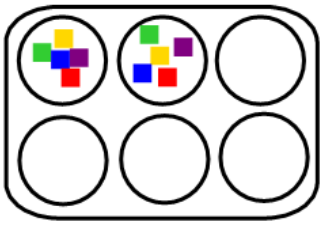
half of 8 is 4
$8 \div 2 = 4$

double 4 is 8
$4 \times 2 = 8$

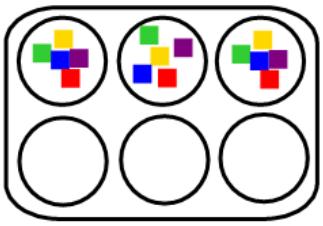
Use fingers to work out doubles up to double 5.

1. Using laminated sheets with circles (groups) on them, children group objects using the correct mathematical vocabulary.

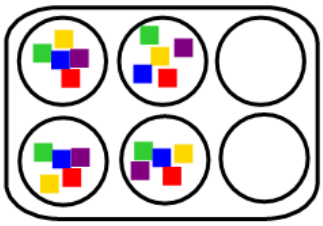
2 groups of 5
2 x 5



3 groups of 5
3 x 5



4 groups of 5
4 x 5

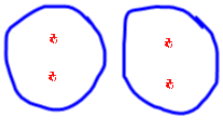


4 groups of 3 = 12
4 columns of 3 = 12
4 rows of 3 = 12
4 lots of 3 =12
4 times 3 = 12
4 multiplied by 3 = 12
3 four times = 12
4 x 3 = 12
3 + 3 + 3 + 3 = 12

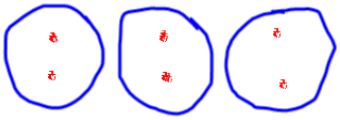
2. Children begin using jottings of simple multiplication with the associated vocabulary.

They begin by drawing the number of groups, then draw the number of dots inside the circles. They count the number of dots they have altogether to get to the answer.

2 groups of 2
2 x 2 = 4

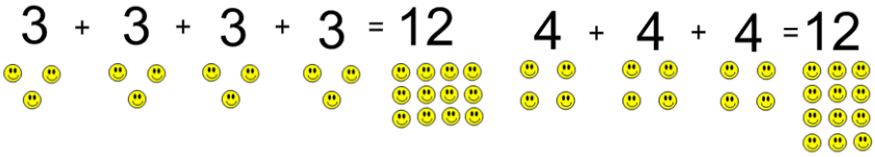


3 groups of 2
3 x 2 = 6

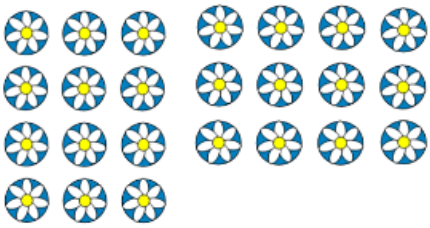


3. Children are exposed to the different ways in which multiplication can be expressed using concrete materials and linking it to real life situations. They begin to understand that repeated addition can also be expressed as multiplication using concrete materials.

Expressing multiplication as repeated addition



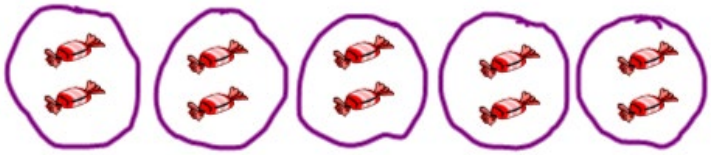
Expressing multiplication as arrays

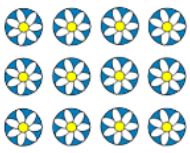


4. Children begin to commit multiples of 2, 5, 10 to memory and use these facts to solve problems.

There are 10 spiders… how many legs do they have altogether?
8 X 10 = 80

When Peter behaves well in school he gets 2 sweets at the end of the day. If he behaves well for 5 days, how many sweets will he get altogether?



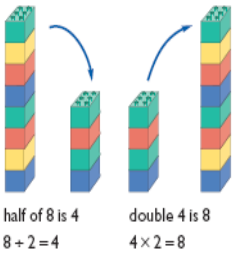


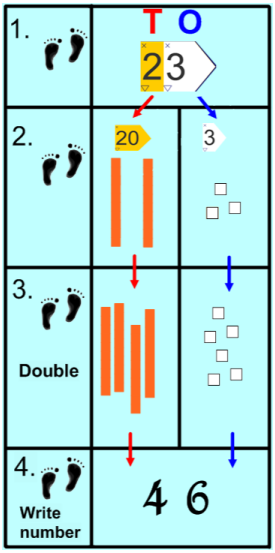
There are 4 flower beds in a garden. Each flower bed has 3 flowers. How many flowers are in the garden altogether?

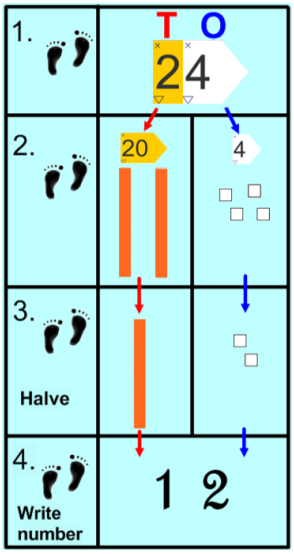
Year 2

Counting choir

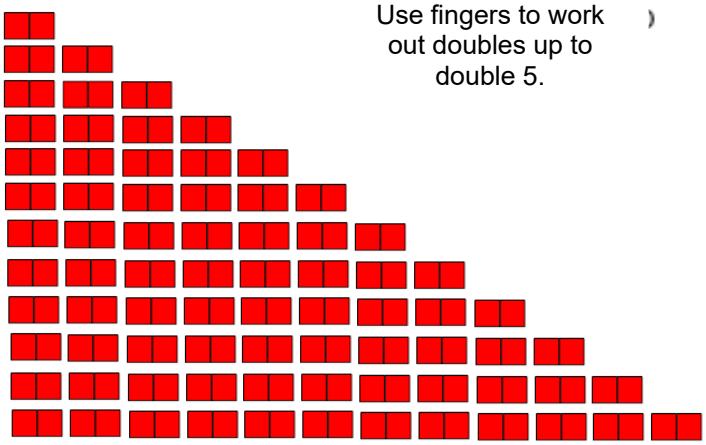
Count in steps of 2s, 3s, 5s, 10s and 20s forward and back from 0 and from any of its multiples using the 100 / 200 square and taking the opportunity to discuss patterns that are recognised.







Use fingers to work out doubles up to double 5.



Know doubles and corresponding halves and extend to partitioning numbers then double / partitioning numbers then halve.

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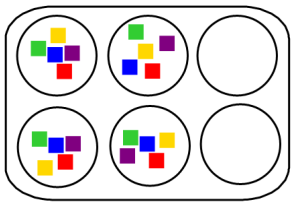
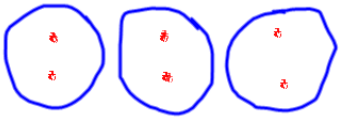
1. Children continue using jottings of simple multiplication with the associated vocabulary and those who still find this difficult will use the laminated sheets with circles to group concrete objects.

They begin by drawing the number of groups, then draw the number of dots inside the circles. They count the number of dots they have altogether to get to the answer.

4 groups of 5
4 x 5



3 groups of 2
3 x 2 = 6



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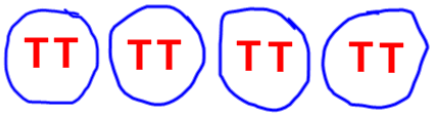
2. Teach using jottings when multiplying multiples of ten by writing T in each of the groups.

They begin by drawing the number of groups, then write the number of T's inside the circles. They count the number of T's using their knowledge of counting in tens to obtain an answer.

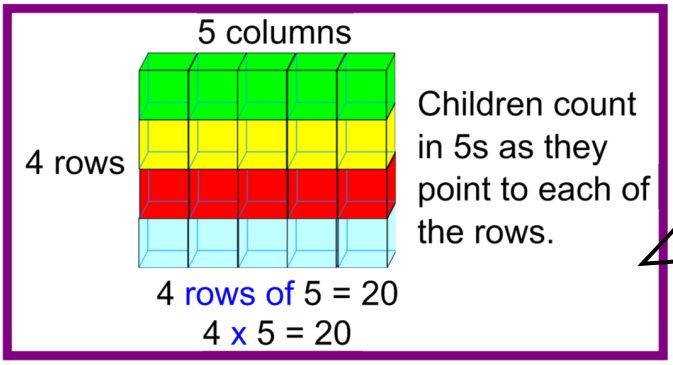
3 groups of 10
3 x 10 = 30

4 groups of 20
4 x 20 = 80



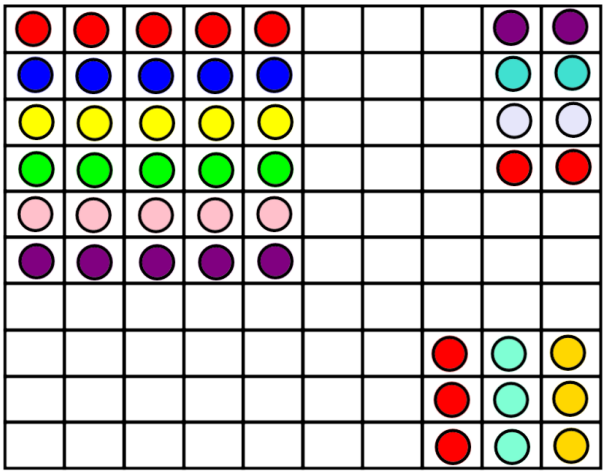
3. They further develop their skills of problem solving using multiplication and begin to relate it to the area of a rectangle / square.

Children investigate the number of multilink cubes needed to create a block with a given number of length and width.



Children count in 5s as they point to each of the rows.

…'five, ten, fifteen, 20. Four times five is 20!'



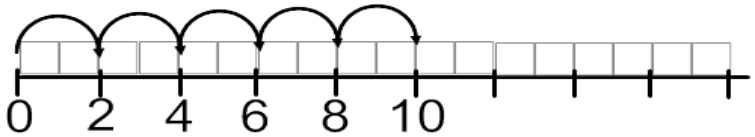
They might use counters in an empty grid to create arrays and they begin to relate this to the commutative nature of multiplication by saying and / or writing:

6 rows of 5 = 5 columns of 6
6 x 5 = 5 x 6
30 = 30

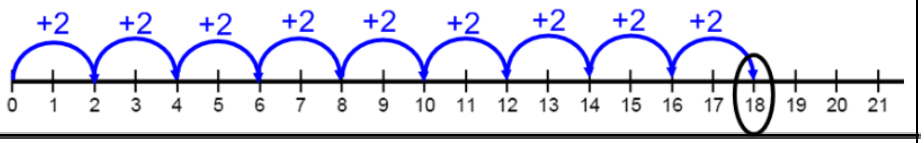
Those who are ready can begin to jot arrays in their books using the squares as a guide.

4. Teach jumping on a marked number line in multiples of 2, 3, 5, 10.

This method requires children to keep the jumps equal in size as they count the number of jumps .This is a challenging process, however it further embeds the understanding of repeated addition.
The constant re-enforcement of vocabulary 'groups of' is very important.



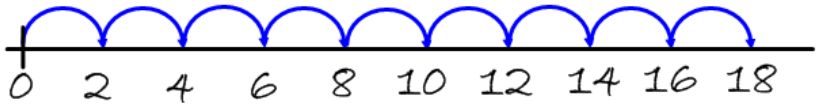
9 groups of 2 = 18
9 jumps of 2 = 18
9 x 2 = 18



5. As children become confident with counting in multiples of 2, 3, 5, 10 they begin to use the empty number line to solve multiplication problems.

In this method there are strong links with the activity of counting choir using 100 / 200 squares and the recognition of patters with each of the multiples. Children write their own number after each time they make a jump.

9 groups of 2 = 18
9 jumps of 2 = 18
9 x 2 = 18



Year 3, 4, 5 and 6: Short and Long Multiplication

Because children have to get used to a new layout which does not necessarily provide understanding, it is important that the multiplication method is taught on split screen which shows the conceptual understanding alongside the procedural. Children must have secure times tables knowledge to 10 x 10 in order for them to see the benefits of this quick efficient method.

The carrying of digits further complicate the learning of this method, therefore the following progression in the teaching is recommended.

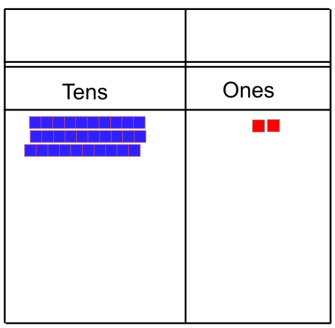
1) Begin with numbers where carrying is not involved. Start with 2 digit, then 3 digit numbers. Examples: 32 x 3 and 423 x 3	2) Then move onto multiplying 3 digit numbers by 1 digit with carrying. Example: 324 x 3	3) When knowledge is secure, higher numbers are used to introduce carrying. Examples: 643 x 4 643 x 8	4) Children will now be ready to move onto multiplying HTO x TO Example: 643 x 24

$$\begin{array}{r} 32 \\ \times\ 3 \\ \hline 96 \end{array} \qquad \begin{array}{r} 423 \\ \times\ 3 \\ \hline 1269 \end{array} \qquad \begin{array}{r} {\scriptstyle 1\ \ \ } \\ 324 \\ \times\ 3 \\ \hline 972 \end{array} \qquad \begin{array}{r} {\scriptstyle 1\ 1\ \ } \\ 643 \\ \times\ 4 \\ \hline 2572 \end{array} \qquad \begin{array}{r} {\scriptstyle 3\ 2\ \ } \\ 643 \\ \times\ 8 \\ \hline 5144 \end{array} \qquad \begin{array}{r} {\scriptstyle 3\ 2\ \ } \\ 643 \\ \times\ 54 \\ \hline 2572 \\ +32150 \\ \hline 34722 \\ {\scriptstyle 1\ \ \ \ \ } \end{array}$$

Always start multiplying by the unit number. So 3 is multiplied by 2 Ones first, then 3 is multiplied by 3 Tens.	**Again, begin by multiplying the Ones.**	**Carrying must be recorded as shown.** **All children should be able to do this by the end of year 4.** **Year 4 should move onto 2D x 2D or 3D x 2D in the summer term but only those children who are secure with their multiplication facts up to 10 x 10.**	Begin by multiplying the Ones with each of the digits. Children need to be taught that the 0 in the second row is written as a placeholder because we are now multiplying the Tens with each digit.

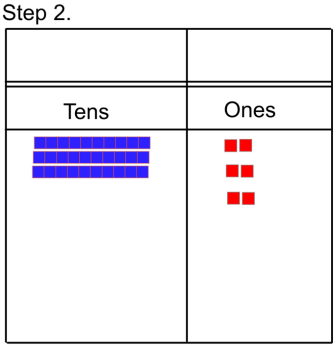
1) Multiplication without carrying. Children use Dienes to create the given number of groups.

Step 1.



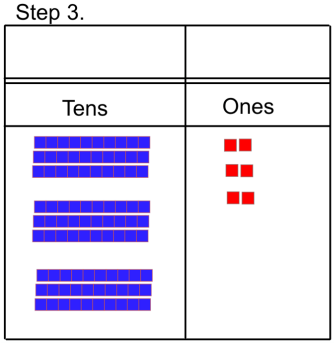
$$\begin{array}{r} 32 \\ \times\ 3 \\ \hline \end{array}$$

Step 2.



$$\begin{array}{r} 32 \\ \times\ 3 \\ \hline 6 \end{array}$$

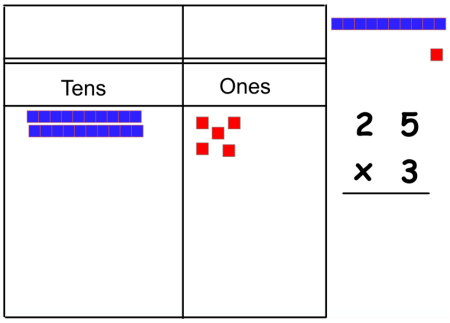
Step 3.



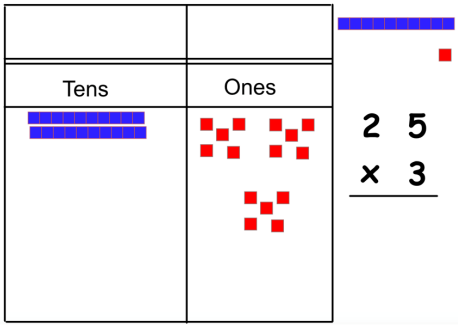
$$\begin{array}{r} 32 \\ \times\ 3 \\ \hline 96 \end{array}$$

2) 2 digit number by 1 digit multiplication with carrying.

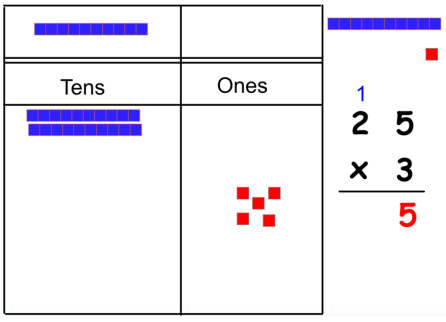
Step 1.



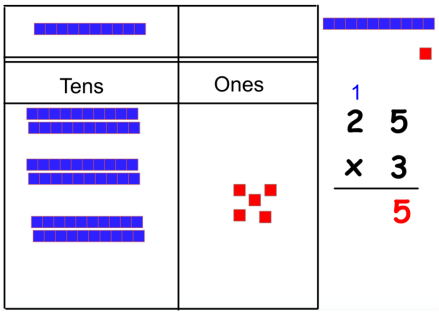
Step 2.



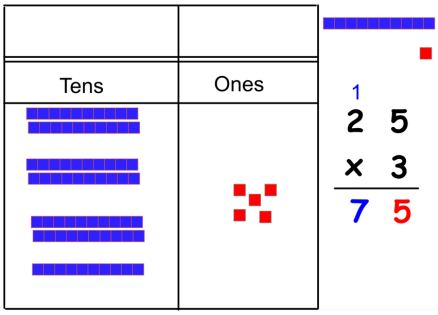
Step 3.



Step 4.

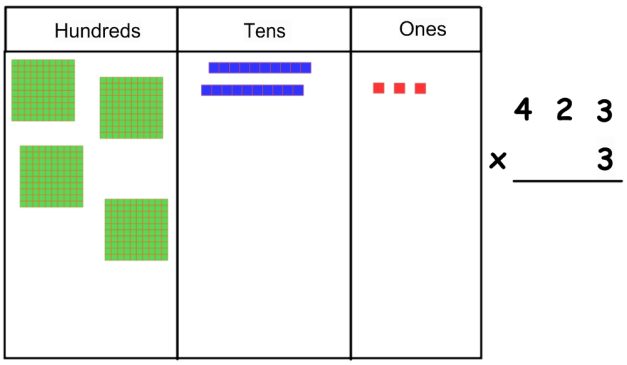


Step 5.

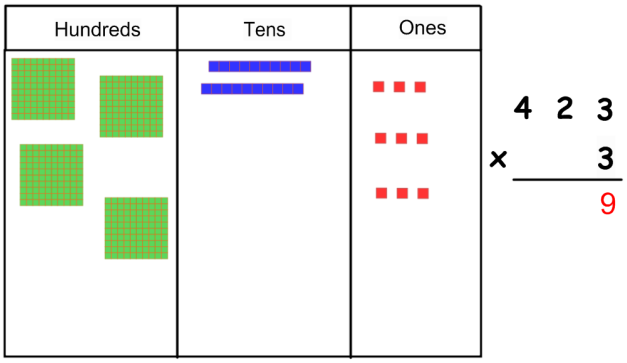


2) 3 digit number by 1 digit multiplication without carrying.

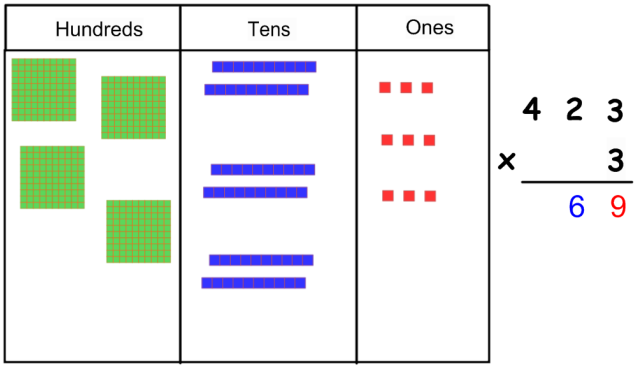
Step 1.



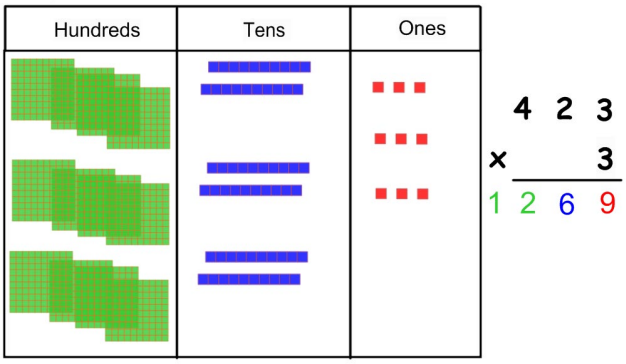
Step 2.



Step 3.

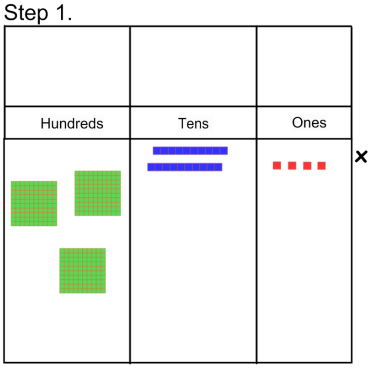


Step 4.



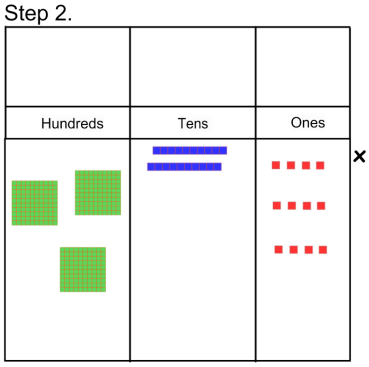
3) 3 digit number by 1 digit multiplication with carrying.

Step 1.



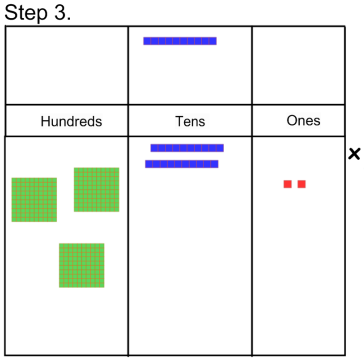
$$\begin{array}{r} 324 \\ \times\ \ 3 \\ \hline \end{array}$$

Step 2.



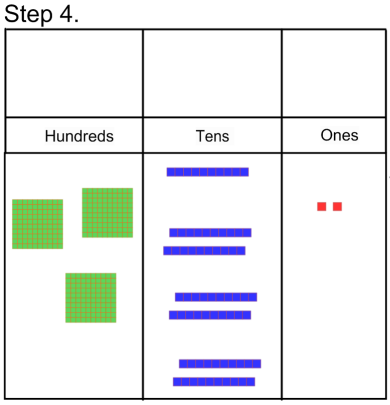
$$\begin{array}{r} 324 \\ \times\ \ 3 \\ \hline \end{array}$$

Step 3.



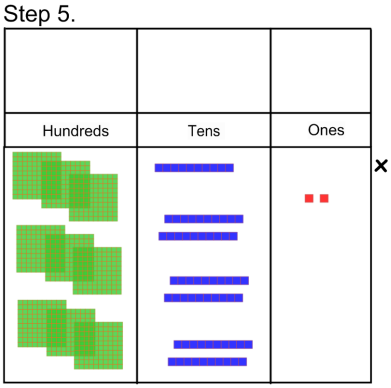
$$\begin{array}{r} {\scriptstyle 1}\ \ \ \\ 324 \\ \times\ \ 3 \\ \hline 2 \end{array}$$

Step 4.



$$\begin{array}{r} {\scriptstyle 1}\ \ \ \\ 324 \\ \times\ \ 3 \\ \hline 72 \end{array}$$

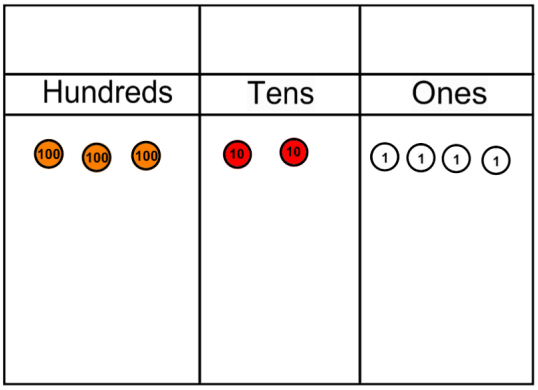
Step 5.



$$\begin{array}{r} \ \ \ \ \\ 3\not{2}4 \\ \times\ \ 3 \\ \hline 972 \end{array}$$

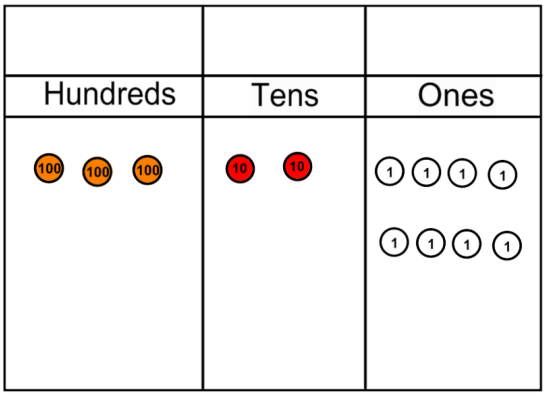
Once children understood the concept of multiplication using Dienes, use PV counters to deepen understanding.

Step 1.



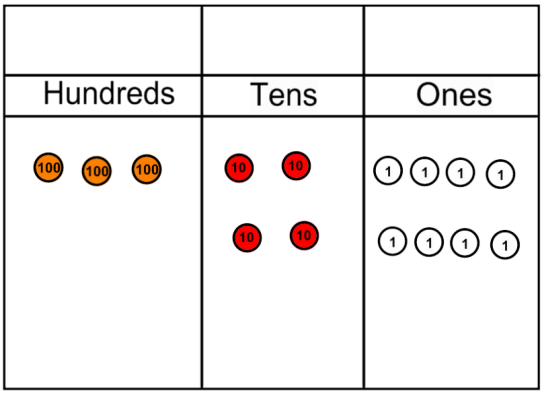
$$\begin{array}{r} 324 \\ \times\ \ 2 \\ \hline \end{array}$$

Step 2.



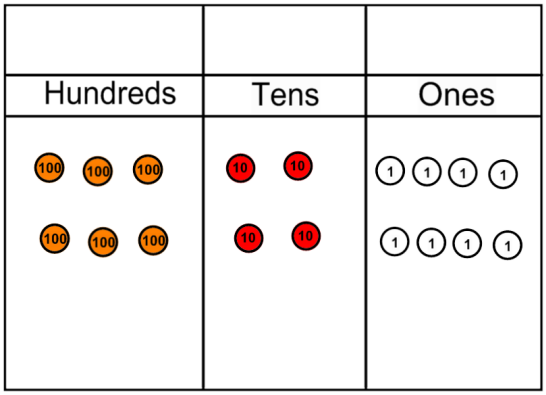
$$\begin{array}{r} 324 \\ \times\ \ 2 \\ \hline 8 \end{array}$$

Step 3.



$$\begin{array}{r} 324 \\ \times\ \ 2 \\ \hline 48 \end{array}$$

Step 4.

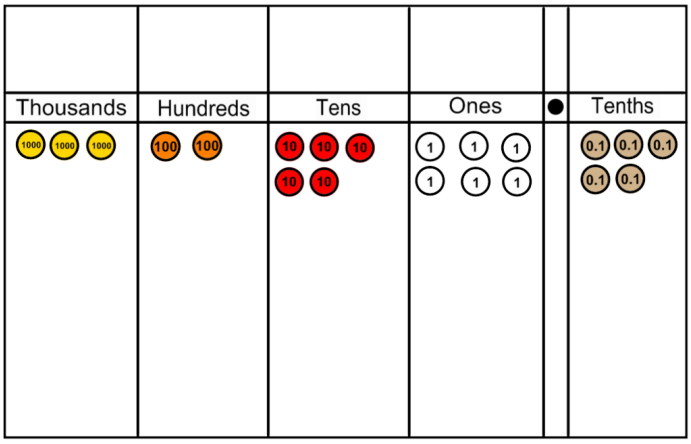


$$\begin{array}{r} 324 \\ \times\ \ 2 \\ \hline 648 \end{array}$$

Extend this knowledge to much larger numbers which also includes decimals.

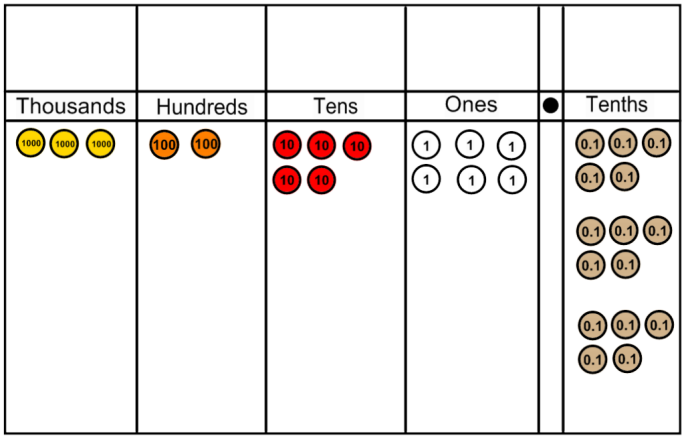
Step 1.

$$\begin{array}{r} 3\ 2\ 5\ 6\ .\ 5 \\ \times \qquad\quad 3 \\ \hline \end{array}$$



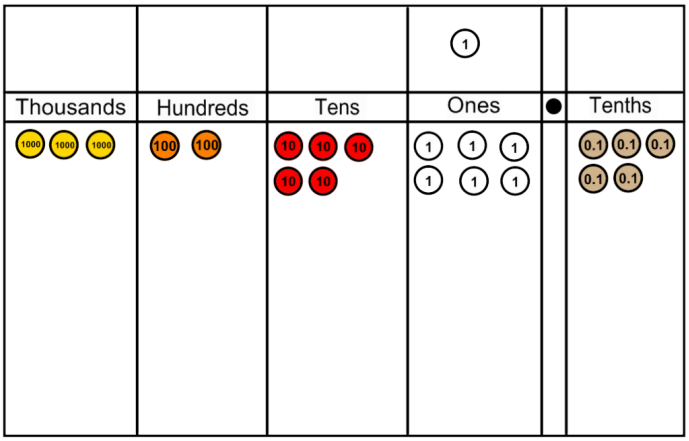
Step 2.

$$\begin{array}{r} 3\ 2\ 5\ 6\ .\ 5 \\ \times \qquad\quad 3 \\ \hline \end{array}$$



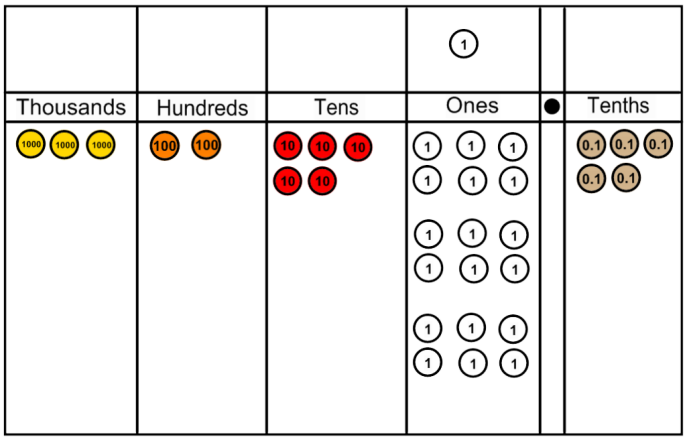
Step 3.

$$\begin{array}{r} \ 1 \\ 3\ 2\ 5\ 6\ .\ 5 \\ \times \qquad\quad 3 \\ \hline \qquad\quad 5 \end{array}$$



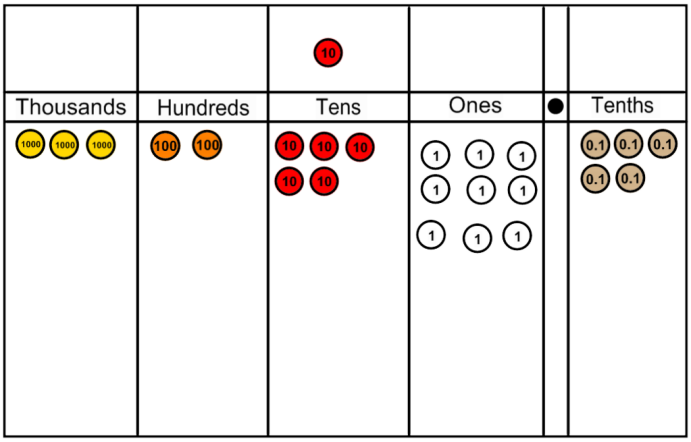
Step 4.

$$\begin{array}{r} \ 1 \\ 3\ 2\ 5\ 6\ .\ 5 \\ \times \qquad\quad 3 \\ \hline \qquad\quad 5 \end{array}$$



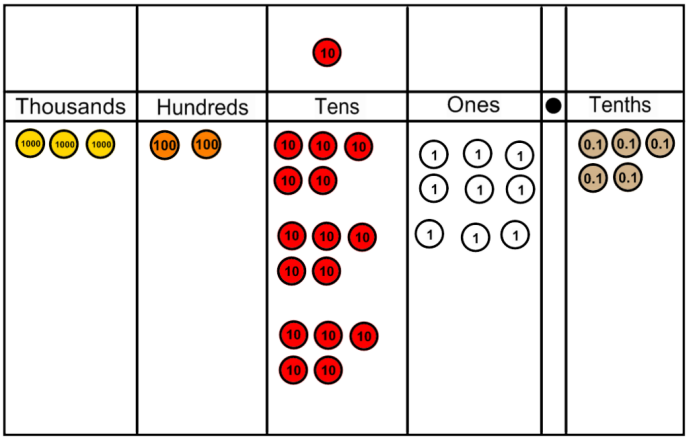
Step 5.

$$\begin{array}{r} \ 1\ \not{1} \\ 3\ 2\ 5\ 6\ .\ 5 \\ \times \qquad\quad 3 \\ \hline \qquad 9\ 5 \end{array}$$



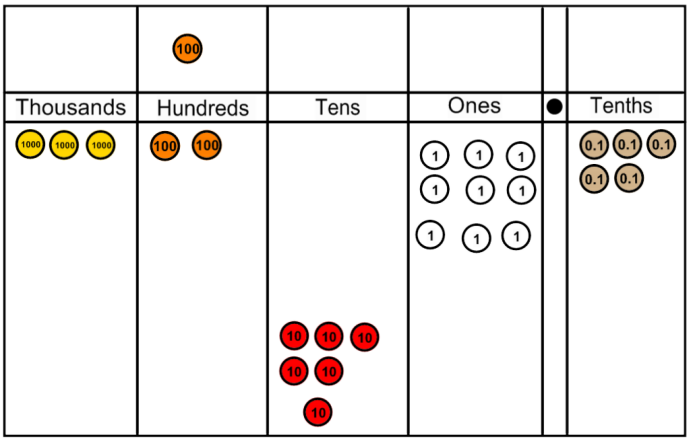
Step 6.

$$\begin{array}{r} \ 1\ \not{1} \\ 3\ 2\ 5\ 6\ .\ 5 \\ \times \qquad\quad 3 \\ \hline \qquad 9\ 5 \end{array}$$



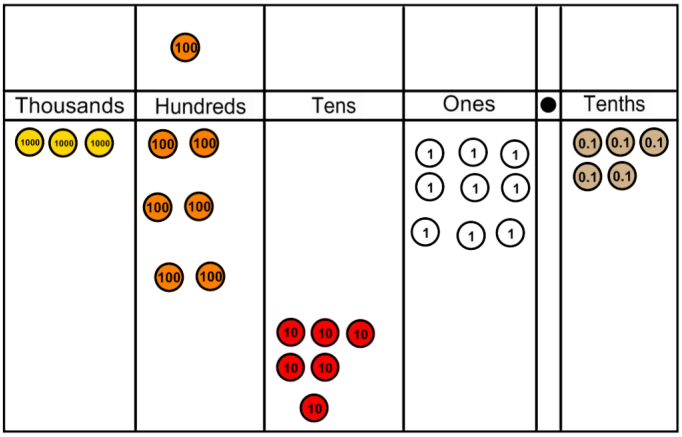
Step 7.

$$\begin{array}{r} {\scriptstyle 1\ \cancel{1}\ \cancel{1}\ \cancel{1}} \\ 3\ 2\ 5\ 6.5 \\ \times \qquad\quad 3 \\ \hline 6\ 9\ 5 \end{array}$$



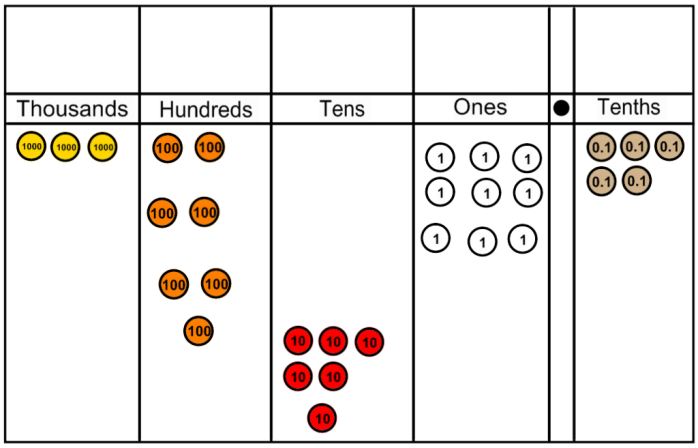
Step 8.

$$\begin{array}{r} {\scriptstyle 1\ \cancel{1}\ \cancel{1}\ \cancel{1}} \\ 3\ 2\ 5\ 6.5 \\ \times \qquad\quad 3 \\ \hline 6\ 9\ 5 \end{array}$$



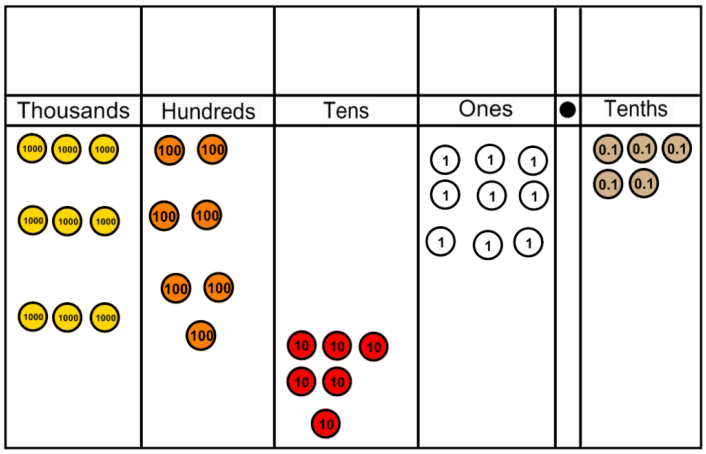
Step 9.

$$\begin{array}{r} {\scriptstyle \cancel{1}\ \cancel{1}\ \cancel{1}\ \cancel{1}} \\ 3\ 2\ 5\ 6.5 \\ \times \qquad\quad 3 \\ \hline 7\ 6\ 9\ 5 \end{array}$$



Step 10.

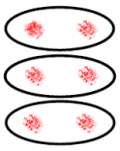
$$\begin{array}{r} {\scriptstyle \cancel{1}\ \cancel{1}\ \cancel{1}\ \cancel{1}} \\ 3\ 2\ 5\ 6.5 \\ \times \qquad\quad 3 \\ \hline 9\ 7\ 6\ 9\ 5 \end{array}$$



Children should use jottings to show understanding of short multiplication.

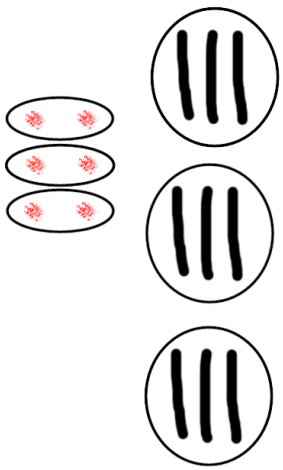
Step 1.

$$\begin{array}{r} 3\ 2 \\ \times \quad 3 \\ \hline 6 \end{array}$$



Step 2.

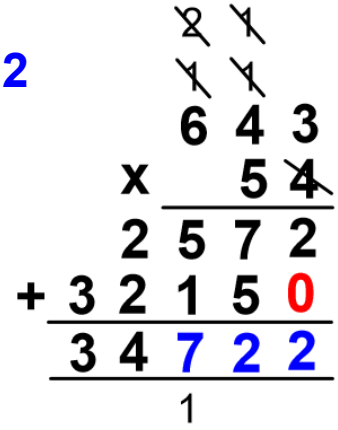
$$\begin{array}{r} 3\ 2 \\ \times \quad 3 \\ \hline 9\ 6 \end{array}$$



Multiplying with decimal numbers

Teach estimating the approximate answer to the multiplication using mental methods. In the below example children are encouraged to multiply the whole numbers of 6 and 5 to get the answer of 30. This will help them gauge whether the magnitude of the number they get as a result is right.

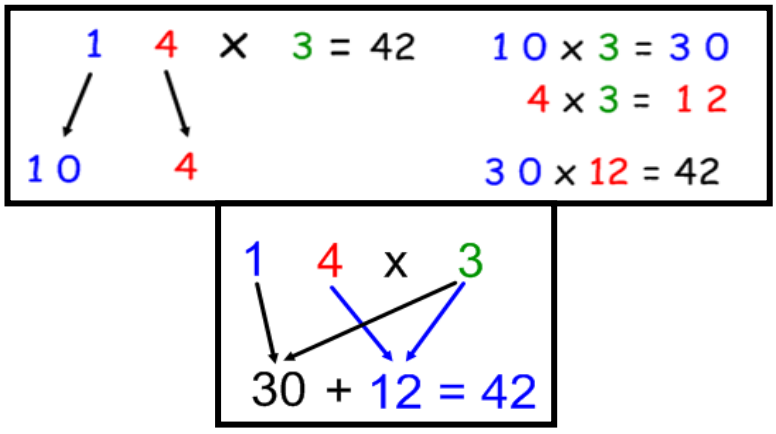
6.43 x 5.4 = 34.722



Decimal points are taken out of both numbers and calculate multiplication just like whole numbers. Once an answer is obtained, the number of digits after the decimal point in both numbers are counted to indicate the number of digits after the decimal point in the answer.

Please note that long multiplication can be taught without the using of Dienes or PV counters as children should have sufficient understanding of multiplication through the use of these when multiplying numbers by one digit using the concrete pictorial and abstract representations.

Mental method of multiplying 2 digit numbers by 1 digit.



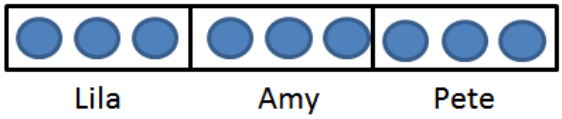
PLEASE NOTE THAT ONCE SHORT MULTIPLICATION IS TAUGHT, IT OFTEN BECOMES CHILDREN'S DEFAULT METHOD TO MULTIPLY NUMBERS EVEN IF A CALCULATION COULD BE SOLVED USING A MENTAL METHOD MUCH FASTER.

THEREFORE, KEEP PRACTISING VARIOUS MENTAL MATHS STRATEGIES FOR CALCULATIONS ALONGSIDE THE SHORT WRITTEN METHODS AND ENCOURAGE CHILDREN TO DECIDE ON THE MOST EFFICIENT METHOD FOR A PARTICULAR SET OF NUMBERS. See example above for a mental method of multiplication.

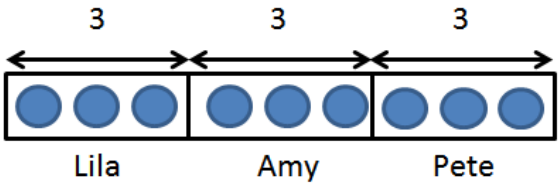
Problem solving involving multiplication using the bar model method

Lila, Amy and Pete have 3 sweets each.
How many sweets do they have altogether?

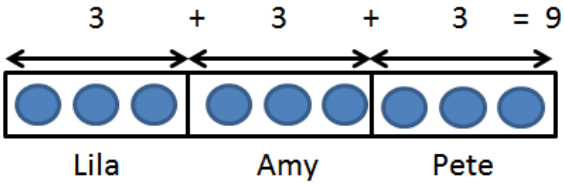
Step 1.



Step 2.



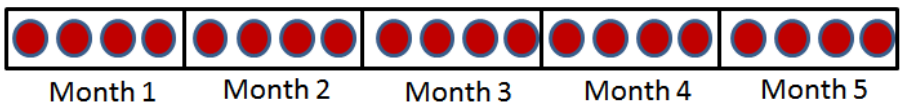
Step 3.



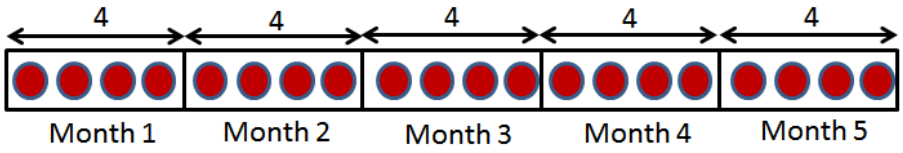
Step 4. **3 groups of 3 = 9**
3 x 3 = 9

George collects dinosaurs. He buys 4 dinosaurs every month.
How many dinosaurs does he have after 5 months?

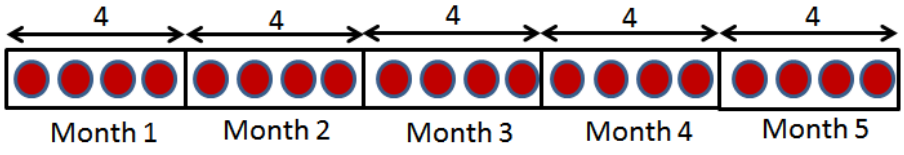
Step 1.



Step 2.



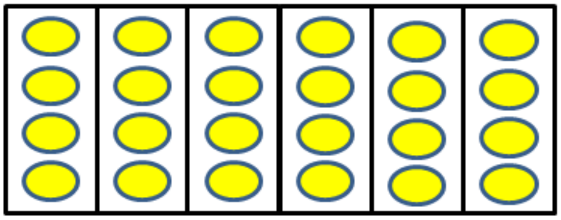
Step 3.



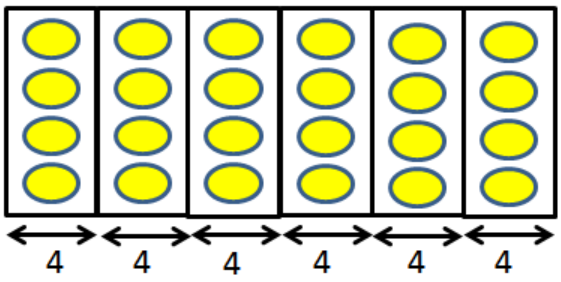
Step 4. **5 lots of 4 dinosaurs = 20**
5 x 4 = 20

Mrs Smith plants tulip bulbs in rows of 6.
In each row she plants 4 bulbs.
How many tulip bulbs does she plan altogether?

Step 1.



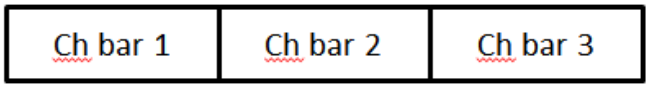
Step 2.



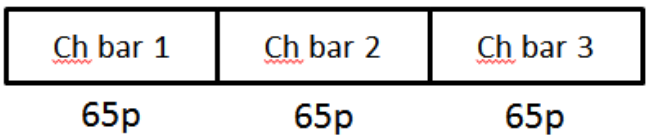
Step 3. **6 rows of 4 tulip bulbs = 24**
6 x 4 = 24

Natalie buys 3 bars of chocolate at 65p each?
How much does she pay altogether?

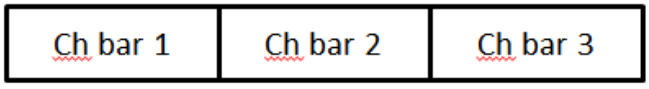
Step 1.



Step 2.



Step 3.

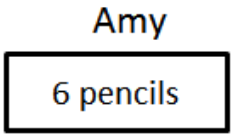


65p + 65p + 65p = £1.95

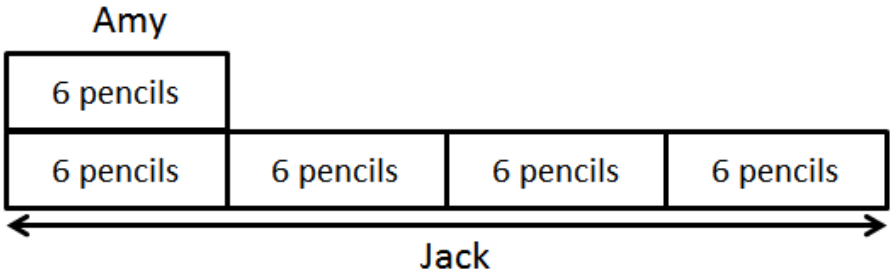
Step 4. **3 lots of 65p = £1.95**
3 x 65p = £1.95

Amy has 6 pencils in her pencil case. Jack however has 4 times as many pencils in his pencil case. How many pencils does Jack have?

Step 1.



Step 2.

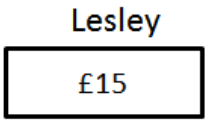


Step 3. **4 lots of 6 pencils = 24**

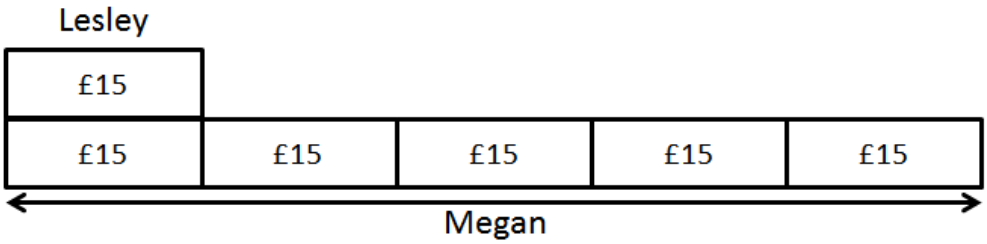
4 x 6 = 24

Lesley spends £15. Megan spends five times as much as Lesley.
How much money does Megan spend?

Step 1.



Step 2.

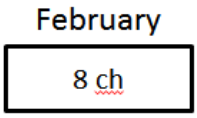


Step 3. **5 lots of £15 = £75**

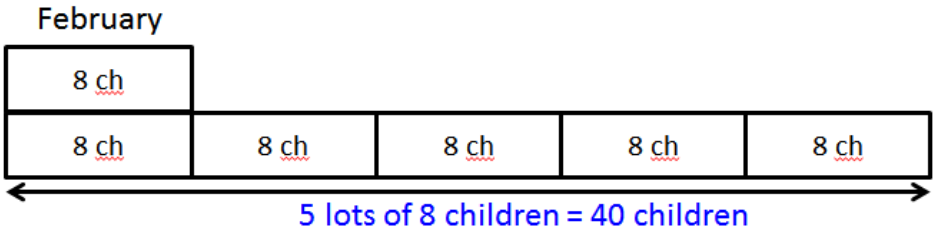
5 x £15 = £75

In February, 8 children join dance club.
During the spring, five times as many children join the club.
How many children are dance club members at the end of spring?

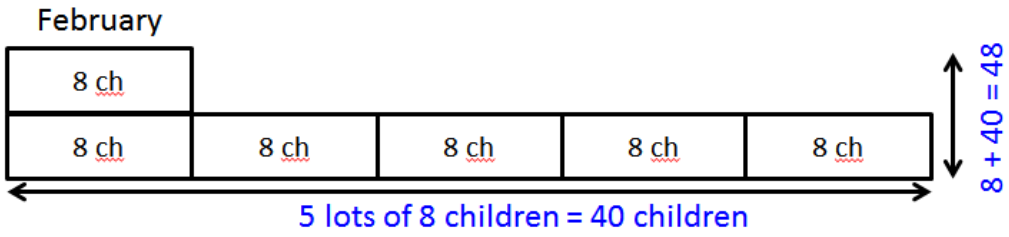
Step 1.



Step 2.



Step 3.



Step 4. **48 children attend the dance club.**