Progression in Calculation

Computation policy for Ocker Hill Academy

At Ocker Hill Academy we meet the requirements of the National Curriculum (2014) in the teaching of written calculations to our pupils.

Ocker Hill Common Computation Policy

A review of written methods taught at Ocker Hill was carried out by members of the Teaching and Learning team in February 2015. The stages of progression outlined in this document were agreed following:

- **=> Guidance from the National Curriculum 2014**
- **=> An audit of current calculation methods taught in each year group**
- **=> Discussion with the numeracy co-ordinator at Ocker Hill Infant School**
- **=> Advice and support gained from the National Centre for Excellence in the Teaching Of Mathematics**
- **=> Reference to and adaptation of Sandwell's recommended progression in calculation document (2002)**
- **=> Consultation and discussion with staff.**

Alongside the agreed calculation stages the review concluded that: a clear and progressive policy for the teaching and learning of calculation will support transition from Key Stage 1 to Key Stage 2. Teaching will be more effective with one strategy being focussed on at a time, but built on over time to ensure understanding. To ensure they understand the place value and size of the numbers they calculate. To ensure continuity and progression all teachers, support staff and parents need to be aware of and confident in this use of this agreed model. This will inevitably have CPD implications and require close communication with parents.

Where children can confidently and accurately use any other written strategy they may do so, although teachers must then ensure children also understand the concepts and processes underlying the four operations in the school methods in order ensure their continued development.

Progression in written methods of calculation

The following pages outline the progression in written calculations for the four operations. They have been adapted from the model put forward by Sandwell's Mathematics Team in 2002 in light of suggestions and advice gained from NCETM.

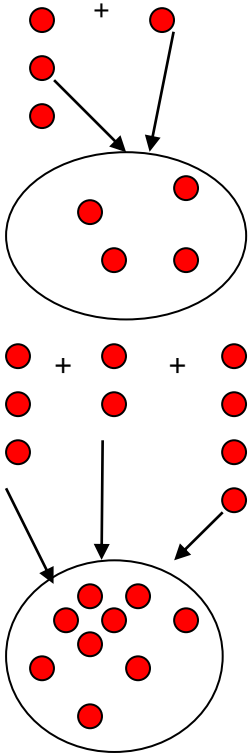
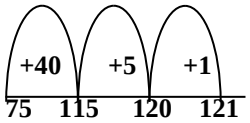
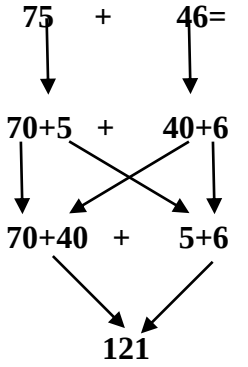
When following these models

- Refer to YR, Y1 and Y2 for previous learning at Ocker Hill Infant School
- The organisation of progression by year groups is a guide only, where children are able to progress to methods beyond their year group they should do so.
- Understanding processes is a priority - move individual children only when their understanding of a method is secure.
- Written methods MUST be supported by confident use of mental strategies and recall of number facts e.g. partitioning, place value, number bonds, multiplication facts.
- Use of place value headings to ensure calculations are set out correctly is encouraged, this will be particularly beneficial when decimal numbers are introduced in upper KS2. These are to be used consistently throughout the school and are listed below:-

M	100 TH	10 TH	TH	H	T	1's	•	t	h	th
(Million)	(100s of thousands)	(10's of thousands)	(thousands)	(hundreds)	(tens)	(ones)	(Decimal Point)	(tenths)	(hundredths)	(thousandths)

- Where children are unable to follow decomposition (SWM) efficiently they should continue with complimentary addition.
- In every year group children should be given opportunities to apply these written methods in problem solving contexts.
- The 'RUSAC' strategy for tackling written problems should be used in ALL areas of maths from Year 3:
    - Read and understand the problem
    - Underline key information and words or phrases
    - Chose operation/s needed and estimate
    - Solve the calculation
    - Answer the problem giving correct units
    - Check your answer (use estimate or inverse operation)

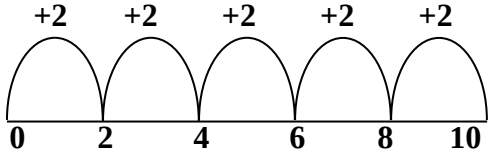
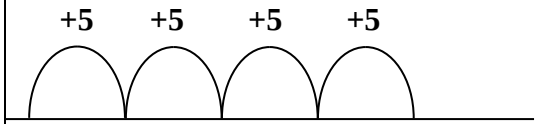
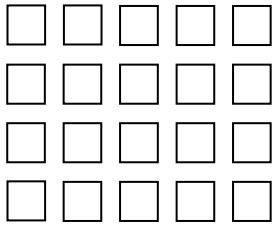
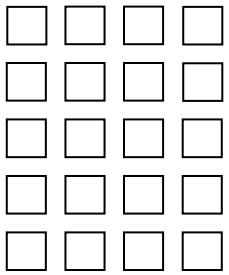
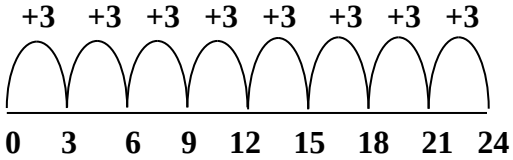
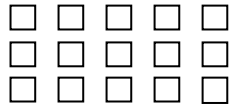
Overview of progress in addition at OHJS

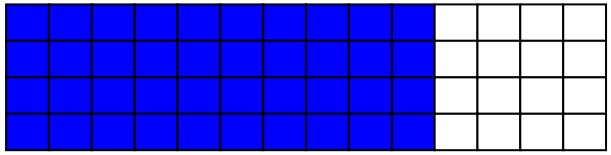
Reception	Year l	Year 2	Year 3	Year 4	Year 5	Year 6
Develop understanding through practical modelling, activities and discussions **One more than 3 is** 	**Model the operation and represent using symbols and numbers whilst still using physical counters** **3+2=Δ** **Using counting on strategies to find a target number** **3+Δ=5** **And understanding that the same strategy can be used if the first number is not given** **Δ+3=5**	**Reinforce using counting on strategies to find a target number to cross the ten. Ensure use of number line/ square is established** **14 + 7 = □** **Use apparatus to solve addition of two digit numbers** **18 + 10 = □** **28 + 12 = □**	**Chn use number lines to count on.** **75 + 46 =**  **Partitioning Tens and units**  **Becomes** **70 + 5** **40 + 6** **110 + 11=121**	***Approximating,* setting out and preparing for carrying.** **Adding least significant digit first.** **3 8 8** **+ 5 3** **1 1 (8+3)** **1 3 0 (80+50)** **+ 3 0 0 (300 +0)** **4 4 1** **Extending to 3 digit numbers added to 3 digit numbers** **4 5 6** **+3 2 5** **1 1 (6+5)** **7 0 (50+20)** **+ 7 0 0 (400+300)** **7 8 1**	***Approximating,* adding least significant digit first and using carrying.** **5 8 7** **+ 4 8 5** **1 0 7 2** **1 1** **Extend use to include decimals** **5 . 4 cm** **+ 7 . 3 cm** **1 2 . 7 cm** **1**	***Approximating,* adding least significant digit first, using carrying and extending to decimals.** **6 5 8 4** **+ 5 8 4 8** **1 2 4 3 2** **1 1 1 1** **4 0 3 . 2 0** **6 0 . 8 2** **+ 0 . 5 1** **4 6 4 . 5 3** **1**

Overview of progress in Subtraction at OHJS

Reception	Year l	Year 2	Year 3	Year 4	Year 5	Year 6
Develop understanding through practical modelling, activities and discussions ●●●● One less is ●●●	**Model the operation and represent using symbols and numbers and support with counters** **10 – 4 = □** **Using counting back strategies to find a target number** **10 -Δ=6** **And understanding that the same strategy CANNOT be used if the first number is not given** **Δ – 4 =6**	**Begin to record mental calculations in number sequences** **90 – 10 = 80** **180 – 10 = 170**	**Use a number line to count up from the smaller to the larger number. (Complimentary Addition)** **For example** **96 – 67 =** +3 +20 +6 67 70 90 96 **20 + 6 + 3 = 29** **So** **96 – 67 = 29**	**Introduction of column subtraction** 3 8 - 1 2 2 6 **Leading to decomposition. EXCHANGE a ten for ten units.** 3 4 - 1 8 **Becomes** $^{2}\not{3}\ ^{1}4$ - 1 8 1 6 **Moving on to 3 digit numbers subtracted from three digit numbers**	**Decomposition across more than one column** 5 3 2 - 3 4 7 5 $^{2}\not{3}\ ^{1}2$ - 3 4 7 5 $^{4}\not{5}\ ^{12}\not{3}\ ^{1}2$ - 3 4 7 1 8 5 **Moving onto subtracting simple decimal values**	**Decomposition across more than one column to include decimal values** $^{2}\not{3}.^{1}4$ - 1.8 1.6 $^{4}\not{5}.^{12}\not{3}\ ^{1}2$ - 3. 4 7 1. 8 5

Overview of progress in Multiplication at OHJS

Reception	Year 1	Year 2	Year 3
Children are expected to experience the concept of multiplication and its associated vocabulary through PRACTICAL ACTIVITIES and DISCUSSIONS	**Understand the operation of multiplication as repeated addition using a numberline and counting patterns**  **Along with PRACTICAL ACTIVITIES and DISCUSSIONS**	 **Larger number line and 100 square pattern jumps leading to statements that:** **4 lots of 5 is 20** **4 x 5 = 20**  **And that 4 groups of 5 = 20** **4 x 5 = 20**  **And that 5 groups of 4 = 20** **5 x 4 =20**	**Understand multiplication as repeated addition**  **Larger number line and 100 square pattern jumps formalising statements:** **3+3+3+3+3+3+3+3=24** **8 lots of 3 = 24** **8 x 3 =24** **Displayed in arrays**  **That 3 groups of 5 = 15** **3 x 5 =15** **And that 5 groups of 3 = 15** **5 x 3 =15** **Leading to And Jotted arrays** **1 x 3 = 3** **3** **2 x 3 = 6** **6** **3 x 3 = 9** **9** **4 x 3 =12** **12** **5 x 3 =15** **15** **6 x 3 =18 etc.** **18** **etc.**

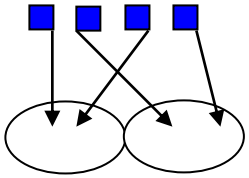
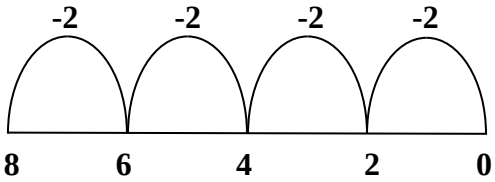
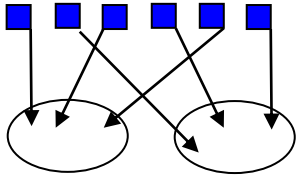
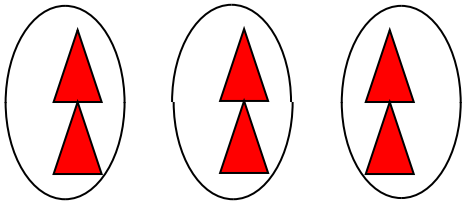
Year 4	Year 5	Year 6
Finding multiples of a single digit greater than the tenth multiple by partitioning the multiple into known multiplication facts **14 x 4 =** **10 x 4 = added to 4 x 4=**  **10 x 4 = 40** **4 x 4=16** **40+16 = 56** **Introduce Standard Written Method alongside this (Short multiplication TU x U)** **1 4 x 4** **1 0 + 4. x 4 x 4** **4 0 +1 6 5 6** **4 0 + 1 6** **Becoming:** **1 4 X 4 5 6 1**	**Introduce approximations** **72 x 38 is approximately** **70 x 40 = 2800** **Extend Standard Written Method (Long multiplication TU x TU) (partition tens first) (then Units)** **4 6 X 2 3 9 2 0 + 1 3 8 1 0 5 8** **4 6 x 2 0 9 2 0 1** **4 6 x 3 1 3 8 1 1** **Becoming** **7 2 x 3 8 2 1 6 0 + 5 7 6 2 7 3 6 1** **And multiply simple decimals by single digits**	**Extend approximations** **217 x 37 is approximately** **220 x 40 = 8800** **3.24 x 7 is approximately** **3 x 7 = 21** **Adapt Standard Written Method to handle decimals (Short multiplication U.th x U)** **3 . 2 4 X 7 2 2 . 6 8 1 2**

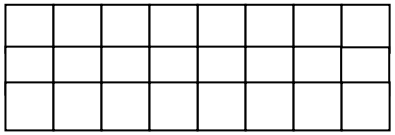
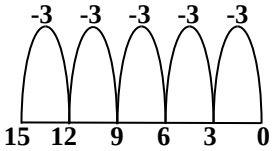
Multiplying by 10, 100 and 1000

When discussing the effect of multiplying a value by 10 (and multiples of ten) the effect of digits moving one place value column to the left must be shown and that the space create by their passage be taken by a **PLACE HOLDER ZERO**. This explanation being adapted for the effect of multiplying a value by 100 (or a multiple of 100) and 1000 (or any of its multiples)

Overview of progress in Division at OHJS

The school policy for division outlines the development of chunking as an efficient written method. Ideally the children should be secure in their use of the Standard Written Method for subtraction. Where the children are not at this level of sophistication their existing strategies of subtraction should be adapted to find differences between chunks In addition pupils should ideally have the ability to find the 1st 2nd, 5th and 10th multiples of the divisor along with (in year 6) their associated multiples of 100's and 1000's which they will display as beside the calculation as **KEY FACTS**

Reception	Year 1	Year 2
Experience the concept of sharing and its associated vocabulary through practical modelling, practical activities and discussions	**Understand the operation of division as sharing and grouping and its associated vocabulary through practical activities.** **Four sweets are shared by two people.** **(One for me and one for you)**  **SHARING**  **GROUPING**	**Understand the operation of division as sharing and grouping and its associated vocabulary** **Six sweets shared are by two people**  **SHARING** **Six triangles put into groups of 2**  **Six triangles put into 3 groups** **GROUPING**

Year 3	Year 4	Year 5	Year 6
Understand the operation of division and the associated vocabulary **How many groups of 3 there are in 24?** **24÷3 =8** **How many lots of 8 are there in 24?** **24 pencils are shared between 8 children.** **How many pencils do they get each?**  **Show division calculations with the divide sign ÷ (Not the bus stop)** **15÷3=5** **Develop the concept of repeated subtraction**  **Understand the relationship between multiplication and division** **4 x 3 = 12** **12 ÷ 4 = 3** **12 ÷ 3 = 4**	**Use informal pencil and paper methods to support, record and explain division** **Introduce the bus stop as a division sign** **Chunking (repeated unequal subtraction)** **Write key facts for 1st 2nd 5th and 10th multiples of the table before commencing the calculation** **2 4** — **Key Facts** **4) 9 6** — **1 x 4 = 4** **- 4 0 (10 x 4)** — **2 x 4 = 8** **5 6** — **5 x 4 = 20** **- 4 0 (10 x 4)** — **10 x 4 = 40** **1 6** **- 8 (2 x 4)** **8** **- 8 (2 x 4)** **0** **10 + 10 + 2+ 2 = 24 (Answer)** **EXTEND TO USE NUMBERS THATGIVE RISE TO SIMPLE REMAINDERS** **Develop derived division facts for all tables**	**Develop and refine written methods for division HTU ÷ U (with and without remainders)** **Reinforce the bus stop as a division sign** **Chunking (repeated unequal subtraction)** **Write key facts for 1st 2nd 5th and 10th multiples of the table (as before) and extend to 20th 50th and 100th where appropriate before commencing the calculation** **4 1 rem 3** — **Key Facts** **6) 2 4 9** — **1 x 6 = 6** **- 1 2 0 (20 x 6)** — **2 x 6 = 12** **1 2 9** — **5 x 6 = 30** **- 1 2 0 (20 x 6)** — **10 x 6 = 60** **9** — **20 x 6 = 120** **- 6 (1 x 6)** — **50 x 6 = 300** **3** **20+ 20 + 1 = 41 rem 3 (Answer)**	**Develop and refine written methods for division HTU ÷ TU (with and without remainders)** **Chunking (repeated unequal subtraction)** **Write key facts for 1st 2nd 5th and 10th multiples of the table (as before) and extend where appropriate before commencing the calculation** **3 2 rem 1** — **Key Facts** **27) 8 6 5** — **1 x 27 = 27** **- 5 4 0 (20 x 27)** — **2 x 27 = 54** **$^{2}\cancel{3}\ ^{1}2\ 5$** — **5 x 27 = 135** **- 2 7 0 (10 x 27)** — **10 x 27 = 270** **5 5** — **20 x 27 = 540** **- 5 4 (2 x 27)** — **50 x 27 =1350** **1** **20+ 10 + 2 = 32 rem 1 (Answer)** **Through place value develop the impact of dividing by 100 and 1000** **Remainders to be displayed as** **A whole number 32 rem 1** **A mixed fraction 32 1/27** **A decimal fraction (where appropriate)**

Dividing by 10, 100 and 1000

When discussing the effect of dividing a value by 10 (and multiples of ten) the effect of digits moving one place value column to the right must be shown and that the space create by their passage be taken by a **PLACE HOLDER ZERO** at the front of the number when there is no value in the units column or any of the subsequent place value columns after the decimal point. This explanation being adapted for the effect of dividing a value by 100 (or a multiple of 100) and 1000 (or any of its multiples)