Mathematics at Tadley Community Primary School

Our Vision and Rationale

At Tadley Community Primary School, Mathematics plays an integral role in our daily lives and is collectively regarded in a positive light. The school delivers a 'Teaching for Mastery' approach, ensuring every child receives a comprehensive and coherent education in this essential subject. The inclusive teaching environment allows all children to experience success, with high-quality instruction fostering a strong foundation in mathematical concepts and skills. This consistent and high level of teaching prepares children not only for academic transitions but also for real-life applications, equipping them with the necessary tools for future success, aligned with the school's philosophy of "Learning for Life – the Tadley way." By exposing children to rich mathematical language and utilising stem sentences, we aim for learners to verbally reason and explain their mathematical thinking as standard practice. We strive to build resilience in learning by encouraging independence, equipping children with strategies to approach unknown problems, and fostering the ability to reflect and learn from mistakes. Additionally, embedded assessments enable children to make continual progress and delve deeper into their understanding of mathematics, ensuring a thorough grasp of the subject.

Children at Tadley Community Primary School develop into confident and resilient learners with an 'I can do maths' attitude, fostering their ability to make connections, reason effectively, and utilise estimation. Misconceptions are promptly identified and addressed within the same day, ensuring continuous progress. Emphasis on collaboration and problem-solving encourages children to work together and tackle challenges collectively. Their curiosity drives them to ask questions about the world around them, using this inquisitiveness for problem-solving and reasoning. They also develop a strong recall of key facts, such as times tables and number bonds. The use of manipulatives, visual representations, and formal methods support their learning, enabling a comprehensive understanding of mathematical concepts.

Staff at Tadley Community Primary School are passionate about mathematics, fostering a shared vision and culture of excellence. With strong subject knowledge and up-to-date training, we are well-equipped to deliver a high-quality programme of study. Learning Support Assistants (LSAs) are provided with regular training and new members of teaching staff receive induction and key training. Our effective lesson structure and thoughtful task design ensure that all children experience success as learners.

Curriculum Aims

The National Curriculum for Mathematics aims to ensure that all children:

- Become fluent in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that children develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.
- Reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language.
- Can solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

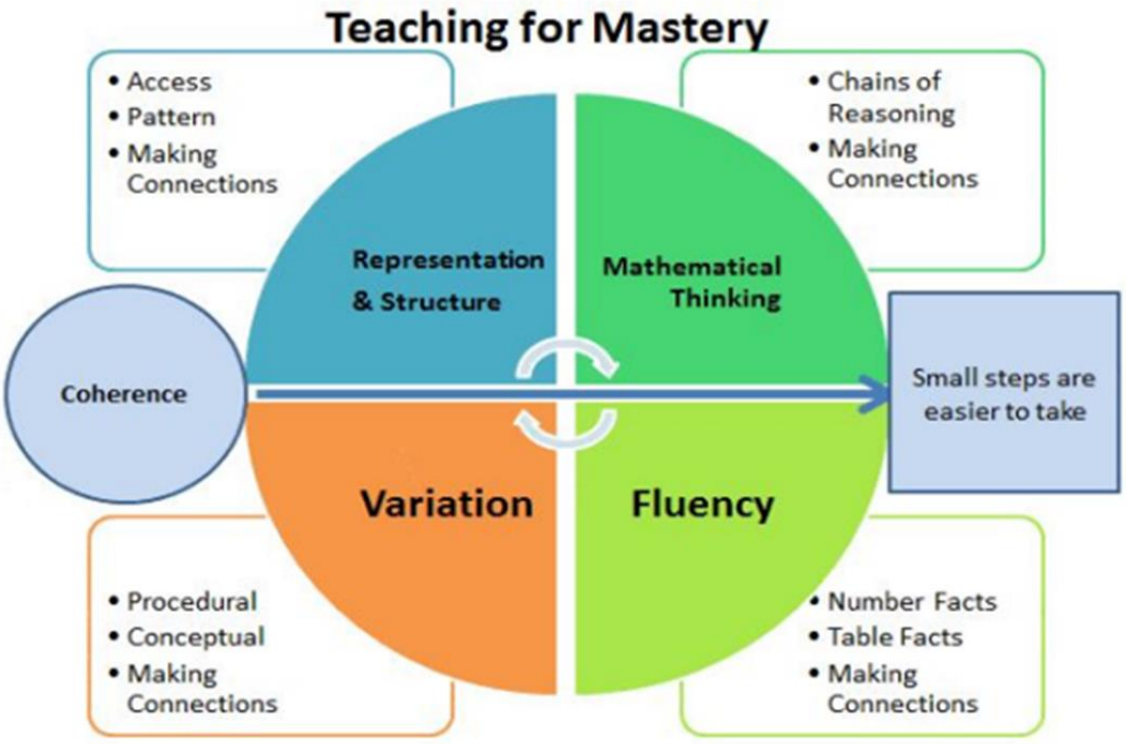
The EYFS Curriculum for Mathematics aims to ensure that all children:

- Can count confidently, developing a deep understanding of the numbers to 10, the relationships and connections between them and the patterns within those numbers.
- Develop a secure base of knowledge and vocabulary from which mastery of mathematics can be built.
- Develop their spatial reasoning skills across all areas of mathematics, including shape, space and measures.

Teaching for Mastery at Tadley Community Primary School

In 2022, our Maths Leaders began a programme of training with the National Centre of Excellence for Teaching in Mathematics (NCETM), working within the North-East Hants and Surrey Maths Hub. The programme and the subsequent work undertaken within school has revolutionised the way that maths lessons are delivered within the school. In essence, 'Teaching for Mastery' enables children to acquire a deep, long-term, secure and adaptable understanding of the mathematics within their relevant programme of study.

For children to master mathematics, there are five core principles which are paramount in teaching and learning. The NCETM represent these principles using the visual below. Each of the ideas displayed are closely linked and interconnected and each element is crucial to success in mathematics.



An excellent Maths Mastery lesson at Tadley Community Primary School would typically encompass several key elements to ensure effective teaching and a deep understanding of mathematical concepts.

The lesson would follow the Concrete, Pictorial, Abstract (CPA) approach, beginning with physical manipulatives to introduce new concepts, transitioning to visual representations such as diagrams or drawings, and finally moving to abstract representations using numbers and symbols.

Differentiation and support are crucial, with activities tailored to meet the needs of all learners, including those requiring additional support and those who would benefit from additional challenge.

Scaffolding is provided using worked examples to help children grasp new concepts, gradually removing this support as proficiency increases.

Active learning and engagement are promoted through interactive activities that encourage child participation and collaboration, as well as connecting mathematical concepts to real-world situations to make learning relevant and engaging.

Mathematical talk and reasoning are emphasised, encouraging children to discuss their ideas with their peers and the teacher, and using open-ended questions to promote deeper understanding.

Fluency and problem-solving are developed by providing opportunities for practice and application of skills to a range of problems, including those that vary in context and complexity.

Assessment for learning is ongoing, using formative techniques to gauge understanding throughout the lesson and providing timely, constructive feedback to guide learning and address misconceptions.

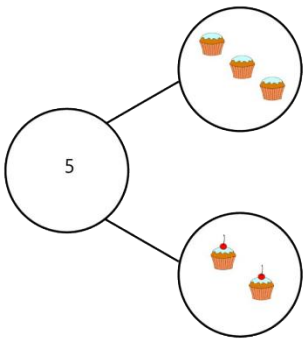
A positive learning environment is fostered through encouragement and support, creating a classroom atmosphere where children feel safe to make mistakes and learn from them, while setting high expectations and encouraging a growth mindset.

By incorporating these elements, a Maths Mastery lesson at Tadley Community Primary School can effectively foster a deep and lasting understanding of mathematics, preparing children for future success in the subject.

The Key Elements of Every Lesson

Representation and Structure

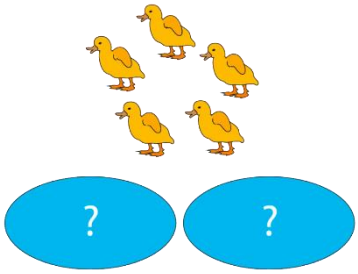
Representation and structure are central to successful teaching and are part of a teacher's toolkit. Maths is an abstract subject – it needs to be represented in a way that allows children to develop their understanding, and how it is represented either prevents or provides access to mathematical structures. When we represent, we are trying to reveal the structure within a concept – how and why the maths works. Maths is about relationships; for example, when we put two quantities together, we make a larger quantity.



The example above represents an additive structure. We sometimes call this the part-part-whole relationship, and it is often represented with circles and shown in a triangular structure or 'cherry model'. This triangular structure represents the partitioning of the whole into two parts, and we can see that the quantities inside the two circles are part of the composition of the whole. We choose to use this particular

structure as it helps children understand the relationship between those three numbers. We use dynamic movement between those three circles to show the relationship between the parts and whole.

This is not the only structure we might use to represent a part-part-whole relationship. In fact, we might not begin with this as it is quite abstract. Initially, it might help to give a context to the maths, such as five ducks deciding which of the two ponds to swim in. This is still a part-part-whole structure but it is not yet formalised into the 'cherry model' structure.



Bar models are another excellent tool, often used to draw attention to equivalence between the parts and the whole.

By selecting different representations, the teacher is able to draw out certain aspects of a concept. Where the 'cherry model' represents partitioning, the bar model emphasises the equivalence of five to three and two.

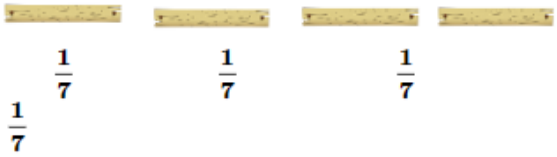
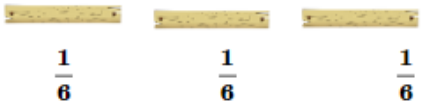
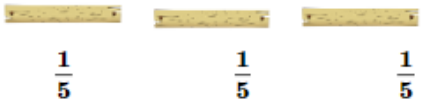
With representation and structure, the main aim is to stimulate children's mathematical thinking and reasoning. Representations are carefully selected and ordered in a coherent manner in order to build and make sense of concepts and their essential structures, as we did with the models above.

Variation

Variation influences the way children think about maths by drawing their attention to essential structures and relationships within a concept. It is characterised by a carefully constructed small-step journey through learning, where consideration is given to what is kept the same and what is changed.

Variation involves looking at a concept through different representations, starting with one and then adding more to consider the concept from different perspectives. Concepts are presented coherently to engage children in mathematical thinking, to reason and make connections. Choosing calculations that children are already fluent in reduces overload and learning is made accessible to all children.

'What we want is to get all children on the bus. Through teaching in small steps and building concepts with depth and rigour, we make learning accessible so that all children stay on the bus.'
– Dr Debbie Morgan

Part 3 – Repeated addition and multiplication.	
Alex has 4 pieces of wood.  Each piece of wood is $\frac{1}{7}$ m long. How long is all of Alex's wood?	$\frac{1}{7} + \frac{1}{7} + \frac{1}{7} + \frac{1}{7} = \frac{4}{7}$ $4 \times \frac{1}{7} = \frac{4}{7}$
Jess has 3 pieces of wood.  Each piece of wood is $\frac{1}{6}$ m long. How long is all of Jess's wood?	$\frac{1}{6} + \frac{1}{6} + \frac{1}{6} =$ $3 \times \frac{1}{6} =$
Alex has 3 pieces of wood.  Each piece of wood is $\frac{1}{5}$ m long. How long is all of Alex's wood?	$\frac{1}{5} + \frac{1}{5} + \frac{1}{5} =$ $3 \times \frac{1}{5} =$

Beginning with a worked example reduces cognitive load and ensures that all learners are 'on the bus'. Gradually, the scaffold is adapted, with more of the structure removed. By this stage, children have become so fluent in their movement through the processes that the cognitive load is lessened therefore making the focus on the mathematics involved, rather than on the demands of question.

The benefit of using variation is enormous: you can improve the progress that children make and the quality of learning. Ensuring depth of understanding and making lessons accessible to all children means that more children make good progress and become confident mathematicians. Using variation relieves cognitive load, so children have space to make deep and lasting connections.

Within variation, there are two sub-groups:

- Conceptual variation involves varying how a concept is represented to draw attention to critical features. Often more than one representation is required to look at the concept from different perspectives and fain comprehensive knowledge.
- Procedural variation considers how the child will 'proceed' through a learning sequence. Purposeful changes are made in order that a child's attention is drawn to key features of the mathematics, scaffolding a child's thinking to enable them to reason logically and make connections.

Fluency

Fluency means having quick and efficient recall of knowledge without a heavy cognitive load. Knowing number fluency facts will help provide good foundations to then be able to solve more sophisticated problems. Some fluency is known as instant recall, such as knowing that 7 x 6 = 32, because is a memorised fact. At other times, children may show their fluency by quickly deriving the answer using existing knowledge; for example, knowing that 9 + 11 will the same answer as 10 + 10 because each of the numbers is 1 away from 10 in value. This type of thinking is known as automaticity. It is important that even when facts are memorised, children still have an understanding of the meaning behind these facts. Having fluency and being able to quickly derive or recall facts, eases cognitive load which can free up thinking for more complex problems. Children may also demonstrate fluency within their written methods and procedures and use these to solve problems. It is important that children are efficient in their thinking and that they choose the best way to solve a problem based on their existing mathematical knowledge.

In order to have fluency and be efficient, children need to have an excellent foundation of 'number sense' which they build upon each year. In Key Stage 1, for example, we aim to develop recall of number bonds to and within 20. These are then built upon in Key Stage 2 where children then make links to other known facts. Within KS1, we use the NCETM 'Mastering Number' programme which aims to secure firm foundations in the development of number sense for all children from Reception through to Year 1 and Year 2. The aim over time is that children will leave Key Stage 1 with fluency in calculation and flexibility with number.

In Key Stage 2, the children will learn the formal written methods for all four number operations. Using the National Curriculum as a guide, we have developed a calculations policy which demonstrates the expectations for and layout across this Key Stage.

Within Key Stage 2, an aim of the National Curriculum is that all children will know their multiplication and associated division facts by the end of Year 4. At Tadley Community Primary School, we have a times tables system which is introduced in Year 2. Children understand and learn their times tables in a coherent journey within their maths lessons. Discrete time is also allocated to embed and assess the children on this knowledge. More detail can be seen in our Times Table Policy which can be found on our school website.

To supplement learning of times tables facts, we encourage children to use the online learning platform 'Numbots' and 'Times Tables Rockstars'. As with all maths, learning facts is just the start and children need plenty of opportunities to strengthen their retrieval.

From September 2024, we will be implementing the KS2 Mastering Number programme in Years 4, 5 and 6 which enables children to develop fluency in multiplication and division facts and a confidence and flexibility with number that exemplifies good number sense.

Consolidation Practice

Once key skills have been taught, these are revisited within 'Flashback Maths' sessions which take place at the beginning of each maths lesson and provide children with regular opportunities to consolidate prior learning.

Year 3 Flashback Maths Example:

Monday	Tuesday	Wednesday	Thursday	Friday
4, 8, 12, 16, ___ 26 + 10 = 67 -10 = 124 + 6 = 255 - 12 =	12,16,20,24, ___ 36 + 10 = 55 – 10 = 124 + 2 = 547 - 12 =	20,24,28,32, ___ 42 +10 = 38 – 10 = 252 + 6 = 256 - 25 =	12,__,20,24,28 48 +10 = 31 - 10 = 252 + 3 = 256 - 22 =	20, ___,28,32,36 50 + 10= 29 - 10 = 341 + 8 = 569 - 53 =

Mathematical Thinking

Mathematical thinking is crucial to how children learn mathematics and includes looking for patterns and relationships, making connections, conjecturing, reasoning and generalising. Children are encouraged to actively engage in mathematical thinking in all lessons, communicating their ideas using precise mathematical language.

Stem sentences

Expressing mathematical ideas orally helps children to build communication skills. It can also form an important part of developing understanding of mathematical concepts and the ability to reason mathematically.

Generic sentence starters help give a structure in which children can express their ideas. Examples might be 'I agree because…'/ 'I disagree because…'/ 'If I know…, then I know…'.

Stem sentences are more specific to the maths being learned but give children a clear 'full-sentence' structure in which to put their own answers. 'This is the number 42. The 4 shows we have 4 groups of ten. The 2 shows we have 2 extra ones.' is an example (when learning about place value in Year 2 – sentence taken from the DfE 2020 maths guidance p.51). The child may be given a whole stem sentence to begin with but over time parts of the stem sentence will be missing and the child will fill in the gaps verbally or in written form. When children use stem sentences over an extended period of time, they will be equipped with the mathematical vocabulary to talk about and explain their mathematical thinking. These sentence frameworks can be used during teaching inputs, as chants, to learn facts or even feature within the children's independent practice.

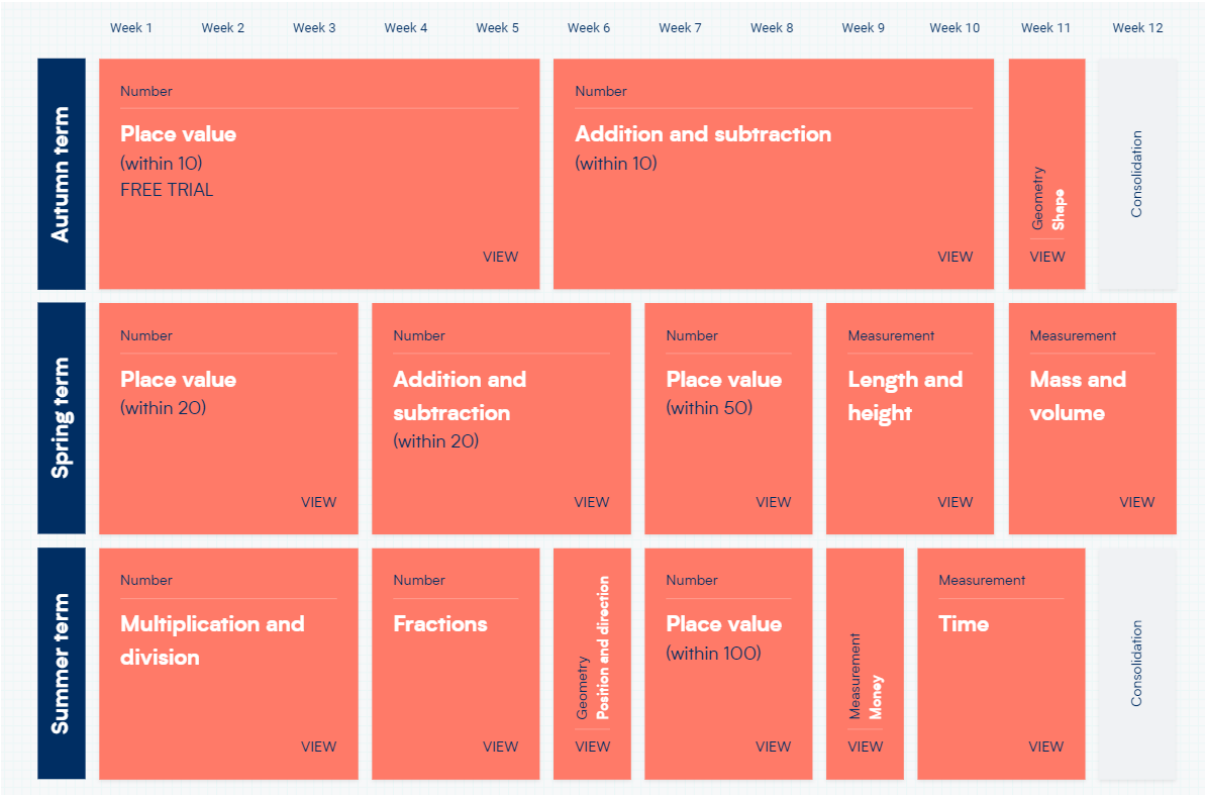
Coherence

For teaching to be coherent, mathematics needs to be planned and taught in a logical journey sequence and also broken down into bite-sized lessons often referred to as 'small steps'.

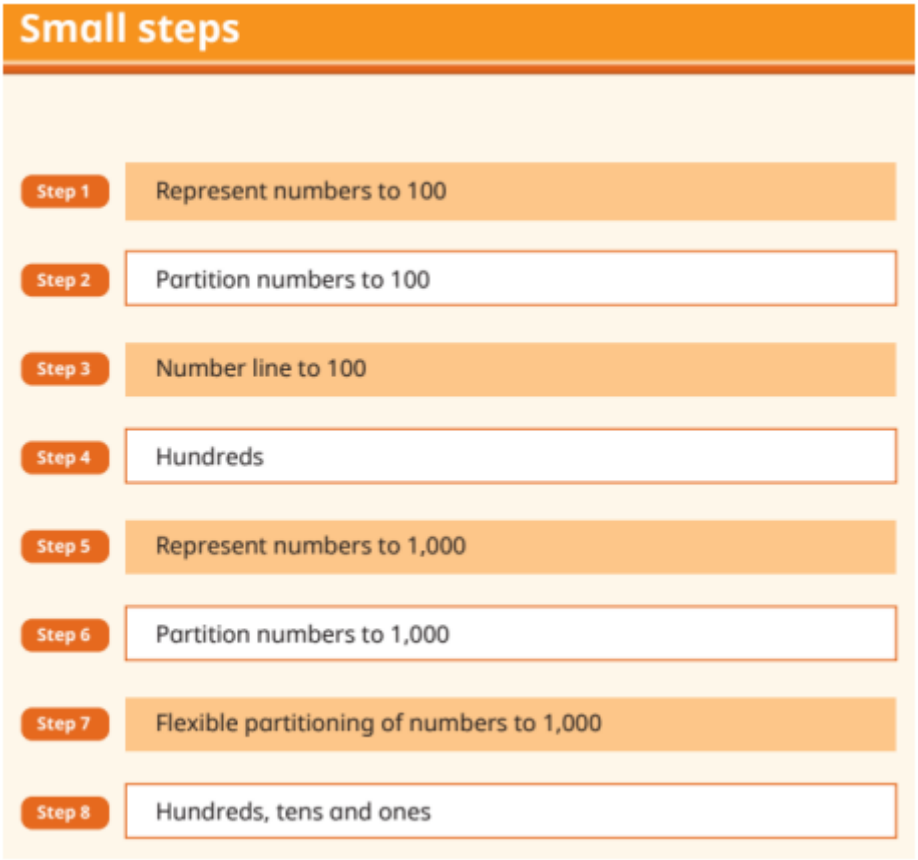
At Tadley School, we use the overviews developed by 'White Rose' as a guide to the sequence we follow in order to teach our maths units over the academic year. This carefully designed and coherent journey means that skills, knowldege and understanding taught in the autumn term will be the foundations which will be built on and applied in the spring and summer units. In most year groups, place value and the four number operations will feature as the first units of the year as this learning is fundamental before any other learning can take place.

Planning

We have been using the White Rose planning as a guide for the last year. We know that these are supported by the NCETM and are also updated yearly. Teachers plan from the yearly overviews and use other resources available as a support tool in order to develop effective lesson and task design. The White Rose yearly planning overviews are available on our school website.



In a coherent maths journey, units are broken down into small, connected steps that gradually unfold the concept, providing access for all children and leading to a generalisation of the concept and the ability to apply the concept to a range of contexts.



Differentiation

At Tadley Community Primary School, we believe that all learners should have the same opportunities to access and succeed within learning. In all year groups, the majority of children will access the same tasks in order for children to move through the curriculum at broadly the same pace. Within lessons and independent practice, differentiation will occur through additional adult support, pace, outcome and time rather than differentiation by task.

Research has shown that we believe that all children should have the same opportunities to access and succeed within learning. In each year group, the vast majority of children will access the same learning in order for children to move through the curriculum at broadly the same pace. Within lessons and independence practice, differentiation occurs by adult support, pace, outcome and time rather than differentiation by task. Research has shown that this way of working has a positive impact on both attainment and on the attitudes of our young learners towards their Mathematics education.

We design our lessons so that they are coherent and 'small step' so that independent practice tasks begin more simplistically then increase in complexity as the child moves through the lesson. The earlier parts of the lesson will be the foundations of learning, which need to be secure before children move on. Each lesson should also have opportunities to challenge children to a 'greater depth' level so that every child is both supported yet challenged in a way that is appropriate for the individual.

Independent Practice and Task Design Lesson design will change depending on where the children are on their journey within a concept however there are key elements which should feature within most independent practice tasks. When the children come to complete their independent practice, this is when they practice the learning from the lesson input and also use this learning to solve problems and reason. When making lesson resources for the children's independent practice, it is important to keep the 5 principles of Teaching for Mastery in mind. Here is an annotated lesson which highlights some of these key elements.

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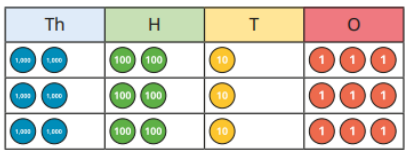
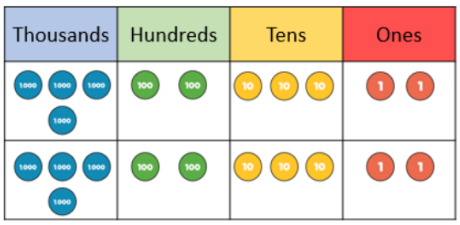
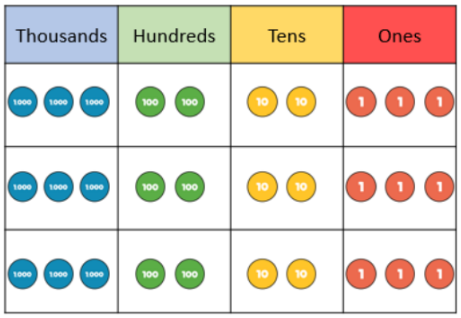
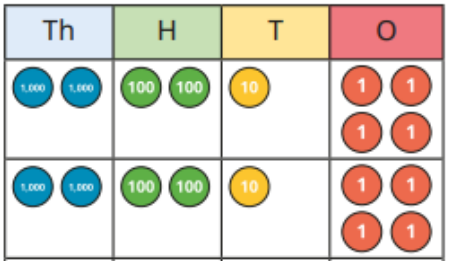
<table>
<tr><th colspan="2">Part 1 – Complete the sentences to describe the multiplication.</th></tr>
<tr><td>Complete the sentences to describe the multiplication.
 
</td><td>There are ____ ones altogether.
There are ____ tens altogether.
There are ____ hundreds altogether.
There are ____ thousands altogether.

2213 x 3 = _____.</td></tr>
<tr><td> 
</td><td>There are ____ ones altogether.
There are ____ tens altogether.
There are ____ hundreds altogether.
There are ____ thousands altogether.
4232 x 2 = _____.</td></tr>
</table>



There are ____ ones altogether.
There are ____ tens altogether.
There are ____ hundreds altogether.
There are ____ thousands altogether.

3223 x 3 = _____.



There are ____ ones altogether.
There are ____ tens altogether.
There are ____ hundreds altogether.
There are ____ thousands altogether.

2214 x _____ = _____.

Part 2 – Answer the multiplication questions using the written method.

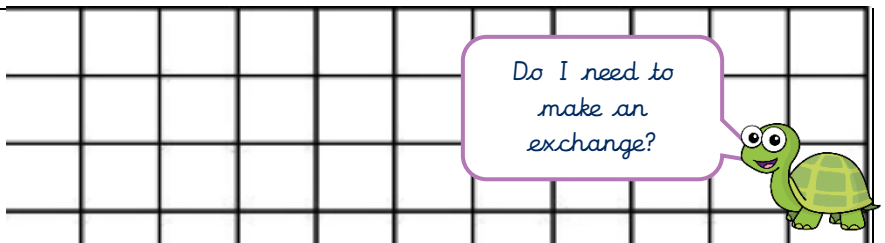
2314 x 2 =

3211 x 3 =

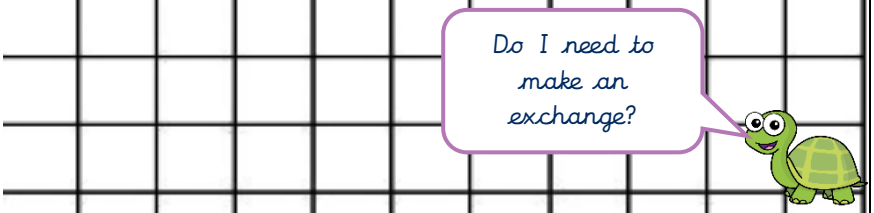
3222 x 3 =

2120 x 4 =

2214 x 4 =

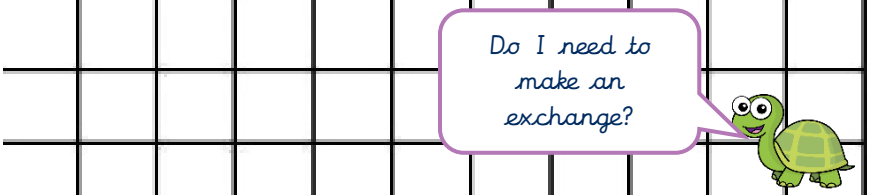


7290 x 3 =

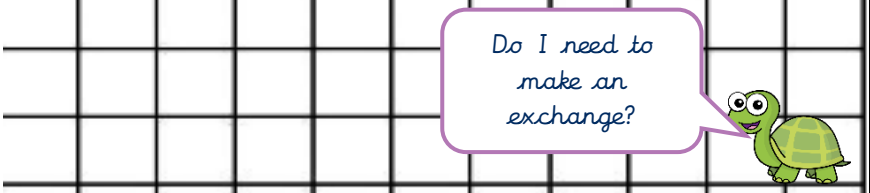


3126 x 3 =

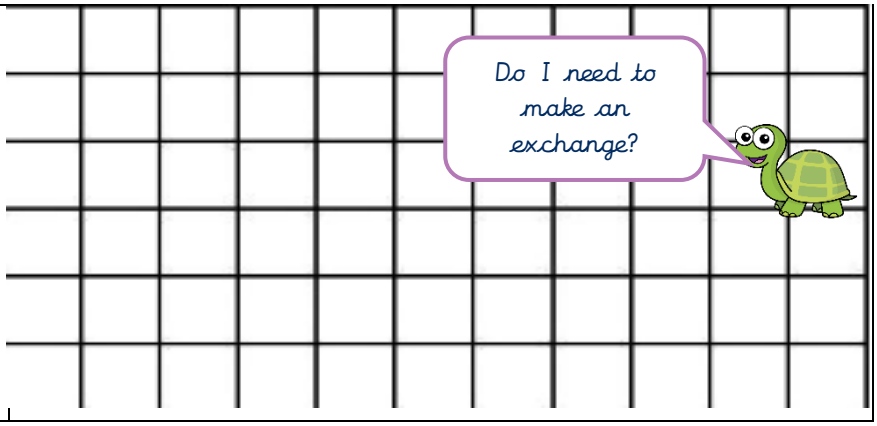
4812 x 2 =



4312 x 6 =



1502 x 5 =



Part 3 – Problem solving

If Diddy earns £1325 per month, how much does he earn in 2 months?

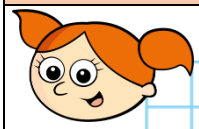
If Diddy earns £1325 per month, how much does he earn in 4 months?

If Diddy earns £1325 per month, how much does he earn in 6 months?

If Diddy earns £1325 per month, how much does he earn in 8 months?

How much would Diddy earn in 9 months?

Part 4 – Challenges



Alex works out that 1432 x 4

		1	4	3	2	
	×				4	
		4	16	12	8	

What mistake has Alex made?

342 x 3 = 1026
Without calculating, which is greater, 342 x 4 or 343 x 3?

Explain your answer.

Use the clues to work out the missing numbers.

	×					5	

- The four digits being multiplied are consecutive numbers.
- The first two digits of the product are the same.
- The fourth and fifth digits of the product add to make the third.

Find all the possible solutions.