



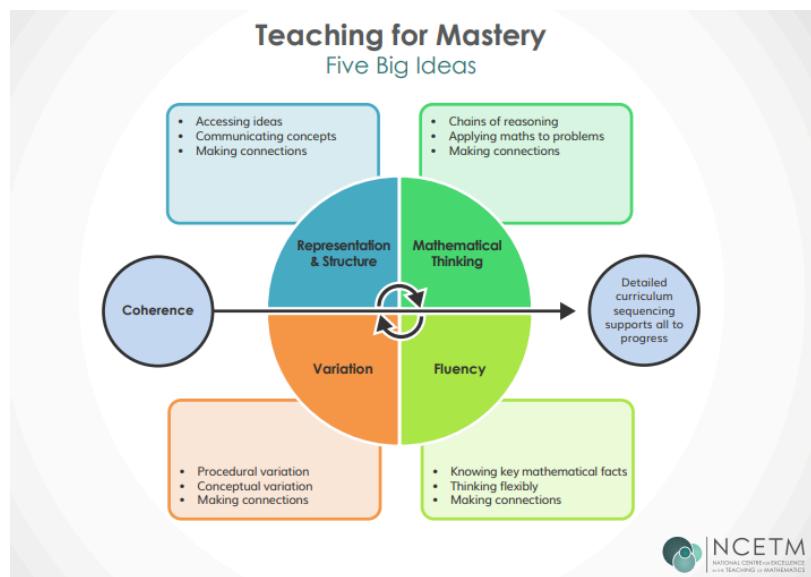
Mathematics: The Lovelace Way

INTENT

Curriculum design, coverage and appropriateness

At Lovelace, we believe using key principles that enable teaching for mastery is the most effective approach in order for our children to become confident and proficient mathematicians. As the NCETM (National Centre of Excellence in Teaching Mathematics) states, *“Mastery means pupils of all ages acquiring a deep, long-term, secure and adaptable understanding of the subject. The phrase ‘teaching for mastery’ describes the elements of classroom practice and school organisation that combine to give pupils the best chances of mastering maths.”*

Pupils are taught through whole-class interactive teaching where there is a key focus on all pupils working together on the same lesson content at the same time. This ensures that all can master concepts before moving to the next part of the curriculum sequence, allowing no pupil to be left behind. This approach develops deep and sustainable knowledge and understanding that enables pupils to be able to reason about a concept, make connections and have conceptual and procedural fluency.



The fundamental characteristic that underpin teaching for mastery are outlined as the 5 Big Ideas and include: coherence, representation and structure, variation, fluency and mathematical thinking.

- 1) Coherence** - Teaching is designed to enable a coherent learning progression through the curriculum, providing access for all pupils to develop a deep and connected understanding of mathematics that they can apply in a range of contexts.
- 2) Representation and structure** - Teachers carefully select representations of mathematics to expose mathematical structure. The intention is to support pupils in ‘seeing’ the mathematics, rather than using the representation as a tool to ‘do’ the mathematics. These representations become mental images that students can use to think about mathematics, supporting them to achieve a deep understanding of mathematical structures and connections.
- 3) Variation** - The purpose of variation is to draw closer attention to a key feature of a mathematical concept or structure through varying some elements while keeping others constant.

- 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 gain comprehensive knowledge.
- Procedural variation considers how the student will ‘proceed’ through a learning sequence. Purposeful changes are made in order that pupils’ attention is drawn to key features of the mathematics, scaffolding students’ thinking to enable them to reason logically and make connections.

4) Fluency - Efficient, accurate recall of key number facts and procedures is essential for fluency, freeing pupils’ minds to think deeply about concepts and problems, but fluency demands more than this. It requires pupils to have the flexibility to move between different contexts and representations of mathematics, to recognise relationships and make connections, and to choose appropriate methods and strategies to solve problems.

5) Mathematical Thinking - Mathematical thinking is central to how pupils learn mathematics and includes looking for patterns and relationships, making connections, conjecturing, reasoning, and generalising. Pupils should actively engage in mathematical thinking in all lessons, communicating their ideas using precise mathematical language.

The Five Big Ideas were first published by the NCETM in 2017.

More information on teaching for mastery or various aspects of this can be found by watching these videos led by Debbie Morgan, NCETM Director for Primary Schools. [A video overview on teaching for mastery at primary | NCETM](#)

We believe that following these key principles enabling teaching for mastery allows our pupils to become confident, ambitious and successful mathematicians who are able to: use prior learning as stepping stones to build coherence; use mathematical vocabulary to articulate and support their learning; demonstrate quick and efficient recall of key facts and procedures; reason logically, explain, conjecture and prove mathematical concepts.

MATHS CURRICULUM & LESSON DESIGN

At Lovelace, we follow the National Curriculum for Maths and the White Rose Scheme of Learning to enable us to deliver a progressive, dynamic and relevant curriculum. We also use the NCETM mastering number programme in KS1 to develop mathematical fluency. These NCETM/White Rose progression maps/ demonstrate how the learning in each content area builds across each year:

[Progression Maps for Key Stages 1 and 2 | NCETM](#)

 [White Rose Curriculum Progression Year 1 to 6.pdf](#)

Our long-term Maths curriculum plans break down the National Curriculum objectives into topic blocks to be covered across the year using the White Rose teaching order. This carefully sequenced content enables us to both stimulate and challenge pupils alongside building on prior knowledge and consolidating.

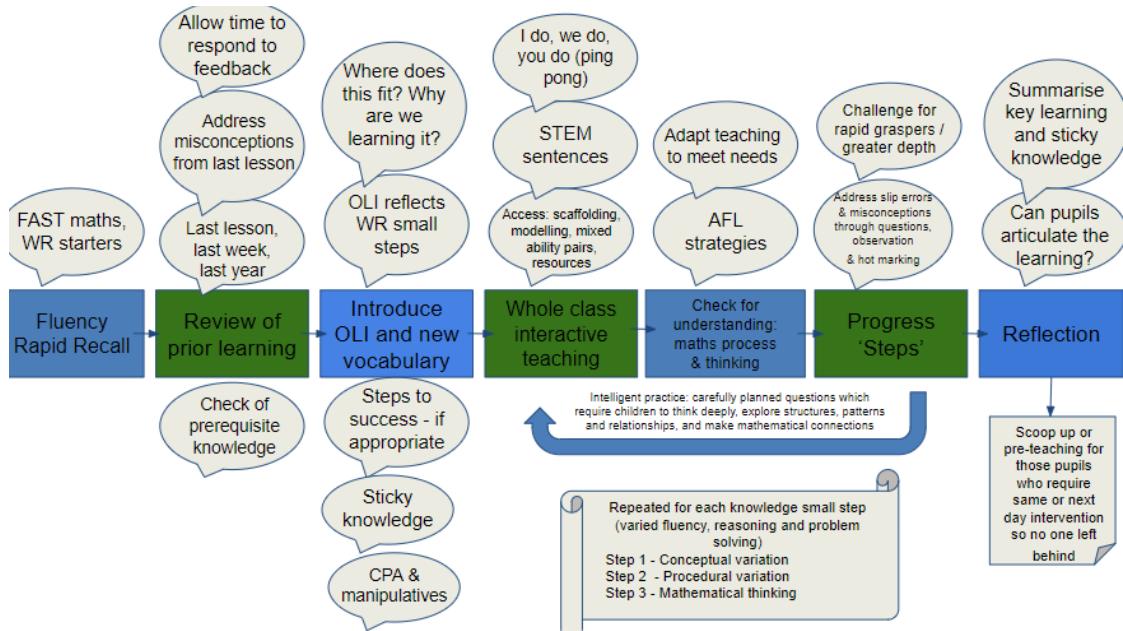
[Long-Term Curriculum Maps](#)

Our medium-term Maths curriculum plans break each term down into the topic blocks that will be covered and the small step teaching sequences that will be followed to progress towards the given objectives (following the White Rose small steps). These small, carefully sequenced steps must each be mastered before pupils move to the next stage, enabling progression to be seen across the school. These are master copies and should be adapted and annotated by teachers to match the needs of their class/number of weeks in the term etc. From Year 1 to 6, Maths should ideally be taught during 5 sessions per week each of 45-60 minutes.

[Medium-Term Curriculum Maps](#)

Before beginning each topic, teachers should use the White Rose end of topic assessment from the previous year group to assess the children's prerequisite knowledge. They should have a clear understanding of where the topic sits as part of the 'big picture' and any misconceptions that may arise.

When planning lessons, teachers should carefully consider the structure and sequence using this example. Lesson SMARTs should be used to support this.



IMPLEMENTATION

Curriculum delivery, teaching (pedagogy), assessment

Lessons should begin with fluency based 'Rapid Recall'. Fluency demands more of learners than memorisation of a single procedure or collection of facts. It encompasses a mixture of efficiency, accuracy and flexibility. This may include: number bonds to 10 and 20, odds and evens, 1 more and 1 less, doubling and halving, multiplication tables, multiplying and dividing by 10, 100, 1000. Pupils should be supporting to develop the most efficient ways to find answers e.g.

- What's the most efficient way to calculate 420 divided by 7?
- What's the most efficient way to calculate 126 divided by 14?
- What's the most efficient way to do 474 x 30?
- What's the most efficient way to do 474 x 12?
- What's the most efficient way to find 99% of 420?
- What's the most efficient way to find £4.99 x 3?
- How can you use 8 + 2 to solve 8 + 5?
- How can you use 3 x 7 to solve 6 x 7?
- Is 81 a multiple of 3?

Partition and draw an image

Number bond to the next hundred

1 more
1 less
10 more
10 less
100 more
100 less

Your number this week is:

Is the number in the 2 times table?
Is the number in the 5 times table?
Is the number in the 10 times table?

Even
Odd

Write the number in words

X10
+10

$$33,630 = 354 \times 95$$

Use this multiplication to complete the calculations below.

$$354 \times 9.5 = \boxed{\quad}$$

$$3,540 \times 95 = \boxed{\quad}$$

$$3,363 \div 95 = \boxed{\quad}$$

$$5,542 \div 17 = 326$$

Explain how you can use this fact to find the answer to 18×326

Cloud shape for writing

Teachers should then review prior learning by allowing the children time to respond to feedback from the previous lesson and as well as addressing any misconceptions.

New learning should then be introduced alongside an explanation of why we are learning it. Teachers should use a ping pong approach to lead back and forth interaction, including questioning, short tasks, explanation, demonstration and discussion. Concepts should be explored together to make mathematical relationships explicit. Stem sentences should be used to aid the development of 'sticky knowledge'.

As the small step journey is key, lessons then slowly guide the children through the new concepts being taught, generally covering representation and structure, formal written methods/calculation and reasoning. The White Rose teaching slides and worksheets can be adapted to create lesson content. Testbase also provides year group appropriate reasoning questions. Lessons should be planned to include all of the following five big ideas (explored in more detail above).

- **Representation and structure**
- **Variation**
- **Mathematical Thinking**
- **Fluency**
- **Coherence**

It is imperative that the class does not move on to new learning until all children have securely grasped the previous knowledge/skills. Therefore, in some lessons, classes may only reach Step 2 of the planned lesson. The next lesson should then continue from this point ensuring all children reach Step 3 and work on the problem solving and reasoning skills rather than moving on to the next planned lesson.

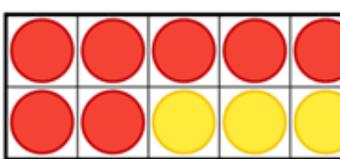
For video lessons examples, see the NCETM website.

<https://www.ncetm.org.uk/teaching-for-mastery/mastery-magnified/primary-lesson-videos/>

Resources

Manipulatives are crucial when introducing new concepts at the 'concrete' stage e.g. *Tens frames, Dienes, Numicon, Cuisenaire rods, pegs, straws, geoboards, place value cards, dominoes, cards, dice, bead strings, Rekenraks, two-coloured counters, place value counters, number sticks, tens frames*. Children need to move back and forth between the use of *Concrete* (doing, see above), *Pictorial* (seeing, visual representations e.g. bar modelling, pictures & diagrams) and *Abstract* (numbers, symbols, maths notation) throughout the teaching.

Resources should be available for **all** children to use during lessons. Teachers should carefully consider which resources to use within the planning stage as some representations may not be appropriate to reveal the structure within the lesson.



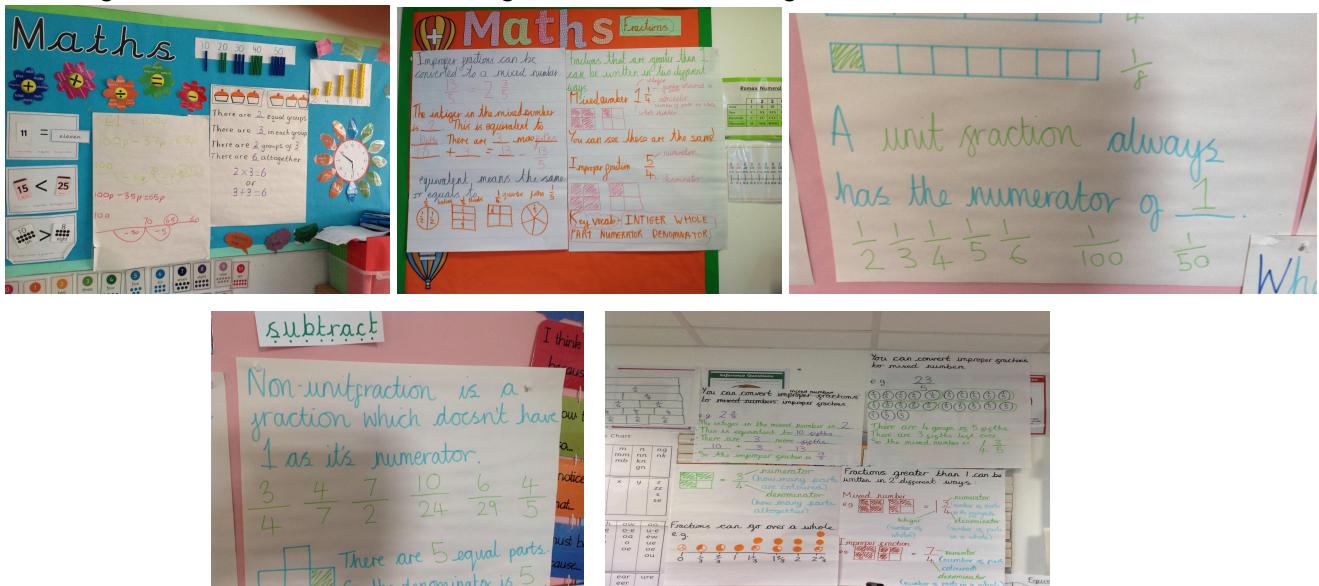
Vocabulary

Each medium-term plan shows key mathematical vocabulary that should be modelled by teachers and learnt by pupils when delivering each topic block. Alongside this there is a progression map of vocabulary for across the school. [Vocabulary Progression Map](#)

The vocabulary used should be clearly displayed in classrooms and referred to during lessons. Children should be able to articulate their learning using the correct and precise mathematical language.

Working Walls/The Silent Teacher/Learning Environment

Working walls should be clearly visible and reflect the maths being taught. Key mathematical vocabulary and definitions, stem sentences and 'sticky knowledge' should be displayed and referred to during the lesson and those following. This could be through the use of anchor charts.



Calculation Policy

We adopt the White Rose calculation policy as a consistent way in which to teach specific methods. This provides guidance as to effective models that can be used to teach each operation and the progression within these across each year group. The benefits of each model and the links between the different operations is also explained.

Addition and Subtraction

Multiplication and Division

ACCESS & INTERVENTION

Access

Teachers should teach in a precise, engaging way which makes it possible for all pupils to participate successfully with tasks at the expected level of challenge.

Within this approach, pupils work on the same tasks and engage in common discussions. Differentiation occurs in the *support and intervention provided* to different pupils, *not in the topics taught*. There is no differentiation in content taught but the questioning and scaffolding individual pupils receive in class as they work through problems will differ, with children being challenged through more demanding problems which deepen their knowledge of the same content.

Access for all can be achieved through the use of resources, adult support, overteaching, stem sentences, mixed ability pairings etc. TAs should actively support the children in lessons to access the learning and encourage them to contribute to the lesson (e.g. putting their hand up) as well as

developing independence. Pupils who are significantly behind because of SEND may need an individual programme as per their EHCP.

Keep Up

Pre-teaching may be used to provide useful vocabulary and skills to assist the children in new learning.

Most pupils' difficulties and misconceptions are identified through immediate formative assessment and addressed with rapid intervention - commonly through individual or small group 'keep up' support ideally later the same day or within the same week. This ensures the pupil(s) is/are ready to move forward with the whole class in the next lesson.

Catch Up

Catch Up Numeracy is a structured intervention programme that was introduced to the school in September 2015. It is designed for learners who are struggling with numeracy rather than learners who are beginning numeracy. It addresses a comprehensive range of numeracy components in 15 minute sessions which are delivered to each individual pupil twice a week by an adult who has attended training by a Catch Up numeracy approved trainer.

It is suitable for learners whose number age is significantly below their chronological age but who have acquired certain basic maths skills.



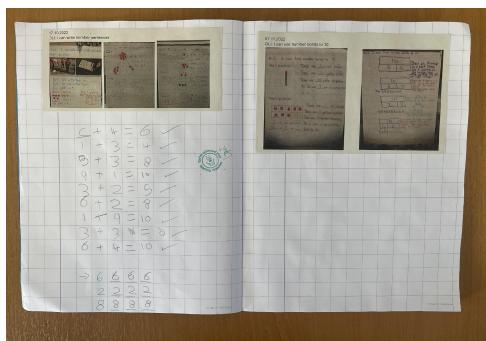
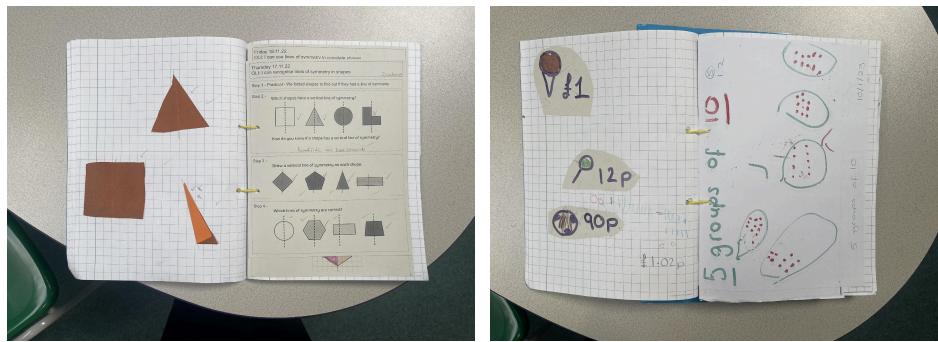
The components covered by the Catch Up programme are: counting verbally; counting objects; reading and writing numbers; hundreds, tens and units; estimation; word problems; translation; remembered facts; derived facts and ordinal numbers.

Recording Learning - Maths Books

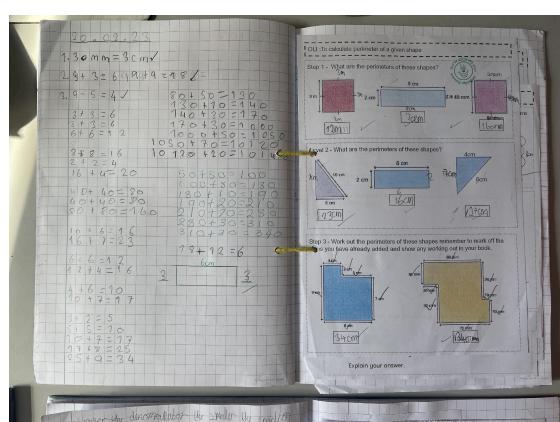
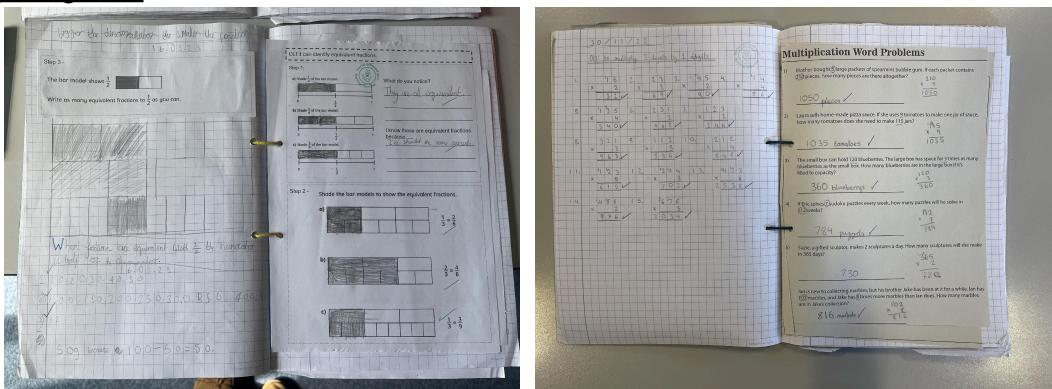
The children's Maths books will show the journey the children have taken through the small steps of learning during lessons as well as the similar small step journey across lessons, building on prior learning and mastering skills.

Children's worksheets are put in maths books using hole punching and reassuring tags. Behind these, children should be encouraged to show their working out (presently neatly) whenever necessary and be supported to write clear mathematical explanations using correct vocabulary when appropriate.

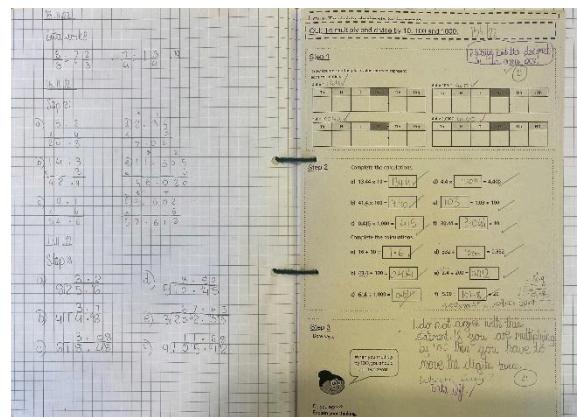
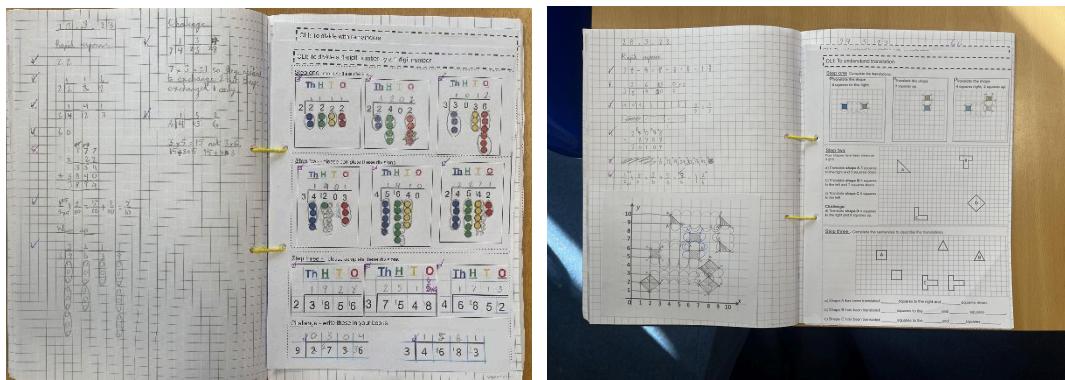
Key Stage 1 –



Lower Key Stage 2 –



Upper Key Stage 2 –



ASSESSMENT

Marking & Evidence Recording

At Lovelace, we follow the NCETM's Marking and Evidence Guidance for Primary Mathematics Teaching. <https://www.ncetm.org.uk/media/wuch3xua/ncetm-primary-marking-guidance-april-2016.pdf>

'Marking' is taken to mean the process whereby a teacher looks at pupils' written work, examines it for errors, misconceptions and/or conceptual and procedural fluency, and then responds in some way, either in writing, speech or action.

'Evidence-recording' is taken to mean the keeping of written or other records to show evidence of pupils' progress in their learning of mathematics.

Research (Black et al 2003) shows that the most effective and beneficial forms of assessment are ones which support learning (i.e. are formative) and are built-in to lesson design.

In primary mathematics they require:

- well-structured classroom activities
- regular opportunities for discussion of answers and strategies to support pupils' reasoning
- skills and check and deepen their understanding;
- interaction and dialogue (between teacher and pupils, and between pupils themselves),
- focusing in particular on key ideas and concepts (including misconceptions and difficult points) and effective, efficient strategies of working mathematically.

Research also shows that pupils benefit from undertaking appropriate written work outside of lessons. Teachers' marking of this work can provide extra feedback to support pupils' learning. However, the most important activity for teachers is the teaching itself, supported by the design and preparation of lessons.

Marking and evidence-recording strategies should be efficient, so that they do not steal time that would be better spent on lesson design and preparation. Neither should they result in an excessive workload for teachers.

It is important for teachers to distinguish between a pupil's simple slip and an error that reflects a lack of understanding:

- For slips, it is often enough to simply indicate where each slip occurs, particularly when the teacher's/school's approach is to encourage pupils to correct them;
- If errors demonstrate lack of understanding, the teacher may decide to take alternative courses of action. For instance, with a small number of pupils, the teacher may arrange same-day intervention while for a large number of pupils, the errors will be addressed in the next lesson.

Evidence shows (Black and Wiliam 1998) that pupils benefit from marking their own work. Part of this responsibility is to identify for themselves the facts, strategies and concepts they know well and those which they find harder and need to continue to work on. OFSTED also outline that 'live marking in lessons' allows teachers to 'swiftly notice pupils' successes, misconceptions and errors' leading to 'adjusting the next lesson for all pupils who need additional support'.

Evidence-recording - If interaction between teacher and pupils is good, then efficient marking strategies can be deployed. Suitable summative assessment will enable a teacher to monitor pupils' progress. Where progress is secure, no further evidence is necessary. Where an individual pupil's progress is a concern, then more detailed monitoring and recording may be justified. It should not be a routine expectation that next-steps or targets be written into pupils' books. The next lesson should be designed to take account of the next steps. The NCETM's Teaching for Mastery (questions, tasks and activities to support assessment) materials, for pupils in year 1 to year 6, aim to assess how well the pupils understand concepts. These questions, tasks and activities, used well, can provide pupils with the opportunity to develop and demonstrate a depth of understanding and proficiency which

Therefore, in most lessons, pupils will use a purple pen to tick or dot their answers. The class teacher will then look through the children's books to identify the next step, being either:

- 1) For slips, the children should be encouraged to go back and correct their 'slips' using a purple pen during the next lesson.
- 2) For errors that demonstrate a lack of understanding, the teacher may decide to lead/ask a TA to lead a same-day/week intervention with a small number of pupils to address the lack of understanding or for a larger number of pupils, address the errors in the next lesson.
- 3) If possible, teachers and TLSAs will circulate the classroom marking when able to do so, enabling slips or errors to be spotted as early as possible.

Within lessons, teachers often undertake mini lessons / plenaries / understanding stops / teaching points throughout the lesson as they observe how children are responding to the teaching. This then enables the teacher to assess the impact of the feedback on a pupils learning and whether further support is necessary.

Assessment

Formative Assessment

Formative assessment takes place on a day-to-day basis during teaching and learning, allowing teachers and pupils to assess attainment and progress more frequently. It begins with diagnostic assessment, indicating what is already known and what gaps may exist in skills or knowledge. If a teacher and pupil understand what has been achieved to date, it is easier to plan the next steps. As the learning continues, further formative assessments indicate whether teaching plans need to be amended to reinforce or extend learning. This is also largely supported by what is stated above in lessons with live marking, listening to pupil discussion, questioning and observing the children.

Teachers should systematically and effectively check pupils' understanding throughout lessons, using discussions, questioning and observation, anticipating where they may need to intervene at the point of learning.

Summative Assessment

OFSTED outlines that summative assessment is necessary but most successful when summative assessment approaches are kept 'low key'. Therefore, at Lovelace, we ensure this assessment takes place in every year group but teachers also use this information along with pupil conferencing to understand gaps and ensure these are then fed into planning.

Key Stage 1 -

Year 2 still participates in optional SATs to help inform end of year data. Marks from the SATs are used alongside teacher knowledge and understanding of their children.

Key Stage 2-

Across Key Stage 2, children participate in end of unit assessments outlined within the WhiteRose curriculum as well as regularly doing Rising Stars arithmetic papers to check fluency and recall. OSFTED outline the importance of assessment such as this to highlight to leaders which forms of knowledge need to be revisited.

In addition to this, during the last summer term, pupils in Year 5 partake in past SAT papers to inform the Year 6 teachers about planning and teaching.

In Year 6, past SAT papers are used to inform teachers on the next steps, inform planning and inform interventions and misconceptions which need to be addressed.

EYFS

Develop a 'can-do' maths attitude & strong foundation in understanding number so that every pupils can develop the necessary building blocks to excel mathematically.

Pre-planning: What Next? Experiences and opportunities linked to interests/topics Plan Do Review

Planning: collaboration of team. Planning best resources to be used

Clear understanding of the concept being taught

Mathematical vocabulary to be modelled, possible misconceptions

SEND/EAL inclusion - Quality first teach identified, scaffold learning using practical resources

Teaching for Mastery:

YR - Dedicated teaching time; 10/15 minute NCETM Mastery programme following one key concept enriching with White Rose. (See Interactive teaching) Representing mathematical thinking with objects and marks to help children make meaning of their thoughts.

YN & YR Maths embedded in the routines, story times, songs, registration, lining up, games. Visual resources to support this. Consistent modelling mathematical vocabulary

YN Key concept focus identified in planning and taught in whole class group and in adult initiated learning across the week

Enabling Environments Indoor and outdoor - Characteristics of Effective Learning (Playing & Exploring, Active learning, Creating & Thinking Critically)

Access to a wide range of resources for children to practise and extend their mathematical knowledge e.g *puzzles, building blocks, objects to make arrangements and patterns, objects to count, numbers, numerals, number lines, ten squares. Everyday items that promote maths - eg. Tape measures, role play, balance scales, natural objects, dice, laying cards, tubes, buttons, clipboards chalk, marker pens. Outdoor learning also reflects the learning being taught that week or previous week so children can apply skills taught using manipulatives.*

Role of the Adult: interacting in self directed play to maximise teaching opportunities **Modelling:** Ideas and mathematical language

Questioning: Open-ended questioning, "What do you see?", "How do you see it?", "What do you notice?" Giving the child time to think, process language and reflect

Sustained shared thinking: recasting or remodelling, repetition - scaffolding and consolidating their language and adding to knowledge. Introducing new vocabulary. Children use 'Stem sentences' taught.

SIX KEY AREAS OF EARLY MATHEMATICS LEARNING



Cardinality and Counting

Understanding that the cardinal value of a number refers to the quantity, or 'howmanyness' of things it represents



Comparison

Understanding that comparing numbers involves knowing which numbers are worth more or less than each other



Composition

Understanding that one number can be made up from (composed from) two or more smaller numbers



Pattern

Looking for and finding patterns helps children notice and understand mathematical relationships



Shape and Space

Understanding what happens when shapes move, or combine with other shapes, helps develop wider mathematical thinking



Measures

Comparing different aspects such as length, weight and volume, as a preliminary to using units to compare later

MASTERING NUMBER (Year R to 2)

From September 2021, Year R to 2 have been taking part in the NCETM's Mastering Number project which aims to secure firm foundations in the development of good number sense for all children across these year groups. The aim over time is that children will leave KS1 with fluency in calculation and confidence and flexibility with number.

Teachers in Years 1 & 2 will provide a daily teaching session for all children of 10 to 15 minutes, in addition to their normal maths lesson. The NCETM has provided all the relevant resources including lesson plans, visual resources, videos and practical equipment (Rekenrek).

MULTIPLICATION TABLES

Through grouping and sharing small quantities, pupils in key stage 1 begin to understand: multiplication and division; doubling numbers and quantities; and finding simple fractions of objects, numbers and quantities. They make connections between arrays, number patterns, and counting in twos, fives and tens.

As they move into key stage 2 pupils continue to practise their mental recall of multiplication tables when they are calculating mathematical statements in order to improve fluency. The national curriculum outlines that by the end of Year 4 all children should know their multiplication and division facts to 12×12 .

The multiplication tables check (MTC) is statutory for Year 4 children. The purpose of the MTC is to determine whether pupils can recall their times tables fluently, which is essential for future success in mathematics. It will help schools to identify pupils who have not yet mastered their times tables, so that additional support can be provided.

It is crucial that all teachers engage with the process of teaching multiplication tables and take ownership of those children who need additional support through intervention. Teachers should use a range of opportunities to allow children to deepen multiplication knowledge and their understanding rather than opt for rote memorisation. As, although learning tables by rote is by far the best method for speed and efficiency, accurately reciting the times tables doesn't mean children 'know' them. Children who claim to know all their tables only have a superficial understanding of them. It is crucial that children go deeper and understand what the numbers mean and how to apply their knowledge in a maths problem. Multiplications have to have a real-life purpose so look for opportunities to use them when problem-solving when shopping or using recipes.

HOMEWORK

Year 3 & 4 – TT Rock Stars

In Year 3, children will be introduced to TT Rock Stars after the Christmas holidays. This will then be set as an optional homework activity for children to access.

In Year 4, children will have maths homework once every week, this will be set on Google Classroom. Alongside this, children will have access to TT Rock Stars which they should use to practise their times tables to prepare them for the multiplication test in the summer term.

Year 5 – Arithmetic

In Year 5, children will be issued an online arithmetic paper via Google Classroom, once a week, which they will need to complete at home. If children do not have a device they can do this on, teachers in year 5 will give those children an opportunity to do it in school during a playtime or lunchtime.

Year 6 – Arithmetic and Reasoning

Pupils in Year 6 will be set one piece of Maths homework per week via Google Classroom. This will cover the children's learning in class retrospectively.