Calculation Policy

Policy Owner	Light Years School
Date Published	April 2024
Date of Next Review	April 2025
Circulation	All Staff and Website
Linked Policies	Safeguarding and Child Protection Policy Positive Behaviour Policy SEND Information Report Ofsted Framework 2019 Numeracy Policy Curriculum Policy
ISS Regulatory Requirements	Part 1 – Quality of Education Sections 1 – 2 (2)(b), 2(2)(h), 3(c)

Safeguarding at Light Years School

At Light Years School, we are committed to providing an environment in which students feel safe and secure to access their education. All stakeholders are responsible for ensuring the safety and well-being of children. Safeguarding is everyone's responsibility, and all staff are encouraged to maintain an "it could happen here" attitude. We recognise our responsibility to safeguard all who access school and promote the welfare of all our pupils by protecting them from physical, sexual and emotional abuse, neglect and bullying. Light Years School are dedicated to creating a strong safeguarding culture, and that the safety and well-being of children is the central thread that embeds itself through all aspects of the school. If a person is concerned about anything they read, witness or hear with regards to the school, they should contact the school's designated safeguarding lead immediately or Headteacher. Safeguarding, and the safety and well-being of all pupils at Light Years School is carefully considered and a central theme through all school policies.

Special Educational Needs & Disabilities (SEND) at Light Years School

At Light Years School, we are passionate about providing an inclusive education to children with special educational needs. We recognise and celebrate the individuality of our pupils and use personalised approaches, allowing pupils with SEND to feel supported during the school day. We strive to provide pupils with the same opportunities and experiences that pupils would have received at a mainstream school, believing passionately that in the right environment, with the right support, pupils will flourish in education. We do this by focusing on providing a SEND friendly environment, an adapted curriculum and a strong focus on developing pupils' personal, social and emotional development. The special educational needs and disabilities of all pupils at Light Years School is carefully considered and a central theme in through all school policies. For more information, please read the school's SEND Information Report.

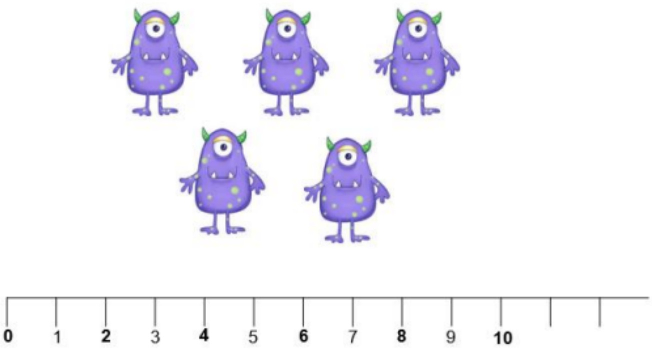
Developing Children’s Fluency with Basic Number Facts

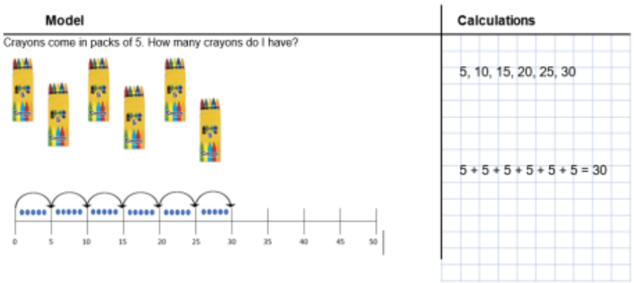
Fluent computational skills are dependent on accurate and rapid recall of basic number bonds to 10, 20 and 100 and times table facts.
At Light Years School we will spend a short time each day on basic facts which will quickly lead to improved fluency. Our Calculation Policy states that this is not through meaningless rote learning but through developing conceptual understanding through identifying patterns and relationships in an active, multi-sensory way.

We will help the children develop a strong sense of number relationships which is an important prerequisite for procedural fluency.

This is the order in which we will support our children learn multiplication tables in order to provide opportunities to make connections.

×10	×5	×2	×4	×8	×3	×6	×9	×7

Model	Calculations
How many legs are there? Count in groups of 2. 	Each alien has 2 legs. I will count in groups of 2. 2, 4, 6, 8, 10 There are 10 legs.

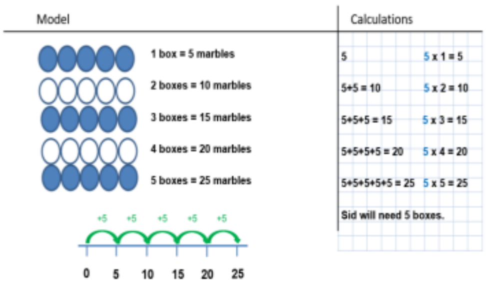
<table>
<tr><th>Worked example</th><th>Thinking</th><th>Your turn</th></tr>
<tr>
<td>


</td>
<td>How many groups of 5 do I have?

How did I use my number line to help me?

How have I written this as a repeated addition sentence?</td>
<td>Glue sticks are sold in packs of 5. How many glue sticks do I have?


</td>
</tr>
</table>

<table>
<tr><th>Worked example</th><th>Thinking</th><th>Your turn</th></tr>
<tr>
<td>'Sid has 25 marbles. He wants to put them in boxes of 5. How many boxes will he need?'


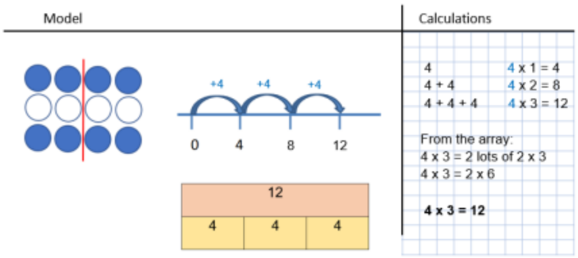
</td>
<td>How did I use the array to help me?

Why did I group the 25 marbles into 5s?

Why did I count on in 5s on the number line?

Why did I stop at 25 on the number line?

How could I check my answer?</td>
<td>'Sid has 35 marbles. He wants to put them in boxes of 5. How many boxes will he need?'</td>
</tr>
</table>

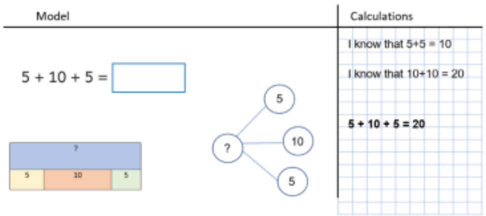
Worked example	Thinking	Your turn
4 x 3 = ☐  	Why have I got 4 counters in the first row of my array? What does the red line in my array show? How did I know that I needed 3 rows in total in my array? Why have I jumped in groups of 4 on my number line? How can I check that my answer is reasonable?	4 x 6 = ☐

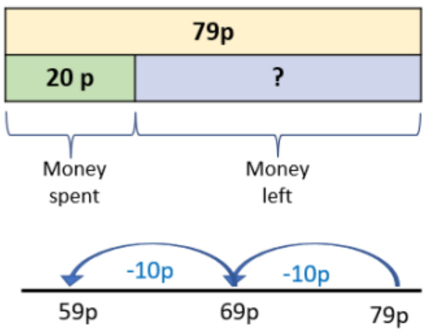
Developing Fluency in Mental Calculation

At Light Years School we identify that efficiency in calculation requires having a variety of mental strategies. In particular, the importance of the 10ness of 10 and partitioning numbers to bridge through 10.

For example: **9 + 6 = 9 + 1 + 5 = 10 + 5 = 15.**

As a school, we will be following the NCTEM Maths Hub guidance and referring to the uniqueness of 10 as “magic 10” and will be reminding the children “it is helpful to make a 10 as this makes calculation easier.”

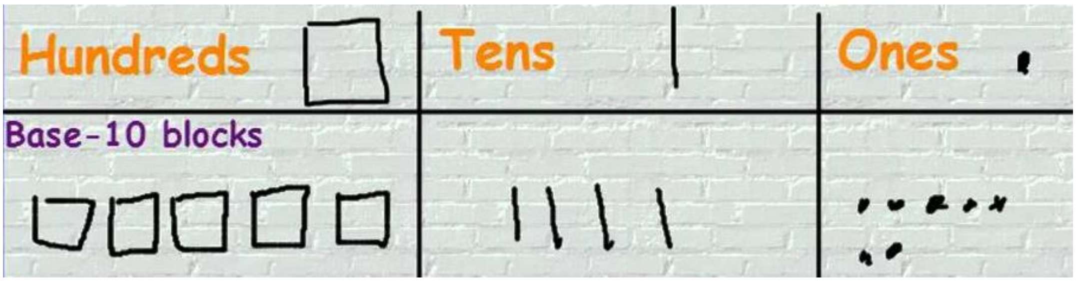
Worked example	Thinking	Your turn
5 + 10 + 5 = ☐ 	How did I use the bar model to help me? How have I represented the question on the part-whole model? Why was my first calculation 5 + 5? Why did I then calculate 10 + 10? How did I use my knowledge of number bonds to help me? How could I check my answer?	**6** + 10 + **6** = ☐

Model	Calculations
	79p – 20p = ☐ 79p – 10p = 69p 69p – 10p = 59p Philip has 59p left.

Developing Fluency in the use of Formal Written Methods

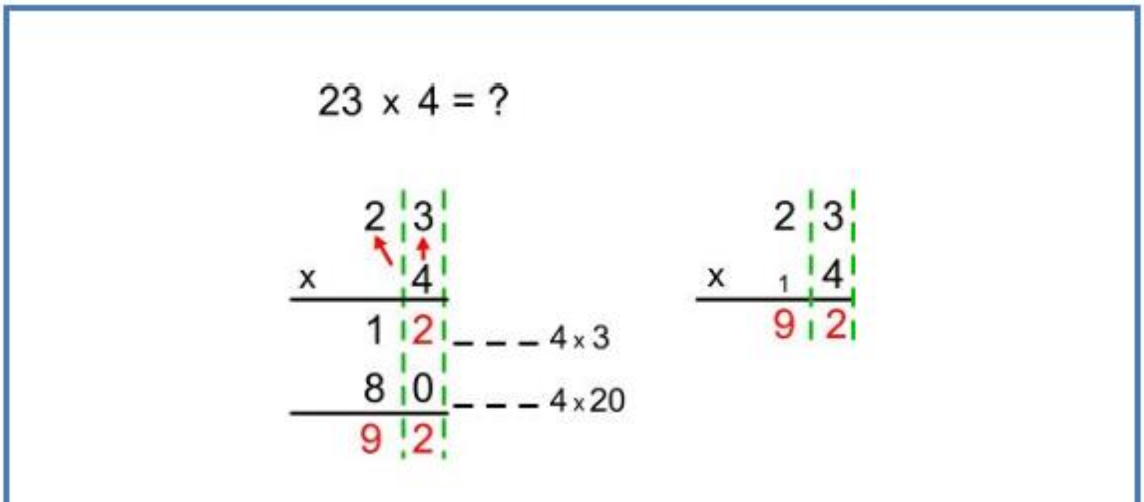
At Light Years School, we will be teaching column methods for calculation which provides the opportunity to develop both procedural and conceptual fluency. We will ensure the children understand the structure of mathematics presented in the algorithms with a particular emphasis on place value. At Light Years School, base 10 apparatus will be used and pictorial representation of base 10 will be encouraged to support the development of fluency and understanding.

For example:



We will also encourage informal methods of recording calculations which are an important step in helping children develop fluency with formal methods of recording. However, we will ensure that these are only used when necessary and for a short period to help children understand the internal logic of formal methods of recording calculations. They are stepping stones for formal written methods.

For example:



Stepping stones to formal written methods

Developing Children's Understanding of the = Symbol

At Light Years School we will use the correct vocabulary to ensure children know that the symbol = is an assertion of equivalence. If we are writing:

3 + 4 = 6 + 1

Then we are stating that what is on the left side of the symbol is necessarily equivalent to what is on the right side of the symbol. However, many children interpret = as being simply an instruction to answer a calculation, as a result of them usually always seeing the symbol used as thus:

3 + 4 =

5 × 7 =

16 – 9 =

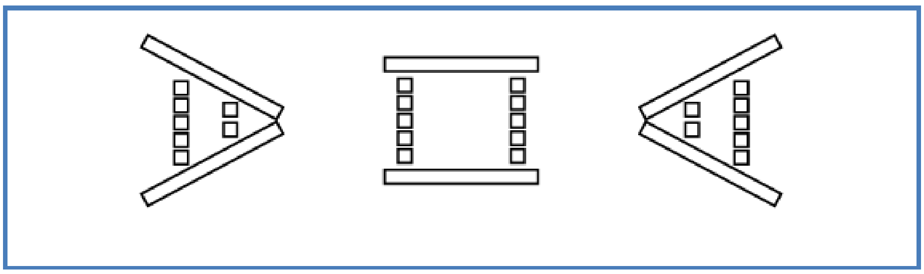
At Light Years, we will address the misconception that children only think of = as meaning 'work out the answer to this calculation' to ensure children are not confused by empty box questions such as:

3 + ☐ = 8

We will model equivalence using balance scales and will include empty box problems right from the start of their journey at Light Years to deepen understanding of the = symbol.

Teaching Inequality Alongside Teaching Equality

To help our children to develop their understanding of equality they also need to develop understanding of inequality. We will introduce < and > by using rods and cubes to make a concrete and visual representation such as:



Which will show that 5 is greater than 2 (5 > 2), 5 is equal to 5 (5=5) and 21 is less than 5 (2 < 5).

We will make an active effort to incorporate both equality and inequality into examples and exercises that can help children develop conceptual understanding.

For example, in the below activity the children have an empty box problem where they must decide whether the missing symbol is <, = or >.

5 + 7 ☐ 5 + 6

An activity like this also allows children to develop their mathematical reasoning skills by using language such as “I know that 7 is greater than 6, so 5 plus 7 must be greater than 5 plus 6”.

We would then ask the children to decide if number sentences are true or false which also helps them develop mathematical reasoning. For example, when discussing this statement:

4 + 6 + 8 > 3 + 7 + 9

We would anticipate the children to reason “I know that 7 is greater than 6, so 5 plus 7 must be greater than 5 plus 6”. We would then ask the children to decide if number sentences are true or false which also helps to develop mathematical reasoning. For example, in discussing this statement:

4 + 6 + 8 > 3 + 7 + 9

The children may reason that “4 plus 6 and 3 plus 7 are both 10. But 8 is less than 9. Therefore 4 + 6 + 8 must be less than 3 + 7 +9, not more than 3 + 7 + 9.”

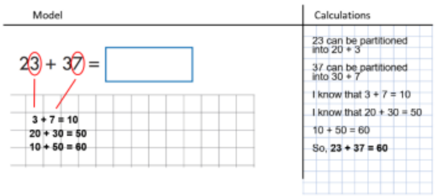
In both the above examples, and within our numeracy lessons, the numbers will be deliberately chosen to allow the children to establish the answer without needing to do the computation. This again emphasises further the importance of mathematical reasoning.

Don’t Count, Calculate

Research shows that young children benefit from being helped at an early age to calculate rather than relying on ‘counting on’ or using fingers as a way of calculating. For example, with a number sentence such as:

4 + 7 =

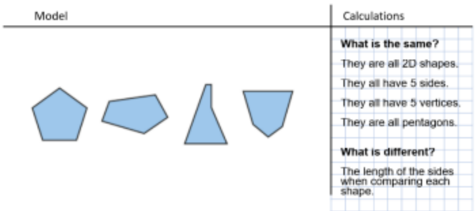
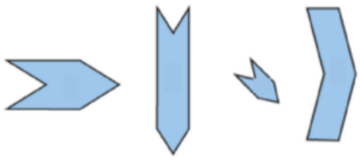
At Light Years School, we would encourage children to use their knowledge to bridge 10 and deduce that because 4 + 6 = 10, 4 + 7 = 11.

Worked example	Thinking	Your turn
23 + 37 =  	Why did I partition 23 into 20 and 3? Why did I partition 37 into 30 and 7? How did I use my number bonds knowledge to help me? Why did I calculate 10 + 50? How could I check my answer?	33 + 47 =

Look for Pattern and Make Connections

At Light Years School, we follow the 'concrete, pictorial, abstract' approach and use a great many visual representations of mathematics alongside concrete resources. We know that understanding doesn't happen automatically and that we need to support our children to begin to reason by themselves and make their own connections.

From the start of their journey at Light Years School, we will encourage our children to reason and look for patterns and connections within mathematics. We will ask the question "what's the same, what's different" to frequently make comparisons. For example, "what's the same and what's different between the 4 times table and 8 times table?".

Worked example	Thinking	Your turn
'What is the same and what is different about these shapes?'  	How did I know that all of the shapes were 2D? How could I check that all the shapes have 5 sides? How could I check that all the shapes have 5 vertices? How could I check that the lengths of the sides when comparing each shape are all different?	**'What is the same and what is different about these shapes?'** 

Using Smart Practice

Through our aspirational numeracy curriculum, we will provide children the opportunity to develop both procedural and conceptual fluency. Our children will be required to reason and make connections between calculations. The connections they are able to make will improve their fluency.

2 × 3 =	6 × 7 =	9 × 8 =
2 × 30 =	6 × 70 =	9 × 80 =
2 × 300 =	6 × 700 =	9 × 800 =
20 × 3 =	60 × 7 =	90 × 8 =
200 × 3 =	600 × 7 =	900 × 8 =

Shanghai Textbook Grade 2 (aged 7/8)

Using Empty Box Problems

At Light Years, we recognise that empty box problems are a powerful way to help children develop a strong sense of number through intelligent practice. Empty box problems provide the opportunity for reasoning and problem solving and finding easy ways to calculate. Empty box problems enable children to practice procedures whilst at the same time allowing them to think about conceptual connections.

A sequence of examples such as:

3 + ☐ = 8

3 + ☐ = 9

3 + ☐ = 10

3 + ☐ = 11

These help the children to develop their understanding that the = symbol is an assertion of equivalence and allows children to spot the pattern and use this to work out the answers.

This sequence of examples does the same at a deeper level

3 × ☐ + 2 = 20

3 × ☐ + 2 = 23

3 × ☐ + 2 = 26

3 × ☐ + 2 = 29

3 × ☐ + 2 = 35

At Light Years, we will also give children plenty of examples where the empty box represents the operation, for the children to complete, for example:

4 × 5 = 10 ☐ 10

6 ☐ 5 = 15 + 15

6 ☐ 5 = 20 ☐ 10

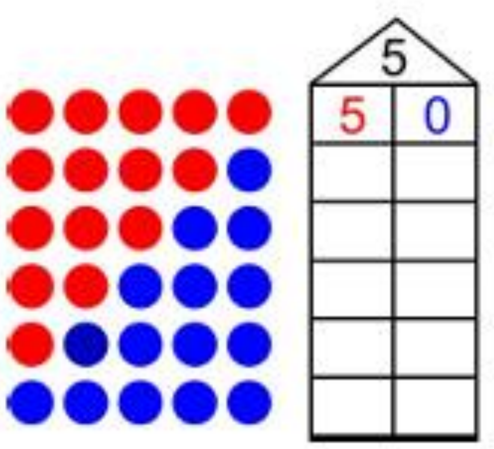
8 ☐ 5 = 20 ☐ 20

8 ☐ 5 = 60 ☐ 20

All of the above examples illustrate a purposeful variation to help children develop both their procedural and conceptual fluency.

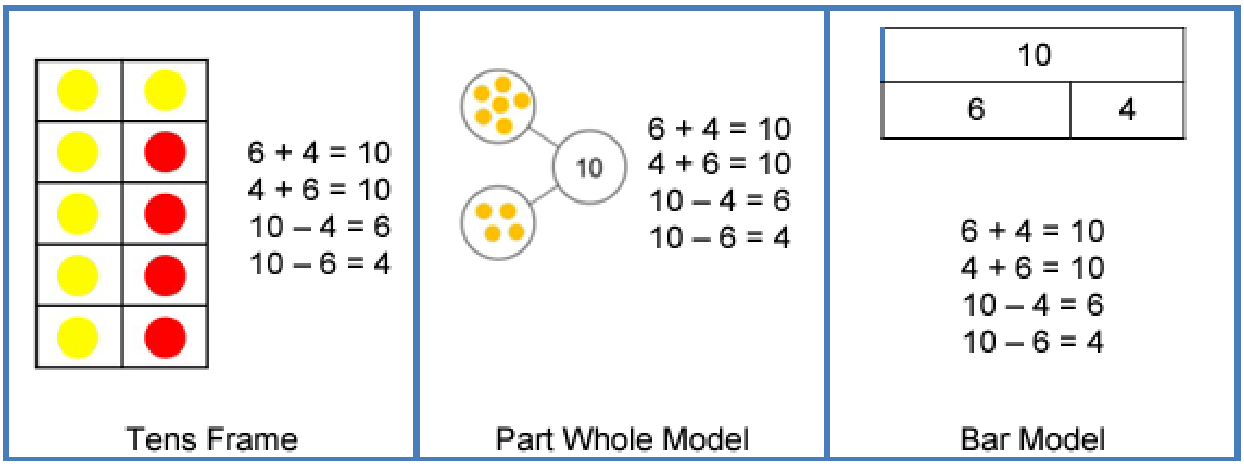
Exposing Mathematical Structure and Working Systematically

At Light Years School, we support the children to develop their instant recall alongside conceptual understanding of number bonds to 10. We support this through the use of pictorial representation such as the example illustrated below:



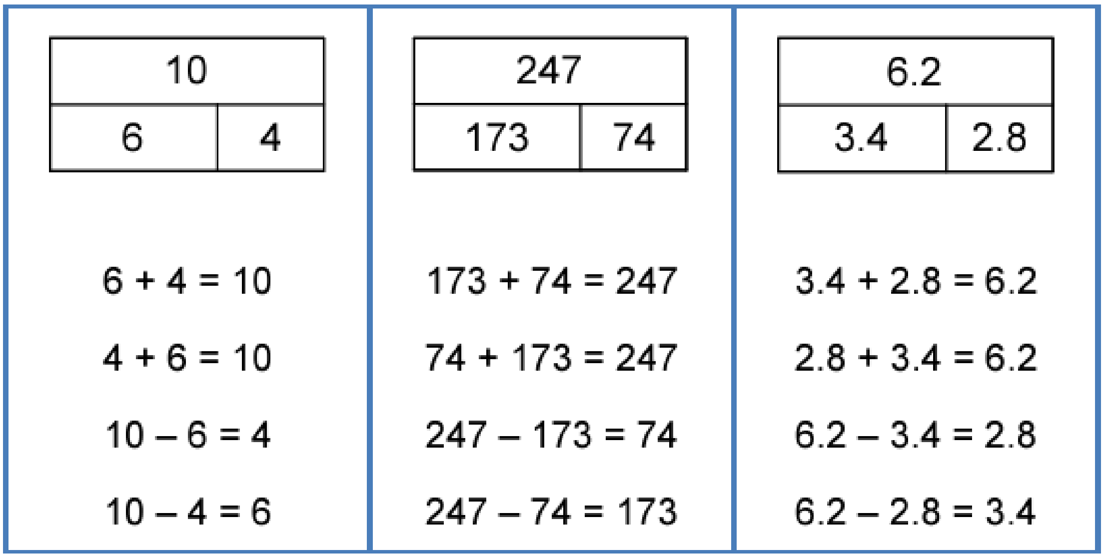
The image above allows the children to seek pattern and work systematically, connecting one number fact to another and be certain when they have found all number bonds to 5.

Using other structured models such as tens frames, part whole models or bar models which can help children to reason about mathematical relationships.



In the example above, at Light Years, we would encourage children to make connections between these models so that they can understand the same mathematics being represented in different ways. Again, we would use familiar language and pose the question "what's the same, what's different?" which allows the potential for children to draw out connections.

Showing that the same structure can be applied to any numbers will help our children to generalise mathematical ideas and build from simple to complex numbers. We support the children to recognise that the structure stays the same, it is only the numbers that change. For example:

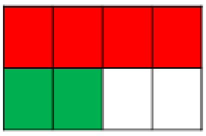


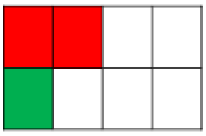
Moving Between the Concrete and the Abstract

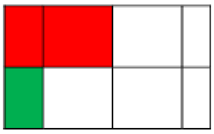
We strengthen the children's conceptual understanding and fluency by using concrete, visual and abstract representations of a concept during a lesson. We move between the concrete and the abstract to help children connect abstract symbols with familiar contexts, which provides the opportunity to make sense of, and develop the fluency and use of abstract symbols.

As an example, in a lesson about addition of fractions children could be asked to draw a picture to represent the number sentence $\frac{1}{4} + \frac{1}{8} = \frac{3}{8}$.

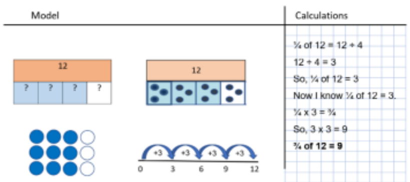
As an alternative, or in a subsequent lesson they could be asked to discuss which of the three images correctly shows the number sentence, asking the children to explain their reasoning.







Other examples:

<table>
<tr><th>Worked example</th><th>Thinking</th><th>Your turn</th></tr>
<tr>
<td>¾ of 12 = ☐

</td>
<td>How did I use the bar model to help me?

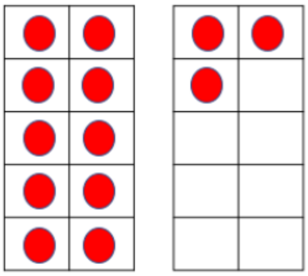
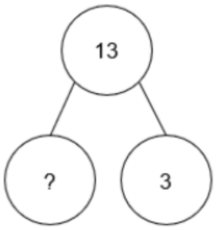
What does the array show?

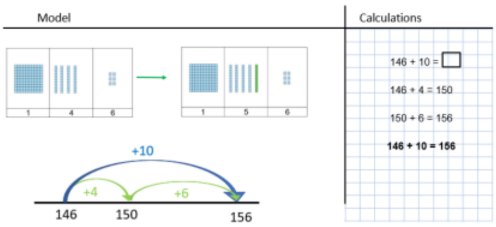
How did the number line help me?

Why did I calculate ¼ of 12 and then multiply it by 3?

Is my answer reasonable?

How could I check my answer?</td>
<td>¾ of 20 = ☐</td>
</tr>
</table>

Model	Calculations
There are 13 marbles in a full bag. Three marbles fall out. How many are left in the bag?  	A teen number is 10 and some more. 13 = 10 and 3 13 = one 10 and 3 ones. 10 + 3 = 13 3 + 10 = 13 13 - 10 =3 **13 – 3 = 10**

Worked example	Thinking	Your turn
146 + 10 = ☐ 	How did I use the Dienes to help me? Why did I add 4 first to 146? Why did I then add 6? How could I check my answer? What is the same / different about 146 and 156?	**126 + 10 = ☐**

Contextualising the Mathematics

A lesson about addition and subtraction could start with this contextual story:

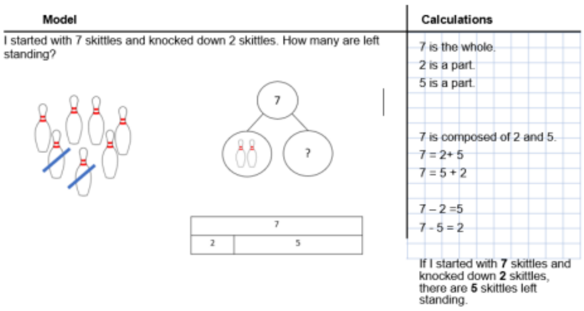
"There are 11 people on a bus. At the next stop 4 people get on. At the next stop 6 people get off. How many are now on the bus?"

Contextualising the mathematics allows children to develop their understanding of concepts. During the lesson, teachers should continue to return to the story. For example, if the children are looking at this calculation

14 – 8

The teacher would then ask the children probing questions such as ‘what does the 14 mean? What does the 8 mean?’ expecting that the children will answer ‘there were 14 people on the bus, and 8 is the number who got off.’

Asking the children to interpret the meaning of the terms in a number sentence such as 7 + 7 = 14 will give a good assessment of the depth of their conceptual understanding and their ability to link the concrete and abstract representations.

<table>
<tr><th>Worked example</th><th>Thinking</th><th>Your turn</th></tr>
<tr>
<td>I started with 7 skittles and knocked down 2 skittles. How many are left standing?

</td>
<td>What is the whole?

Are the parts going to be bigger or smaller numbers than the whole?

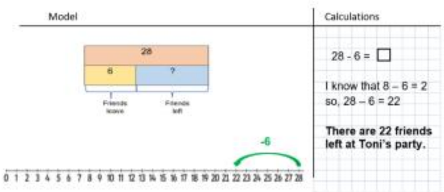
Why did I put 2 as one part?

How did I work out the missing part?

7 is composed of 2 and 5.

Which number sentence matches my story?</td>
<td>I started with 7 skittles and knocked down 3 skittles. How many are left standing?</td>
</tr>
</table>

Other examples:

<table>
<tr><th>Worked example</th><th>Thinking</th><th>Your turn</th></tr>
<tr>
<td>‘Toni has 28 friends at her party. Six have to leave early. How many are left?’

</td>
<td>How did I use the bar model to help me?

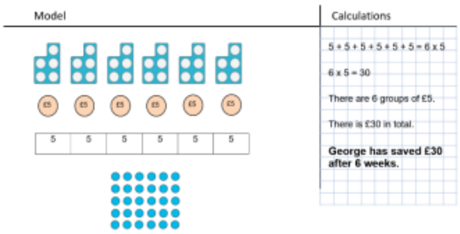
Why did I put 28 at the end of my number line to start with?

Why did I then subtract 6?

What number facts did I use to help me?

How could I check my answer?</td>
<td>‘Toni has 30 friends at her party. Eight have to leave early. How many are left?’</td>
</tr>
</table>

<table>
<tr><th>Worked example</th><th>Thinking</th><th>Your turn</th></tr>
<tr>
<td>‘George saves £5 pocket money each week for 6 weeks. How much does he save?’


</td>
<td>How did I use Numicon to help me?

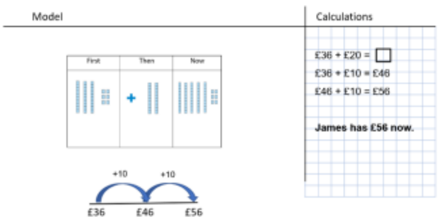
What does the bar model show?

What calculation does the array show?

Why did I use repeated addition?

How could I check my answer?</td>
<td>‘George saves £5 pocket money each week for 8 weeks. How much does he save?’</td>
</tr>
</table>

<table>
<tr><th>Worked example</th><th>Thinking</th><th>Your turn</th></tr>
<tr>
<td>‘James has £36 in his money box. He receives £20 for his birthday. How much money does he have now?’


</td>
<td>How did I use the Base 10 to show my workings?

What does the first, then, now board show?

What calculation does the number line show?

What would a more efficient strategy be to use on the number line?

How could I check my answer?</td>
<td>‘James has £36 in his money box. He receives £30 for his birthday. How much money does he have now?’</td>
</tr>
</table>

Using Questioning to Develop Mathematical Reasoning

Our teachers use carefully planned, probing questions in mathematics lessons which are asked in order to find out whether children can find the answer to a calculation or a problem. In order for us to develop children’s conceptual understanding and fluency, at Light Years we have a strong and consistent focus on questioning that encourages and develops mathematical reasoning.

We do this simply by asking the children how they worked out a calculation or solved a problem and to compare and contrast different methods. We do this in a consistent way so that children quickly come to expect that they need to explain and justify their mathematical reasoning, meaning they will soon do this automatically and with enthusiasm.

We note that some calculation strategies are more efficient than others and therefore our teachers scaffold children's thinking to guide them to use the most efficient method whilst still valuing the children's ideas.

Again, our rich questioning strategies include:

- *'what's the same, what's different'*.

We could ask the children 'what's the same, what's different' about the below sequence of expressions:

23 + 10	23 + 20	23 + 30	23 + 40

We use discussion to identify the relationship between calculations and to use the pattern to calculate the answers.

- *Odd one out*

We could ask the children to find the odd one out in a list of numbers.

For example, 24, 15, 16 and 22.

"15 is the odd one out because it's the only odd number in the list."

"16 is the odd one out because I's the only square number in the list."

"22 is the odd one out because it's the only number in the list with exactly 4 factors. "

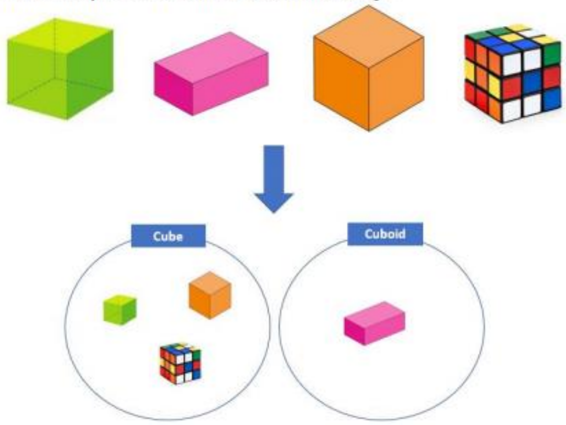
If the children are then asked to identify an 'odd one out' in this list of products:

24 × 3   36 × 4   13 × 5   32 × 2

They might note that:

"36 x 4 is the only product whose answer is greater than 100".

"13 x 5 is the only product whose answer is an odd number."

Model	Calculations
Which shape is the odd one out and why? 	They all have the same number of faces. **6** They all have the same number of edges. **10** The cuboid is the odd one out because it does not have squares for all its faces.

- *Here's the answer. What could the question have been?*

We ask the children to suggest possible questions that have a given answer. For example, in a lesson about the additions of fractions, children could be asked to suggest possible ways to complete this sum:

$$\square + \square = \frac{3}{4}$$

- *Identify the correct question:*

Here children are required to select the correct question:

A 3.5m plank of wood weighs 4.2 kg

The calculation was:

3.5 ÷ 4.2

Was the question:

a. How heavy is 1m of wood?

b. How long is 1kg of wood?

- True or False

The children are given a series of equations and are asked whether they are true or false:

$4 \times 6 = 23 \quad 4 \times 6 = 6 \times 4 \quad 12 \div 2 = 24 \div 4 \quad 12 \times 2 = 24 \times 4$

We expect children to reason about the relationships within the calculations rather than purely to calculate.

- *Greater than, less than or equal to >. , < or =.*

$3.4 \times 1.2 \bigcirc 3.4 \quad 5.76 \bigcirc 5.76 \div 0.4 \quad 4.69 \times 0.1 \bigcirc 4.69 \div 10$

These types of questions are further examples of purposeful practice where conceptual understanding is developed alongside the development of procedural fluency. They also give the pupils who are rapid graspers the opportunity to apply their understanding in more complex ways.

Expecting Children to use Correct Mathematical Terminology and to Express their Reasoning in Complete Sentences

We know that the quality of children's mathematical reasoning and conceptual understanding is significantly enhanced if they are consistently expected to use correct mathematical terminology e.g. saying 'digit' rather than 'number' and to explain their mathematical thinking in complete sentences.

I say, you say, you say, you say, we all say.

The above technique enables teachers to provide a sentence stem for all children to communicate their ideas with mathematical precision and clarity. These sentence structures express key conceptual ideas or generalities and provide a framework to embed conceptual knowledge and build understanding. For example:

If the rectangle is the whole, the shaded part is one third of the whole.

Having modelled the sentence, the teacher then asks individual children to repeat this, before asking the whole class to chorus chant the sentence. This provides children with a valuable sentence for talking about fractions. Repeated use helps to embed key conceptual knowledge.

Another example is where children would fill in the missing parts of a sentence; varying the parts but keeping the sentence stem the same. For example:

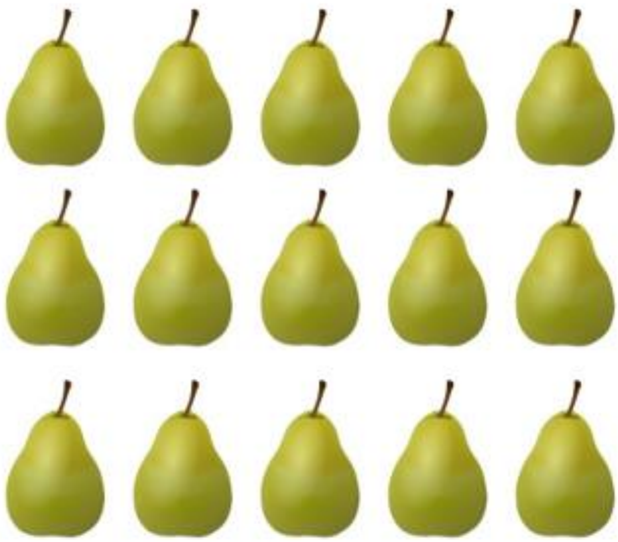
There are 12 **stars**. $\frac{1}{3}$ of the **stars** is equal to **4 stars**

Children use the same sentence stem to express other relationships. For examples:

There are 12 **stars**. $\frac{1}{4}$ of the **stars** is equal to **3 stars**

There are 12 **stars**. $\frac{1}{2}$ of the **stars** is equal to **6 stars**

Similarly:



There are **15 pears**. $\frac{1}{3}$ of the **pears** is equal to **5 pears**

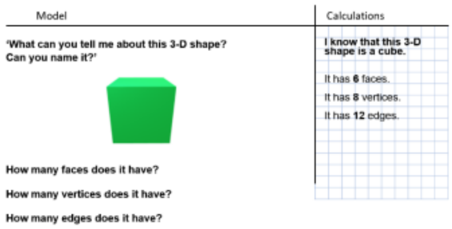
There are **15 pears**. $\frac{1}{5}$ of the **pears** is equal to **3 pears**

When talking about fractions it is important to make reference to the whole and the part of the whole in the same sentence. The above examples help children to get into the habit of doing so.

Another example is where a mathematical generalisation or “rule” emerges within a lesson. For example:

When adding 10 to a number, the ones digit stays the same.

This is repeated in chorus using the same sentence, which helps to embed the concept.

Worked example	Thinking	Your turn
‘What can you tell me about this 3-D shape? Can you name it?’  	How did I know that the 3-D shape was a cube? How did I know how many faces it has? How could I check how many vertices it has? How did I know how many edges it has? How could I check my answer?	**‘What can you tell me about this 3-D shape? Can you name it?’** **How many faces does it have?** **How many vertices does it have?** **How many edges does it have?**

Identifying Difficult Points

Difficult points and misconceptions need to be identified and anticipated when lessons are being planned and these will be an explicit part of the teaching, rather than just a teacher responding to children’s difficulties if they arise in lessons. The teachers actively seek to uncover possible difficulties because if one child has a difficulty it is likely that others will have a similar difficulty.

Sticking points also give an opportunity to reinforce that we learn most by working through ideas which we aren’t fully secure or confident with. Having discussion about difficult points can be stimulated by asking children to share thoughts about their own examples when these show errors arising from insufficient understanding. For example:

$$\frac{2}{14} - \frac{1}{7} = \frac{1}{7}$$

Our teachers will also use visualisers as a valuable resource as it allows teachers the ability to quickly share a child’s thinking with the whole class.