Maths Investigations
Guide to the Wise Owls
for parents and teachers

(Version 2.2, 19 Nov 2016, covering the first 12 owls)

(With a new overview of all the owls and revisions to the content of Mully, Divvy, Fizzy and Quarty.)

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Introduction

The wise owls are a set of activities that children can work through on their own in school or at home. They can do these in addition to any activities that the teacher sets up for their class or group.

Each owl has its own group, which children can join. There is a link to all the owls from the main page. Working on their own, children are free to choose any owl they wish and can move between them freely.

If you want to support your children's learning at home, you may wish to explore the owls together, in order. Your children will then be following a carefully planned skills progression. The guides below suggest practical activities that you can do together to complement the online ones.

Completing and regularly revising these activities will help to ensure that your children are really secure in their core number skills.

Practical experience of number is really important in the early stages. To support use of the online owl materials, various practical equipment is recommended.

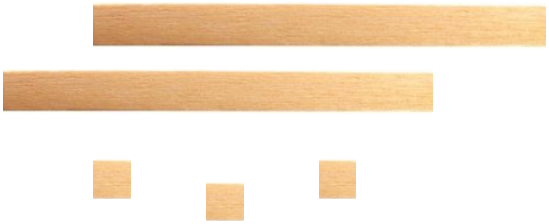
For 'counters' be creative. The kitchen will provide lots of possible objects to count. Coloured pasta shells are particularly good!

It will also help to have two metre sticks. Your hardware store should be able to cut a strip of wood into two 1m lengths. Use a tape measure to mark where the 10cm (and 5cm) divisions are and write them on.

Then mark divisions (but not the numbers) for the in-between numbers.

If you prefer, you can order ready-made ones from the Ruler Company (http://www.rulerco.co.uk/index.php?doc=13&vid=60).
If you are really enthusiastic, base ten rods and unit cubes would also be useful (any colour). You can get these from educational suppliers.

As an alternative to these, you can make your own tens and unit sticks. Standard lolly sticks are 11.5cm long and 1cm wide so they can be cut to create 10cm sticks and 1cm sticks.



In some cases, printable materials are referred to. These can be found by following the *Printable Activities* links in the parent area of the Maths Investigations web site.

The other thing that is really important for your children's understanding is **getting them to explain their thinking** (using the practical equipment to demonstrate). Constantly challenge them to say **why** things work the way they do. Suggestions are given in some of the pages about the different owls.

The words 'so' and 'because' are particularly useful. You may enjoy playing around with these and make a big thing out of using them:
'3 + 7 = 10 **sooo** 3 tens + 7 tens = 10 tens **sooo** 30 + 70 = 100'

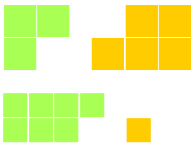
Have fun!

Patience and **gentle encouragement** are really important for effective learning. See the separate pdf '*Tips for Helping with Maths at Home*' for some helpful hints.

Overview of the first 12 Owls

BOD (*Numbers within 10, Odds and Evens*) – *page 10*

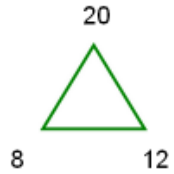
Bod covers numbers within 10 and develops the skills of counting, adding & subtracting.



Particularly important are:
- practical experience with counters
- arranging counters in pairs – this will help with the understanding of odd and even numbers
- memorising the pairs that add to make ten (eg 3 + 7) – these are an essential foundation to what comes next.

TEENY (*Numbers within 20*) – *page 11*

Teeny covers numbers to 20, looking particularly at the teens numbers, the doubles and the pairs that add to make twenty. Particularly important are:
- understanding the links between the pairs that add to ten and the pairs that add to twenty – these should be thoroughly explored using two sets of ten counters arranged in pairs.
- understanding why the teens numbers have the names they have (eg six and ten is sixteen)
- understanding the link between addition and subtraction – investigate addition triangles and the patterns in their fact families – the 'altogether' number always comes at the top of the triangle, at the end of the additions and the start of the subtractions

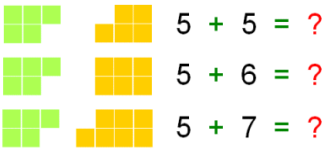


- memorising the key facts - they are the basis of much of what follows.

DIDGIE (*Add and Subtract with Single Digits*) – *page 12*

The crucial idea behind Didgie is that, if you know some number facts by heart, you can work out others **without counting**. If children can master this key skill at an early stage, they will make much more rapid progress in subsequent work. Important points:

- strategies need to be taught and skills practised -:doubles help with near doubles (eg 5+6), pairs that make 10 help with near tens pairs (eg 3+6), the teens facts can help with near teens (adding 9 and 8)
- practise the individual skills first, then work on mixed examples
- as your children work through the tablet activities, watch them carefully – if you catch them counting, then go over the key ideas again!



MULLY (*Concept of Multiplication, with Numbers up to 50) – page 13*

Before learning their tables, children need to understand what multiplication is. The best illustration of this is the multiplication rectangle. Once you understand the concept, you can then learn to count forwards and backwards in different multiples and finally memorise the facts. Important points:
- make sure the concept is thoroughly understood through making and talking about rectangular arrays of counters
- turn the rectangles round the other way to show linked pairs of facts (3x4, 4x3 etc.)

- do lots of speaking practice using the phrases 'rows', 'in each row' and 'altogether'
- give practice counting tens and make sure your children understand that eg 4 tens is the same as 4 lots of ten, which is the same as 4x10
- give daily practice with the two printable games: The Counting Caterpillar and Tap Say Turn – this will help with memorising the facts which again is crucial as a foundation for what comes next – begin with the 10x, 2x and 5x tables
- take time to investigate factors and factor rainbows – these provide a lovely pictorial understanding of which rectangles you can make with a particular number of counters

HONEY (*Numbers up to and just beyond 100) – page 14*

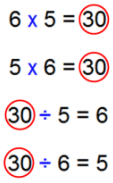
A really fundamental idea for children to grasp is that of the number line. Numbers are arranged in sequence, and go on for ever! The numbers to 100 are best understood using a metre

stick. Ideally you want one where the tens and fives numbers are marked but only the divisions for the

in-between numbers are there, not the numbers themselves - discussion of what the missing numbers are is really good for building understanding of how the numbers are arranged. Tens sticks from base ten material can be used to explore what happens if you add and subtract different multiples of ten two and from any number. If you want to explore beyond 100, you can then add another metre stick to the end off the first one and see that the patterns repeat themselves. Particularly important are:
- counting forwards and backwards in 1s and 10s
- understanding what happens when you count in 10s beyond 100 - silly number names like eleventy and twelvety can help with this
- exploring the tens pairs that add to make 100 (the number complements) and linking these to the pairs that add to make ten

DIVVY (*The Concept of Dividing) – page 15*

Division, like multiplication, is best understood using rectangles. The important points:
- make sure the concept is thoroughly understood through making rectangular arrays of counters and then splitting them up in different ways.
- do lots of speaking practice using the phrases 'altogether', rows', 'in each row' – turning the rectangle around shows how paired facts are related (eg 12 ÷ 3 = 4, 12 ÷ 4 = 3)
- continue daily practice with The Counting Caterpillar and Tap Say Turn to memorise multiplication and division facts.- once secure with the 10s, 5s and 2s, move on to the 3s and 4s
- understand the link between division and multiplication – investigate multiplication triangles and the patterns in their fact families – the altogether number always comes at the top of the triangle, at the end of the multiplications and the start of the divisions

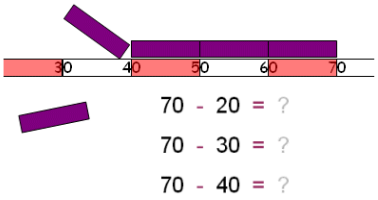


In parallel with the work on division, your children should also be starting to explore the idea of fractions, looking first at fractions of shapes and how to write and speak fractions correctly. This is fully covered in the printable guide 'Success with Fractions'. These ideas are an important foundation for the tablet activities on fractions that come in later owls.

STICKY (*Magical Metre Sticks!*) – *page 16*

This owl builds on the skills introduced in both Honey and Divvy. The activities make extensive use of metre sticks and tens rods to add and subtract multiples of ten to and from other numbers, and to introduce the concept of 'difference', the distance between two numbers, and to see how this is linked to subtraction. Metre sticks are also used to further develop doubling and halving skills within 200. Important points:

- give lots of practical experience with the metre stick and with tens sticks
- encourage children to use the number facts they have already memorised to help them with others (eg double 4 is 8 so double 4 tens is 8 tens)



FIZZY (*Work with Fives and Fifties and Halves) – page 17*

This owl builds further on the skills in the previous four owls, focusing particularly on numbers involving fives. Part particular attention:

- the number complements – why it is (eg) 65 + 35 = 100 and not 65 + 45
- the link between difference and subtraction
- how metres and centimetres work

ADDISUB (*Add and subtract single digits to and from larger numbers) – page 18*

Once your children are secure both adding and subtracting with single digits (see Didgie) and adding and subtracting tens from two-digit numbers (Honey) then they are ready to explore how to add and subtract a single digit to or from a 2-digit number. As with the earlier work on single digits, there are a series of different mental strategies to be mastered here. Take them one at a time and practise each thoroughly. Again keep an eye out to ensure that your children are using the strategies taught and not simply falling back on counting.

8 + 8 = ?

so

18 + 8 = ?

28 + 8 = ?

38 + 8 = ?

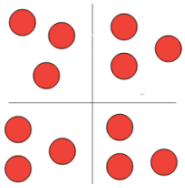
48 + 8 = ?

Also covered in Addisub are the number pairs that make 100. These build on the fives pairs learned in the previous owl. Understanding these will give a firm foundation for money skills, in particular with finding change from £1. They are also really useful when you move on to learning mental strategies with 3-digit numbers.

QUARTY (*Work with Fours and Understand Quarters) – page 19*

Fractions are often poorly understood by children, because not enough time is spent on the fundamental concepts. The work you have already done using the Success with Fractions guide (see Divvy) will be a good foundation for the ideas introduced here. Also really important again is practical work. Things to focus on:

- the metre stick – use this to represent one whole and investigate where you need to chop it to get two or four equal pieces
- being really secure in understanding that the denominator of a fraction tells you WHAT KIND of fraction it is, the numerator tells you HOW MANY you have
- the idea that you can get more than two halves and more than four quarters by extending to a second metre stick
- the idea that there are two ways of thinking about fractions larger than one metre – either by counting the number of whole metres and then adding on the remaining piece (eg 2 $\frac{1}{4}$) or counting the fractions from the beginning (eg 9 quarters altogether)
- using (eg) 12 and then 20 counters to explore how to find first 1 quarter, then 2 quarters, then 3 quarters of small numbers, and how you can extend this idea to help you find other simple fractions of the same two numbers
- in all of the above, look for patterns – do not teach rules – these come much later!

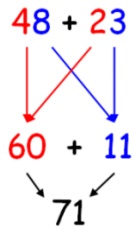


TOODIE (*Add and Subtract 2-digit Numbers) – page 20*

It is tempting, when you get to adding and subtracting 2-digit numbers, to go straight to introducing the standard written methods (chimney sums). This is a mistake! There is plenty of research showing that children who are held back from learning the written methods too soon, and instead are encouraged to develop

mental skills and record their answers horizontally, become much more numerate later.

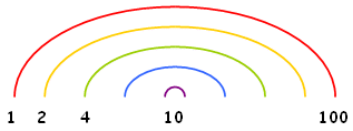
The work your children have done in Honey, Sticky, Fizzy and Addisub on adding and subtracting both tens and single digits ro / from 2-digit numbers will be a good basis for the mental strategies introduced here. As before, you will need to devote plenty of time to exploring the different strategies and discussing when each is best used. Again, when your children are working on the tablet activities, look out for them simply counting on or back and remind them of the more efficient strategies you have explored together.



DESSY (*Understand Decimal Halves, Tenths and Fifths)* – *page 21*

Following close on the heels of your exploration of quarters comes an introduction to decimals. Again the metre stick or counting stick (ten sections with no numbers at all) is brilliant for helping children to understand the concept. A really good starting point is the printable activity 'How Big is the Room'. Once the idea of whole metres and 'bits' of metres is established you can let your children loose on the tablet activities. Things to note:

- only the first place of decimals is introduced here – the second place comes in a subsequent owl, Decipercy
- as soon as decimals are introduced we explore their equivalences with fractions, initially halves and tenths, then fifths
- there is an interesting link between the decimal values for 1 tenth and 1 half and the factor rainbow for 100 – see if you can find it!



Help Sheets for Each Owl

As constantly emphasised throughout the Maths Investigations web site, it is really important for children to have lots of practical activities in the early years of their mathematical learning and to talk, in depth, about their understanding using the correct vocabulary. The following pages give suggestions for practical and talking activities that you can do with your children to support their use of the tablet activities.

BOD (*Numbers within 10, Odds and Evens)*

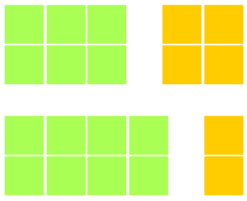
Count sets of up to 10 objects, of different kinds, shapes and sizes.

Count forwards and backwards within 10 (without objects).

Use counters to make pictures of numbers like this.

Odd:

Even:



Explore together the idea that odd numbers stick out and even numbers are smooth – if you add two odd numbers the sticky out bits fit together. If you put two even numbers together, it stays smooth. If you put an odd onto an even you get another odd.

Discuss the idea of 'one (or two) more than' and one (or two) less than. Link this to the idea of adding 1 or 2 (+1, +2) and subtracting 1 or 2 (-1, -2).

3 + ? = 10

Investigate the number pairs that add to make ten. (5 + 5, 4 + 6, 3 + 7 etc)

See the printable activities, '*Tap Say Turn – Number Bonds*' for help memorising,

TEENY (*Numbers within 20)*

Use counters to explore doubles (double 1 is 2: 1 + 1 = 2, double 6 is 12: 6 + 6 = 12, etc.) up to double 10. Investigate linked subtractions: 14 – 7 = 7. (See '*Tap Say Turn – Number Bonds*' for help with memorising),

Use counters to explore ways of partitioning 12 (eg 6 + 6, 10 + 2 etc). Repeat for other teens. Arrange the counters in pairs like this.

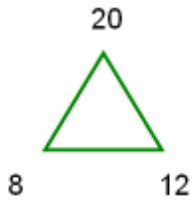
6 + 6 = 12 10 + 2 = 12

Investigate teens facts (4 + 10 = 14, 6 + 10 = 16 etc) using counters. Speak aloud *four* and *ten* is *four-teen* etc. Memorise them: (see *Tap Say Turn – Number Bonds* again for help with memorising),

Explore doubles and teens together: 7 + 7 = 14; 10 + 4 = 14; etc.

Explore how the pairs that make 10 can help with pairs that make 20.

7 + 3 = 10 **so** 7 + 13 = 20 etc.
7 + 13 = 20 **so** 20 – 7 = 13.



12 + 8 = 20
8 + 12 = 20
20 - 8 = 12
20 - 12 = 8

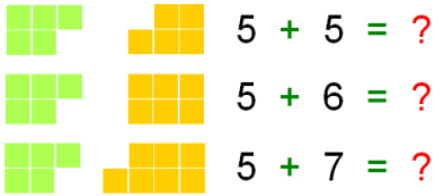
Explore addition triangles and their fact families. Investigate: the number at the top of the triangle is at the end of the additions and the start of the subtractions and is (usually!) the larger number.

DIDGIE (*Add and Subtract with Single Digits)*

Establish with cubes or counters the idea that double 5 is 10. Then explore what happens if you add one more counter to one group so that you have 5 + 6. Discuss the related subtraction facts.

Use SO (and/or BECAUSE) to discuss the patterns:

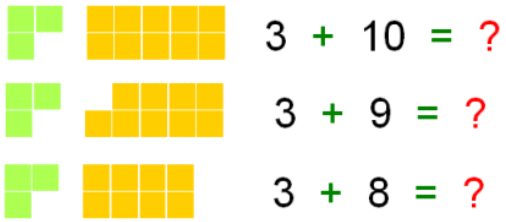
5 + 5 = 10	11 – 5 = 6
so	because
5 + 6 = 11	5 + 6 = 11
so	
5 + 7 = 12	



Repeat for other doubles.

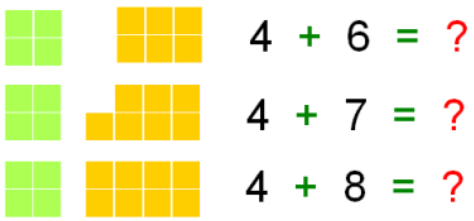
Explore teens facts and near teens facts in the same way:

3 + 10 = 13	13 – 3 = 10
so	so
3 + 9 = 12	12 – 3 = 9
so	so
3 + 8 = 11	11 – 3 = 8



Repeat with near tens pairs:

4 + 6 = 10	10 – 4 = 6
so	so
4 + 7 = 11	11 – 4 = 7
so	so
4 + 8 = 12	12 – 4 = 8



MULLY (*Concept of Multiplication, with Numbers up to 50)*

Bundle and count straws in bundles of 10. Explore the idea that one ten is 10, two tens are 20 etc. Introduce 10cm rods (shortened lolly sticks) and use these to count tens.

Group small numbers of counters in rectangular arrays and introduce the concepts and language associated with multiplication.

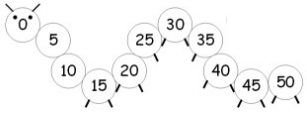
How many rows/groups?
How many in **each** row/group?
How many **altogether**?

3 rows/groups
4 in **each** row/group
12 **altogether**

3 rows/groups/lots/sets of 4 is 12 etc.

Explore the link between pairs of facts:
3 rows of 4 is 12, 4 rows of 3 is 12.

Use a metre stick to explore counting in 10s, 2s and 5s. Use a 'counting caterpillar' and the 'tap say turn' game (see printable activities) to count up and down in 10s, 2s and 5s and to learn the 10x, 2x and 5x tables.



Investigate the different rectangles you can make with 10 counters. Link them to the related multiplication facts.

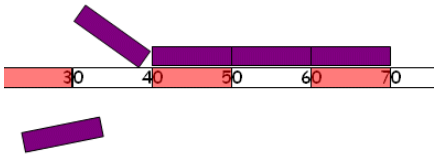
5 x 2 = 10, 2 x 5 = 10, 1 x 10 = 10, 10 x 1 = 10.

Repeat with 20 counters.

HONEY (*Numbers up to and just beyond 100)*

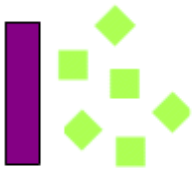
Explore the number line to 100 and just beyond using the metre stick. Count in 1s orally up and down. Count in 10s orally up and down.

Do a 'show me' activity with a metre stick to locate numbers correctly (see *Two Hands One Piano*). (Put two metre sticks end to end to go above 100.)



Investigate tens sticks and the metre stick together – discover that two tens matches with twenty, three tens matches with 30 etc. Count in tens using tens sticks.

Use tens sticks to explore tens number names: Speak aloud 6 tens is 6T (*six-ty*), 7 tens is 7T (*seven-ty*) etc.



Explore the difference between teens (6 + 10 is *six-teen*, 7 + 10 is *seven-teen* etc) and tens: 6 tens is 6T (*six-ty*), 7 tens is 7T (*seven-ty*).

Explore tens beyond 100:
11 tens = 10 tens + 1 more ten = 100 + 10 = 110
12 tens = 10 tens + 2 more tens = 100 + 20 = 120

DIVVY (*The Concept of Dividing*)

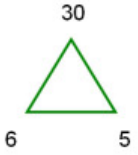
Recap rectangles and multiplication facts for 12 counters.
2 x 6 = 12, 6 x 2 = 12 etc

Explore the idea of dividing. Start with 12 counters and split them into 2 groups, 3 groups, 4 groups etc. Explore linked division and multiplications.

12 **altogether**
4 in **each** row/group
3 rows/groups

12 ÷ 4 = 3
because
3 x 4 = 12

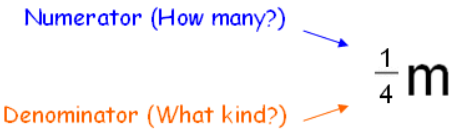
Explore multiplication triangles and their fact families.



6 x 5 = 30
5 x 6 = 30
30 ÷ 5 = 6
30 ÷ 6 = 5

Investigate: the number at the top of the triangle is at the end of the multiplications and the start of the divisions and is (usually!) the larger number.

Do some of the practical activities from Step 2 of the Success with Fractions Guide. (See printable activities.)
In particular, explore how to say and write fractions.



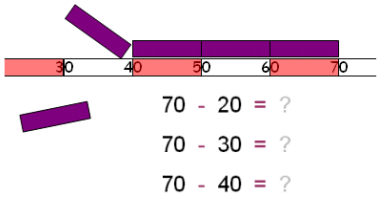
Introduce the term 'denominator' for the bottom number of the fraction. It tells us **what kind** of fraction we have.

The 'numerator' (top number) tells us **how many** we have.

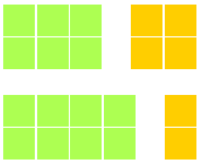
STICKY (*Magical Metre Sticks!*)

Discuss how a metre stick is one metre (1m) long and is made of 100 centimetres (100cm). Half a metre is 50 cm.

Use a metre stick and tens sticks (eg shortened lolly sticks) to explore adding and subtracting ten and then multiples of ten, first from tens numbers:

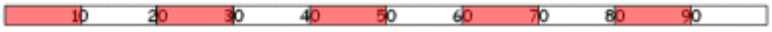


then from any number: 40 + 20 = 60 so 41 + 20 = 61, 42 + 20 = 62 etc.



Use counters to recap on the number pairs that make ten (eg 6 + 4, 8 + 2)

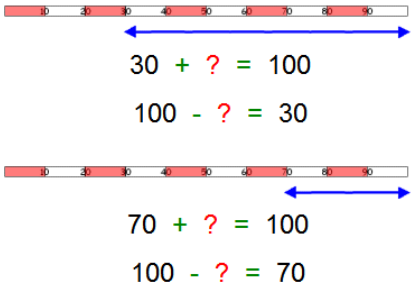
Take a metre stick and imagine chopping it in different places.



Practice giving spoken explanations as to why (eg) 60 + 40 = 100.
'6 + 4 = 10 **so** 6 tens + 4 tens = 10 tens **so** 6T + 4T = 10T **so** 60 + 40 = 100'

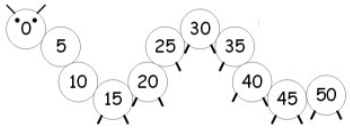
Investigate the 'difference' (distance between) two tens numbers on the stick.

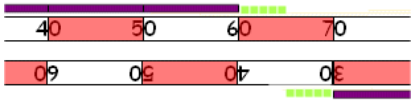
Explore the related 'missing number' addition and subtraction problems.



FIZZY (*Work with Fives and Fifties and Halves)*

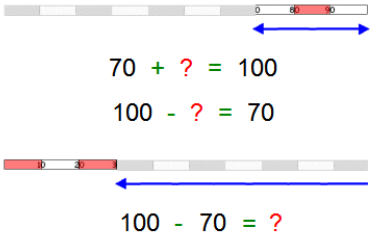
Use a metre stick and then a 'counting caterpillar' and the 'tap say turn' game (see printable activities) to revise counting up and down in 5s and to memorise the 5x table.





Put two metre sticks back to back and place 10cm sticks and 1cm sticks alongside them to show 65 + 35.

Practice giving spoken explanations as to why (eg) 65 + 35 = 100.
'6 tens + 3 tens = 9 tens and the extra ten units makes another ten'
'70 + 30 = 100 so if you take 5 off 70 and put it on 30 then 65 + 35 = 100'

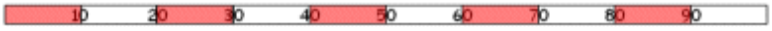


Explore how finding the difference between (eg) 70 and 100 is like chopping the **bottom** 70cm off the metre stick and just being left with the top 30cm. Subtracting 70 from 100 is chopping off the **top** 70cm and being left with the bottom 30cm. So you get the same answer! Investigate with fives differences and subtractions as well. (35 + ? = 80)

Use two metre sticks to explore half metres. ½m is 50cm. How long would two halves be? What about three halves? What about four halves? Practice different ways of saying the numbers:
'3 halves' is 'one whole metre and a half' which is '1½ (one & a half) metres'

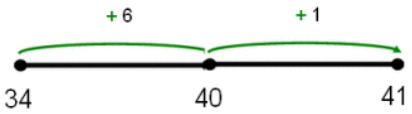
ADDISUB (*Add and subtract single digits to and from larger numbers)*

Use a metre stick to explore how to **count on** from a number.



Eg 34 + 7: First count on from 34: 35, 36, 37, 38, 39, 40, 41.

Then explore how to do it more quickly by **jumping** to the next ten.



34 + 6 + 1 = 41

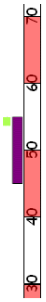
34 + 6 = 40 (**because** 4 + 6 = 10)
so
34 + 7 = 41

Do the same with subtraction.

Next use the doubles and near doubles, teens and near teens, tens pairs and near tens pairs that you learned from 'Didgie' to **build patterns** like these.

Explore how this lets you work out how to add or subtract any single digit to or from a 2-digit (or larger) number.

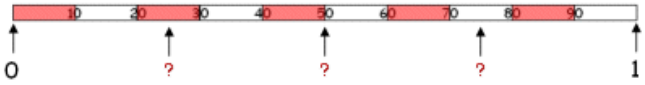
Use the idea of the express elevator (explained within the 'Quick Ways of Adding 9 & 8' activity) to add or subtract 9 (and 8) by first adding or subtracting 10 and then **going 1 or 2 steps back** the other way.



QUARTY (*Work with Fours and Understand Quarters)*

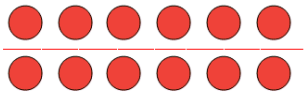
Use a 'counting caterpillar' and the 'tap say turn' game (see printable activities) to count up & down in 4s and then learn the 4x table. Repeat with 3s.

Take a metre stick and investigate where you would have to chop it to make four **equal** pieces. Practice counting in 25s beyond 100.



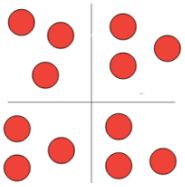
Investigate two quarters and $\frac{3}{4}$ and four quarters of a metre.
Explore (eg) $\frac{3}{4}$m = 75cm.

Explore fractions of 12 counters:



$\frac{1}{2}$ of 12 = 6
because
2 x 6 = 12

half of 12 is 6
because
2 rows of 6 is 1



$\frac{1}{4}$ of 12 = 3
so
$\frac{3}{4}$ of 12 = 9

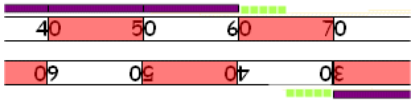
Repeat with fractions of 20 counters.

Use counters to explore quartering other numbers in the four times table.
(eg $\frac{1}{4}$ of 12 = 3)

Explore doing this by **halving and halving again**:
'$\frac{1}{2}$ of 12 = 6 **so** $\frac{1}{4}$ of 12 = 3'

Explore using the **4x table facts** backwards:
(3 x 4 = 12 **so** 12 ÷ 4 = 3 **so** $\frac{1}{4}$ of 12 = 3)

TOODIE (*Add and Subtract 2-digit Numbers)*

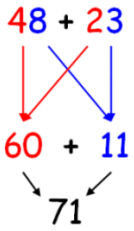


Use two metre sticks back to back with 10cm sticks and 1cm sticks to explore all the number pairs that make 100.

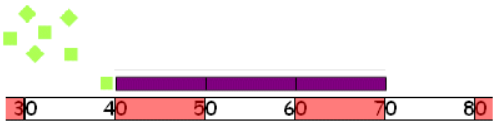
Practice giving spoken explanations as to why (eg) 64 + 36 = 100.
'6 tens + 3 tens = 9 tens and the extra ten units makes another ten'

Explore how to add pairs of two digit numbers by *partitioning* into tens and units:

'40 + 20 = 60, 8 + 3 = 11 **so** 48 + 23 = 71'



Subtract by taking away first from tens and then from any 2-digit number:
70 – 20 = 50
so
70 – 21 = 49
70 – 22 = 48

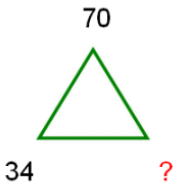


Subtract by using differences:

37 + ? = 40
so
37 + ? = 70
37 + ? = 60
37 + ? = 80

So 80 – 37 = 43.

Work with number triangles:



34 + ? = 70
? + 34 = 70
70 - ? = 34
70 - 34 = ?

DESSY (*Understand Decimal Halves, Tenths and Fifths)*

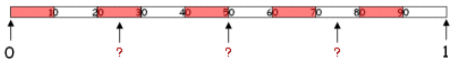
Explore the idea that a counting stick (1 metre long, divided into ten equal sections but no with numbers on) is divided into 10 equal 'bits' or 'tenths'.

Use it to measure the length and width of a room giving the answers in whole metres and bits (tenths) of metres:

4 whole metres and 8 'bits' can be written as 4.8 (4 point 8)
3 whole metres and 6 'tenths' can be written as 3.6 (3 point 6)

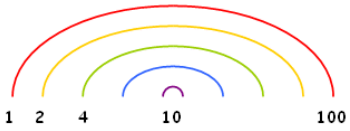
Numbers with (decimal) points are called *decimals*.

Explore where to cut, to chop a metre stick into 2, 4, 5, 10 equal pieces.

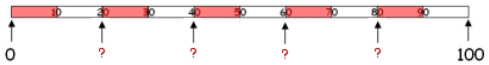


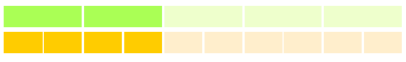
Count in 20s, 25s beyond 100.

Investigate the factor rainbow for 100.
2 x 50 = 100, 5 x 20 = 100



Explore equivalences with halves, tenths, fifths and decimals:
1 *half* of a metre = 5 *tenths* of a metre = 0.5m = 50cm
2 *fifths* of a metre = 4 *tenths* of a metre = 0.4m = 40cm





$\frac{2}{5} = \frac{4}{10}$ ✓