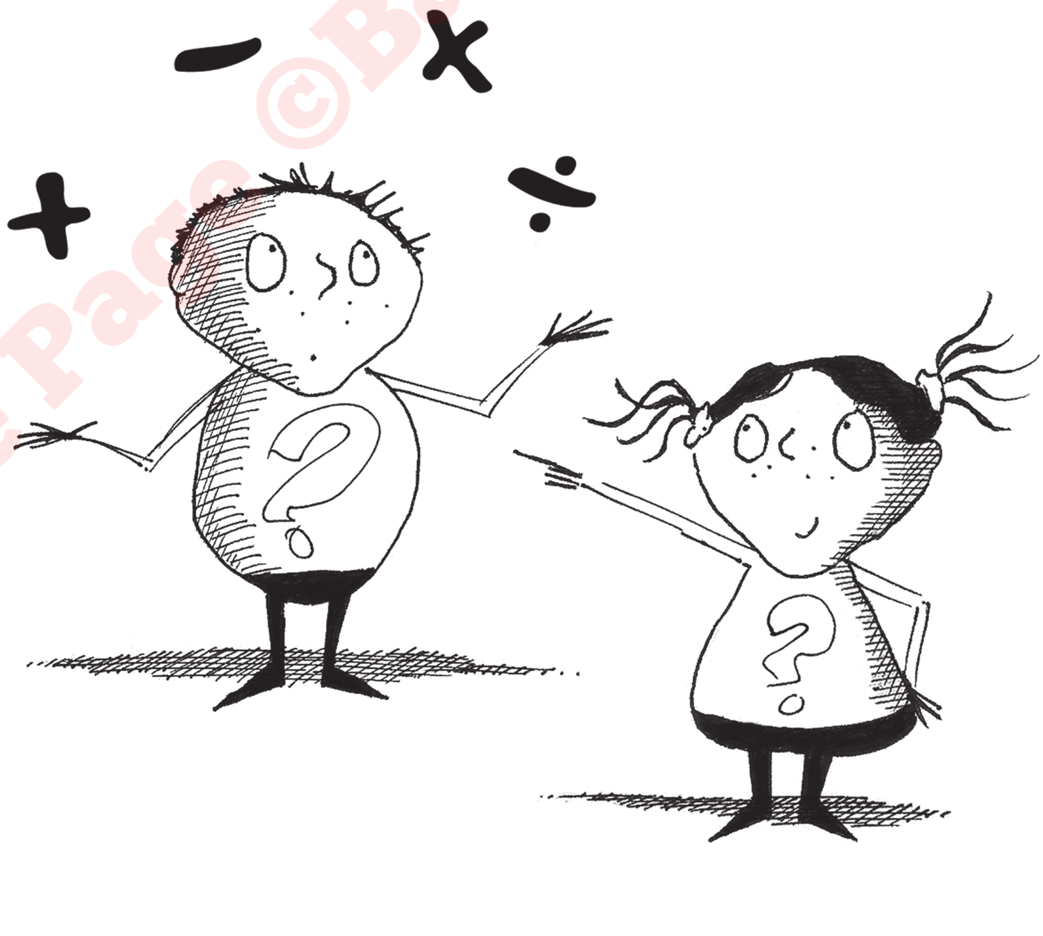
We Have a Problem!



Contents

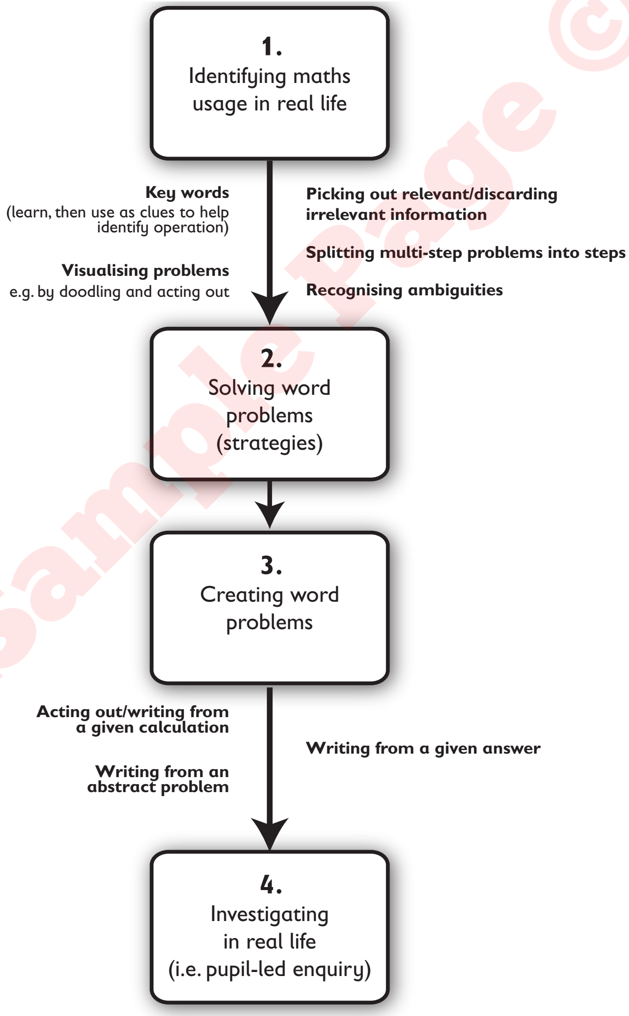
Introduction

What is 'We Have a Problem!' About?

The short but dull answer to this question is 'it's about helping to teach word problem-solving skills'. A slightly wordier, but far more interesting answer is 'it's about how kung fu, blobs and Mexican waves (amongst other things) can help turn an area of maths that pupils have traditionally found difficult and uninteresting into something more absorbing, challenging and fun!'

This book has useful advice, starter activities, lesson plans, photocopiable resources and a host of creative ideas all aimed at helping teach word problems to a Year 3 class.

These lessons (supplemented by the starter activities), take pupils through the following progression:



In other words, pupils learn the strategies needed to answer teacher-posed questions and eventually use those strategies to answer problems they have come up with themselves.

Before teaching word problems to any class try writing the following two questions on the board.

4 x 6 = ___

There are four rockets on the school field waiting to take the class on a trip to the moon.

Each rocket will only hold six people. How many pupils can go on the trip?

Then ask the class which question they prefer to be asked. Here are the three most common replies:

'I don't care. They're both the same.'

'The top one because it tells you exactly what to do.'

'The bottom one. It's more interesting.'

Most children give the second response, but that is not the point here. These replies highlight three important features about word problems:

1. *Word problems are just the same as number questions.*
2. *They're just disguised a bit, that's all.*
3. *Despite the fact that they can sometimes be about the same old topics, word problems have the* ***potential*** *to be interesting, relevant and even quite enjoyable.*

And yet, for many children, word problems are not interesting or enjoyable – they're tricky little things. To see through their disguise and pull out the hidden maths needs several skills – skills that have often got nothing to do with numbers. Perhaps a child has difficulties retaining information in their working memory or grasping abstract concepts, i.e. they need to 'see' the actual sum. Maybe they find it hard to apply their knowledge in new contexts or they struggle with reading comprehension. None of these examples are specifically maths-related, but they are integral to solving word problems. If a child struggles with them, they are going to find the subject difficult.

Although good teachers recognise and teach these types of transferable thinking skills, there is no escaping the fact that the maths curriculum still leans heavily towards the solving of algorithms. This is sad because, as 21st century teachers, we are 'preparing students for jobs that don't exist using technologies that haven't been invented in order to solve problems that we don't even know are problems yet' (from *Did You Know V6*, see p.64). Now there's a challenge! The world is changing so rapidly and the using and applying of maths has to keep up.

It's our job as teachers to take the abstract concepts of maths and give children opportunities to use them and see them used – in practical activities, real-life settings, role-play tasks and across the curriculum. It's teachers' role to provide practical experiences out of which pupils can pull out the maths. It's what Foundation Stage and KS1 teachers do all the time, it's what KS2 teachers look for opportunities to do and it's what this resource tries to encourage.

We Have a Problem! will get the class thinking about and dissecting word problems. Hopefully, in amongst the activities, some of the following ideas will be evident.

Remember 'real life' just means life

The term 'real life' seems to be vanishing from the KS2 maths curriculum, which is arguably a good thing. It came to mean anything from 'things that will happen to children when they grow up' *(But, Miss, when will we need this in real life?)* to 'random DIY projects that involve maths', e.g. questions on tiling your swimming pool. Wherever possible, it's important that children are shown that maths is all around them and that it's not just useful when they are adults and are laying carpet. Point out the maths in their lives now. Every time they are splitting into groups; discussing the Premiership table; or counting down the minutes until home time; raise one finger, pause for dramatic effect, and say, 'See? Maths!!'

Hover over their shoulders like some kind of maths genie, they'll soon get the message!

On a serious note, it's impossible to make sure every word problem reflects the life of a Year 3 pupil but, where it *is* possible, show that word problems are as relevant to their life now as they will be when they are tiling that swimming pool.

Keep things as open-ended as possible

We Have a Problem! begins by giving pupils word problems and leading them through some of the strategies they can use to answer them. It ends with pupils coming up with the questions and investigating them. Getting children to lead the way is one of the most exciting (and dangerous!) ways to teach maths. Take a look at some of the links provided on p.63 for ideas in this area.

As well as in investigations, try to pepper word problems with open-ended questions too. For example, instead of asking '*What is the product of 12 and 10?*' rephrase it as '*The product of two numbers is 120. What could the numbers be?*'.

Mixing up question types is crucial

It's so easy to sell pupils short in this regard. Most teachers have done it... After two weeks of division lessons, they wheel out the 'Real-Life Division' worksheet. But, what's the point? Pupils know what's coming. They don't need to understand the question; they just have to divide the numbers. Try it with a class. At the end of a multiplication lesson, ask if they can answer the following...

Mae Alvin yn ysgrifennu cân, ond all e ddim meddwl am ddigon o eiriau.

Mae'n defnyddio 10 o 'oohs' ym mhob cytgan ac mae 8 cytgan yn y gân gyfan.

Faint o 'oohs' sydd yna i gyd?

You don't have to be a fluent Welsh speaker to work out that the answer is 80. Incidentally, the translation is, 'Alvin is writing a song, but he is a bit stuck on the words. He sings 10 "oohs" in every chorus and there are 8 choruses in the whole song. How many "oohs" are there altogether?' However, the answer can be worked out without needing to know the finer details of Alvin's lack of creativity!

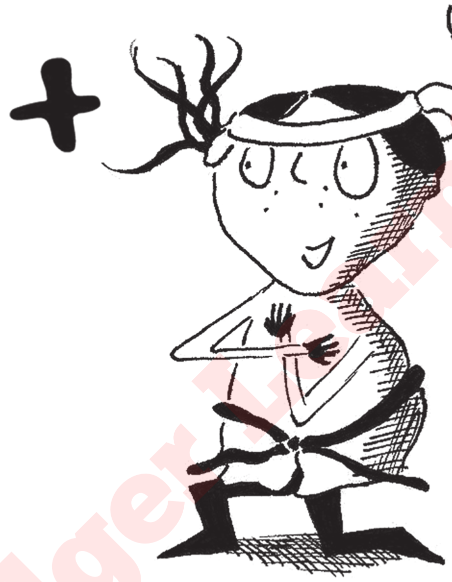
In real life, numbers fly at us from all angles. The key skill is knowing what to do with them. Don't give the class a block of multiplication word problems – it won't build that skill.

Initially focus on the question rather than the answer

In order to develop something that is transferable and ultimately of use to children in the real world, it makes sense initially to look to build a skill rather than simply answer a question. In many ways, the *way* pupils reach the solution is much more important than *what* it actually is. Focus more on the *how* than on the *what*. With every word problem from now on, start by telling the class it doesn't matter what the answer is yet – it's more important to know how they will work it out. For pupils who struggle with number work, this takes a load of pressure off immediately. Get hold of a buzzer and read them word problems with bleeped out numbers. Ask the class how they would go about working out the answer. There is a lot of mileage in this little activity.

A slightly different idea is to give the solution straight away. Here is an example. '*Don't worry about the answer... It's 38 chickens! But how do we know it's 38 chickens? What clues are there in the question?*'

Nowhere in this resource is there a discussion on pencil and paper methods for answering problems. Similarly, the important process of estimating an answer, calculating, then evaluating it to check whether it makes sense is hardly mentioned. However, just because these steps are not focussed on, shouldn't mean that they are ignored. There's an answer section at the back (p.60-62) and, of course, it's important that pupils actually answer and evaluate. But in this particular resource the focus of the lessons and activities is always on **how** pupils would work out the answer, rather than **what** it actually is.



Word problems needn't be boring

Word problems help us with life. Life isn't boring, nor should they be. Over the course of this book, pupils will have opportunities to grapple with word problems – cut them up, act them out and write them down. They'll have worked backwards and forwards to answer them and create them. By the end of the book, they'll have developed a survival kit, a bank of word problems and learned that those key word posters every classroom has are not all they're cracked up to be. This book will show that doodles, kung fu and blobs can all be used to liven up dull word problem lessons.

Remember, interested pupils make the best learners and teachers who can spark that interest make the best teachers. Be sparky!

As 21st-century learners, it's vital that pupils can use and apply the maths they learn, transferring it into different contexts. Developing critical thinking skills is part of this process. In *We Have a Problem!*, the teaching is **through** thinking rather than the explicit teaching **of** thinking.

The skill of …		… is developed through …	
	PROCESSING INFORMATION		• identifying the important information in a question • discarding irrelevant information • looking closely at questions to see what they really mean
	REASONING		• justifying a point of view or a strategy adopted • inferring/deducting from key information
	ENQUIRING		• open-ended investigations • breaking down a problem into parts to understand what it is asking
	THINKING CREATIVELY		• predicting possible answers • visualising word problems through doodling • designing own word problems
	EVALUATING		• judging the value of information and ideas • plugging answers back into questions to check they make sense
	DECISION-MAKING		• choosing the most appropriate operation to use • selecting the best strategy to solve a problem

We Have a Problem! will enable teachers to develop these all-important skills in ways that are both interesting and relevant. This isn't an exhaustive resource – please take the ideas within, improve them and build on them. Why not get pupils writing word problems from the point of view of a Roman centurion or in response to *Moonlight Sonata*? What about using cartoons instead of words? Or revising strategies by acting out emergency public service broadcasts for 'What to Do in the Event You Are Attacked by a Word Problem'?

Word problems are tricky little things, but if *We Have a Problem!* inspires teachers to come up with ways to arm their pupils for battle with them, then that can only be a good thing.

The Trouble with Key Words

It is easy to over-emphasise the importance of key words and phrases in deciphering word problems. For example, most classroom walls contain posters stating that a question containing the words 'more than' is an addition question. Of course, for the majority of time it does mean addition as in, 'what is £34 more than £56?'. But those two words could just as easily feature in a subtraction question such as, 'how many more than 92 is 100?'. Or even as part of the story in multiplication or division questions such as, 'Jacob gets paid for helping in the garden and usually earns more than his brother. Last week he earned £12, but this week he earns half that, etc.'

An even more striking example is the word 'add'. Does 'add' always mean 'add'? Think again! 'What would you add to 26 to get 50?' is more easily solved by subtraction than by counting on from 26. In 'Mystery number' questions, the answers are found by doing the opposite to the key words, e.g. 'I think of a number. Multiply it by 20 and I get 60. What was my number?' The word used is 'multiply', but it is actually more useful to divide. This can all get quite confusing for children!

So, although spotting key words and phrases is an important skill, it's nothing compared to understanding what the question is asking and seeing the key words in that context. Teach key words as clues rather than facts. Clues can be misleading, but every so often they do lead you to the culprit.

When pupils are aware of the ambiguity of key words, the whole subject comes alive. Test the class. Challenge them. Ask them, 'Does it really mean that? Can anyone come up with a question where it would mean something different?'. Instead of having static posters, create something more flexible, e.g. a wall display using post-it notes. Don't just collect key words, collect question types as well. The following table is by no means exhaustive, but here are some key words and key questions that might help.

add **plus** **total** **altogether** **sum of** **increases** **together** **and** **more than** **perimeter**	**+** What is __ ***added*** to __? /***plus*** __? ***Add*** __to__. What's the ***total*** of __ ***and*** __? __ ***and*** __, how many ***altogether***? What is the ***sum of*** __ ***and*** __? Which two numbers could have a ***sum of*** __? __ ***increases*** by __ What is the new amount? How much do they weigh ***together***? __ ***and*** __ How much ***altogether***? What is __ ***more than*** __? I think of a number and ***subtract*** __ I get __. What was my number? The sides of a shape are__, what is the ***perimeter***? Make as many ***totals*** as you can using any pairs out of __, __, __, __ ***and*** __.	**subtract** **difference** **decreases** **minus** **take away** **fewer than** **less than** **how many left?**	**−** What is __ ***subtracted*** from __? /***minus*** __? ***Subtract*** __ from __. What is the ***difference*** between __ and __? __ ***decreases*** by __ What is the new amount? I have __ and __ are ***taken away***. ***How many left***? What is __ ***fewer than*** __? /***less than*** __? How much will I have ***left***? What number would you ***take away*** from __ to end up with __? How much ***longer/shorter*** is it? How much change will I have? How many ***less*** is __ ***than*** __? Something ***added*** to __ makes __ What is it? I think of a number and ***add*** __ I get __ What was my number?
times **multiply** **lots of groups of** **total** **altogether** **each in the statement** **twice** **product** **area** **per** **for every** **doubled/ trebled** **perimeter**	**×** What is __ ***times*** __? What is __ ***multiplied by*** __? What are __ ***lots of*** __? /***groups of*** __? __ ***groups of*** __.What's the ***total***? __ ***lots of*** __. How many ***altogether***? __ people have __ pounds ***each***. How much in ***total***? What is __ ***doubled/trebled***? What is the ***product of*** __ and __? I think of a number and ***divide*** by __ I get __. What was my number? Is __ a ***factor/multiple*** of __ ? The length of a rectangle is __ and the width is __.What's the area? __ ***per/for every*** __. How many ***altogether***? Make as many ***products*** as you can using the numbers __, __, __ and __.	**shared** **split** **how many lots/groups?** **split into/ between** **divide** **each in the question** **per** **quotient** **separate** **halved/ quartered** **factors**	**÷** What is __ ***shared*** between __? /***split*** into __? ***How many lots of*** __? /***groups of*** __ are there in __? ***Divide*** __ by __. __ pounds is ***split between*** __ people. How much will they have each? What is the ***quotient*** of __ and __? The area of a shape is __. What could the length and width be? How long will it take to save up __ if I save __ ***per*** week? How many different ways can you ***separate*** __ so that there's the same amount in each pile? What are the ***factors*** of __? I think of a number and ***multiply by*** __ I get __. What was my number?

Supporting Lower-Ability Pupils

For a lot of pupils, answering word problems is like a bad game of pass-the-parcel. Before arriving at the answer they have to negotiate several heavily sellotaped layers:

Read the words (and numbers)

↓

Understand the **context** of the words

↓

Recognise the question behind the words

↓

Identify the important information

↓

Decide on the **correct operation** to use

↓

Calculate the answer

There are some tricky skills there for your lower-ability pupils. And it can leave pupils a little deflated when they eventually reach the grubby, half-melted chocolate bar in the middle of the parcel. *(All that just to find out I had to add them together?)*

Look at a similar list in the context of a word-free calculation...

Read the numbers

↓

Understand the **symbol**

↓

Calculate the answer

You can see why children might prefer wordless problems! The lesson plans that follow include examples of ways to support pupils who have difficulties with maths, but here are ten general tips to make word problems accessible for them.

Keep your objectives clear

Don't get bogged down in a reading comprehension activity if you want to focus on choosing the correct operation. Concentrate on teaching one skill at a time.

Take the reading aspect away from the task

Give lower-ability pupils a chance to get down to the actual maths by removing reading comprehension barriers to entry. Read problems aloud, record onto tape or use a computer, allowing problems to be heard, not read.

Use illustrations

Pupils derive meaning from illustrations of word problems as with illustrated stories. Seek out illustrated problems in textbooks or collect a bank of suitable photos to accompany problems by doing an Internet image search.

Look for opportunities to use hands-on strategies

Doodle and use real-life objects related to the question as well as things like Cuisenaire rods, plastic cubes, etc. (e.g. *Can you show me the question using real coins?*). This strategy is linked closely to...

Act out problems

Encourage pupils to be the characters in the question and to act out the scenario. This is a great way of helping them to visualise what is going on. *Show me what actually happened here.*

Provide plenty of connections with real-life

Tailor questions to pupils' interests, hobbies, and school topics – anything that helps them build links with the maths.

Use games to reinforce concepts

Use the starter activities on pp.14-29 to build on existing skills/knowledge, then try and turn them into games.

Choose problems with an unknown final quantity

Pupils generally find it easier to work out the answer to questions where the missing answer is at the end. For example, 'Laura has £14, Samantha has £6. How much do they have altogether?' is more straightforward than 'Laura and Samantha have £20 between them. Laura has £14. How much does Samantha have?'.

Encourage pupils to rewrite the problems

Ask pupils, 'Can you put the question in your own words? What if we use simpler numbers?'.

Get pupils to physically dissect the problems

Enlarge copies of problems to enable pupils to cross out/highlight/move around/cut and paste/alter words in the text. Ask them, 'Can you pull out any information we don't need? Where is the key word?'.

Keeping it Relevant

'When am I ever going to need this?' is a question our secondary maths colleagues have to face on a regular basis. To back up pupils' concerns, there is a mildly amusing graph doing the rounds on the Internet showing that the more recently a person has learned something in maths, the more irrelevant it is to real life!

There may be some truth in that, but don't fall into the trap of thinking that every word problem has to be based on shopping or DIY. Yes, word problems are about accumulating knowledge for real-world situations, but they are also about things like problem solving, using logic and evaluating answers. Pupils can learn these skills just as easily through a word problem about the plight of their favourite football team or 'The X Factor' as one about measuring wood.

In fact, it's just as important to be relevant to a Year 3 class as it is to reflect real-world maths. Your word problems need to resonate with them. In his excellent book *Oops! Helping Children Learn Accidentally,* Hywel Roberts emphasises the need to lure a class into learning by gripping them with interesting content, 'if the content is relevant, you may have to work quite hard to make it dull' (from p.51 of Roberts' book). With that in mind, here are six tips for keeping it relevant.

Get to know what makes your class tick

Outside of school, what are their interests? Is your word problem on 'Doctor Who' going to click with them or does it just show how woefully out of touch their teacher is?! There is no need to pass a questionnaire round – the teachers who know this sort of information are the ones who take the time to chat to their class.

Personalise word problems

Include pupils' names in word problems. Make up far-fetched scenarios that they find themselves in. These may be completely untrue, but if the children in question are good sports they will often play along. Do remember though, that for every child that relishes the limelight there are others who don't want the attention. Know your class.

Write questions based on current events, local or national

Is there anything in the news that is capturing pupils' interest at the moment such as, a sporting event, a local issue or a school trip? Get a handful of newspapers and ask pupils to write word problems based on the issues of the day.

Get pupils to make word problems more relevant

Give them copies of existing word problems (from textbooks/worksheets). Encourage them to use the same numbers and question, but to change the subject matter to something more interesting to them, e.g. a favourite film, famous person or book.

Use humour/the element of surprise

Be creative. Write the sorts of word problems someone like Roald Dahl would have written. If in doubt, remember there is something intrinsically amusing about penguins and chickens!

Build up a bank of word problems

To get the most from *We Have a Problem!*, you're going to need a lot of word problems! Collect together everything your class comes up with during lessons and/or activities by getting pupils to write problems on cards. Categorise them (see pp.56-57), put them in a box and you have a ready-made relevant resource.

Key Word Cards

RESOURCES NEEDED:

Set(s) of *Key Word Cards* (pp.15-17)

The following *Key Word Cards* feature either a key word or phrase used in word problems (pp.16-17) or one of the four operation symbols (p.15). The final card is a 'joker' ('how much?'). The answer to this card can be solved by using any of the four operations – it provides no clues whatsoever. There is a temptation for pupils to rely solely on what they perceive to be a key word or to expect every word problem to contain one. Including the joker card is a way of showing pupils the ambiguity of word problems and should provoke some healthy discussion!

For lower-ability pupils, some of the more difficult key words can be taken out of the pack to allow a focus on some of the more common examples.

SNAP!

- Split class into groups of two or more.
- Photocopy enough cards for at least one set per group.
- Dealer shares out the cards equally (point out that that's division!) and players keep their piles facedown, without looking at them.
- The first player flips over his or her top card and places it in the middle of the table.
- Each player in turn flips over the top card and adds it to the growing pile.
- If a new card matches the uppermost card in the pile, the first player to shout 'Snap!' wins the central pile and adds it to the bottom of their facedown cards.
- Play continues with a new starting card and the winner is the last player remaining when all others have lost their cards.
- To eliminate arguments about who said what first, put a piece of paper on the table and label it **SNAP!** Instead of calling out the word, pupils have to be the first to put their hand on the paper.

PAIRS

- Shuffle one set of *Key Word Cards* and deal them upside-down on the table in a grid formation.
- The first player turns over any two cards.
- If the upturned cards make a pair of a symbol and corresponding word/ phrase (e.g. a **+** sign and the words **Find the total of...**), player one collects the pair and keeps them. Play continues with player two.
- If the upturned cards do not make a pair (e.g. a **+** sign and the word **Share**), the cards are turned back over and play continues with the second player.
- The winner is the player with the most cards at the end.
- N.B. Due to the ambiguous nature of some of the cards (e.g. **Find the total of...** could refer to **+** or **x**), play ends when there are no more pairs possible, not when all the cards are used up.

+	−	×
÷	+	−
×	÷	+
−	×	÷

total	What is the difference between __ and __?	__ groups of __
shared into	How many altogether?	__ less than __
__ lots of __	split into	plus
How much heavier is it?	multiply	How many will they each have?

How many in all?	How many more than __ is __?	times
divide	What is the sum of __ and __?	What is half of __?
double	What is __ more than __?	__ fewer than __
increase	How many left?	How much?