

SPEAR Maths Sample Pack



The
Primary
Maths
Problem
Solving
Framework



A comprehensive framework that:

- supports teaching and learning in Maths problem solving
- is easy to use
- is flexible
- promotes independence
- encourages the transfer of process skills
- includes a resource of over 550 problems
- has been fully updated in line with the 2014 Curriculum

The Challenge

- Problem solving in Maths is under-developed in many primary schools
- Few primary school teachers are Maths specialists
- Maths problem solving is complex
- Many teachers feel they should do more problem solving in Maths but don't know where to start
- The 2014 Curriculum centres on problem solving but provides little guidance or support for this
- Pupils often struggle to transfer knowledge and understanding to unfamiliar contexts

The Framework

- A five step process which children can understand, remember and use
- Supported by a comprehensive range of materials: graded problems, records, self evaluation sheets, etc.
- Linked to the NC but not restricted to it or by it
- Accessible to children of all ages and abilities from EYFS to Y7 and above
- An ideal resource to use alongside schemes such as Singapore Maths

Sample Pack

The contents of this sample pack have been selected to give you a clear understanding of what you get when you purchase a licence for using SPEAR Maths.

Overview of SPEAR Maths Contents

Activity Records

Activity record sheets for each type of problem as well as general and simplified record sheets.

Name:	Problem Type: DVP
Problem Name:	
Search Have you got everything ready in order to make a start? Do you understand the question? What is the question asking you to do? Where have you come across similar questions before? How did you solve questions like this in the past? What else do you need to know?	
Notes:	
Plan Can you create a way to tackle the problem? Identify the important information	
Notes:	
Explore Can you work systematically (step by step)? Use drawings or annotations (notes) to help visualise (imagine) the problem using familiar shapes or patterns	
Notes:	

Apply How will you record your thinking and working out? Decide what to record and how to present it in another way; try other possibilities to check the solution
Notes:
Review Have you answered the question or solved the problem fully? Decide if your solution was sensible
Notes:

There are **7** different Activity Record Sheets in all.

Help Me Cards

Help Me Cards for each stage of each type of problem (a common SEARCH card and specific cards for PLAN, EXPLORE, APPLY and REVIEW for each problem type).

Also, the same information organised into Help Me cards for each Level of each problem type and for each Year Group (2014 version)

All: SEARCH

Level 1	Talk to an adult about what you are doing With help, find different ways to do it or put things in order
Level 2	With a little help, decide how you are going to start With a little help, decide on what's important to think about Tell an adult how you will use something you learned before to solve this problem
Level 3	Use pictures, writing, numbers and talk to explain exactly how you could solve the problem Talk about how to tackle the problem, remembering what you did with similar problems in the past and explaining the steps to take
Level 4	Use pictures, writing, numbers and talk to clearly explain the mathematical ideas you are using to solve the problem Think about questions to do with the problem and try and answer them using mathematical ideas
Level 5	Even when asked to solve a complicated problem that you have never seen before, use what you have learned in the past to think of things you can try in order to solve the problem Even when asked to solve a complicated problem that you have never seen before, try to work out a way to tackle it without asking for help

Level 4 FAP	Use pictures, writing, numbers and talk to clearly explain the mathematical ideas you are using to solve the problem
	Think about questions to do with the problem and try and answer them using mathematical ideas
	Think of your own ways to tackle a problem you have never seen before by remembering how you solved problems in the past, if this is helpful
	Use your imagination to come up with new ways of trying to solve a problem
	Make a good choice about the way to record all the answers you find that will be easiest to do and clearest for others to understand
	Organise the important information into a list or table, as you decide, in order to see what might be missing
	Write down your answers in a clear and organised way using symbols that other people can understand
	Without help, find a way to work that allows you to be clear about what you have tried and what you still need to do
	Only record what you need to record and be able to explain your choices about this and, when you have found some results, say what else you expect to find using mathematical ideas to give reasons
	Use mathematical ideas and mathematical language to explain clearly how you know your answer(s) are correct
Use what you have learned in one problem to say what you expect to find in other problems before you do them	
Without any help, explain how you know your answer is right even for difficult problems involving lots of information	

There are **46** different Help Me Cards in the SPEAR Maths resources

2014 Versions

Year 3 General	Tell an adult how you will use something you learned before to solve this problem
	Tell an adult your plan for solving the problem
	With a little help, explain the problem in your own words to an adult and say which bits are important
	With help, choose the apparatus you need to solve the problem and draw any pictures that will help you
	Find all the answers that you can
	With a little help, highlight the words and numbers in the problem that are important and say why you have chosen them
	With a little help, decide how to solve the problem one step at a time
	Remember that you can choose which clue to start with
	Explain why some clues go together to tell you something important
	With a little help, make drawings about the problem you are working on to show how you will do it
	With a little help, talk about different ways to show the information in the problem and explain which you prefer
	Explain to an adult what would happen if the problem was changed
	Write or draw what you have done and what you have found out in the best way you can think of so that other people can understand
	Talk to an adult about whether it would help to start with the smallest number
	With a little help, fill in an empty table given to you by an adult by putting the information you have in the right places
	With a little help, decide whether to add (+), subtract (-), multiply (x) or divide (÷). If you need to do more than one of these, decide which you need to do first
	Explain to an adult why you are sure you have found all the possible answers
	With a little help, explain how you know that your answer is right
	With a little help, look for missing answers (and answers you have written down twice) by organising what you have found out
	With a little help, look for answers you have written down twice
Try to remember to say what units your answer is measured in	

Year 7 Logic	Even when asked to solve a complicated problem that you have never seen before, use what you have learned in the past to think of things you can try in order to solve the problem
	Even when asked to solve a complicated problem that you have never seen before, try to work out a way to tackle it without asking for help
	Explain to others in a way that they can easily understand, by talking or in writing, how you intend to tackle the problem and why you think this is a good way to approach it
	In complicated problems, highlight the words and numbers that you will need to use and put them in the order in which you will use them, using mathematical ideas to decide this
	Even before you have started to work on a tricky problem, think of ways you could find out, and write down, important information and results
	Be able to use a lot of different types of lists, table, notes, drawings, symbols, plans and calculation strategies to solve different types of problem, showing that you can make the best choices in different situations
	Always work step by step, showing that you can choose one piece of information and see what happens when you use this information in the problem
	Always work step by step, without needing to be told, when you are looking for answers, writing them down and checking that the answers are right
	Write down what you have found out, using words and symbols in the best ways you can to make it easy for other people to understand, ask questions about and use your findings
	Ask yourself questions about your answers to a problem, for example 'what would happen if...?' and then try to find an answer to that question
Use mathematical ideas about logic problems to make choices about what the solution might, or might not, be	
Without help, and without waiting to be told, use what you have learned in one problem to say what you expect to find in other similar problems and draw some general conclusions about problems of this type	
Without any help, and without waiting to be told, explain how you know your answer is right even for the most complicated problems involving lots of information	
Without any help, and without waiting to be told, use mathematical ideas to decide whether your answer is correct, sensible and complete in every respect	

Key Questions

Key questions in SPEAR Maths colours at three levels of difficulty (Y12, Y34 and Y56)

Specific Key Questions for each type of problem

SPEAR Maths Key Questions	SPEAR Maths Key Questions	SPEAR Maths Complete Key Questions
Search Have I got everything ready in order to make a start?	Search Have I got everything ready in order to make a start? What is the question asking me to do? How did I solve questions like this in the past?	Search Have I got everything ready in order to make a start? Do I understand the question? What is the question asking me to do? Where have I come across similar questions before? How did I solve questions like this in the past? What else do I need to know?
Plan Can I create a way to tackle the problem?	Plan Can I create a way to tackle the problem? Can I identify the important facts and instructions? How might I record my thinking?	Plan Can I create a way to tackle the problem? Can I identify the important facts and instructions? Can I create a system for identifying the important information? Can I identify the words and numbers? Have I identified the information which is relevant and ignored it? How might I record my thinking?
Explore Can I work systematically (step by step)?	Explore Can I work systematically? How can I organise the data into a list or pattern that helps to identify gaps?	Explore How I work systematically (step by step) starting with the simplest case? How can I organise the data into a list or pattern that helps to identify gaps? Can I use drawings or annotations to help me solve the problem using familiar shapes or patterns? Can I list key facts in order?
Apply How will I record my thinking and working out?	Apply How will I record my thinking and working out? Which operations should I use and in which order? Can I organise, track, predict and check?	Apply How will I record my thinking and working out? Which operations should I use and in which order? Can I predict what comes next and see if this is right? Can I record the data to identify all possibilities? How will I track what has been included and what has not?
Review Have I answered the question or solved the problem fully?	Review Have I answered the question or solved the problem fully? Have I recorded my thinking in a way others will understand? What have I learnt that I can use again in future?	Review Have I answered the question or solved the problem fully? Is my work accurate? Have I checked for repeats, or mistakes? Have I recorded my thinking in a way others will understand? Is my answer sensible? Have I used the correct units of measurement? What have I learnt that I can use again in future?

There are **8** different question sheets in all.

Next Step Records

General pupil records for all problem types (Landscape and Portrait layouts) organised in Levels and year groups (2014 version)

Sample

Next Steps Record for All Problem Types

Level	Date
Level 1 <ul style="list-style-type: none"> be able to use everyday language to talk about their work with support, be able to make connections and use prior knowledge to solve similar practical problems in a new context with support, be able to 'act out' a simple problem within a small group with support, be able to use practical resources to represent aspects of a problem be able to describe verbally, or with resources, possible solutions to a problem be able to count accurately the number of possible solutions to a simple problem be able to understand a 'mat' statement in the context of a simple problem (L) with support, be able to record solutions using simple pictures, diagrams or resources with support, be able to recognise solutions with common characteristics and group them (FAP) with support, be able to understand key concepts eg that the number of possible solutions increases with the number of options available (FRDP) with support, be able to check a solution for a simple problem and be able to explain why some solutions are not acceptable <ul style="list-style-type: none"> may be able to use this information to find missing solutions or repeats (FAP) (L) 	
Level 2 <ul style="list-style-type: none"> with limited support, be able to find a starting point for solving a problem, identifying key facts and relevant information be able to independently transfer knowledge and use it to solve problems be able to use practical resources to accurately represent aspects of a problem with some independence, be able to 'act out' a simple problem within a small group with limited support, be able to find examples that satisfy the rules of a simple problem (FAP) with support, be able to work systematically (after initial explanation) on a simple problem be aware that facts can be used in any order (limited number of facts) (L) be able to identify links between two given facts (L) be able to explain an approach to a problem orally, with some evidence of reasoning begin to use drawings to illustrate ideas about simple problems be able to record solutions found through annotating, sketching a diagram or using simple mathematical symbols be able to organise solutions into groups with similar characteristics e.g. 'all the rectangles made up of two squares' (DVP) (FAP) be able to predict what would happen to the pattern if the criteria were changed, with reference to results already found, giving simple reasons (FRDP) be able to check that the solution meets all criteria -after adult prompting if necessary with support, be able to use organising (eg ordering) and recording information to find repeats and missing solutions (FAP) (FRDP) be able to describe verbally why they are sure they have found all the solutions (FAP) 	

Year 5 <ul style="list-style-type: none"> be able to explain an approach to a problem orally, with written jottings to support the explanation, with clear evidence of mathematical reasoning be able independently to use discussion to break into a problem, recognising similarities to previous work and identifying strategies to use in solving the problem move from 'acting out' to working with practical apparatus or diagrams to solve the problem (DVP) (FP) (FRDP) be able independently to put the problem into their own words and identify the important information needed to solve it be able to move between different representations of a problem eg a verbal description, a diagram etc. be able independently to identify key words and numbers in a two-step problem (W) be able independently to make decisions about how to record the information needed to show the possibilities or describe the pattern (FP) (FRDP) tackle a range of problems systematically (after initial exploration) <ul style="list-style-type: none"> eg by grouping some solutions with similar characteristics (DVP) (FP) eg by starting with the simplest case when appropriate (1 person, 2 people, 3 people, ...) (FRDP) be able independently to justify why a particular fact was used first, or not chosen, from a greater range of facts (L) be able to suggest links between 2 or more facts which may be given or deduced (More complex problems) (L) use drawings to help visualise the problem using familiar shapes or patterns be able to suggest alternative ways of representing the given information ie interpret diagram with resources, draw own diagram, represent solutions with letter codes be able to record using appropriate diagrams, annotations, symbols or coding to represent their work, enabling their results to be checked know when it's a good idea to start with the smallest number (FP) be able to describe a simple arithmetic rule found in the results (eg 0,1,3,6,10... add 1, add 2, add 3, ...) (FRDP) be able to predict and check the next few terms in a range of sequences to test their rule (FRDP) be able to create and complete a two-way table based on a suggested format (L) be able to decide which operations to use and which order to use them in when answering a two-step problem (W) be able to give a clear justification, based on mathematical reasoning, for why they are sure all possibilities have been found (FP) consistently look for missing solutions with reference to systematic working and checking for repeats (DVP) (FP) consistently be able independently to check for repeats (DVP) (FP) (L) consistently be able independently to check that the solution meets all of the criteria with limited support, be able to check that the solution includes the correct units of measurement (W) 	
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Pupil records for each type of problem. There are **13** different Next Steps Records to choose from.

Target Cards

Target cards for Levels 1-5 (three versions). Also Target cards in individual year groups (2014 version)

Name:	Date:
I know that these targets will get me a Level 1 in Maths Problem Solving	
I can talk to an adult about what I am doing	
I can find different ways to do it or put things in order, with help if I need it	
I can act out the problem with other people, with help if I need it	
I can collect the things I can use to answer the problem, with help if I need it	
I can tell a friend or an adult what I think the answer is	
I can tell some-one how many answers there are	
I can explain to an adult what a 'not' statement means (L)	
I can show my answer in a picture or using other things, with help if I need it	
I can put all the answers that go together in groups, with help if I need it (FP)	
I can explain what I think will happen if I have more choices or use more things, with help if I need it (FRDP)	
I can check my answer and then tell some-one how I know it is right, with help if I need it	
I can check my answers and find the ones that are missing and the ones I have done twice, with help if I need it (FP)(L)	

Name:	Date:
I know that these targets will get me a Level 2 in Maths Problem Solving	
I can decide how I am going to start and decide on what's important to think about, with a little help if I need it	
I can tell an adult how I will use something I learned before to solve this problem	
I can say what I would like to use to help me solve the problem	
I can act out the problem with other people, with a little help if I need it	
I can find all the answers that I can, with a little help if I need it	
I can decide how to solve the problem one step at a time, with help if I need it	
I can remember that I can choose which clue to start with and explain how some clues go together (L)	
I can explain to an adult what I did to try and solve the problem	
I can make drawings about the problem I am working on to show how I did it	
I can draw pictures to show my answer to the problem	
I can put my answers in groups that go together (FP)	
I can explain to an adult what would happen if the problem was changed (FRDP)	
I can explain to an adult how I know that my answer is right and that there are no more answers to find (FP), with a little help if I need it	
I can organise my answers and show how to find missing answers or answers I have got twice, with help if I need it (FP)(FRDP)	
I can make sure I said what units my answer is measured in, with help if I need it (W)	

Year 4 Targets for Maths Problem Solving	Date
I can use pictures, writing, numbers and talk to explain exactly how I could solve the problem	
With a little help, I can talk about how to tackle the problem, remembering what I did with similar problems in the past and explaining the steps to take	
With a little help, I can choose the apparatus I need to solve the problem and draw any pictures that will help me	
With a little help, I can explain the problem in my own words and say which bits are important	
With a little help, I can decide what will be the best way to record the information I need to collect	
I can plan a step by step approach to solving the problem	
I can look for patterns in my answers and group similar answers together	
I can see if I can start with the smallest number of choices first	
With a little help, I can think about which clue to start with and explain why I think this	
I can look for clues that go together to tell me something important and use this information to solve the problem	
I can draw diagrams or pictures to show the information in the problem in a new way	
With a little help, I can think of different ways to show the information in the problem and explain which I prefer	
I can decide if it would help to start with the smallest number	
With a little help, I can explain any patterns I have noticed in my results, using the appropriate mathematical vocabulary	
I can say what I think the next few numbers in the pattern will be and try and find out if I am right	
I can fill in a table given to me by an adult by putting the information I have in the right places	
I can decide whether to add (+), subtract (-), multiply (x) or divide (÷). If I need to do more than one of these, I can decide which I need to do first	
I can use mathematical ideas to explain to an adult why I am sure I have found all the possible answers	
Without being told to do it, I can try to look for missing answers (and answers I have written down twice) by organising what I have found out	
Without help, I can explain how I know that my answer is right	
With help, I can make sure I said what my answer is measured in	

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Self Evaluation Sheets

Self Evaluation Sheets for each type of problem with or without a teacher's column.

Self Evaluation: Logic Problems

Self Evaluation: Finding Rules and Describing Patterns

Name	Date	Pupil	Teacher
Problem Title			
I read through the problem carefully and made sure that I understood what it was about			
I thought about similar problems I had seen in the past and decided whether I could use a similar approach			
I had a way to start exploring the problem			
I had a system for deciding on the information needed to describe the pattern			
I worked systematically, starting with the simplest case			
I organised the data I collected into a list or table to help identify any patterns that there were			
I chose an appropriate way of recording my ideas about what came next in the pattern			
I predicted what came next and tested this to see if I was right			
I had a way to track what had been included and what had not			
I had a way to find the general rule			
I used the general rule to say whether a number or shape would be in the sequence or not			
I checked my work to make sure it was accurate			
I decided if I had fully answered the question or solved the problem			

S	earch
P	lan
E	xplore
A	pply
R	review

Name	Date
Problem Title	
I read through the problem carefully and made sure that I understood what it was about	
I thought about similar problems I had seen in the past and decided whether I could use a similar approach	
I had a way to start exploring the problem	
I identified the given facts and put them in order (I prioritised them)	
I looked for any relationships and patterns in the information given	
I worked systematically	
I had a way to use one piece of information at a time and see what effect it has, then to keep one thing fixed and test the other	
I chose an appropriate recording system	
I used the recording system to organise the information given in the problem	
I checked my work to make sure it was accurate	
I checked for any repeats and removed them	
I checked that the answer met all the criteria	
I decided if I had fully answered the question or solved the problem	

S	earch
P	lan
E	xplore
A	pply
R	review

There are **10** Self Evaluation Sheets in all.

SPEAR Graphics

SPEAR graphic with key questions for each problem type:

Search Have I got everything ready in order to make a start? Do I understand the question? What is the question asking me to do? Where have I come across similar questions before? How did I solve questions like this in the past? What else do I need to know?	Plan Can I create a way to tackle the problem? Can I identify the important facts and instructions? Can I create a system for identifying the important information? Can I decide on the information needed to describe the pattern? How might I record my thinking?	Explore Can I work systematically (step by step)? How can I organise the data into a list or pattern that helps to identify gaps? Can I use drawings or annotations to help see the problem using familiar shapes or patterns?	Apply How will I record my thinking and working out? Can I reorder the data to identify all possibilities? How will I track what has been included and what has not? Can I choose and use an appropriate recording system to organise the information given in the problem?	Review Have I answered the question or solved the problem fully? Is my work accurate? Have I checked for repeats or mistakes? Have I recorded my thinking in a way others will understand? Is my answer sensible? What have I learnt that I can use again in future?
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Finding Rules and Describing Patterns Problems

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Simplified SPEAR graphic with icons for younger children:



There are **10** documents like this in all.

Teachers' Manuals

Teachers' Guides for each type of problem containing Statements of Attainment with examples of achieving each objective and suggested next teaching steps. The same information compiled into a comprehensive teachers' guide covering all problem types.

SPEAR Maths Next Steps Teachers' Guide with SPEAR Colours

Level	Descriptor	Example	Next Teaching Steps
Level 1	• be able to use everyday language to talk about their work	With some prompts is able to explain what has been done using mathematical language eg 'I put two cakes on Teddy's plate and three cakes on Humpty's plate and that makes five altogether'	Create opportunities for children to explore and discuss patterns (eg patterns of Lego bricks in a model) using mathematical language
	• with support, be able to make connections and use prior knowledge to solve similar practical problems in a new context	With support, engages with practical mathematical activities involving sorting, counting and measuring by direct comparison eg can find different ways to dress teddy, can order cars in a line, can find out how many cars can be made using eight wheels	Create opportunities for children to find lots of possibilities eg find different ways to make a tower with three coloured blocks Give children opportunities to choose useful resources from a limited range of resources
	• with support, be able to 'act out' a simple problem within a small group	With support eg packs a picnic for the Three Bears, lays the table for the Three Bears; solves practical problems involving counting, adding, subtracting in the context of numbers, measures or money	Create opportunities for children to act out a wide range of mathematical problems involving numbers, measures or money with more independence
	• with support, be able to use practical resources to represent aspects of a problem	With support eg chooses criteria to sort buttons, shows that toy cars can be lined up in different orders	Create opportunities for children to identify the mathematical knowledge needed to solve a problem eg by using coins to buy items of shopping
	• be able to describe verbally, or with resources, possible solutions to a problem	Is able to explain eg 'the blue car is biggest because it's longer', 'there are five sheep and seven cows', 'there are three dolls and six hats, so the dolls can have two hats each'	Create opportunities for pupils to listen to each other's explanations, try to make sense of them, compare and contrast, evaluate...
	• be able to count accurately the number of possible solutions to a simple problem	With some support, is able to say eg 'there are three ways to have two plates of cakes with two cakes altogether (1+1, 2+0 and 0+2)'	Create opportunities for pupils to start to make connections and begin to apply their knowledge to new situations eg to recognise that the number of ways to throw three bean bags into two buckets involves the same pattern as the number of ways to put three apples in two bowls
	• be able to understand a 'not' statement in the context of a simple problem (L)	Is able to explain eg that 'the ball is not on the top shelf' means that the ball is on the middle or the bottom shelf of a three shelf bookcase	Create opportunities for pupils to practice applying their understanding of 'not' statements in a range of increasingly challenging contexts eg include an extra shelf and an extra toy

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A new teachers' guide organised into year groups (2014 version)

Year	Descriptor	Example	Next Teaching Steps
Year 4	• be able to explain an approach to a simple problem orally, with written jottings to support the explanation, with some evidence of reasoning	Is able to put the problem into their own words and use a wide range of pictures, diagrams and some mathematical symbols to communicate their thinking or demonstrate a solution or process; is able to make a generalisation with some assistance of probing questions or prompts; when they have solved a problem, is able to pose similar problems for a partner	Create opportunities for pupils to experience a broadening range of problems of different types, asking them to make suggestions about how they might tackle each one and encouraging them to try different approaches, making connections to previous work eg explore ways to navigate a maze finding a route that totals 100
	• with limited support, be able to use discussion to break into a problem, recognising similarities to previous work and identifying strategies to use in solving the problem	With limited support, is beginning to try a variety of approaches to overcome difficulties when solving problems eg when covering an area with rectangular tiles; with limited support, is able to break up a complicated task into smaller steps in order to make a start; is able to answer questions to clarify a problem; with limited support, is able to show understanding of a general statement by finding examples that match it eg 'If you add two odd numbers you get an even number'	Create opportunities for children to make choices about how they intend to approach a problem and then to explain the thinking behind the choices made, using language such as 'it can't be... because...' Create opportunities for pupils to discuss, and show understanding of general statements that are true by finding examples that match it and statements that are false by giving counter examples eg Sam says 'all numbers ending in 4 are in the 4x table. Is Sam correct?'
	• with limited support, move from 'acting out' to working with practical apparatus or diagrams to solve the problem (DVP) (FAP) (FRDP)	With limited support, is able to choose appropriate practical resources, including resources that are not immediately available, and use these resources effectively to break into problems of different types.	Create opportunities for pupils to choose, and use, formal problem-solving strategies; encourage pupils to move quickly on from 'acting out' to more formal strategies; encourage pupils to think creatively to search for a solution to a problem eg by asking questions such as 'how are you going to show the rest of the class what you did?' and 'is there another way you could do this?'
	• with limited support, be able to put the problem into their own words and identify the important information needed to solve it	With limited support, is able to tackle and solve one-step problems involving numbers, money or measures including time using Y4 content; with limited support, is able to tackle	Create opportunities for pupils to practise reframing a problem eg by putting it into their own words, by explaining it to a peer, by discussing it in a group, by presenting to the

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Pupil Passports

Suggested collections of graded and ordered problems arranged termly for Y1 to Y6 classes. Each passport contains a mixture of problem types of increasing levels of difficulty and includes a brief description of each problem and necessary prior knowledge:

Type					Y3 Autumn			
D	L	P	R	W	Title	Description	Necessary Prior Knowledge	Date/ Comment
*					D6 Spot the Shapes I	Count triangles/ rectangles in a picture	Recognise triangles and rectangles Count accurately to 20	
	*				L15 Take it Easy	Understand how to win a simple number based logic game	Add and subtract mentally 1,2 and 3	
		*			W1 Stamps	Find multiples of 5 and 10 which add to 55	5x and 10x table facts	
			*		R80 Hundred Square Fragments	Complete fragments of hundred square by filling in missing numbers	Understand the layout of a hundred square	
	*				P128 Which Toys Can You Buy?	Which combinations of 3 out of 6 toys can you buy with £5?	Add and subtract £ and p to around £5	
*					D64 Odd Square	Put numbers 1-9 in 3x3 grid so that differences of adjacent numbers are odd	Know the meaning of 'difference'	
*					L13 Build a Tower	Use clues to work out which cube was on top of a four colour tower	Know positional language	
	*				P124 Odd Numbers	Find ways of adding 4 odd numbers to make 20	Add mentally to 20 Understand 'odd' and 'even'	
		*			R10 L-shaped Model	Understand the pattern in a sequence of shapes and predict the 10 th term	Recognise and describe patterns	
		*			P30 Ben's Number	Whole numbers whose digits add to 5	Add small numbers mentally	
		*			W94 I Think of a Number	Simple word problems involving inverse operations	Experience of using inverse operations	
	*				P22 Christmas Tree	How many ways can four stars on a Christmas tree be coloured either red or yellow?	Work systematically	

There are **6** Pupil Passports in all.

Problems

Over **550** problems covering Levels 1-5 and all problem types in an easy to use searchable database. In addition, there are EYFS ideas for Maths problem solving. New problems are being added all the time. Many problems now include ready-made resources such as empty tables, as well as extension and support materials. All problems include complete answers.

ID	Category	Year Group	Description	Necessary Prior Knowledge	Key Learning Objectives
41	Logic Reasoning	3	Which combinations of coins add to 50p?	Recognise coin values and understand the value of the coins Add more than two numbers, 5 or less Count in ones and tens	Recognise simple addition or subtraction Generalise and justify Suggest extensions by asking 'what if?' or 'what could you next?' Organise the recording of possibilities eg in an ordered list
42	Logic Reasoning	3	What game of number adding to 8?	Addition of two numbers Counting on Recs of number that make 8 Playing a logic game	Recognise simple addition or subtraction Generalise and justify Suggest extensions by asking 'what if?' or 'what could you next?' Organise the recording of possibilities eg in an ordered list Begin to look a system for finding the possibilities eg start with the smallest number
43	Logic Reasoning	3	Add two numbers 1 to 10 make 5, 6, 7	Addition and subtraction facts up to 10	Recognise simple addition or subtraction Organise the recording of possibilities eg in an ordered list
44	Logic Reasoning	3	The sum of some numbers chosen from 1, 2, 3 and 4	Addition and subtraction facts up to 10 Simple mental addition and subtraction	Recognise simple addition or subtraction Organise the recording of possibilities eg in an ordered list Begin to look a system for finding the possibilities eg start with the smallest number
45	Logic Reasoning	3	Ways of making 10 using odd	Number bonds to 10	Recognise simple addition or subtraction Generalise and justify Suggest extensions by asking 'what if?' or 'what could you next?' Organise the recording of possibilities eg in an ordered list

Early Years Ideas

These activity sheets are intended to be used by adults to inform their support of pupils as they experience learning opportunities. Each sheet includes an activity, resources and focusing and extending questions, as well as key objectives:

E8 Feely Bag Shapes

Resources
Feely bag, collection of shapes of different types, sizes and materials (if possible). The shapes could be flat, 3D or a mixture of 2D and 3D.

Activity
Each child in turn finds and feels a shape in the bag and talks about its properties, trying to describe what shape it is before bringing it out to see.

Focusing Questions
Tell me about your shape.
Does it have straight sides?
How many sides does it have? How do you know?
What do you think your shape is made of?
What is your shape called?
Has it got corners? How many?

Extending Questions
How many shapes are in the bag?
Is there another shape it could be?
Is there another shape the same as yours in the bag?
How many the same can you feel?
Can you see other shapes like yours in the classroom? Where?
Can you draw the shapes you have found?
What is the same about these (two) shapes and what is different?

Objectives

- Take everyday language to talk about size, weight, capacity, position, direction, time and money.
- Use everyday language to compare quantities and objects and to solve problems.
- Explore characteristics of everyday objects and shapes and use mathematical language to describe them.

E22 Boxes

Resources
A collection of empty boxes of different shapes, sizes and colours. The boxes should be fairly sturdy and not too difficult to open.

Activity
Let the children explore the boxes.

Focusing Questions
How many boxes are there? How do you know?
How many are the boxes one like?
How many more red than blue boxes are there?
Which is the biggest box? How do you know?
Do any boxes fit inside other boxes?
Can you tell me about this box?

Extending Questions
Which box do you like best? Why?
How many boxes can fit into this one?
What could you put in this box?
Are there any boxes you don't like? Why?
Which box is the prettiest? Why?
Can you build a tower with the boxes? Which one will go on the bottom?
Are there any boxes which are the same size? How do you know?
Can you sort the boxes? Is there another way to sort them?

Objectives

- Count objects with numbers from 1 to 10.
- Use everyday language to talk about size, weight, capacity, position, direction and money.
- Use everyday language to compare quantities and objects and to solve problems.
- Explore characteristics of everyday objects and shapes and use mathematical language to describe them.

E25 On the Beach

Resources
A collection of objects from the beach: shells, pebbles, wood, etc.

Activity
Encourage the children to touch, manipulate, play with and sort the objects.

Focusing Questions
Where did these things come from? How do you know?
Are there more shells or stones? How do you know?
How many shells are there?
How many are the shells one like?
Which is the biggest stone? How do you know?
Which is your favourite object? Why?
Is there anything here you don't like? Why?
Which stone weighs the most?

Extending Questions
Can you sort the objects into groups? What?
Which is your favourite shell? Why?
Can you put the stones in order? How?
Can you sort the shells?
Is there another way to sort them?
Which of the objects is the most unusual?

Objectives

- Count objects with numbers from 1 to 10.
- Use everyday language to talk about size, weight, capacity, position, direction, time and money.
- Use everyday language to compare quantities and objects and to solve problems.
- Explore characteristics of everyday objects and shapes and use mathematical language to describe them.

There are **25** EYFS activities.

A complete problem:

Here is an example Y1 problem with answers, resources, simplified version etc:

P2 Down the Path

The robot is on 2.

You roll a 1 to 6 dice.
After 3 moves it lands on 0.

Find all the different ways the robot can do this.

Objectives

- Recognise simple patterns or sequences.
- Generate and predict.
- Support children to bring 'what if...?' or 'what could it be next?'.
- Engage the children in problem-solving and to use mathematical language to describe the problem.

P2e Down the Path

The robot is at the start of the path.

You roll a 1 to 6 dice.
After 2 moves it lands on 5.

Find all the different ways the robot can do this.

Objectives

- Recognise simple patterns or sequences.
- Generate and predict.
- Support children to bring 'what if...?' or 'what could it be next?'.
- Engage the children in problem-solving and to use mathematical language to describe the problem.

Answer to P2 Down the Path

- 1 + 5
- 2 + 4
- 3 + 3
- 4 + 2
- 5 + 1

Notes

Some children may find the idea of the robot starting on 2 confusing. For this reason, you may wish to use the simplified version of the problem on the next page. This generates exactly the same answers but without the complication of starting on 2.

Diagram and Visual Puzzles

There are currently **70** separate Y1-Y6 DVP problems in the Problem Bank:

D1

Gold Bars

Pete is a pirate.
His gold bars are in piles.
He can move one or more bars at a time.



He makes all the piles the same height.
He makes just two moves.
How does he do it?

Objectives

- Use drawings or annotations to help visualise the problem.
- Test ideas as you go if they work.
- Explain methods and reasoning.
- Use a systematic approach to solve the problem.

© 2007 2011 Source: Mathematics Challenges for Ages 7-11

D15

Tony's Ice Cream

Tony is an ice cream man.



He visits 5 towns each day.

He gets bored visiting them in the same order every day.

Tony lives in town A, so he starts and finishes there every day.



Using the map, can you list all the different possible routes so Tony can vary which way he travels each day?

Objectives

- Use drawings or annotations to help visualise the problem.
- Use a systematic approach to solve the problem.
- Choose and use an appropriate method of recording.

© 2007 2011 Source: Maths for All Problem Bank

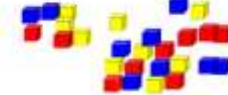
D19

Seventy-two Cubes

Seventy-two cubes can be used to make a cuboid two cubes high, three cubes deep and 12 cubes long (2 x 3 x 12 = 72) like this:



How many other cuboids can be made using exactly 72 cubes?



How can you be sure that you have found them all? You might want to record your answers in a table.

Objectives

- Use drawings or annotations to help visualise the problem.
- Use a systematic approach to solve the problem.
- Choose and use an appropriate method of recording.
- Try other possibilities to test the solution.

© 2007 2011 Source: NKS Equipment 1998

D25

House Numbers

On my street, the houses on one side of the street are numbered 1, 2, 3, 4 and so on.
The houses on the other side of the street are numbered backwards, so that the house with the largest number is opposite house number 1.



My house number is 52 and I live opposite house number 29.
How many houses are on my street?

If the houses are re-numbered so that one side of the street is the even numbers 2, 4, 6 and so on and the other side of the street is the odd numbers with the largest odd number opposite house number 2, which house number will be opposite mine?

Objectives

- Use drawings or annotations to help visualise the problem.
- Choose and use an appropriate method of recording.
- Use a systematic approach to solve the problem.
- Identify the given information and represent it in another way.

© 2007 2011 Source: Delta Primary Problem Bank

D31

Garden Perimeter

You have been asked to design a garden with an area of 24 square metres. The shape of the garden is up to you. The garden will have to be fenced for security, so a shape with a shorter perimeter is better: that one with a longer perimeter (as you will need to buy lots of fencing).

Using 1cm squared paper, explore the perimeters of shapes with an area of 24 square centimetres.

NOTE: We are using 1cm squared to represent a real life area of 1 metre squared. In other words, we are using a scale of 1:100.

Start with simple shapes like rectangles. What about a square? What about a circle? What about more complex shapes?



Which shape would be best?

Objectives

- Use drawings or annotations to help visualise the problem.
- Use a systematic approach to solve the problem.
- Choose and use an appropriate method of recording.
- Visualise all solutions.

© 2007 2011 Source: AQA

D34

Five Rectangles

With twelve squares you can make exactly three different rectangles:



Find out how many squares can be arranged to make exactly five different rectangles.

How does this link with factors?



Objectives

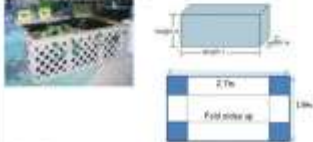
- Use drawings or annotations to help visualise the problem.
- Use a systematic approach to solve the problem.
- Choose and use an appropriate method of recording.
- Try other possibilities to test the solution.

© 2007 2011 Source: NKS Equipment 1998

D38

Garden Pond

Your school wants a formal rectangular pond. Of course, it's not really a rectangle, it's a cuboid! The pond will be raised (it will sit on the ground and the water will be held in by walls).



The pond that you have is a rectangle 2.7m long and 1.5m wide. You can use an A4 sheet of 1cm squared paper with the margins cut off to represent this site on a scale of 1:10 (the sheet of paper will be 27cm x 18cm).

Work out the biggest rectangular pond you can make using the four outside. The biggest pond is the one that can hold the most water. The volume of a cuboid is given by $l \times b \times h$ (which means length \times breadth \times height).

Objectives

- Use drawings or annotations to help visualise the problem.
- Use a systematic approach to solve the problem.
- Choose and use an appropriate method of recording.
- Try other possibilities to test the solution.

© 2007 2011 Source: AQA

D61

Ski Lift +

On a ski lift the chairs are equally spaced. They are numbered in order from 1.



Kelly went skiing.

She got in chair 17 to go to the top of the slopes.

Exactly half way to the top, she passed chair 93 as it's way down.

How many chairs are there on the ski lift?

Objectives

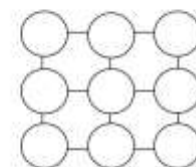
- Use drawings or annotations to help visualise the problem.
- Use a systematic approach to solve the problem.
- Choose and use an appropriate method of recording.

© 2007 2011 Source: AQA

D64

Odd Square

Put the numbers 1-9 in the circles so that the difference between each pair of joined numbers is odd.



A 'difference' is what you get when subtract the smaller number from the larger number.

Note: there are lots of ways to do this!

Objectives

- Use drawings or annotations to help visualise the problem.
- Use a systematic approach to solve the problem.

© 2007 2011 Source: NKS Equipment 1998

Logic Problems

There are currently **109** separate Y1-Y6 Logic problems in the Problem Bank:

L1

Toys

Follow the clues to put the toys on the shelves.



The bear is on the middle shelf.
The skipping rope is on the top shelf.
The car is on the bottom shelf.
The ball is next to the bear.
The teddy is between the bear and the car.

- Objectives**
- Recognise simple patterns or relationships, generalise and predict.
 - Suggest alternatives for solving what if...? or what could I try next?
 - Use one piece of information at a time and see what effect it has.
 - Check that the answer meets all of the criteria.

© 2009 2011 Source: P18 Problem Solving 101 1000 00000

L5

Sally's Super Sandwich Shop

Sally runs a sandwich shop. She gets a very muddled order for lunchtime sandwiches from the office next door. Can you sort it out using the clues?



How many of each sandwich must Sally make for the office?
Sandwiches can be brown bread or white bread.
They can be cheese or salad.

Order
We need 5 white bread sandwiches.
We need 2 white bread sandwiches with cheese.
We need 3 cheese sandwiches.
We need double the number of brown bread salad sandwiches as white bread salad sandwiches.

- Objectives**
- Recognise simple patterns or relationships, generalise and predict.
 - Suggest alternatives for solving what if...? or what could I try next?
 - Use one piece of information at a time and see what effect it has.
 - Use two or more pieces of information at a time and see what effect it has.
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 - Use one or more pieces of information at a time and see what effect it has.

© 2009 2011 Source: P18 Problem Solving 101 1000 00000

L15

Take it Easy

Take



Here are the rules:

Start with seven cubes on a counting tray.

Take turns

When it's your turn, you must take one or two cubes.
The person who takes the last cube is the loser.

Can you see how to win?

Remember: the person who takes the last cube is the loser.

When you have worked out how to win every time, try making the person who takes the last cube the winner. How can you win now?

- Objectives**
- Recognise simple patterns or relationships, generalise and predict.
 - Suggest alternatives for solving what if...? or what could I try next?
 - Use one piece of information at a time and see what effect it has.
 - Use two or more pieces of information at a time and see what effect it has.
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© 2009 2011 Source: Problem Bank

L20

Rows of Coins



1. Take five coins: 1p, 2p, 5p, 30p, 30p.
Put them in a row using these clues. The total of the first three coins is 27p. The total of the last three coins is 30p.
The last coin is double the value of the first coin.

2. Take six coins: two 1p, two 2p and two 5p.
Put them in a row using these clues: Between the two 1p coins there is one coin. Between the two 2p coins there are two coins. Between the two 5p coins there are three coins.

What if you take two 10p coins as well as the six listed in question 2, and between them are four coins?

- Objectives**
- Use one piece of information at a time and see what effect it has.
 - Use two or more pieces of information at a time and see what effect it has.
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© 2009 2011 Source: Mathematical Strategies for Mini Pupils 26

L28

K x A

$K \times A = DF$
 $F \times A = BD$
 $D \times A = H$
 $E \times A = BE$
 $J \times A = DG$
 $H \times A = BK$
 $B \times A = A$
 $G \times A = DB$
 $BC \times A = AC$
 $BD \times A = AH$
 $BB \times A = AA$
 $A \times A = J$

Each letter (in the equations on the left of the page) stands for a single digit.

Where there are two letters next to each other, this stands for a two-digit number.

Each letter stands for the same digit throughout all of the equations.

Can you work out what digit each letter stands for?

Hint! You don't have to start at the top!

- Objectives**
- Recognise simple patterns or relationships, generalise and predict.
 - Suggest alternatives for solving what if...? or what could I try next?
 - Use one piece of information at a time and see what effect it has.
 - Use two or more pieces of information at a time and see what effect it has.
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© 2009 2011 Source: Problem Bank

L29

Nicknames

Down, Mark, Josh and Tina are friends. They each have a nickname. Their nicknames are Spider, Curly, Ace and Fudge, but not in that order.



What is the nickname of each of the friends? Here are some clues to help you!

Josh plays tennis with Curly and goes swimming with Ace.
Tina has been on holiday with Curly but travels to school with Fudge.
Spider, Curly and Dave play in the football team.
Spider sometimes goes to tea with Josh.

- Objectives**
- Recognise simple patterns or relationships, generalise and predict.
 - Suggest alternatives for solving what if...? or what could I try next?
 - Use one piece of information at a time and see what effect it has.
 - Use two or more pieces of information at a time and see what effect it has.
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© 2009 2011 Source: P18 Problem Solving 101 1000 00000

L39

Send in the Clowns

Six clowns stand in a line. Two have red noses, two have blue noses and two have green noses.



Use the clues to decide the colour of each clown's nose:

There is one nose between the two red noses.

There are two noses between the two blue noses.

There are three noses between the two green noses.

(There are two possible answers that fit these clues)

Now find as many answers as you can that match these clues:

The green noses are next to each other.

There is a blue nose at one end of the line but the other blue nose is not at the other end of the line.

The red noses are not next to each other.

- Objectives**
- Solve a problem by identifying given facts and understanding them.
 - Use one piece of information at a time and see what effect it has.
 - Use two or more pieces of information at a time and see what effect it has.
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L47

At The Zoo

At The Zoo

Three girls visit the zoo. Can you find their favourite animal, what they had to eat and with whom they went?

Girl: Ella, Emily, Jessica
Animal: Elephant, Zebra, Giraffe
Lily: Giraffe, Plooper, Ziger
Mia: Aunt, Giraffe, Mia

- Ella went to the zoo with her Grandma, but did not have a Ziger.
- Mia went with the girl whose favourite animal was the elephant.
- The girl whose favourite was the giraffe did not have a Plooper.
- The Aunt bought a Giraffe for the child she took to the zoo, this was not Jessica's.

- Objectives**
- Solve a problem by identifying given facts and understanding them.
 - Use one piece of information at a time and see what effect it has.
 - Use two or more pieces of information at a time and see what effect it has.
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© 2009 2011 Source: Problem Bank

L57

Lunchbox Riddle

Amy, Billy, Chloe, Daniela and Enzo each own a lunchbox. The lunchboxes are in a straight line in the dining hall. Each lunchbox is a different colour and contains a sandwich, a drink and a piece of fruit. Each child has a different sandwich, a different drink and a different piece of fruit. Who has a pear for lunch?

Facts:

Amy has a red lunchbox.

Daniela has a banana for lunch.

Billy only drinks squash.

Chloe only eats plain sandwiches.

The first lunchbox belongs to Enzo.

The lunchbox in the middle contains milk.

Daniela's lunchbox is next to the blue one.

The green lunchbox's owner drinks lemonade.

The person who eats plain sandwiches has a drink.

The owner of the yellow lunchbox has a ham sandwich.

The green lunchbox is on the left of the white lunchbox.

The lunchbox with the egg sandwich is next to the one with the orange.

The apple is in the lunchbox next to the one with the ham sandwich.

The owner of the cheese sandwich has milk to drink.

The water-drinker's box is next to the egg-eater's box.



- Objectives**
- Recognise simple patterns or relationships, generalise and predict.
 - Suggest alternatives for solving what if...? or what could I try next?
 - Use one piece of information at a time and see what effect it has.
 - Use two or more pieces of information at a time and see what effect it has.
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 - Use one or more pieces of information at a time and see what effect it has.

© 2009 2011 Source: Skills Beyond 21 Problem Bank

Finding All Possibilities Problems

There are **152** separate Y1-Y6 Finding All Possibilities problems in the Problem Bank:

P1

Lollipops

Jodie bought a lollipop. It cost 7p.



She paid for it exactly. Which coins did she use?
There are five different ways to do it. How many of these ways can you find?

How many ways would there be if the lollipop cost 7p?

Objectives

- Recognise simple patterns or relationships
- Generate and predict
- Suggest extensions by asking 'what if...?' or 'what could I try next?'
- Organise the recording of possibilities as in an ordered list

© 2009 2011 Source: NKS Problem Solving (2010) ISBN: 9781851967200

P14

Buttons

Lisa has 7 buttons. She puts them into 3 boxes:



How many different ways can Lisa sort 7 buttons into 3 identical boxes?
Show your thinking.

Objectives

- Recognise simple patterns or relationships
- Generate and predict
- Organise extensions by asking 'what if...?' or 'what could I try next?'
- Organise the recording of possibilities as in an ordered list or table
- Have a system for finding the possibilities as start with the smallest number, know when all possibilities are found, check for repeats of possibilities

© 2009 2011 Source: Inductive (A Problem Solver)

P25

Three Monkeys

Three monkeys ate a total of 25 nuts. Each of them ate a different odd number of nuts.



How many nuts did each of the monkeys eat?
Find as many different ways to do it as you can.

Objectives

- Recognise simple patterns or relationships
- Generate and predict
- Organise extensions by asking 'what if...?' or 'what could I try next?'
- Organise the recording of possibilities as in an ordered list or table
- Have a system for finding the possibilities as start with the smallest number, know when all possibilities are found, check for repeats of possibilities

© 2009 2011 Source: Mathematics Challenges for Girls (Page 1)

P43

Lining Up

In how many different orders can a group of children line up at the door?



One person?

Two people?

What about three people? Four people?
Put this information into a table and look for a pattern!

In how many orders can 10 people line up?
Can you find the general rule? How many orders for N people?

Objectives

- Use drawings or illustrations to help resolve the problem
- Recognise patterns or relationships
- Organise the recording of possibilities as in an ordered list
- Have a system for finding the possibilities as start with the smallest number, know when all possibilities are found, check for repeats of possibilities

© 2009 2011 Source: NKS

P52

Three Dice

Sigurd rolls three dice:



He adds up all three numbers.

How many different totals could he get?
Try to work systematically.
Show your thinking.

Objectives

- Recognise patterns or relationships
- Organise the recording of possibilities as in an ordered list
- Have a system for finding the possibilities as start with the smallest number, know when all possibilities are found, check for repeats of possibilities

© 2009 2011 Source: Inductive (A Problem Solver)

P54

Island Menu

Oh dear, you are shipwrecked on a desert island. You have had a look round and managed to collect the following foods for dinner:

- Bread
- Fish
- Bananas
- Yams
- Berries
- Seaweed

For this problem assume that the order you choose the items is important, as a choice of 'fish first and bread second' is different to choosing bread first and fish second.

How many different ways can you choose:

- One item for dinner?
- Two different items for dinner?
- Three different items for dinner?



What if the order isn't important?
How many different ways can you choose one, or two, or three items now? (Note: this is a much harder problem!)

Objectives

- Use drawings or illustrations to help resolve the problem
- Organise the recording of possibilities as in an ordered list
- Have a system for finding the possibilities as start with the smallest number, know when all possibilities are found, check for repeats of possibilities

© 2009 2011 Source: NKS

P67

Half Time Score

The football match ended in a draw (the score could have been 0-0 or 1-1 or 2-2 etc.)



What might the score have been at half time?
Start with a full time score of 0-0.
Work systematically.
Show your thinking.

Objectives

- Recognise patterns or relationships
- Generate and predict
- Suggest extensions by asking 'what if...?' or 'what could I try next?'
- Organise the recording of possibilities as in an ordered list
- Have a system for finding the possibilities, know when all possibilities are found, check for repeats of possibilities

© 2009 2011 Source: Inductive (A Problem Solver)

P104

Tracksuits +

You have 3 new tracksuits with matching socks:



One morning you get dressed in the dark. You reach into your clothes cupboard and take out a top, a pair of trousers and a pair of socks without looking.

How many different possible outfits are there?

If you bought a yellow tracksuit with matching socks, how many more possibilities will there be?
Show your thinking.

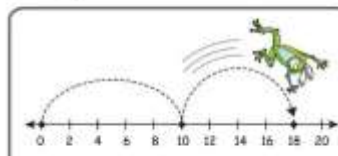
Objectives

- Have a system for finding the possibilities as start with the smallest number, know when all possibilities are found, check for repeats of possibilities
- Organise the recording of possibilities as in an ordered list or table
- Use a method of tracking what has been included and what has not

© 2009 2011 Source: NKS

P144

Three Hops to 20



Freddie the Frog takes 3 hops to get from 0 to 20

One way he does it is: $10 + 8 + 2 = 20$

How many ways can you find for Freddie to take 3 hops to get from 0 to 20?

Write each one down as a number sentence.

Objectives

- Organise the recording of possibilities as in an ordered list
- Use a systematic approach to solve the problem
- Recognise simple patterns and relationships, generate and predict

© 2009 2011 Source: NKS Mathematics (2)

Finding Rules and Describing Patterns Problems

There are **95** Y1-Y6 Finding Rules and Describing Patterns problems altogether:

R2 Teddy's Birthday Candles

Teddy is 7 years old today.



How many birthday candles has he blown out since he was born?

- Objective**
- Describe and extend simple number sequences
 - Recognise simple patterns and relationships, generative and practical
 - Choose and explain their solution to a given problem

© 2009 2011 Source: NKS Problems Inquiry 2003 1007 2004

R24 The 49th Counter



A line of counters is set out in a pattern: two white, four blue, two white, four blue and so on.

What colour is the 49th counter? How do you know?

What colour is the 49th counter in each of these patterns? How do you know?



- Objective**
- Describe a rule of a pattern or relationship in words or symbols
 - Decide on the information you need to continue the pattern
 - Use drawings or symbols to help visualize the problem

© 2009 2011 Source: NKS Problems Inquiry

R27 Sequence of Shapes

Make these shapes with plastic cubes:



Can you see how the pattern develops? Make a table of your results:

Shape Number	1	2	3	4	5	6
Number of Cubes	4	6	9	13	18	24

How many cubes will there be in Shape 20?
How many cubes will there be in Shape 1000?

Find a general rule for how many cubes there are in 'shape *n*' where *n* stands for 'any shape you choose'

- Objective**
- Describe a rule of a pattern or relationship in words or symbols
 - Decide on the information you need to continue the pattern
 - Produce the next few terms of a sequence to test the rule

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R30 Tennis Tournament

A number of people take part in a tennis tournament.



In every round the winners of each game progress to the next round, the losers are out. If there is an odd number of people in a round, one player has a 'bye' to the next round.

How many games of tennis will be played in the tournament? Look at tournaments with different numbers of players

Can you write a general rule to work out the number of games played for any number of players starting a tournament?

- Objective**
- Describe a rule of a pattern or relationship in words or symbols
 - Decide on the information you need to continue the pattern
 - Produce the next few terms of a sequence to test the rule
 - Use a systematic approach to solve the problem
 - Choose and use an appropriate method of recording

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R36 Handshakes

Everyone in a group shakes hand with everyone else once only.



How many handshakes is that all together?

Try and work systematically, starting with the easiest case. You could record your findings in a table:

No. of People in group	1	2	3	4	5	6
No. of Handshakes	0	1				

Can you find a general rule for the number of handshakes?

- Objective**
- Describe a rule of a pattern or relationship in words or symbols
 - Decide on the information you need to continue the pattern
 - Produce the next few terms of a sequence to test the rule
 - Use a systematic approach to solve the problem
 - Choose and use an appropriate method of recording

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R44 Square & Triangular Numbers

Test this statement and decide if it is true:

'Any square number is the sum of two consecutive triangular numbers'

For example:

$$4 = 1 + 3$$

4 is a square number

1 and 3 are consecutive triangular numbers

Find other examples that match the statement

Is the statement always true? Explain your thinking.

Square Numbers: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100 etc.
Triangular Numbers: 1, 3, 6, 10, 15, 21, 28, 36, 45 etc.



- Objective**
- Recognise and extend patterns or relationships, generative and practical
 - Describe a rule of a pattern or relationship in words or symbols
 - Use a systematic approach to solve the problem

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R46 Unichains

You can make a chain by adding together any pair of digits and writing only the units digit total in the next link. For example, if the chain starts with 1 and 8:



$$1 + 8 = 9$$

$$8 + 9 = 17 \text{ (so write '7')}$$

$$9 + 7 = 16 \text{ (so write '6')}$$

$$7 + 6 = 13 \text{ (so write '3')}$$

and so on

Try starting with different pairs of numbers. Does the chain form a loop?

Try other pairs of digits. Note that the order makes a difference (starting with 8, 1 creates a different chain to starting with 1, 8)

- Objective**
- Recognise and explain patterns or relationships, generative and practical
 - Use a systematic approach to solve the problem
 - Choose and use an appropriate method of recording

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R86 Olympic Medals

At the Olympics, the winners stand on boxes to get their medals:

For three medal winners, four boxes are needed:



For five medal winners, you need this arrangement of boxes:



How many boxes is this?

How many boxes will you need for 7 people to get medals? What about 9 people?

Can you find the general rule: How many boxes for any odd number of winners?

- Objective**
- Describe a rule of a pattern or relationship in words or symbols
 - Decide on the information you need to continue the pattern
 - Produce the next few terms of a sequence to test the rule
 - Use a systematic approach to solve the problem
 - Choose and use an appropriate method of recording

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R88 Socks

Harish has a pile of socks:



He decides to sort them into pairs:

He has one sock left over.



How many socks could Harish have altogether?

He finds another sock to complete the final pair. How many socks could Harish have altogether now?

- Objective**
- Recognise and explain patterns or relationships, generative and practical
 - Describe a rule of a pattern or relationship in words or symbols
 - Use a systematic approach to solve the problem

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Word Problems

There are currently **125** Y1-Y6 Word Problems in the SPEAR Maths Problem Bank:

W2

Stickers

The twins collected some animal stickers. They each had the same total number. They stuck some in their sticker books and kept some loose for swaps.



Wendy had 3 full sheets and 4 loose stickers. Wendy had 2 full sheets and 12 loose stickers.

Every full sheet has the same number of stickers. How many stickers are there in a full sheet?

Objective

- Choose and use appropriate number operations and appropriate ways of calculating to solve problems.
- Use a systematic approach to solve the problem.
- Check that the answer makes all of the sense.

© 2007 2011 Source: Mathematics 4 Challenge for Able Pupils 22

W22

1, 2, 3 and 4 make...

Use **only** the digits 1, 2, 3, and 4 (one of each).

You can also use any operations you like: + - × ÷ as many times as you like.

Here is a calculation that totals 1: $2 + 3 - 4 \times 1 = 1$

Here is a calculation that totals 40: $43 - 2 - 1 = 40$

Now make-up calculations that total 2, 3, 4, 5, 6, 7 etc.

Can you make each number from 1 to 40?

Create a way to work systematically.



Objective

- Choose and use appropriate number operations and appropriate ways of calculating to solve problems.
- Use a systematic approach to solve the problem.
- Use all four operations to solve more problems involving numbers in Year 20.

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W25

Sandcastles

Lia went on holiday. In 5 days she made 80 sandcastles.



Each day she made 4 fewer castles than the day before. How many castles did she make each day?

Lia went on making 4 fewer castles each day. How many castles did she make altogether?

Objective

- Choose and use appropriate number operations and appropriate ways of calculating to solve problems.
- Recognise simple patterns of multiplication, addition and subtraction.
- Use a systematic approach to solve the problem.
- Check that the answer makes all of the sense.

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W38

Reading Rate



1. I started to read a book on Thursday. On Friday, I read 10 more pages than I read on Thursday and I got to page 60. How many pages did I read on Thursday?

2. I started to read another book on Monday. On Tuesday, I read 10 more pages than on Monday and I got to page 46. How many pages did I read on Monday?

3. I started a third book on Wednesday. Each day, I read 3 more pages than the day before. On Friday, I got to page 50. How many pages did I read on Wednesday?



Objective

- Choose and use appropriate number operations and appropriate ways of calculating to solve problems.
- Use a systematic approach to solve the problem.
- Check that the answer makes all of the sense.

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W46

What makes 1?

Find as many different ways as you can to complete the following equation:

$$\square + \triangle + \bigcirc = 1$$

Organise your answers into groups of similar type

Answers using whole numbers	Answers using decimals	Answers using negative numbers	Answers using ...?
1+0+0=1			

Objective

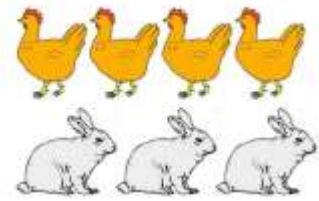
- Organise the recording of possibilities eg in an ordered list.
- Explore to find a system for finding the possibilities eg start with the smallest number.
- Choose and use an appropriate method of recording.
- Use a systematic approach to solve the problem.
- Check that the answer makes all of the sense.

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W48

Hens and Rabbits

A farmer has hens and rabbits. These animals have 50 heads and 140 feet altogether. How many feet are there and how many rabbits?



Objective

- Recognise simple patterns of multiplication, addition and subtraction.
- Choose and use an appropriate method of recording.
- Use a systematic approach to solve the problem.
- Check that the answer makes all of the sense.

© 2007 2011 Source: Unknown

W53

Coins on the Table

Anna put some 10p coins on the table. One half of them were tails up.



Anna turned over two of the coins, and then one third of them were tails up.

How many coins did Anna put on the table?

Objective

- Choose and use appropriate number operations and appropriate ways of calculating to solve problems.
- Use a systematic approach to solve the problem.
- Check that the answer makes all of the sense.

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W79

Lining Up Takes Time!

A group of 10 children can line up at the door in $10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 3628800$ ways!



If they could change position every second, how long would it take them to make all the different orders that are possible? How many seconds? How many minutes is that? How many hours? How many days?

When you have found out how long it would take for 10 people to make all the different orders, work out how long it would take for 11 people to do the same.

Objective

- Choose and use appropriate number operations and appropriate ways of calculating to solve problems.
- Use a systematic approach to solve the problem.
- Check that the answer makes all of the sense.

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W97

Motorbikes and Limos



Motorbikes have two wheels. Limos have six wheels.

Can saw a collection of motorbikes and limousines. He counted 18 wheels altogether.

How many motorbikes were there and how many limousines?

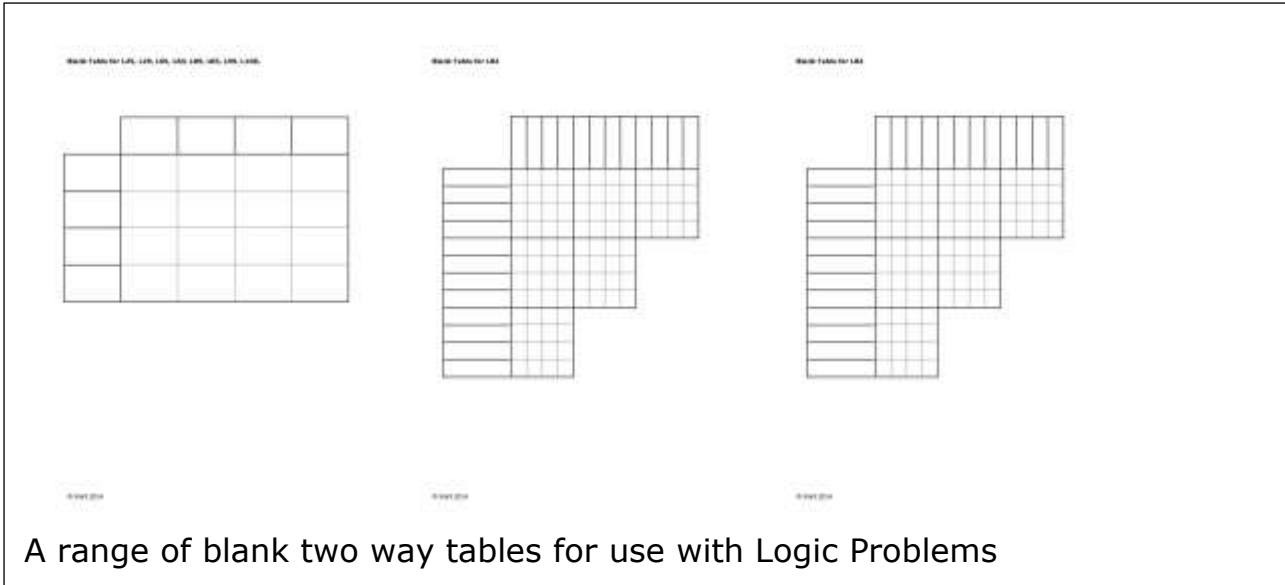
Find as many different answers as you can.

Objective

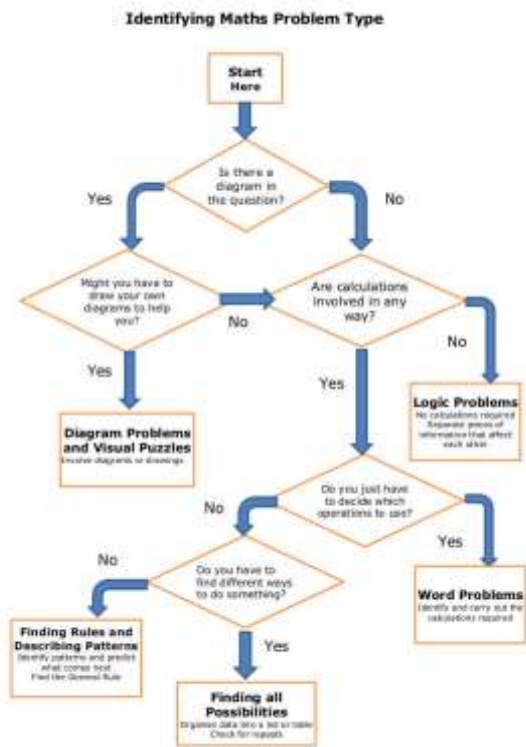
- Choose and use appropriate number operations and appropriate ways of calculating to solve problems.
- Use a systematic approach to solve the problem.
- Check that the answer makes all of the sense.

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Other Resources included in SPEAR Maths



How to identify the type of problem



Coming Soon

- US versions of all materials
- Materials for KS3
- Improved notes and resources
- More simplified problems to use with less able pupils