Problem Solving
Drawing a Table

by Sharon Shapiro

Blake's Topic Bank
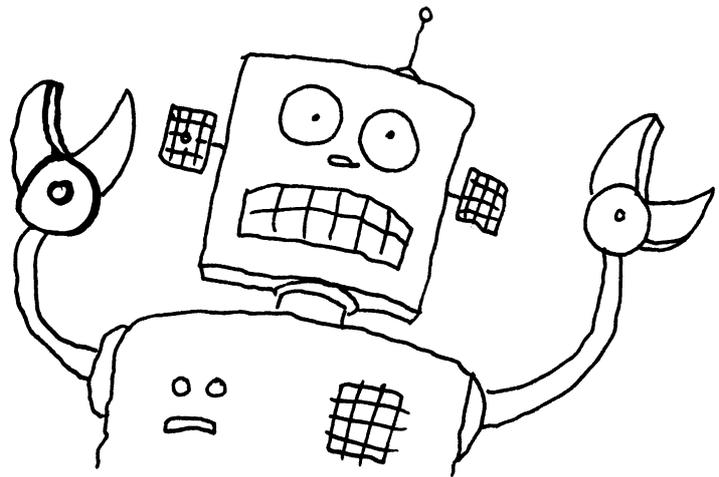
This unit contains:

- Teaching notes
- 3 teaching examples
- 1 BLM
- 15 task cards
- Answers

Problem Solving
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Middle Primary

Sharon Shapiro

THE PROBLEM SOLVING PROCESS

It is important that students follow a logical and systematic approach to their problem solving. Following these four steps will enable students to tackle problems in a structured and meaningful way.

STEP 1: UNDERSTANDING THE PROBLEM

❖ Encourage students to read the problem carefully a number of times until they fully understand what is wanted. They may need to discuss the problem with someone else or rewrite it in their own words.

❖ Students should ask internal questions such as, what is the problem asking me to do, what information is relevant and necessary for solving the problem.

❖ They should underline any unfamiliar words and find out their meanings.

❖ They should select the information they know and decide what is unknown or needs to be discovered. They should see if there is any unnecessary information.

❖ A sketch of the problem often helps their understanding.

STEP 2: STUDENTS SHOULD DECIDE ON A STRATEGY OR PLAN

Students should decide how they will solve the problem by thinking about the different strategies that could be used. They could try to make predictions, or guesses, about the problem. Often these guesses result in generalisations which help to solve problems. Students should be discouraged from making wild guesses but they should be encouraged to take risks. They should always think in terms of how this problem relates to other problems that they have solved. They should keep a record of the strategies they have tried so that they don't repeat them.

Some possible strategies include:

❖ Drawing a sketch, graph or table.
❖ Acting out situations, or using concrete materials.
❖ Organising a list.
❖ Identifying a pattern and extending it.
❖ Guessing and checking.
❖ Working backwards.
❖ Using simpler numbers to solve the problem, then applying the same methodology to the real problem.
❖ Writing a number sentence.
❖ Using logic and clues.
❖ Breaking the problem into smaller parts.

STEP 3: SOLVING THE PROBLEM

❖ Students should write down their ideas as they work so they don't forget how they approached the problem.
❖ Their approach should be systematic.
❖ If stuck, students should reread the problem and rethink their strategies.
❖ Students should be given the opportunity to orally demonstrate or explain how they reached an answer.

STEP 4: REFLECT

❖ Students should consider if their answer makes sense and if it has answered what was asked.
❖ Students should draw and write down their thinking processes, estimations and approach, as this gives them time to reflect on their practices. When they have an answer they should explain the process to someone else.
❖ Students should ask themselves 'what if' to link this problem to another. This will take their exploration to a deeper level and encourage their use of logical thought processes.
❖ Students should consider if it is possible to do the problem in a simpler way.

Teaching Notes Drawing a Table

When a problem contains information that has more than one characteristic, an effective strategy is to set out that information in a table. A table helps to organise the information so that it can be easily understood and so that relationships between one set of numbers and another become clear. A table makes it easy to see what information is there, and what information is missing. When a table is drawn up, the information often shows a pattern, or part of a solution, which can then be completed. Students will usually have to create some of the information in order to complete the table and so solve the problem.

Using a table can help reduce the possibilty of mistakes or repetitions.

Frequently teachers will need to assist students to decide how to classify and divide up the information in the problem and then how to construct an appropriate table. Teachers should give advice on how many rows and columns are needed and what headings to use in the table. Symbols and abbreviations are also helpful in making tables clearer and students should be encourged to use them where possible.

Certain skills and understandings should be reinforced before students begin to work with this strategy.
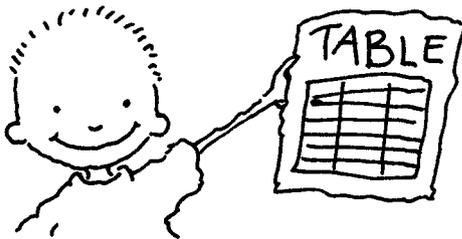
DECIDING ON THE NUMBER OF COLUMNS TO FIT THE VARIABLES

When drawing up a table, the first very important step is for students to read the problem carefully and establish how many variables are to be included in the table. This is a skill that student should be encouraged to develop. First they should decide how many factors are involved in each problem and then discuss whether the factor requires a column or row. Students should be clear about what the table is going to tell them. Headings for columns and rows are also important because they indicate the exact contents of the table.

For example: There are 18 animals at the farm. Some are chickens and others are cows. Seventy legs are visible. How many of each type of animal can be seen?
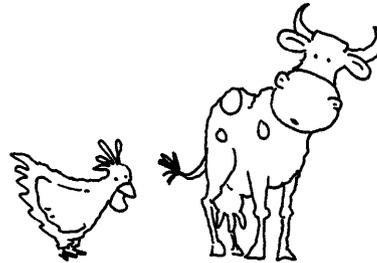
Students will need to draw up a table that has three columns.

Number of chickens	Number of cows	Number of legs

LEAVING GAPS IN TABLES AND COMPLETING PATTERNS MENTALLY

Often when a table is drawn up a pattern becomes obvious. The student may be able to leave out some of the data, (that is, leave a gap in the table) and by following the pattern, calculate mentally until the required number, or amount, is reached.

For example, two people are being compared in this problem: Mrs Shappy is 32 years old and her daughter Lisa is eight years old. How old will Lisa be when she is half as old as her mother?

A two column table is drawn.

Lisa	Mrs Shappy
8	32
9	33
10	34
11	35
12	36
13	37
24	48

By leaving gaps and calculating mentally we established that when Lisa is 24 years old her mother will be 48 years old.

Teaching Notes Drawing a Table

DRAWING TABLES TO HELP CALCULATE MULTIPLES OF NUMBERS

When calculating multiples of numbers a pattern quickly emerges. Once again, it may be necessary only to complete certain steps to establish the pattern and by following the pattern to reach the required number.

For example: Research shows three out of ten people are blond. How many blonds will be found in 1000 people?

Blond	Number of people
3	10
30	100
300	1000

This second example shows how a pattern can be established when calculating a cumulative total.

Five out of 12 students in the school are boys. If there are 768 children how many are girls?

Girls	Boys	Total
7	5	12
14	10	24
28	20	48
56	40	96
112	80	192
224	160	384
448	320	768

448 of the 768 students are girls.
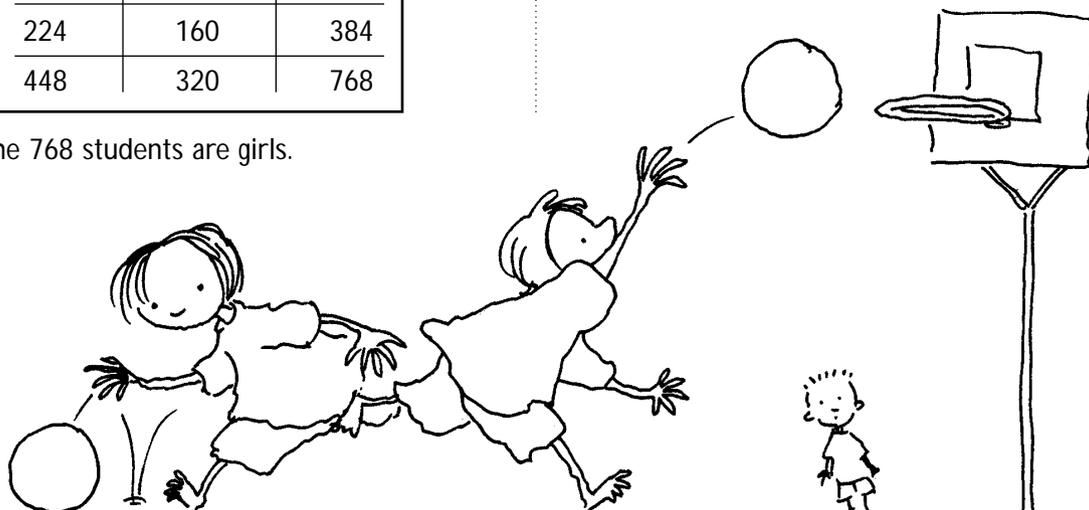
FOLLOWING PATTERNS

Tables can be used to establish many different types of patterns. The information presented in the problem can be listed in the table and then examined to see if there is a pattern.

For example: A child is playing a game of basketball by himself in the park. Then, at regular intervals, other groups of students begin to arrive at the park. From each new group, two children decide to join the basketball game. The first group has three children, the second group has five children and the third group has seven children. How many groups will have appeared by the time there are 64 people in the park?

Three columns are needed for the table. The columns should be headed groups, people and total.

Groups	People	Total
	1	1
1	3	4
2	5	9
3	7	16
4	9	25
5	11	36
6	13	49
7	15	64

Seven groups will have appeared.

Teaching Examples Drawing a Table

EXAMPLE 1

A group of students are learning a long poem to perform at the school concert. Each week they are taught a certain number of verses. The first week they are taught one verse and by the end of the second week they know three verses. At the end of the third week the students can recite six verses and at the end of the fourth week they know ten. How many verses would they be able to recite after 12 weeks?

Understanding the problem

WHAT DO WE KNOW?

In the first week students are taught one verse.
At the end of the second week they know three.
At the end of the third week they know six.
By the end of the fourth week they know ten.

WHAT DO WE NEED TO FIND OUT?

Questioning: How many verses did they know at the end of 12 weeks?
Is there a pattern that will help with the completion of the chart?

Planning and communicating a solution

Students should draw up a table consisting of two rows and 13 columns or two columns and 13 rows. The first row should list the week numbers (1–12) and the second row should list the number of verses. Once the known data has been inserted a pattern will emerge and the number of verses can be calculated. (The pattern here is +1, +2, +3....)

Week	1	2	3	4	5	6	7	8	9	10	11	12
No. of verses	1	3	6	10	15	21	28	36	45	55	66	78

The students would be able to recite 78 verses after 12 weeks.

Reflecting and generalising

Once the table has been drawn up a pattern is easy to see. A student who has gained confidence may leave part of the table empty and simply complete the pattern mentally. Students should be encouraged develop the skill of looking for patterns and completing them.

Extension

The problem can be extended by including revision weeks at regular intervals, when no new verses are learnt. How will this affect the result?
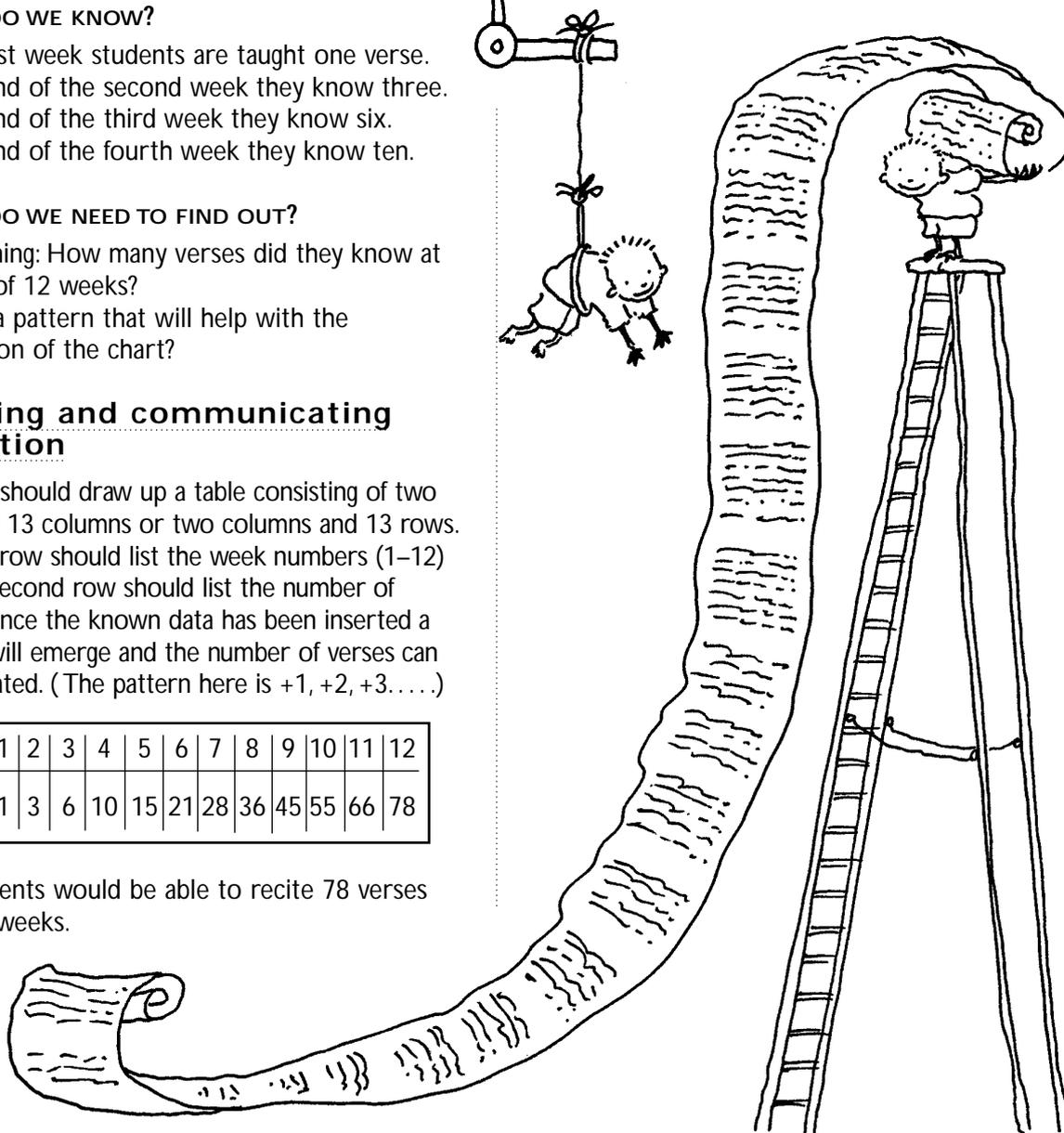
Example 2

We are running a fund raising concert in our school hall. The first member of the audience comes in on her own, then a group of three friends come in together. Each time a group of people arrives there are two more than in the previous group. How many people will arrive in the twentieth group?

Understanding the problem

What do we know?

The first person is on her own.
Then three people come in.
Each time the group increases by two.

What do we need to find out?

Questioning: How big is each subsequent group? How many people are in the twentieth group?

Planning and communicating a solution

Draw up a table consisting of two rows and 21 columns (or two columns and 21 rows.) Write the heading of the first row as 'audience groups' and the second 'numbers'. The audience groups are numbered to 20 and the numbers increase in odd numbers starting from one.

Reflecting and generalising

By following the pattern it is easy to calculate how many people are in the twentieth group. A more confident student would be able to leave part of the middle section of the table incomplete as they see the pattern that is emerging.

Extension

The problem can be extended by varying the size of the groups or including more groups.

Audience groups	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Numbers	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39

There will be 39 people in the twentieth group.
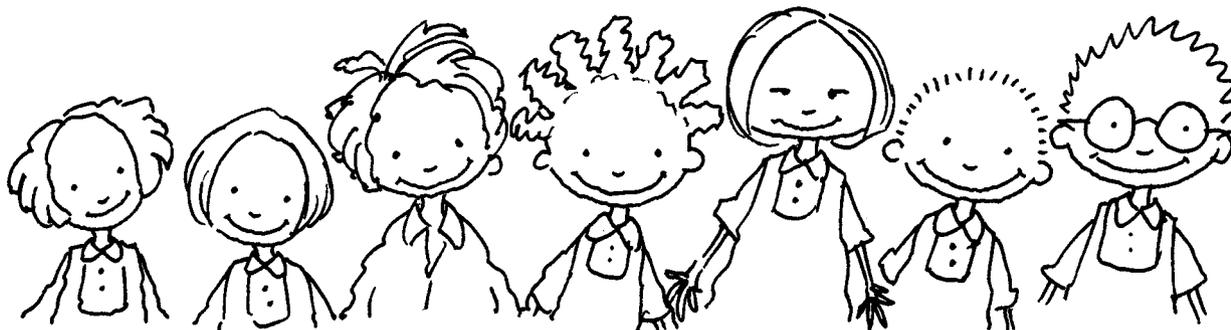
Teaching Examples Drawing a Table

EXAMPLE 3

How many different ways can you change a $1 coin into 50c, 20c and 10c coins?

Understanding the problem

WHAT DO WE KNOW?

We have a $1 coin.
We can change it into 50c, 20c and 10c coins.

WHAT DO WE NEED TO FIND OUT?

Questioning: How many different ways can you make $1 out of 50c, 20c and 10c coins?

Planning and communicating a solution

Start by using only 50c coins and work through the possible combinations which make $1, then include those in the table.
Then look at all possible combinations of 50c + 20c + 10c.
Leave out 50c and look at combinations of 20c and 10c.
Finally, see how many 10c coins are needed to make up $1.

By setting out all the combinations in a table we made sure that none were missed or repeated.

50c	20c	10c
2		
1	2	1
1	1	3
1		5
	5	
	4	2
	3	4
	2	6
	1	8
		10

There were ten different ways to make up $1 out of 50c, 20c and 10c coins.

Reflecting and generalising

Our approach to the problem was logical and systematic and ensured that we found all combinations of the coins.

Extension

Ask students to use a similar strategy to change $2 coins into $1, 50c, 20c and 10c coins. How many different combinations would there be?
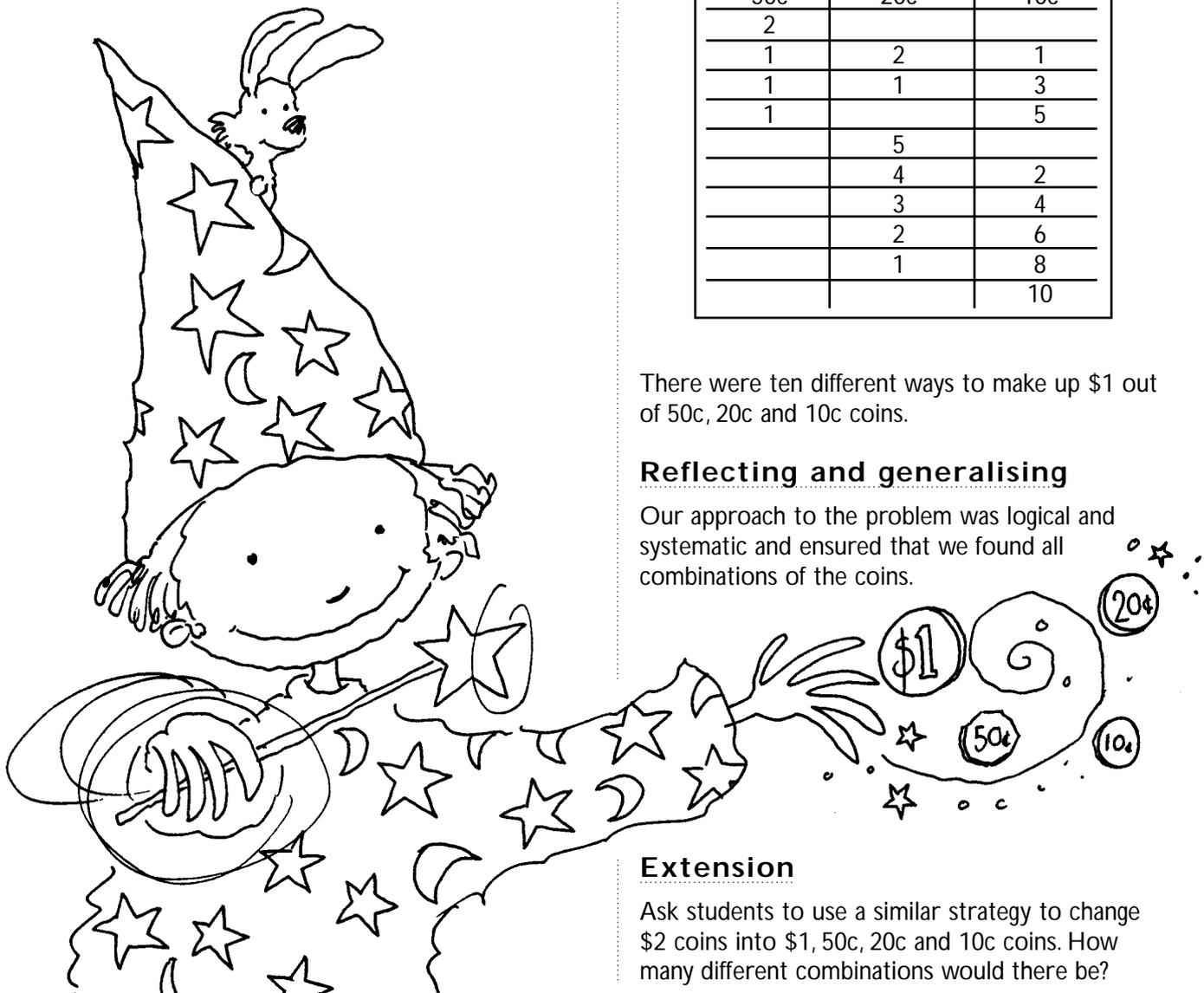
BLM   Drawing a Table

★ Understanding the problem

List what you know ....

....

....

★ What do you need to find out?

Questioning: What questions do you have? What are you uncertain about? Is there any unfamiliar or unclear language? What you are being asked to do?

....

....

....

★ Planning and communicating a solution

How many variables are there? How many columns will be needed in the table? What would be suitable headings? Can symbols or images be used? Can gaps be left in the table once a pattern is established?

★ Reflecting and generalising

How accurate is the answer? How can this strategy be applied to other situations? Could a more effective method have been used? What technology was useful?

....

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★ Extension

How can this problem be extended? What factors can be added as part of a 'what if' question?

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Problem 1   Number 1 2 3

Level 1

Susan and Marilyn both go the gym each week. Susan goes every three days but Marilyn goes every fourth day. If they both attend on Monday when will they next be at a class together?
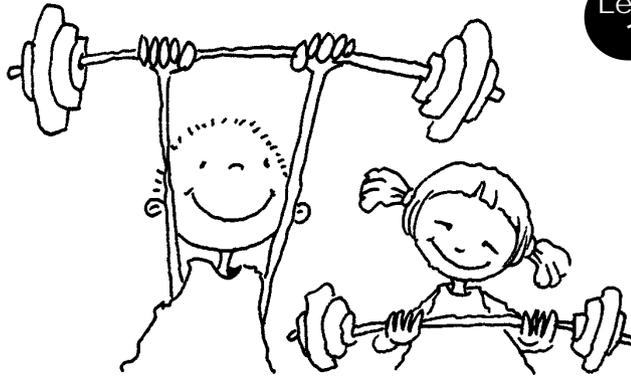
Problem 2   Number 1 2 3

Level 1

There were 18 people seated on the roller coaster ride. For every two seats there was one empty. How many empty seats were there?
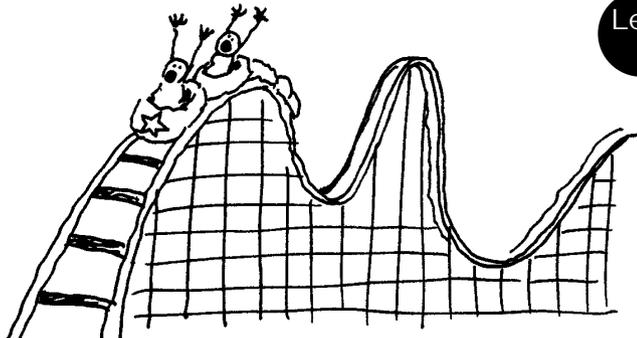
Problem 3   Number 1 2 3

Level 1

Arlene has a holiday job picking apples. Her employer is happy to pay her one cent for the first tree she picks, two cents for the second, four cents for the third and eight cents for the fourth. How much will she receive for the eighth tree she picks and how much will she earn altogether for the eight trees?

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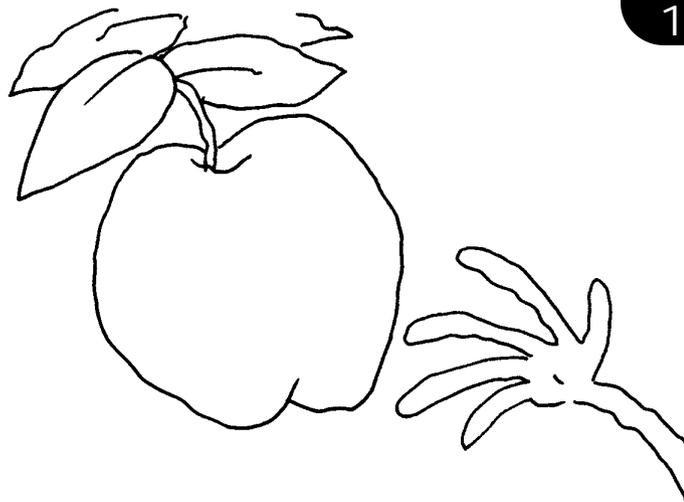
Problem 4   Number 1 2 3

Level 2

A farmer has three different hen houses. One hen house contains red hens, the second black hens and the third white hens. Every day the red hens lay five eggs, the black hens lay eight eggs and the white hens lay three eggs. How many days will it take for the hens to lay a total of 80 eggs?
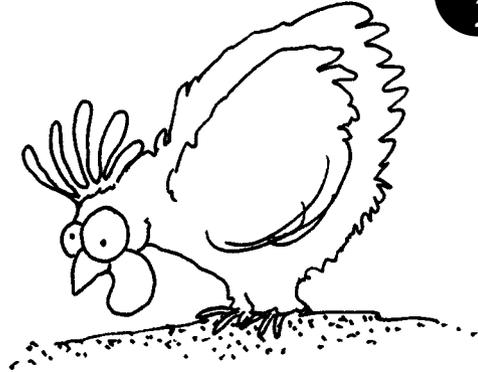
Problem 5   Number 1 2 3

Level 2

There are 18 animals on the farm. Some are chickens and others are sheep. If you can count 50 legs how many chickens and how many sheep are there.
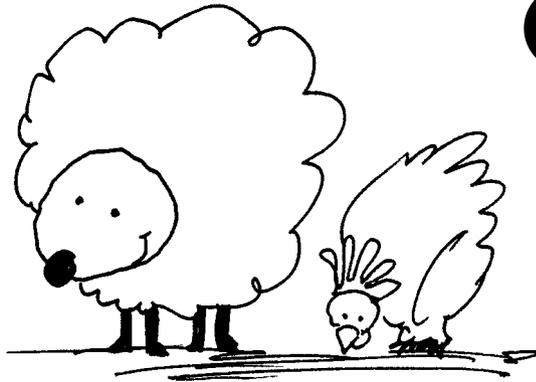
Problem 6   Number 1 2 3

Level 2

Simone had three peach and three plum trees in her garden. For every eight ripe peaches she picked, she picked three ripe plums. When the trees were bare she had 64 peaches. How many pieces of fruit did she collect altogether?
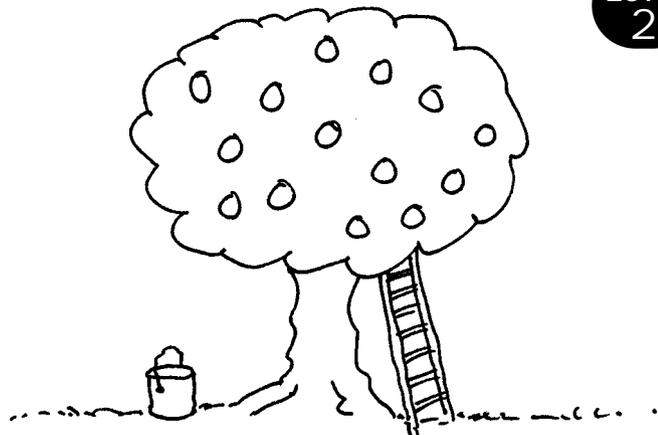
PROBLEM SOLVING TASK CARDS - Drawing a Table

Problem 7   Number 1 2 3

Level 2

A wild dog swallowed a total of 105 nuts in five days. Each day he managed to eat eight more than he had on the previous day. How many did he eat on each day?

Problem 8   Measurement

Level 2

Each time a bouncy ball bounces, it bounces to half the height from which it falls. If Jack drops a ball from a building and it rises to a height of 24 metres, how high will it bounce on the fifth bounce?
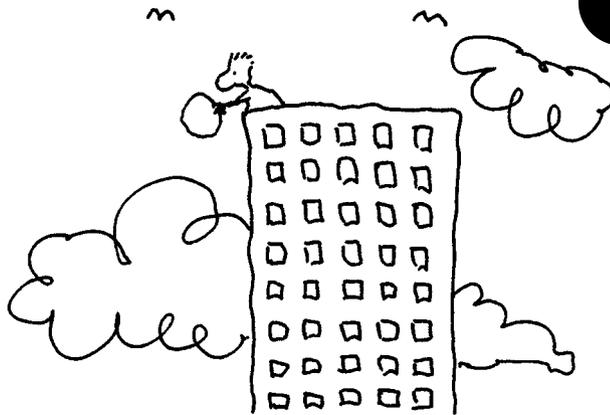
Problem 9   Number 1 2 3

Level 2

Nicole is baking 100 biscuits for the school fete. She becomes bored with decorating the biscuits so she decides to vary the decoration. She tops every third biscuit with a nut, ices every fourth and places a cherry on every fifth. When she has finished all 100, how many biscuits will have all three decorations?

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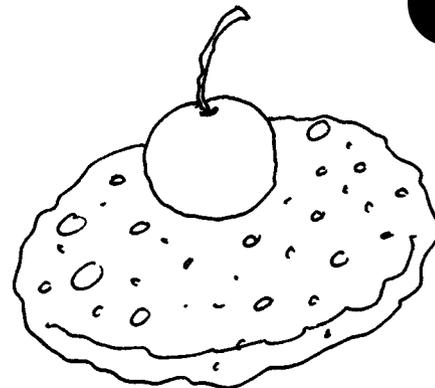
PROBLEM SOLVING TASK CARDS - Drawing a Table

Problem 10   Number 1 2 3

Level 3

At the pet shop it was found that for every seven female goldfish born, only five male goldfish were born. If there were 156 goldfish hatched in a year how many will be females?
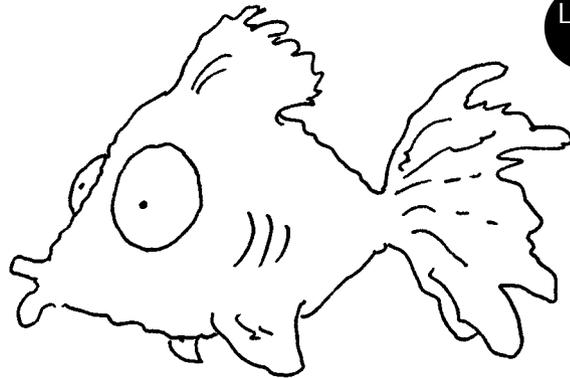
Problem 11   Number 1 2 3

Level 3

On an alien planet, six out of twenty inhabitants are animals, nine out of twenty are humans and the rest are robots. If there are 108 humans on the planet how many robots are there?
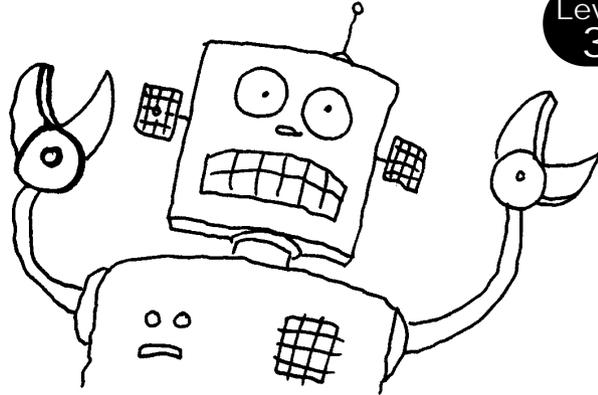
Problem 12   Number 1 2 3

Level 3

A bike shop was selling bicycles and tricycles. In the shop there were 25 wheels. How many bicycles and how many tricycles were there?
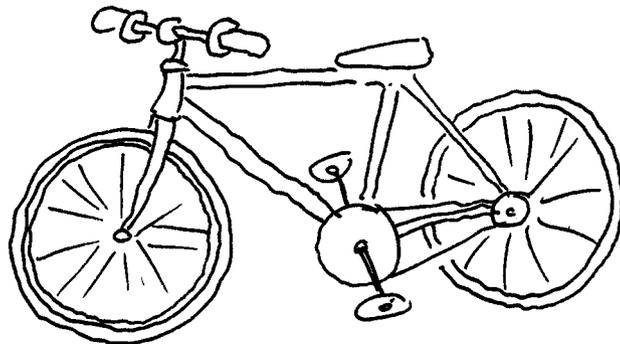
Problem 13   Number 1 2 3

Level 3

Peter lives next door to the golf course. Every day he goes and collects golf balls after school. On the first day he collects one and on the second day he also collects one. On the third day he collects two and on the fourth day three. Then on the fifth day he collects five and on the sixth day eight. On the seventh day he collects 13 golf balls. How many will he collect the next day? How many golf balls will he have in total?
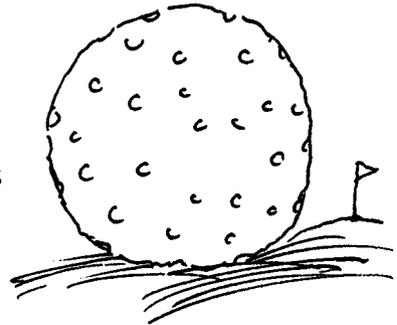
Problem 14   Number 1 2 3

Level 3

You have been asked to bury some bags of money on an island. The money has been divided into nine separate bags containing these amounts: $21, $20, $19, $12, $11, $10, $3, $2, $1.

You must bury the money in a three by three grid so that each row and column, either horizontal, vertical or diagonal, has $33.

Problem 15   Number 1 2 3

Level 3

Jessica is rowing along the coast to Sunshine Cove. Each day she rows less because she gets more tired. On the first day she covers 38 kilometres, on the second day 35 kilometres, on the third day 32 kilometres and on the fourth day 29 kilometres. How many days will it take her to cover the distance of 203 kilometres to Sunshine Cove.

Answers to Task Cards

Problem 1

Saturday of the second week both Susan and Marilyn will be at the gym.

Days	S	M	T	W	T	F	S
Susan week 1		x			x		
week 2	x			x			x
Marilyn week 1		x				x	
week 2			x				x

Problem 2

There are nine empty seats.

Filled	2	4	6	8	10	12	14	16	18
Empty	1	2	3	4	5	6	7	8	9
Total	3	6	9	12	15	18	21	24	27

Problem 3

Arlene will be paid 128 cents for the eighth tree and she will be paid 255 cents altogether.

Apple tree	Cents	Total cents
1	1	1
2	2	2 (+1) = 3
3	4	4 (+ 3) = 7
4	8	8 (+ 7) = 15
5	16	16 (+15) = 31
6	32	32 (+ 31) = 63
7	64	64 (+ 63) = 127
8	128	128 (+ 127) = 255
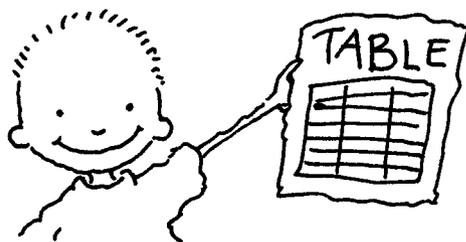
Problem 4

It will take five days for the hens to lay 80 eggs.

Days	Red	Black	White	Total
1	5	8	3	16
2	10	16	6	32
3	15	24	9	48
4	20	32	12	64
5	25	40	15	80

Problem 5

There are eleven chickens and seven sheep.

Chickens	1	2	3	4	(+ 1 each time)	11
Sheep	17	16	15	14	(– 1 each time)	7
Legs	70	68	66	64	(– 2 each time)	50

Problem 6

She collected 88 pieces of fruit altogether.

Peaches	Plums	Total
8	3	11
16	6	22
24	9	33
32	12	44
40	15	55
48	18	66
56	21	77
64	24	88

Problem 7

Day	Number of nuts each day	Total
1	5	5
2	13	18
3	21	39
4	29	68
5	37	105

Problem 8

The ball will bounce $1\frac{1}{2}$ metres on its fifth bounce.

Bounce 1   24 metres
Bounce 2   12 metres
Bounce 3   6 metres
Bounce 4   3 metres
Bounce 5 $1\frac{1}{2}$ metres

Problem 9

Only one biscuit has all three decorations, the sixtieth one.

		N	I	C	N		I	N	C
	NI			NC	I		N		IC
N			NI	C		N	I		NC
	I	N		C	NI			N	IC
	N		I	NC			NI		C
N	I		N	C	I	N			NIC
		N	I	C	N		I	N	C
	NI			NC	I		N		IC
N			NI	C		N	I		NC
	I	N		C	NI			N	IC

Problem 10

There will be 91 female goldfish out of 156 born.

Female	Male	Total
7	5	12
14	10	24
21	15	36
28	20	48
35	25	60
42	30	72
49	35	84
56	40	96
63	45	108
70	50	120
77	55	132
84	60	144
91	65	156

Problem 11

There are 60 robots.

Total inhabitants	20	80	160	240
Animals	6	24	48	72
Humans	9	27	72	108
Robots	5	20	40	60

Problem 12

There are 11 bicycles and one tricycle in the shop.

Bicycles	1	2	3	(+ 1 each time)	11
Tricycles	11	10	9	(– 1 each time)	1
Wheels	35	34	33	(– 1 each time)	25

Problem 13

On the eighth day Peter collected 21 golf balls. He collected 54 in total.

1	1	2	3	5	8	13	21
	1+0	1+1	2+1	3+2	5+3	8+5	13+8

Problem 14

$12	$19	$2
$1	$11	$21
$20	$3	$10

Problem 15

It will take Jessica seven days to reach Sunshine Cove.

Day	Kilometres	Total
1	38	38
2	35	73
3	32	105
4	29	134
5	26	160
6	23	183
7	20	203

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