Multiplication strategies

AC
EA
AA
AM
AP

The 1 That Got Away

We are investigating the powers of 2 and other numbers.
We are solving problems involving the powers of 2

Exercise 1 – Powers of 2

You might need a calculator.

What to do

1) Use your doubling strategies or the calculator
2) Do the problems in your head if you can.
3) **Complete the table** by looking for the pattern and doubling
4) If you have time extend the table and see how far you can go!

	1		1
	2		
	2×2		4
2^3	$2\times2\times2$		
2^4			16
	$2\times2\times2\times2\times2\times2$		
2^7			128
			4096

How many digits in 2^{50}?

What digit does 2^{50} end with?

Exercise 2* – The Mystery of the Cubes

You will need multilink blocks

TASK

Which of the powers of two that you discovered in Question 4 can you make into a cube?

What is the secret?

Pssst….Write your secret here

Exercise 3* – Power Tower

You will need:

- multilink blocks
- a tape measure
- a calculator
- a trundle wheel and some marker pegs
- a large playground and a spaceship

TASK – Make a Tower of the Powers of 2.

Start with 1 block (one colour) and then place 2 (of a different colour) on top and then 4 (of a different colour) on top of those and so on and on and on and on.

When the classroom is too small or you run out out of blocks, tip the tower over and use the marker pegs on the playground and your calculator to mark out the length of your tower.

Which power of 2 would build a tower to reach the moon?

Exercise 4 – A Mouth Full of Bacteria

You will need a calculator

When you cleaned your teeth this morning you left a little group of 1000 bacterial cells that started doubling in number every 20 minutes all through the day.

Complete the table and find out how many are in your mouth at the end of the day!

Time	Number of Bacteria
8:40am	1000
9:00am	2000
9:20am	
9:40am	8000
	64000
Noon	
12:20pm	

Exercise $2^2 + 2^0$ – Powers of 3

You might need a calculator.

What to do

1) Use the calculator
2) Do the problems in your head if you can.
5) Complete the table by looking for the pattern and doubling

	1		1
	3		
3^2	3×3		9
	$3\times3\times3$		
			81
3^6	$3\times3\times3\times3\times3\times3$		
			2187
			177147

How many digits in 3^{50}?

What digit does 3^{50}end with?

Exercise $2^2 + 2^1$ – A Number by Any Other Name

You might need this chart with some of the powers of 2

2^0	2^1	2^2	2^3	2^4	2^5	2^6	2^7	2^8	2^9	2^{10}	2^{11}	2^{12}
1	2	4	8	16	32	64	128	256	512	1024	2048	4096

What to do

1) Rename the numbers below by **adding** two or more powers of 2. You can use a power once only and you may not need all of them. The first two problems are done for you.

1)	$10 = 2^3 + 2^1$	(2)	$29 = 2^4 + 2^3 + 2^2 + 2^0$	(3)	7
4)	11	(5)	28	(6)	56
7)	33	(8)	15	(9)	21
10)	129	(11)	128	(12)	127
13)	257	(14)	256	(15)	255
16)	65	(17)	100	(18)	101
19)	67	(20)	68	(21)	72
22)	79	(23)	2047	(24)	2049
25)	8192	(26)	8192	(27)	8193
28)	80	(29)	800	(30)	8000

What combination of the powers of 2 adds up to one million?

What is the last digit when you multiply any power of 2 by 5? Why?

Name two numbers that do not contain a zero that multiply to make a million.

Exercise 7 – Four in a Row

You need the sheet below and 3x4 groups of different coloured counters

What to do

Place four counters on the shaded 0, 0, 0 and 1 at the bottom. These are the counters you choose to move. You are **NOT** allowed more than one counter on any shaded number at the bottom.

Take turns

Move ONE counter at the bottom and add up the numbers underneath them. Place your colour on that number on the board.

The winner is the first person to form "four in a row".

3	5	7	9	11
13	15	17	19	21
23	25	27	29	31
33	35	37	39	41
2	4	6	8	10
12	14	16	18	20
22	24	26	28	30

0	0	0	1	2	4	8	16	32	64

Exercise 8 – Primetime

You will need a CAS calculator to factorise the big numbers

What to do

1) Complete the chart. The third power of 2 and some others have been done for you.

Prime?	2^n-1	2^n	2^n+1	Prime?
		1		
		2	3	Yes
		4		
Yes	7	8	9	No
		16		
		32		
		64		
		128		
		256		
		512		
		1024		
		2048		
No	4095	4096		
		8192		

Two other expressions to investigate are $3^n - 2$ and $3^n + 2$

Create your own expression that makes some prime numbers.

Exercise 9 – Powers of ☆

You might need a calculator.

Task

Choose a number to replace the ☆ and complete the chart. See Exercise 1 in this series or your teacher for help.

$☆^0$	1		1
$☆^1$	$1\times$ ☆		
$☆^2$	$1\times$ ☆ $\times$ ☆		
$☆^{14}$			

How many digits in $□^{50}$?

What digit does $□^{50}$ end with?

The 1 That Got Away
Answers

Exercise 1
Chart patterns are self evident.
Number of digits in 2^{50} is 16
The number ends in a 4 as evidenced from patterning in the table.

Exercise 2
Secret is 2^{3n} where 3n represents a multiple of 3

Exercise 3
2^{34} cubes would reach the moon.

Exercise 4
Chart patterns are self evident.

Exercise 5
3^{50} has 24 digits and ends in a 9

Exercise 6
$2^{19}+2^{18}+2^{17}+2^{16}+2^{14}+2^{9}+2^{6}$ is 1 million. The last digit is always zero because $2\times5 = 10$ and multiplying by 10 always gives a zero. The two numbers are 64 and 15625

Exercise 7
Game

Exercise 8
Use CAS calculator to factorise the numbers.

Exercise 9
No one solution.