Let's Investigate (KS2 Maths)

24 multi-step KS2 maths investigations to build pupils' fluency, reasoning and problem solving skills

Years 5 & 6

(easily adaptable for Years 3 and 4)

THIRD SPACE LEARNING

Let’s Investigate (KS2 Maths)

Name..

Date...Class..

1 What’s missing?

3	1	7
6	4	34
8	7	71
9	8	

Find the value of the missing number in the table above.

2 1, 2, 3, 4

Using the digits 1, 2, 3 and 4 and +, - , x and ÷ symbols make the numbers from 1 to 30.

For example, 1 + 2 + 3 + 4 = 10.

Requirement: you must use each of the numbers every time.

3 Just four you

Can you use just four 4s and any operations to write the numbers from 0–10.

For example

To make the number 3 you could do 4 + 4 + 4 and then divide by 4.

Work together and compare answers. Can you find more than one way of making a number?

4 Make 6

Now work out how you can make 6 from any of the following combinations using only two maths symbols (including square roots).

0 0 0 = 6

1 1 1 = 6

2 2 2 = 6

3 3 3 = 6

4 4 4 = 6

5 5 5 = 6

6 6 6 = 6

7 7 7 = 6

8 8 8 = 6

9 9 9 = 6

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5 Straight 8s

Write a calculation using only the digit 8, eight times to make 1000. You can use any operations you want, or symbols like brackets, decimal points, and fractions.

How many different equations that equal 1000 can you write?

6 Times 8

Copy and complete the following:

$1 \times 8 = 8 \rightarrow 0 + 8 = 8$

$2 \times 8 = 16 \rightarrow 1 + 6 = 7$

$3 \times 8 = 24 \rightarrow 2 + 4 =$ $\boxed{}$

$4 \times 8 = 32 \rightarrow 3 + 2 =$ $\boxed{}$

$5 \times 8 = 40 \rightarrow 4 + 0 =$ $\boxed{}$

$6 \text{ x } 8 = 48 \rightarrow 4 + 8 = 12 \rightarrow 1 + 2 = 3$

$7 \times 8 = 56 \rightarrow 5 + 6 = 11 \rightarrow 1 + 1 = 2$

$8 \times 8 =$ $\boxed{}$

$9 \times 8 =$ $\boxed{}$

$10 \times 8 =$ $\boxed{}$

Now continue the table from 11×8 to 20×8 to see if the pattern continues.
Investigate other tables.

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7 Strings

> Start with a 2-digit number, e.g. 24
> Multiply the tens digit by 9 and add the units digit:
> 2 x 9 + 4 = 22
> Do the same with your new number:
> 2 x 9 + 2 = 20

Keep repeating again… and again… and again… until…?
Repeat using other starting numbers.
What happens?
What do you notice?
Can you find and explain any patterns?

8 That’s odd

> Write down an **odd** number, e.g. 9
>
> Square it (multiply it by itself), e.g. $9 \times 9 = 81$
>
> Divide by 4 and write down the remainder, $81 \div 4 = 20$ remainder 1

Repeat with some more odd numbers.

What do you notice about the remainder?

Is it always true?

Investigate doing the same with even numbers.

9 Odd Todd and Even Steven

Even Steven and Odd Todd need some help working out the statements about odd and even numbers. Can you help them?

In your maths group or working with a maths partner, investigate as many as you can.

When you have finished, compare your answers to another group or pair and see if you agree.

Statement	True or False	Comments
The sum of three even numbers and one odd number is always an even number.		
The sum of three odd numbers and one even number is always an even number.		
The sum of six odd numbers is always an even number.		
The difference between two even numbers is always an even number.		
The difference between an even number and an odd number is always an odd number.		
The difference between two odd numbers is always an even number.		
If you treble any odd number the answer is always an even number.		
If you quadruple any even number the answer is always an even number.		
If you quintuple any even number between 20 and 30 then the answer is sometimes odd.		
If you add three odd numbers you will always make a prime number.		
If you add three consecutive odd numbers you will sometimes make an even number.		
The squares of all even numbers are even, and the squares of all odd numbers are odd.		

10 Consecutive numbers

The number 15 can be expressed as the sum of two consecutive numbers.
In fact 15 = 7 + 8.

1. Write the following numbers as sums of two consecutive numbers:

11 = ______ + ______   21 = ______ + ______   17 = ______ + ______

25 = ______ + ______   13 = ______ + ______   31 = ______ + ______

2. Write the following numbers as sums of three consecutive numbers:

15 = ______ + ______ + ______   12 = ______ + ______ + ______   21 = ______ + ______ + ______

27 = ______ + ______ + ______   24 = ______ + ______ + ______   33 = ______ + ______ + ______

3. Write each the following numbers as the sum of two or more consecutive numbers, where possible. In some cases there may be more than one answer.

10   18   22   16   20   26   28   30   36   45

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11 Fun factory

The number 8 has four factors: 1, 2, 4 and 8.

When you divide 8 by 1, 2, 4 or 8 the remainder is always 0.

1. What about the number 11 - how many factors does it have?
2. Make a list of the numbers from 2 to 20. Write the factors of each number?
3. Which numbers have two factors only? Which numbers have three factors only? Which numbers have most factors? Are there any numbers with no factors?
4. Investigate numbers that are bigger than 20 and discuss/write down your conclusions.

12 Subtracting squares

1. Copy the following and complete the next 6 lines.

$2^2 - 1^2 = 4 - 1 = 3 = 2 + 1$

$3^2 - 2^2 = 9 - 4 = 5 = 3 + 2$

$4^2 - 3^2 = 16 - 9 = 7 = 4 + 3$

$5^2 - 4^2 = 25 - 16 = 9 = 5 + 4$

2. Without using a calculator find the value of:

a) $21^2 - 20^2$ ☐ b) $37^2 - 36^2$ ☐

c) $100^2 - 9^2$ ☐ d) $125^2 - 124^2$ ☐

3. Investigate

a) $3^2 - 1^2$ ☐ b) $4^2 - 1^2$ ☐ c) $5^2 - 1^2$ ☐

d) $4^2 - 2^2$ ☐ e) $5^2 - 2^2$ ☐ f) $6^2 - 1^2$ ☐

g) $5^2 - 3^2$ ☐ h) $6^2 - 3^2$ ☐ i) $7^2 - 3^2$ ☐

What conclusions do you draw?

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13 Operation maths

Use the numbers 1, 2, 4, 5 and 7 and the operations ×, +, − and ÷ to make some calculations. For example: 5 + 7 = 12 or 14 = 7 × 2.

1. How many different calculations can be found using + only?
2. How many ways are there of rearranging 7 = 5 + 2?
3. How many different equations can be found using all 5 cards?
4. Investigate equations using other sets of 5 numbers.

14 A product of our times

1. Using the numbers 2, 3, 4 and 5 form two 2-digit numbers , e.g. 35 and 42.
2. Multiply the two numbers using a calculator: $35 \times 42 = 1470$
3. Arrange the four numbers in another way, e.g. 25 and 43. Again multiply the two numbers.
4. How many different products can you make?
5. What is the largest possible product? What is the smallest possible product?
6. Investigate other sets of 4 numbers.

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15 Handshakes

Everyone in class shakes hands with everyone else.
Investigate how many handshakes there will be.

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16 Prime time

This pattern always appears to give prime numbers.

> $1 \times 1 - 1 + 17 = 17$ which is a prime
> $2 \times 2 - 2 + 17 = 19$ which is a prime
> $3 \times 3 - 3 + 17 = 23$ which is a prime

Continue this pattern. Will it always give prime numbers?

17 In your prime

1. Write the prime numbers from 5 to 61.

2. Write the 6 times table from 1 × 6 to 10 × 6.

3. Then subtract 1 and add 1 to each answer as follows:

6 − 1 = 5

6 + 1 = 7

12 − 1 = 11

12 + 1 = 13

18 − 1 = $\boxed{}$

18 + 1 = $\boxed{}$

4. Compare the number you get in 1 and numbers you get in 2 and write down your observations.

5. Investigate further with larger multiples of 6.

18 Mirror primes

13 and 31 are both prime numbers. If a number and its mirror number are both prime then it is called a mirror prime. 29 is a prime number, but 92 is not.

Therefore 29 is not a mirror prime.

1. Which of the following are mirror primes? 11, 17, 19, 23.
2. Find all the mirror primes up to 100. How many are there?
3. What is the smallest 3-digit mirror prime? What is the biggest?

19 6174

Choose any four-digit number whose digits are not equal and arrange the digits to form the largest possible number.

Now reverse this number and subtract it from the larger number.

Take the digits that make up your answer and again rearrange them to form the largest possible number.

Reverse this new number and subtract it from the larger.

Continue this process.

An example is shown below.

8421…1248…7173

7731…1377…6354

6543…3456…3087

8730…0378…8352

8532…2358…6174

1. If you begin with any four-digit number whose digits are not all equal, will the above process always product 6174?
2. What happens when this process is applied to three-digit numbers whose digits are not all equal? Is there a special number in this case?
3. What happens when the process is applied to five-digit numbers? Is there a special number in this case?
4. You may wish to continue this investigation for numbers with more digits.

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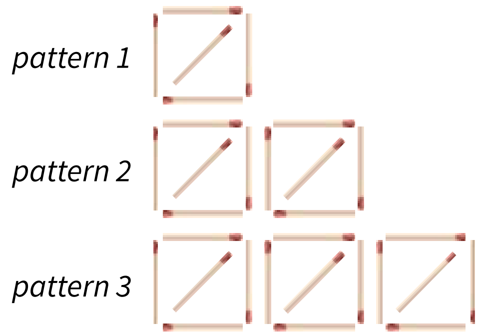
20 What's the connection?

If 5 + 3 = 835 and 2 + 4 = 642 and 7 + 0 = 707

Then what is 6 + 1?

6 + 1 = $\boxed{}$

21 Patterns with matchsticks



Raxa is making patterns with matchsticks.

1. How many matchsticks are used to make:

pattern 1, pattern 2, pattern 3.

2. Without the help of a diagram, find the number of matchsticks required to make:

pattern 4, pattern 10, pattern n.

3. Which pattern will have:

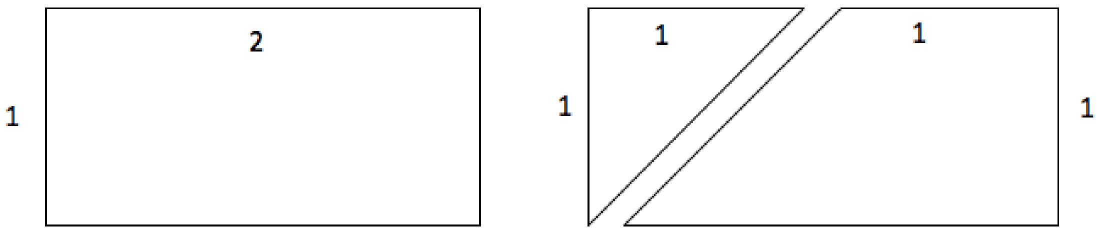
a) 21 matches

b) 81 matches

Investigate other patterns with matchsticks.

22 Wrecked-angle

Start with a 2 by 1 rectangle. Cut out these two shapes.



What new shapes can you make with them?

Name them and write down about their properties.

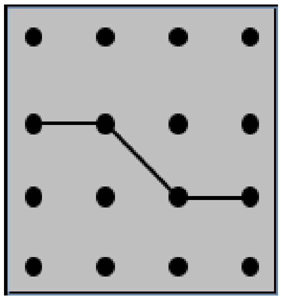
23 Patterns with matchsticks

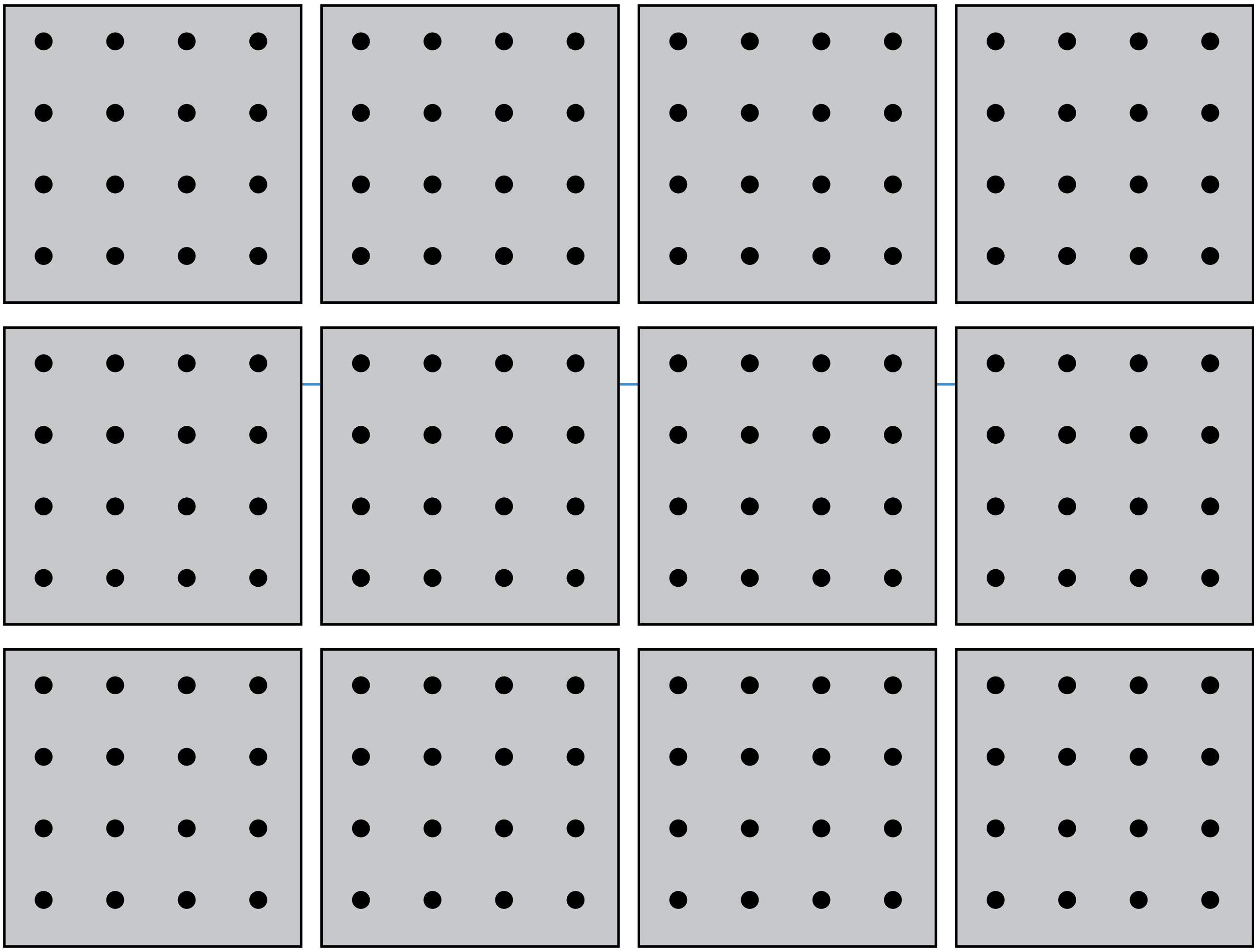
For this investigation you will need a 16-pin board or use the squares of dots below.

How many ways can you bisect it into two identical parts?

Keep a record of your findings.

Investigate dividing the board into three equal parts.

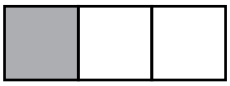
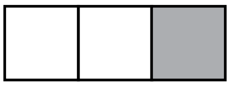
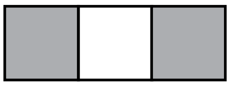




24 Shady maths

Freddie has some strips of paper with 3 squares on them. He shaded each square grey or white, and finds that there are 8 possible ways.

1. Three of these are shown below. Copy them and draw the other 5 ways.

A  **B**  **C** 

2. Heidi notices that if A is turned around it looks the same as B. A and B are really the same.

Look at your 8 drawings. Can you see any more that are the same?

How many different ways can the 3 squares be shaded?

4. How many ways could the strip be shaded if it had 4 squares like this? Draw them.

5. If some of them were turned around they would look the same. How many different ways can the 4 squares be shaded?

6. Investigate further with 5 squares, 6 squares, etc.

Solutions

We have deliberately only provided solutions in a few instances where we think they might be most helpful for the teacher. Many of the investigations involve pattern spotting from a sequence of established number facts or they are sufficiently open-ended that pupils will come to different solutions depending on their approach.

1. What's missing?

The first 2 columns are multiplied. The first two columns are added. These are then added together. E.g.

(3 x 1) + (3 + 1) = 3 + 4 = 7

(6 x 4) + (6 + 4) = 24 + 10 = 34

(8 x 7) + (8 + 7) = 56 + 15 = 71.

Missing number….

(9 x 8) + (9 + 8) = 72 + 17 = 89.

2. 1, 2, 3, 4

Many possible solutions

3. Just Four You

0 = 4 + 4 – 4 - 4

1 = 4 ÷ 4 + 4 - 4

2 = 4 ÷ 4 + 4 ÷ 4

3 = (4 + 4 + 4) ÷ 4

4 = 4 × (4 – 4) + 4

5 = (4 × 4 + 4) ÷ 4

6 = (4 + 4) ÷ 4 + 4

7 = 44 ÷ 4 – 4 = 4 + 4 – (4 ÷ 4)

8 = 4 + 4.4 – .4 = 4 + 4 + 4 – 4

9 = 4 ÷ 4 + 4 + 4

10 = (44 – 4) / 4 = 44 ÷ 4.4 = 4 + √4 + √4 + √4

4. Make 6

2 + 2 + 2 = 6

(3 × 3) – 3 = 9 – 3 = 6

(√4) + (√4) + (√4) = 2 + 2 + 2 = 6

(5 ÷ 5) + 5 = 1 + 5 = 6

6 + (6 – 6) = 6 + 0 = 6

7 – (7 ÷ 7) = 7 – 1 = 6

8 – √ (√ (8+8)) = 8 – √ (4) = 8 – 2 = 6

(√9 × √9) – √9 = 9 – 3 = 6

20. What's the connection

The first digit is the addition of the numbers on the right hand side and the second and third digit are same as the reverse of the numbers on the RHS.

5 + 3 = (5 + 3) 3 5 = 835

So….6 + 1 = (6 + 1) 1 6 = 716