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1. **Making and summing equal step-patterns (linear sequences)**

Here is an equal step pattern containing five terms: 2, 5, 8, 11, 14

An equal-step pattern is called a ‘linear sequence’

The sum (Ʃ) of this linear sequence 2, 5, 8, 11, 14 is 40

Make up some of your sequences and record the information you gather.

|  |  |  |
| --- | --- | --- |
| **Sequence** | **Number of terms** | Ʃ |
| 2, 5, 8, 11, 14 | 5 | 40 |
| 1, 2, 3, 4, 5, 6, 7, 8, 9 | ? | ? |
| 4, 6, 8, 10, 12, 14 | ? | ? |
| 17, 15, 13, 11 | ? | ? |
|  |  |  |
|  |  |  |
|  |  |  |

Explore how you can you can calculate the sum of a sequence without adding together every term of the sequence. I used this with Y5/Y6 students, despite summation of series being an A-level type concept.

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1. **Exploring addition**

**=**

**+**

together with

You have the digits

and

**1**

**2**

**3**

**4**

one addition sign

 and the equal sign

Arrange the cards to make two 2-digit numbers and find the total

**4**

**2**

**1**

**+**

**3**

**=**

 E.g. this total is 55

* How many different totals can be made?
* How do you know you have found them all?
* What are the minimum and maximum totals?
* Arrange your totals in order from smallest to largest and calculate the difference between successive pairs.
* What happens?

**Extension 1** Start with four other consecutive digits, what happens?

**Extension 2** What about four values such as 1, 3, 5 and 7

**Extension 3** What about choosing any single digit values?

**Extension 4** Suppose you had the ‘values’ *a, b, c* and *d*, where *a* < *b* < *c* < *d*.

How would you arrange these to minimize and to maximize totals?

**Extension task 5** How would you minimise and maximise totals four consecutive values: ***n****,* **(*n* + 1)**, **(*n* + 2)**, **(*n* + 3)** ?

This task could be used with students from Y3 to Y10.

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1. **Playing with three or four piece tangrams**

Cut out the three from a square.

Make new shapes by fitting edges, of the same length, together.

**A starting question might be:**

*How many different shapes can be made?*

**Further tasks**

As students make their collection of shapes, further questions could be:

* *How many sides does each of your shapes have?*
* *What are the names of the shapes?*
* *Can you find any more shapes?*
* *Why do you think you have found them all?*
* *Which of your shapes contain line symmetry?*
* *What are the fractional areas of each shape?*
* *By labeling the sides of the smallest triangle* ***s*** *(for shortest side) and* ***l*** *(for longest what are the perimeters of the shapes you have made?*
* *?*

This task is perfect for “collecting like terms” with purpose!**Constructing a three by three magic square from first principles**

Give students, perhaps working in pairs, the numbered playing cards 1 to 9.

Ask them to make three sets of 3 cards so each of the sets totals to the same amount. In the first instance I would not reveal what this total is.

Now arrange their cards in a 3 by 3 array, so each row totals to 15.

Now arrange them so the three rows add to 15 and the three columns also total to 15.

The final challenge is to arrange them so all rows, columns and the two diagonals each total to 15.

You may wish to suggest they place the 5 in the middle in order to achieve this result; then again you may choose not to tell them where to place the 5.

**Extension tasks**

Explore the how to arrange the values 1, 3, 5, 7, 9, 11, 13, 15, 17 into a magic square

What about 5, 8, 11, 14, 17, 20, 23, 26, 29?

What about 6, 5, 4, 3, 2, 1, 0, -1, -2?

 What about 3.4, 3.7, 4, 4.3, 4.6, 4.9, 5.2. 5.5, 5.8?

The initial task, with the playing cards I have used with KS1 students.

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1. **Number of dominoes problem**

How many dominoes are there in a 3-3- set?

How many dominoes are there in other sets?

Try to find a way of working out how many spots there are without counting each spot one-by-one

**Extension task 1**

Try to predict how many dominoes there would be in a 7-7 set, an 8-8 set and a 9-9 set?

**Extension task 2**

How many spots are there in different sizes of sets of dominoes?

E.g. in a 3-3 set there are a total of 30 spots

**Extension task 3**

Here is a 2-2 set of triominoes

Explore different set sizes and spot totals of triominoes.

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1. **Sticks**

This puzzle is about making different arrangements using a number of sticks or straws and placed either horizontally and/or vertically.

If all sticks are parallel there will be zero crossing points. Unless all sticks are parallel then horizontal and vertical sticks will always cross (imagine they are infinitely long).

Here is an 8 stick crossing diagram:

There are 12 crossings

Explore numbers of crossings for different numbers of sticks.

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1. **Joining squares**

Students are given four squares and are allowed to join them full edge to full edge or half edge to half edge, or a combination of both.

**Further questions**

* What is the perimeter of this shape?
* What are the smallest and the largest perimeters that can be made?
* Make all the different possible perimeters.
* What are the minimum and the maximum perimeters?
* How would you need to change the ‘joining rule’ in order to gain perimeter of 10.5?
* What happens if we use more squares?
* Explore the minimum and maximum perimeters of shapes made from many squares.
* Try to write a ‘procedure’ that someone could use to find the minimum perimeter for a shape made from a lot of squares. [This task might extend the thinking of KS4 mathematicians].
* What happens if we use equilateral triangles?

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1. **Playing with Cuisenaire**

Using the white, red and green rods there are four ways (equations) to make trains the same length as the green rod, e.g.

***w* + *r* = *g***

***g* = *g***

***r + w* = *g***

***w* + *w + w* = *g***

**=**

**=**

**=**

**=**

How many equations are there to make other coloured rods?

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1. **Exploring Factors (‘Guzintas’)**

Here are the factors of 20: {1, 2, 4, 5, 10, 20}

Collect together some numbers that have different amounts of factors, from one factor to six factors.

From your data write some conjectures

**Factor Chains:**

A factor chain is produced by adding together all the factors of a number, except for the number itself. For example, starting with 12, the sum of the factors except for 12 itself is {1 + 2 + 3 + 4 + 6}, i.e. 16.

Similarly, 16 has a factor sum of 15 and the chain continues as follows:

12 → 16 →15 →9 →4 →3 →1

The diagram below shows how some other numbers are connected together:



This is not only a practise and consolidation type task; it lends itself to pattern spotting, looking for connections, predicting and making conjectures.[**https://www.mixedattainmentmaths.com/**](https://www.mixedattainmentmaths.com/) **Conference 5** 26-01-19

1. **Folding and cutting IRATs** (Isosceles, Right-angled Triangles)

This is one of my all-time favourite problems which I first met when studying with the Open University.

Step 1: Fold and cut an IRAT down its line of symmetry

Step 2: Start with a new IRAT and fold it as for step 1 then fold it a 2nd time and cut it down this 2nd fold line.

Step 3: Start with another new IRAT, fold it three times and cut it down the 3rd fold line

Explore the areas of the pieces the areas of individual if the original IRAT has an area of 1 unit. However seeing how the denominators and conservation of area occurs both within different shapes of the same area and the ‘fact’ for each separate situation all the factional sizes of the pieces must sum to 1

Exploring the number of pieces is a problem which two-year PGCE mathematicians have worked with have struggled with. This task, therefore, this will be something of a challenge.

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1. **Dice, fractions and a calculator**
2. **Using two dice to make fractions**
* In pairs each person has a dice
* The first person to throw is the numerator
* The second person is the denominator
* Turn your fractions into their decimal values.
* How many different numbers can you make?

When I used this with a class of Y4 to Y6 students there was a lovely moment when they returned to this task, after ‘playtime’, and I had drawn a two-way table on the board and without me saying anything one student said “Wow...”

1. **Finding equivalent fractions**

Find five different fractions all of which are equal to 0.4

Find five different fractions all of which are equal to 2.5

What do you notice?

Why does “it” happen?

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1. **Place Value**

|  |  |  |
| --- | --- | --- |
| **100** | **10** | **1** |
| **Hundreds** | **Tens** | **Ones** |
| **H** | **T** | **U** |
| **0** | **0** | **0** |
| **0** | **0** | **0** |

Place two different digits which do not ‘bridge’ a ten, one in each row, and record the total.

Make all possible different totals?

Place them in order from highest to lowest.

Find the differences between adjacent pairs of totals

Sum these differences.

Why is each difference a multiple of 9?

Proof?

There are a range of different Place Value grids to be found at [www.mikeollerton.com](http://www.mikeollerton.com)

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| 4, 6, 8, 10, 12, 14 |  |  |
| 17, 15, 13, 11 |  |  |
| 11, 8, 5, 2, **-**1, **-**4 |  |  |
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| 11, 8, 5, 2, **-**1, **-**4 |  |  |
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