The NRICH Maths Fair

Ages 14-17

This pack contains 18 of our favourite NRICH activities aimed at children aged about 14-17 to enable you to run a Maths Fair. This pack contains:

- An activity list with information about required resources
- 40 printable activities (their instruction sheets and game boards)
- Printable resources (to be printed and cut out)

Many of the activities require physical resources which are not included. These are standard maths classroom equipment such as multi-link, counters and dice.

Please carefully check the equipment needed for each activity you decide to use. Many require printable cut outs which can be found at the back of this pack. Not all of the printable resources included at the back of the pack are essential.

The NRICH Maths Fair

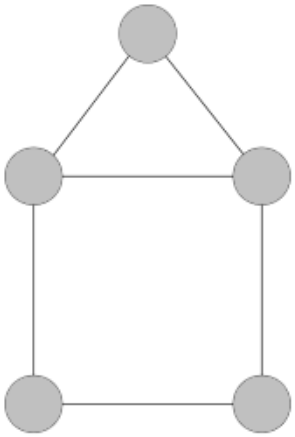
No.	Activity Name	Age Suitability			Resources	
		7-11	11-14	14-16	Essential	Optional
4	Can You Traverse it?		✓	✓		Paper and pencils.
6	Crossing the Bridge			✓	Paper and pencils.	
8	Domino Square		✓	✓	10 specific dominoes (or the printed cutouts).	
10	Domino Windows			✓	A full set of 28 dominoes (or the printed cutouts).	
12	Factors & Multiples Game		✓	✓	At least 40 small counters (or lots of copies of the printed grids and pencils).	
16	Frogs		✓	✓	10 counters (2 colours, 5 of each).	
17	Gabriel's Problem		✓	✓	Numbered counters (or the printed cutouts).	
18	Largest Product		✓	✓	Paper and pencils.	
19	Last Biscuit		✓	✓	12 counters (2 colours, 8 of one and 4 of the other).	
21	Marbles in a Box			✓	Paper and pencils.	27 multi link cubes, made into a cube.
24	Nine Colours			✓	27 multi-link cubes (9 colours, 3 of each).	
27	Pentanim	✓	✓	✓	10 counters.	
28	Sandwiches		✓	✓	14 printed number cutouts.	14 fridge magnet numbers.
30	Sticky Numbers		✓	✓	17 printed number cutouts	
31	Take three from five			✓	Paper and pencils.	
32	Teacups		✓	✓	16 printed teacup and saucer cutouts	
35	The Tower of Hanoi	✓	✓	✓	7 printed cutouts	Wooden Tower of Hanoi puzzle
40	Who's Who?		✓	✓	13 printed name cutouts	

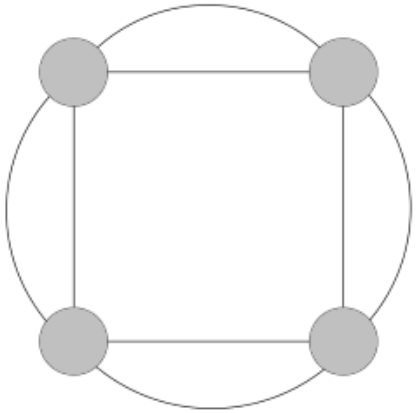
Can You Traverse It? 1

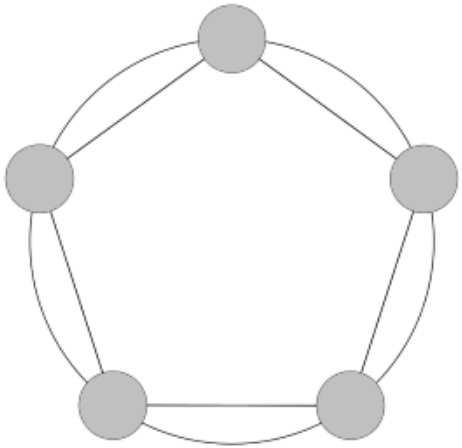
A traversable graph is one you can draw without taking your pen off the paper, and without going over any edge twice.

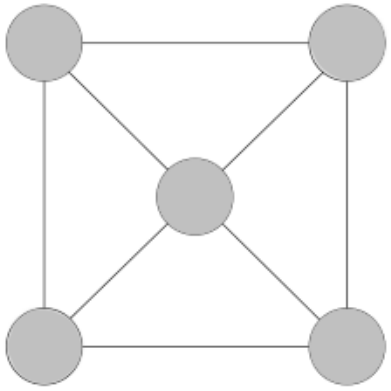
For each graph, decide whether or not it it traversable.

It might be helpful to keep a track of where you started, the route you took, and where you finished.

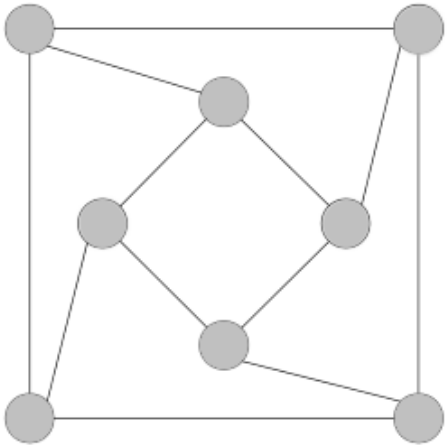


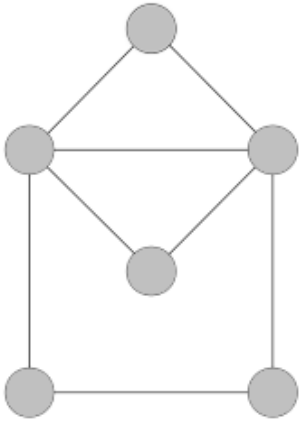


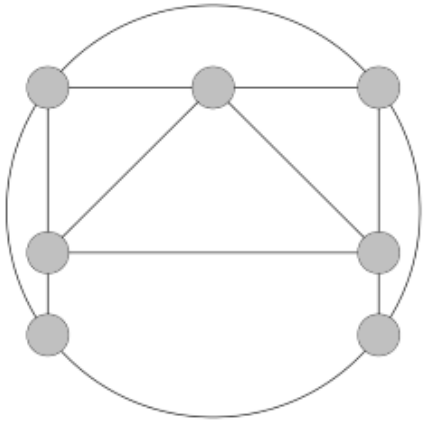


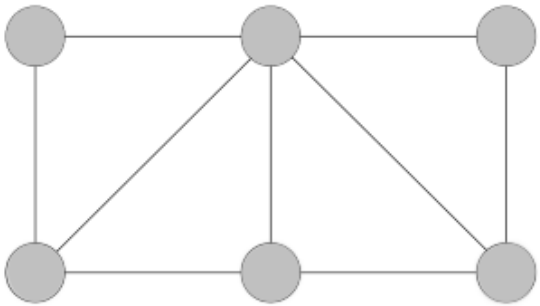


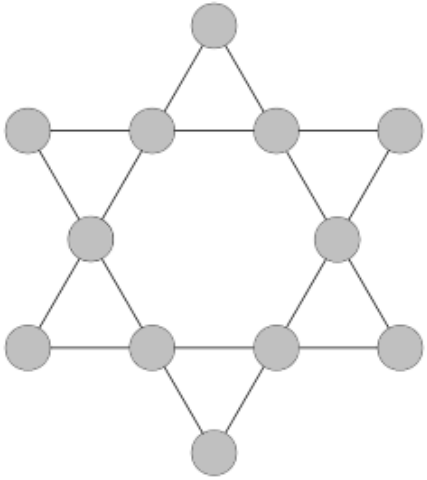
Can You Traverse It? 2

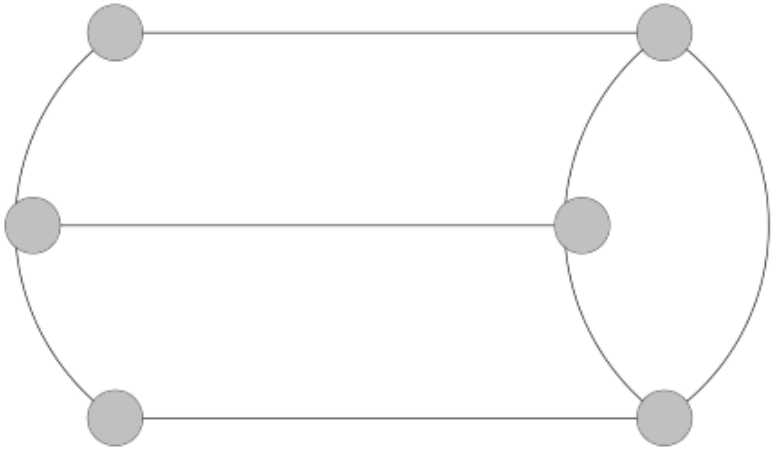












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Activity 4

Crossing the Bridge

Four friends (Matt, Helen, Tom and Asha) need to cross a bridge. **They all start on the same side of the bridge**.

It is an old bridge so **a maximum of two people can cross at once.**

It is dark and dangerous and they have just one lamp. **When anyone crosses the bridge they must carry the lamp** to see the way.

Each person walks at a different speed:

- Matt takes **1 minute** to cross
- Helen takes **2 minutes** to cross
- Asha takes **7 minutes** to cross
- Tom takes **10 minutes** to cross

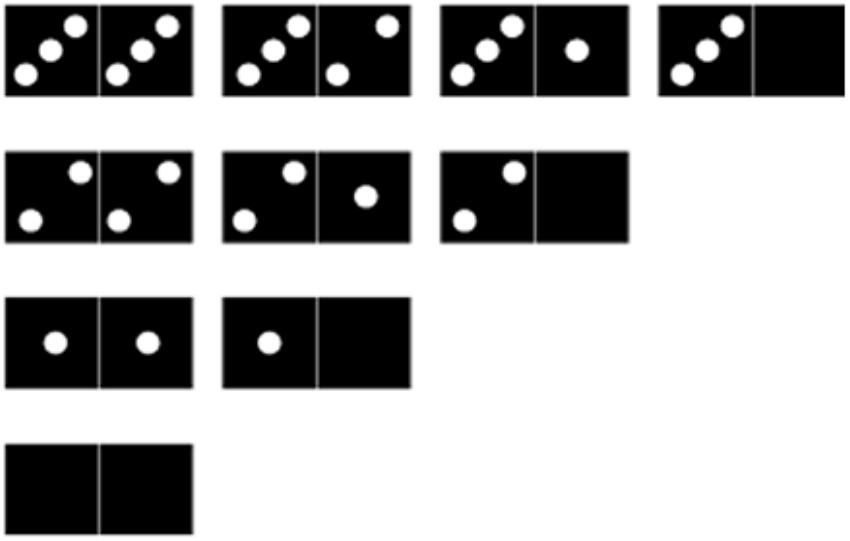
When a **pair crosses together they cross at the speed of the slower person.**

Can you figure out how all four friends can get to the other side in just **17 minutes**?

Domino Square

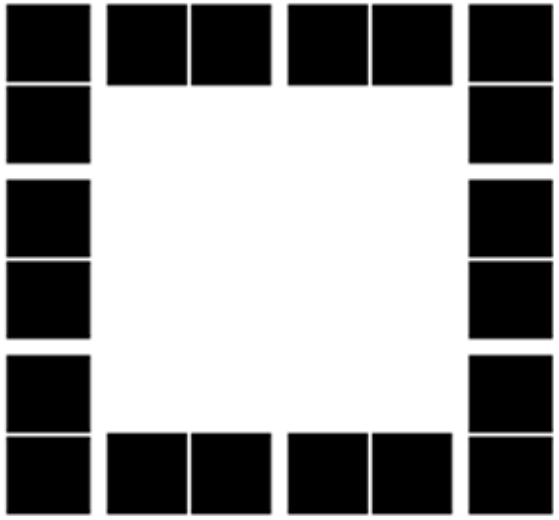
You need these 10 dominoes.

The highest is ‘double three’.



Use these dominoes to make a square so that each side has **8 dots.**

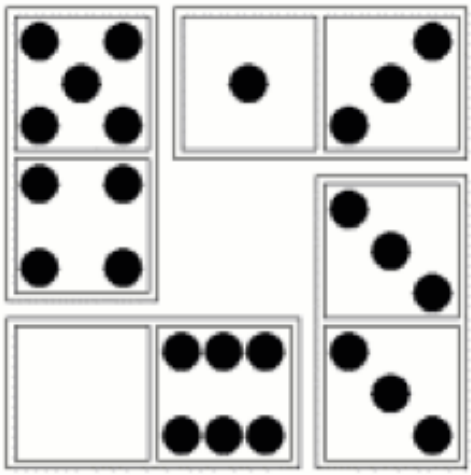
The dominoes do not have to match.



Domino Windows

In this diagram the four dominoes make a small square.
We will call this small square a “domino window”.

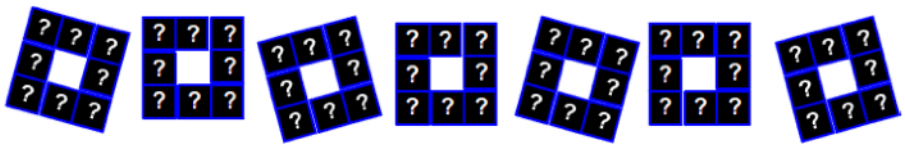
The spots on all four sides add up to make 9.
We will call this total the “spot sum”.



Use an entire set of 28 dominoes to make **7 domino windows**, each made up of 4 dominoes.

Each window must have the same "spot sum” on all 4 sides.

However, your windows can have different spot sums. In fact, it is not possible to have the same spot sum on every every window. Can you explain why?



Factors & Multiples Game 1

This is a game for two players. You can either play with counters on a board or by crossing numbers out on a printed sheet.

To Start

Decide who will go first, that person chooses an even number from the grid that is less than 50, and crosses it out (or puts a counter on it).

To Play

On your turn you choose a number and cross it out. The number you choose must be a factor **or** multiple of the number crossed out last turn.

To Win

If there are no valid numbers remaining for you to cross out then you lose the game.

An example game

The first five turns in the game on the right were:

Player A: **12**

Player B: **4**

Player A: **88**

Player B: **11**

Player A: **77**

It is now player B's turn and there is only one number which they can cross out.

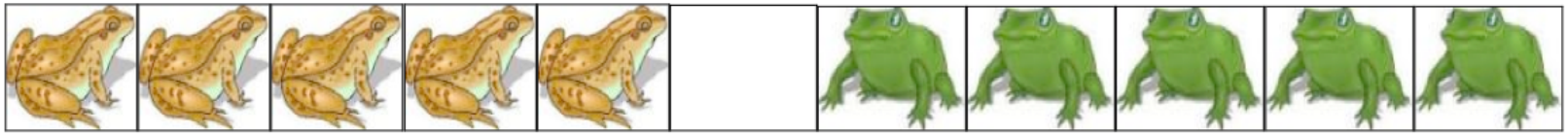
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Factors & Multiples Game 2

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Frogs 1

There are five brown frogs and five green frogs sitting on their lily pads like this:



The aim: Swap the positions of the green frogs and the brown frogs.

The Rules

Only **one frog can move** at a time.

Frogs can jump over another frog, but not two or more frogs.

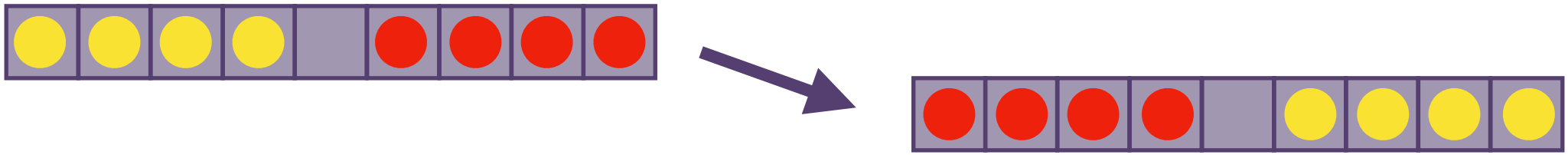
Frogs can only move **one square at a time.**

The **brown** frogs can only move (or jump) **right.**
The **green** frogs can only move (or jump) **left.**

Frogs 2

If you can't find real frogs, use counters. Choose one of the grids to start with and set up your counters (the smaller grids are the easiest).

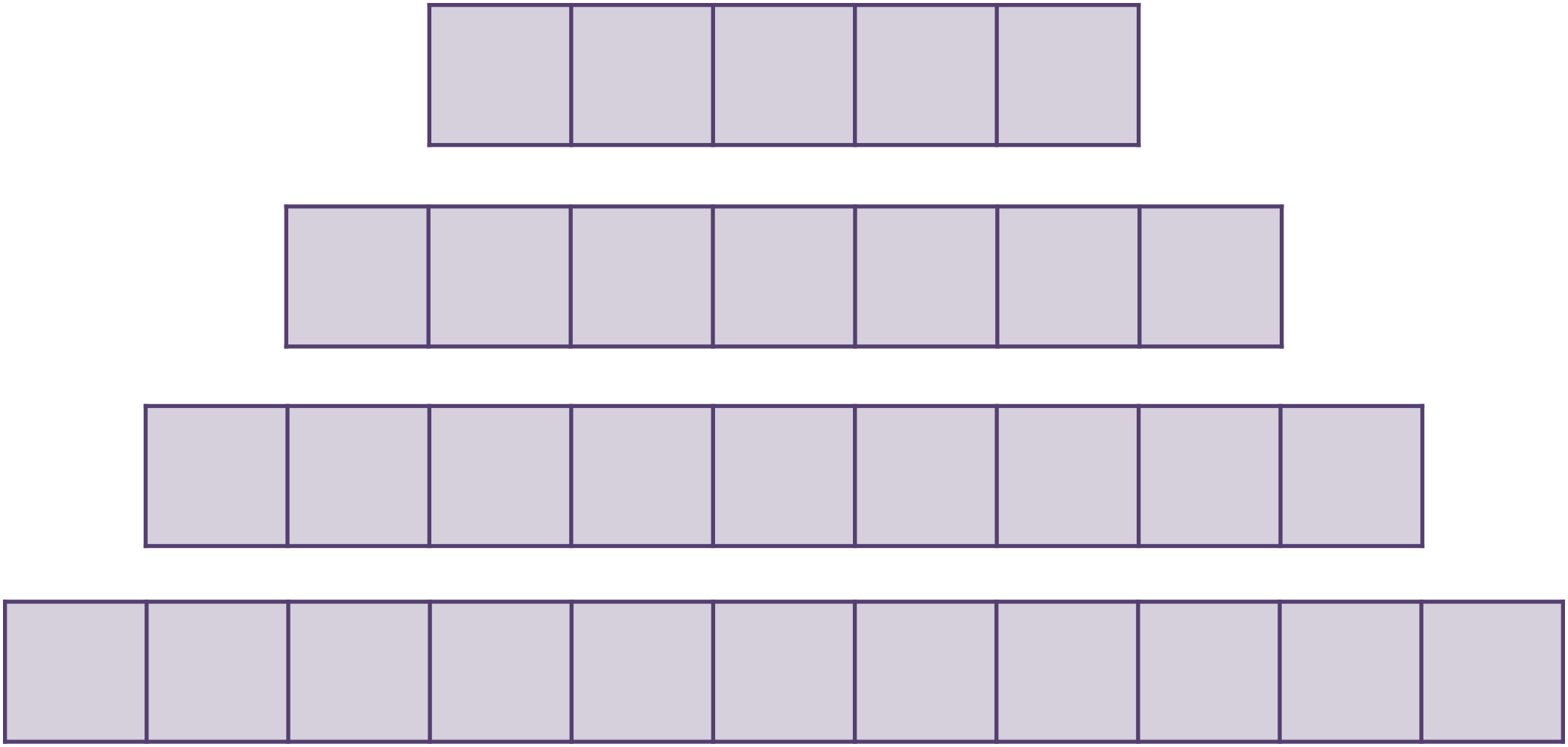
Move and jump the frogs until they have completely swapped positions.



What is the smallest number of moves it takes to swap all the frogs over?

Try putting more frogs at one end than the other.

Frogs 3



Gabriel's Problem 1

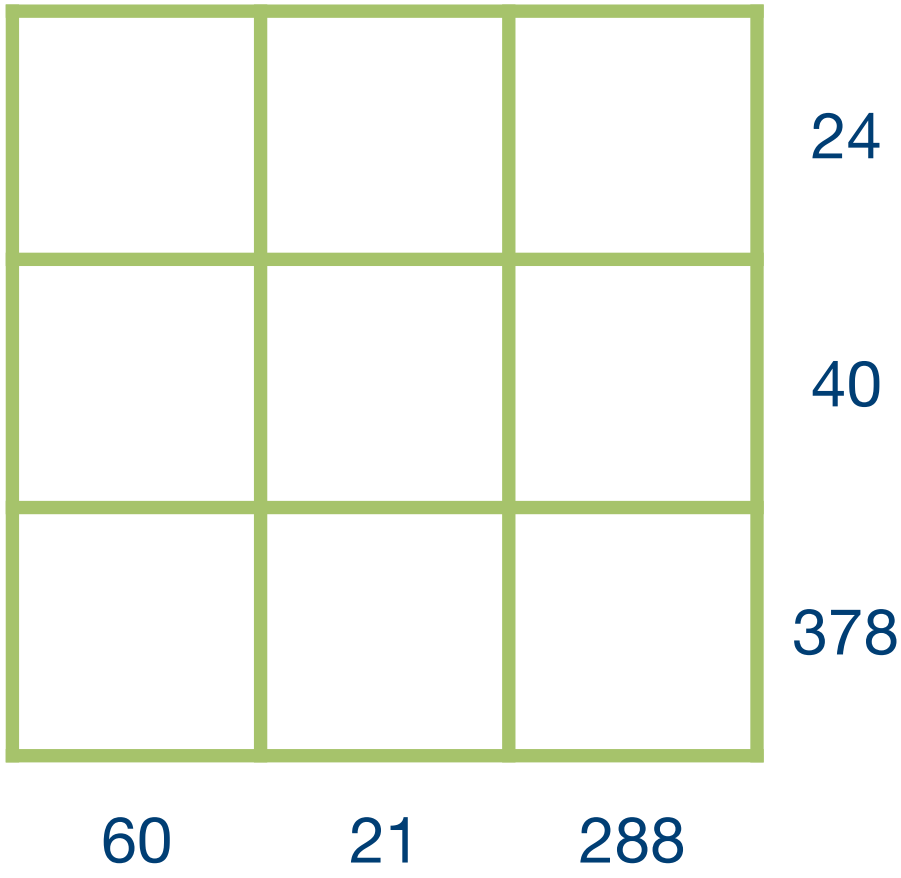
Gabriel wrote the numbers 1-9 in a 3x3 grid.

He then multiplied together all the numbers in each row and wrote the resulting product next to that row. He also multiplied the numbers in each column together, and wrote the product under that column.

He then rubbed out the numbers 1-9.

Can you work out where Gabriel placed the numbers 1-9 in the grid?

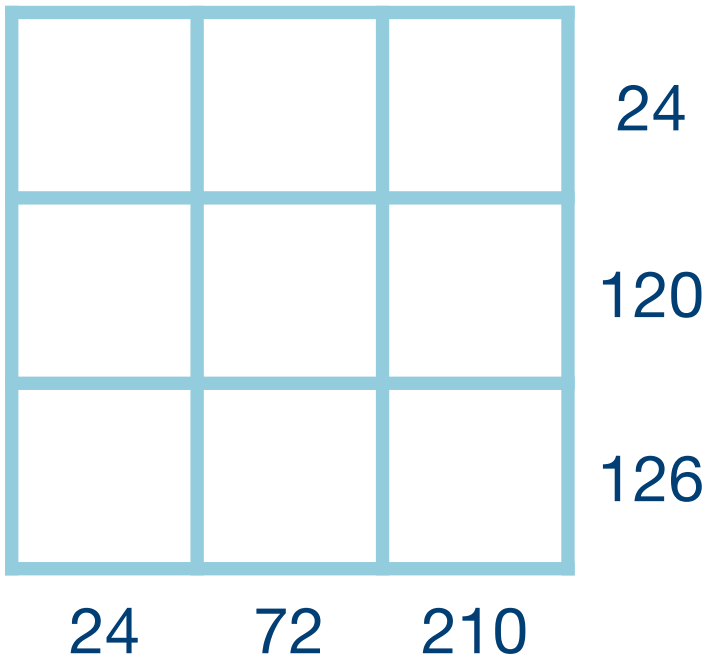
Did you have enough information, not enough, or exactly the right amount?

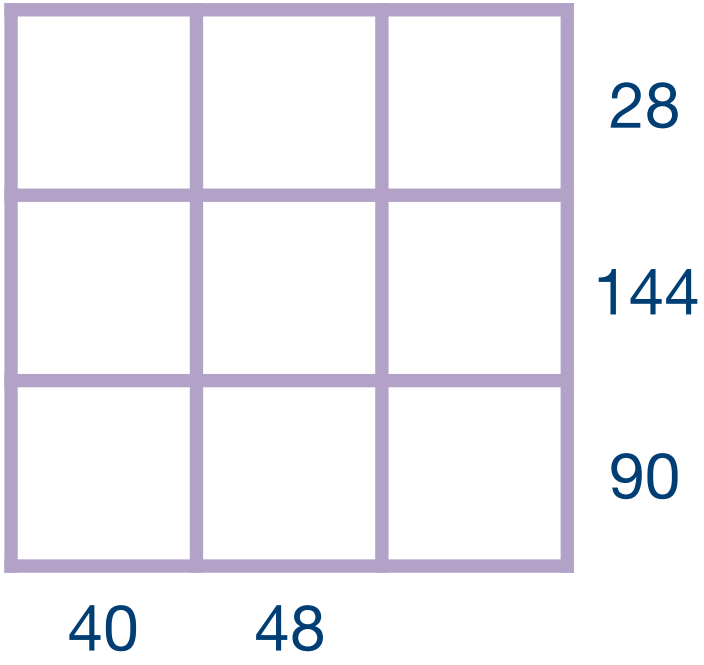


Gabriel's Problem 2

Can you place the numbers 1-9 in the grid to give the marked products in each row and column?

One of these two grids has more than one solution.

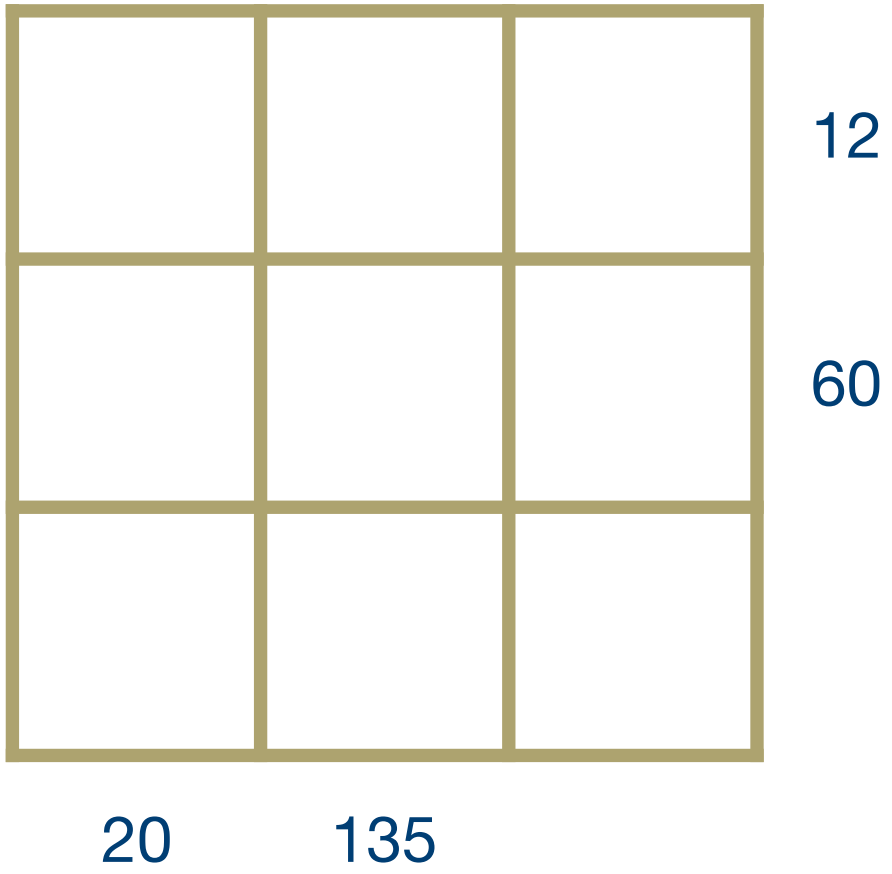




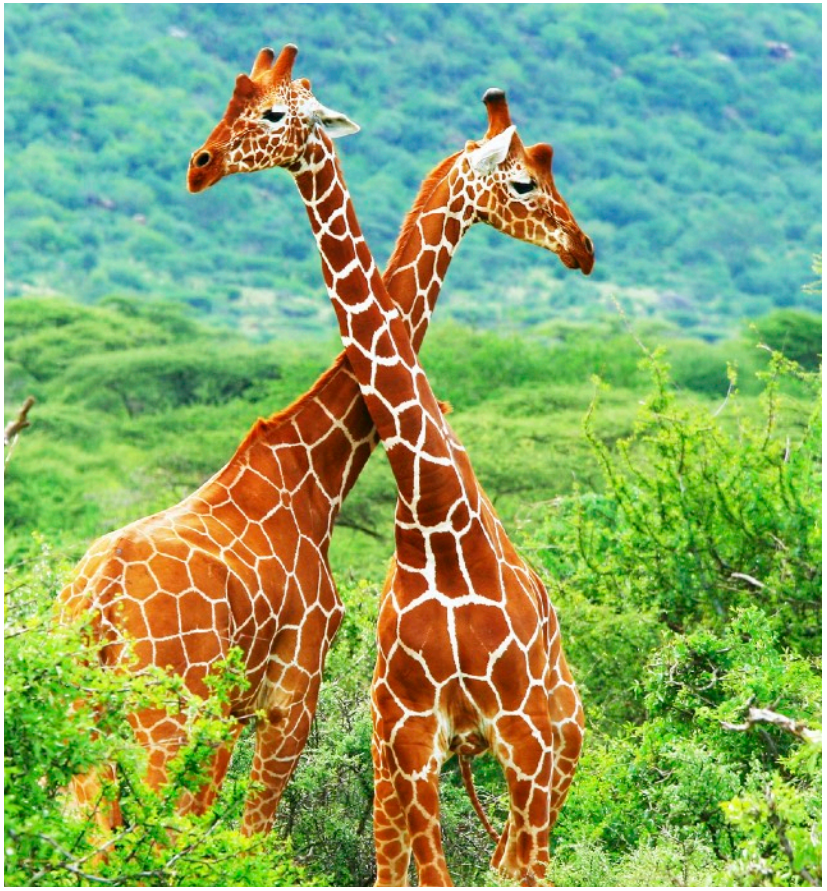
Gabriel's Problem 3

To make this grid, Gabriel used the numbers **1**, **2**, **3**, **4**, **5**, **6**, **9**, **10** and **12**.

Can you place these numbers in the grid to give the marked products in each row and column?



Largest Product



$3 + 3 + 4 = 10$
$3 \times 3 \times 4 = 36$

$3.3 + 6.7 = 10$
$3.3 \times 6.7 = 22.11$

What is the greatest product that can be made from numbers that add up to 10?

$5 + 5 = 10$
$5 \times 5 = 25$

$1 + 9 = 10$
$1 \times 9 = 9$

$1 + 2 + 3 + 4 = 10$
$1 \times 2 \times 3 \times 4 = 24$

Last Biscuit 1

This is a game for two players.

To Start

Put 4 biscuits in one jar and 8 in the other jar.

To Play

Take turns to remove biscuits from the board following the rules below:

When it's your turn you can either:

1) take any number of biscuits from just one jar, or

2) take the same number of biscuits from both jars.

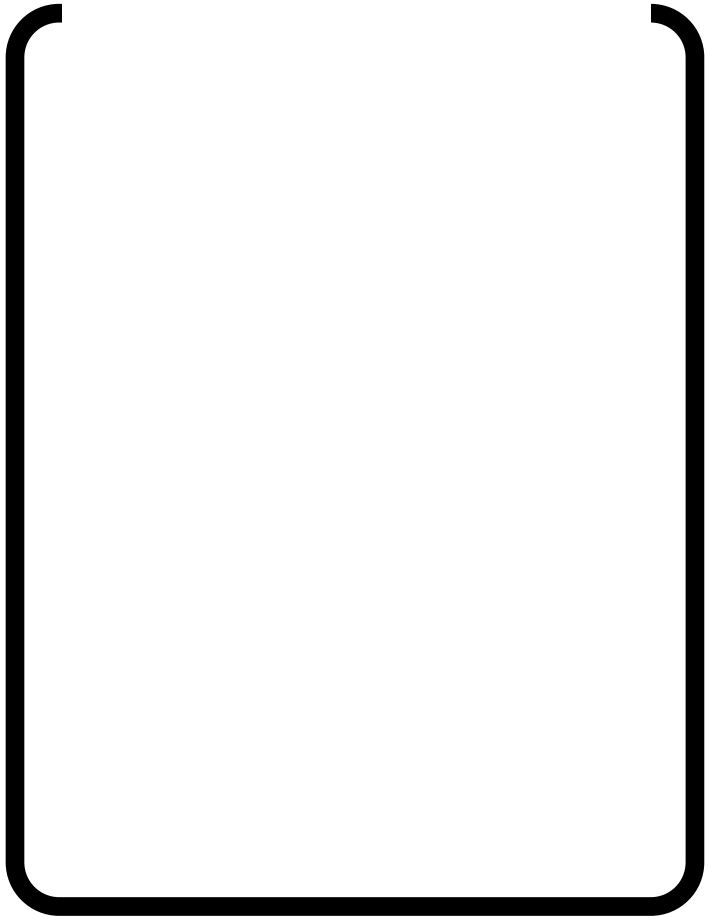
To Win

The winner is the person who takes **the last biscuit** (or biscuits).

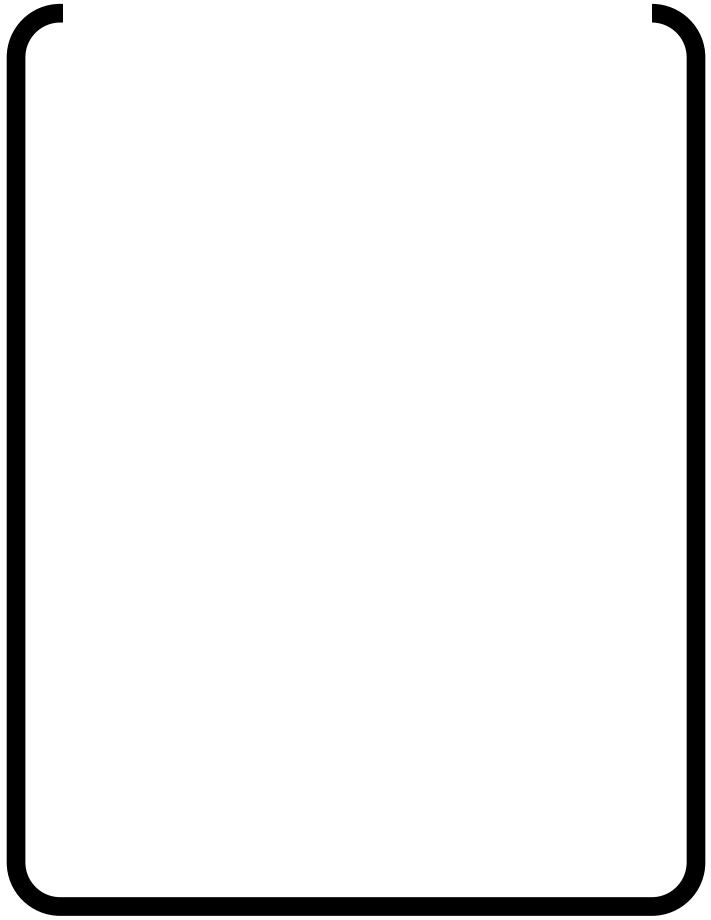
Think carefully and see if you can discover a winning strategy.

Do you think it matters who goes first?

Last Biscuit 2



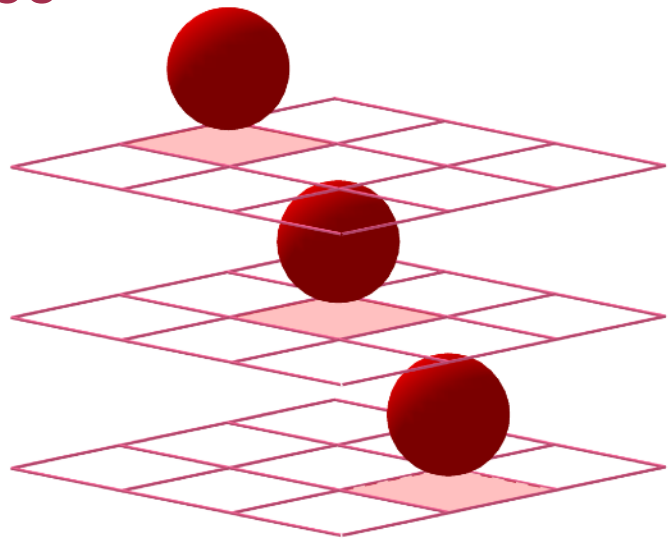
Start with 8 biscuits
in this jar.



Start with 4 biscuits
in this jar.

Marbles in a Box

Imagine a three dimensional version of noughts and crosses where two players take it in turn to place different coloured marbles in a box.



The box is made from 27 transparent unit cubes arranged in a 3-by-3 array.

The object of the game is to complete as many winning lines of three marbles as possible.

How many different ways can you make a winning line?

Nine Colours

You have 27 small cubes of 9 different colours. There must be 3 cubes of each colour.

Can you use all the small cubes to make a larger cube (3x3x3) so that each face of the larger cube contains one of each colour?

Pentanim 1

This is a game for two players.

To Start

Put 10 counters onto the ‘Pentanim’ game board, one in each space.

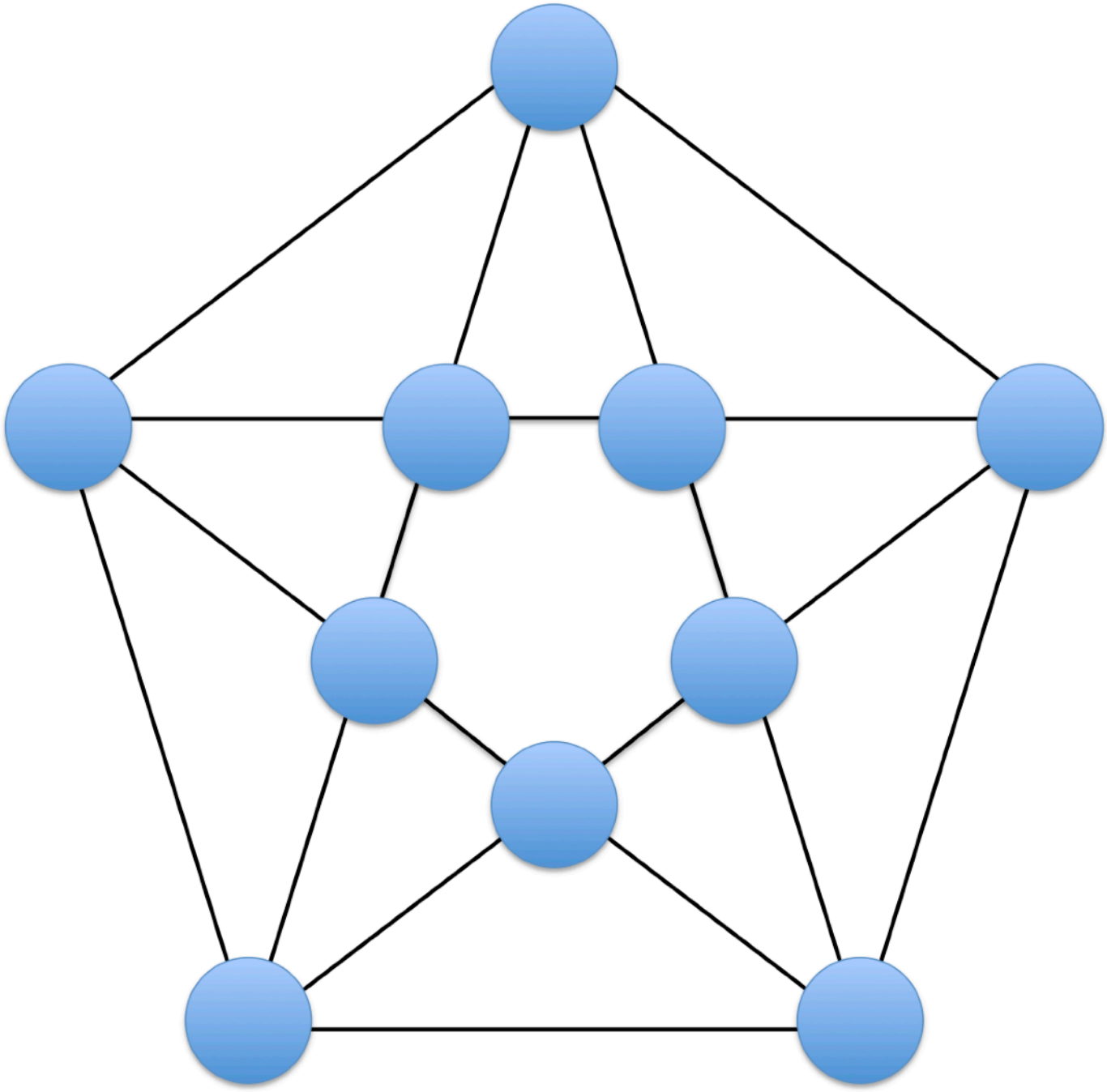
To Play

Take turns to remove either one counter or two counters from the board. You can only remove two counters if they are connected by a straight line (there can be empty spaces between the two counters).

To Win

The winner is the player who picks up the last counter (or the last two counters).

Pentanim 2



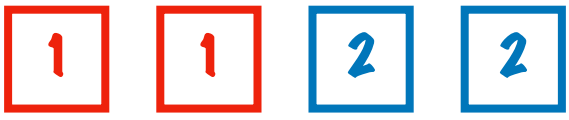
Sandwiches 1

1) Start with two 1's, two 2's and two 3's (as below).

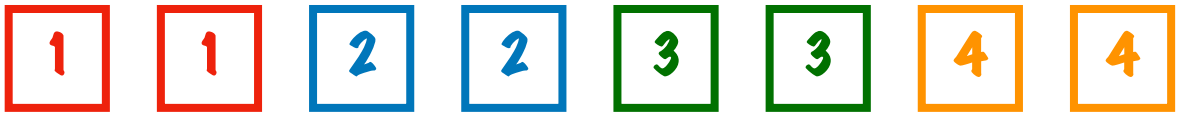
Arrange these six digits in a line so that:

- between the two 1's there is one digit,
- between the two 2's there are two digits, and
- between the two 3's there are three digits

2) Now, try to do it if you only have two 1's and two 2's (one digit between the 1's and two digits between the 2's). **Can it be done?**

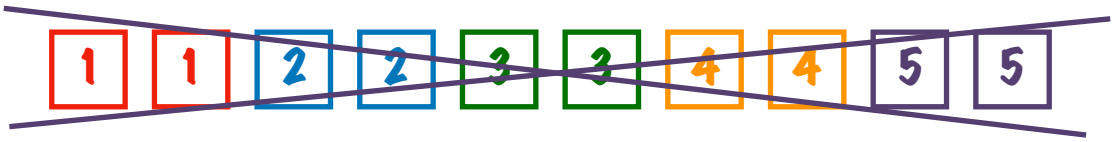


3) It is possible to add two 4's and then arrange all the numbers as in part **(1)** but now with four digits between the two 4's.

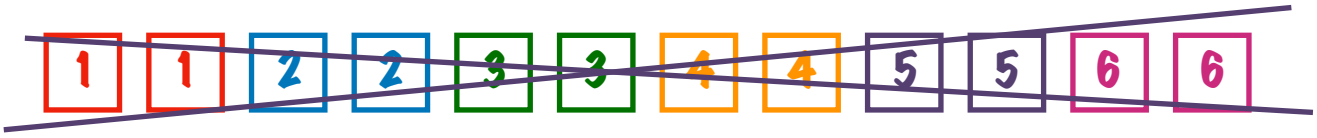


Sandwiches 2

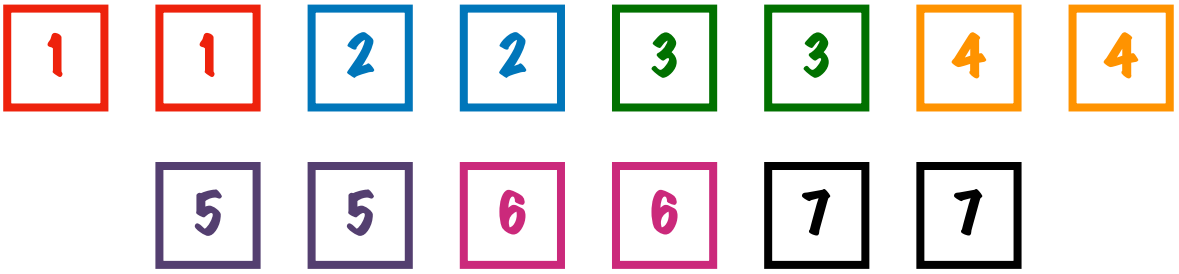
4) If you try to add two 5's (as below) it is **impossible** to arrange them in a 'sandwich'!



It's also **impossible** to do if you also add two 6's.



However, it can be done when you add two 7's! Can you manage it?



5) There is more than one way of doing this – try to find at least two arrangements that work with all seven digits.

Sticky Numbers

Look at the following line of numbers:

10	15	21	4	5

They are arranged so that each pair of adjacent numbers adds up to a square number:

$$10 + 15 = 25$$
$$15 + 21 = 36$$
$$21 + 4 = 25$$
$$4 + 5 = 9$$

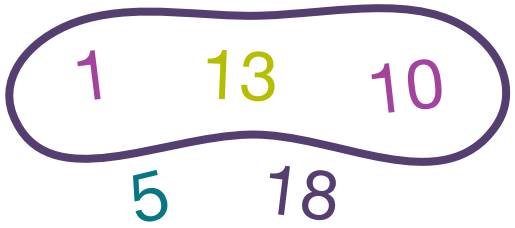
Your Task

Try to arrange the numbers 1 to 17 in a line so that every adjacent pair adds up to a square number.

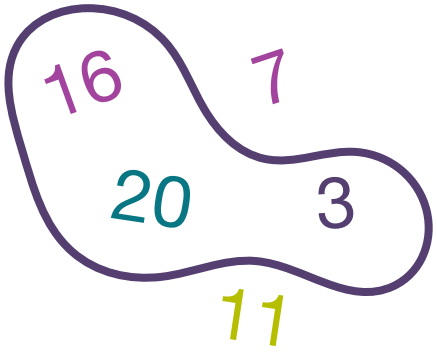
Can you arrange them in more than one way? If not, can you explain why your solution is the only one?

Take 3 from 5

Choose any five positive whole numbers.



Now find three of the numbers which, then you add them up, make a multiple of 3.



Will any set of five always include three numbers that will add up to a multiple of 3?

Teacups

Arrange the cups and saucers into the four by four grid so that:

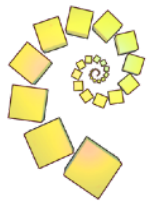
- Every **row** has only one cup of each colour and one saucer of each colour.
- Every **column** has is only one cup of each colour and one saucer of each colour.

AND

Put each cup on top of a saucer so that there are no repeated combinations.

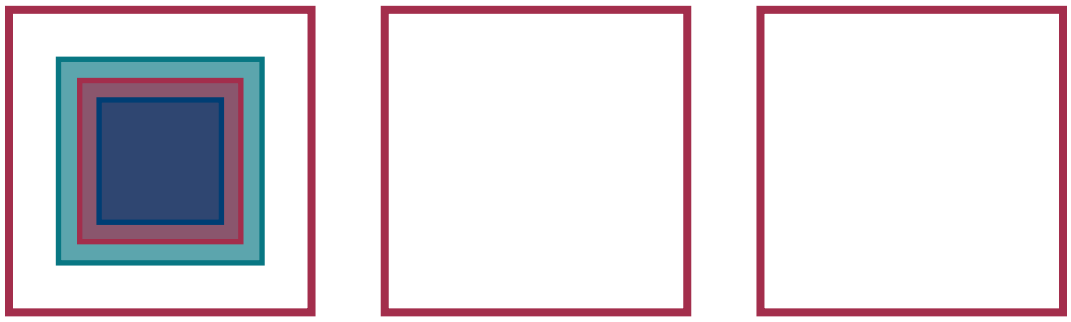
For example, you could have a blue cup on a blue saucer, a red cup on a blue saucer, a blue cup on a red saucer, etc…

Teacups



The Tower of Hanoi

This is a very old puzzle from Asia which is sometimes called “The Tower of Brahma”.



To Start

Put the three smallest pieces in the left square with the largest on the bottom and the smallest on the top.

The Aim

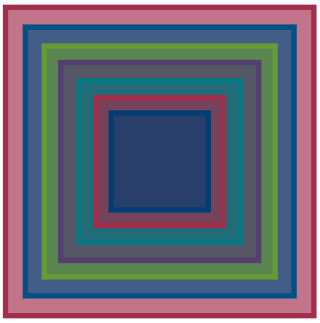
Move all three pieces to the right area.

The Rules

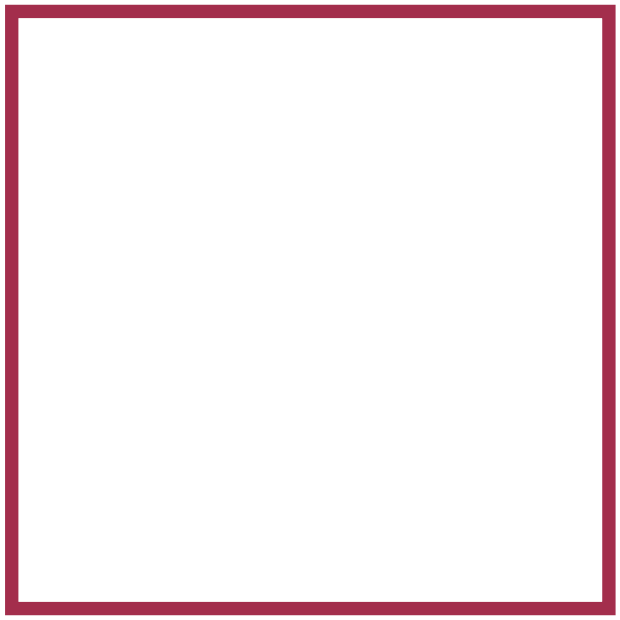
- You can only move one piece at a time.
- You may not place a larger piece on top of a smaller piece.

What is the smallest number of moves with which you can move all the pieces?

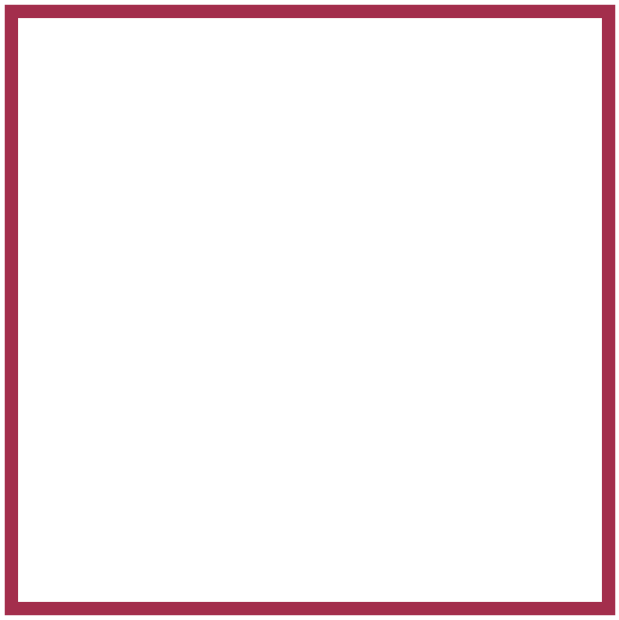
Now try starting with 4 pieces on the left, then with 5 and so on…

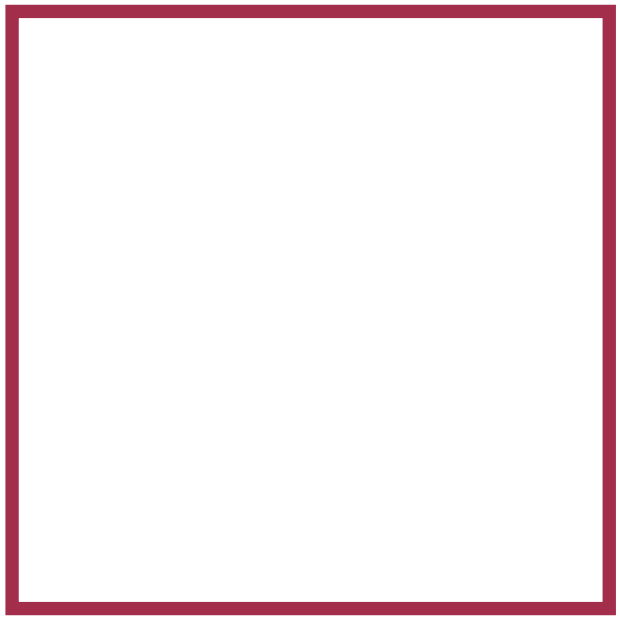


The Tower of Hanoi



Start with all the pieces in this space.





Finish with all the pieces in this space.

Who's Who? 1

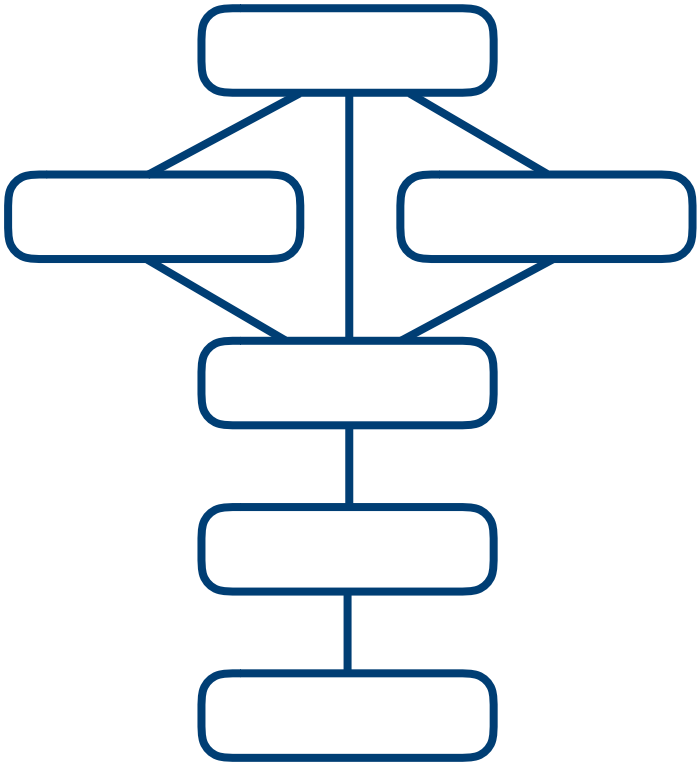
We can represent a group of friends by drawing a graph.

Each node (circle) represents a person.

An edge (line) joins two nodes if and only if those two people are friends.

Below is a graph showing a group of friends.

Can you work out who's who using the clues?

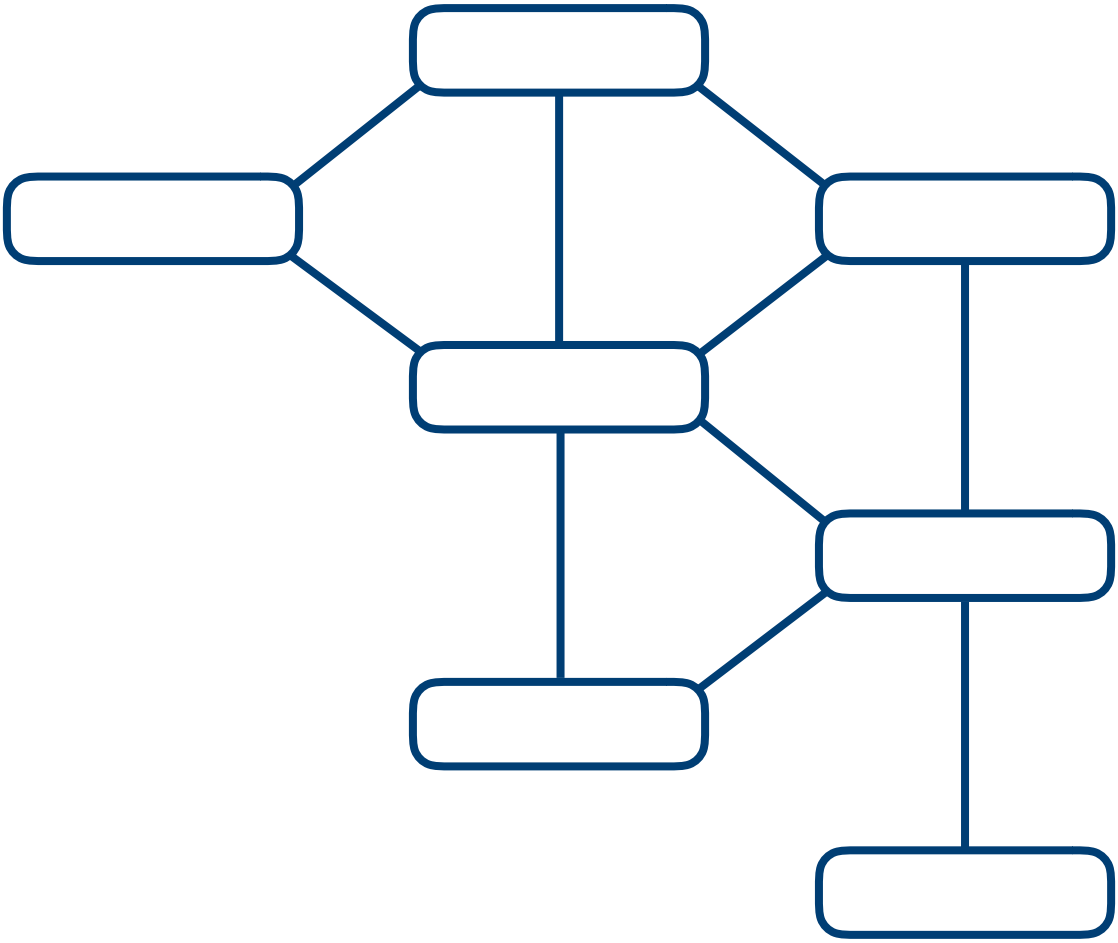


1. Alan has 3 friends, Barney, Charlie, and Daniel.
2. Barney and Ed are both friends with Charlie.
3. Ed is Frank's only friend.

Who's Who? 2

Here is a second network of friends.

Again, **use the clues below to figure out who's who**.

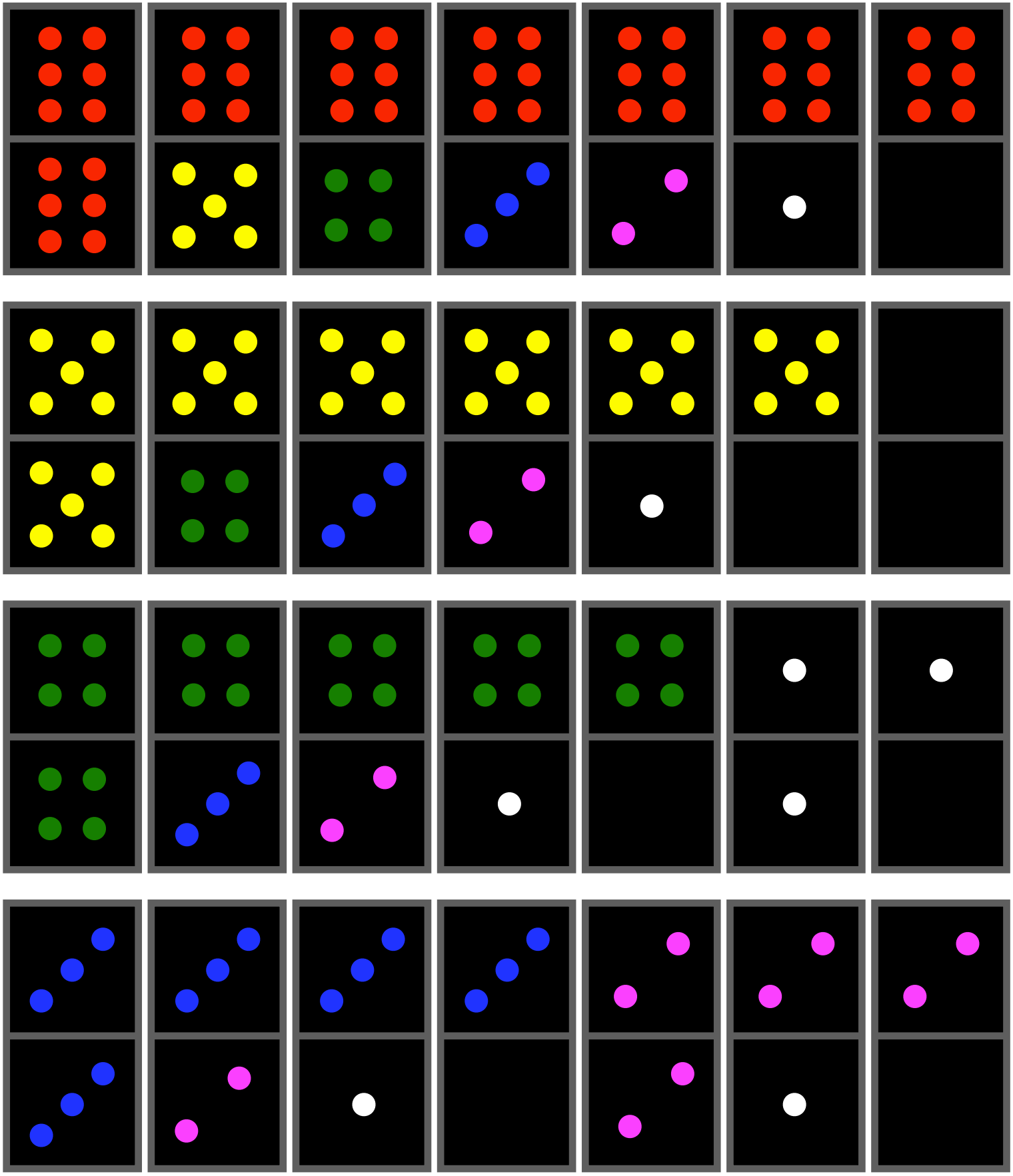


1. Bella and Ciara are friends
2. Emily and Ciara are not friends
3. Bella is Fiona's only friend
4. Anna has more friends than anyone else
5. Daphne has three friends
6. Gill and Daphne are not friends
7. Emily has two friends

Activity 10

Domino Windows

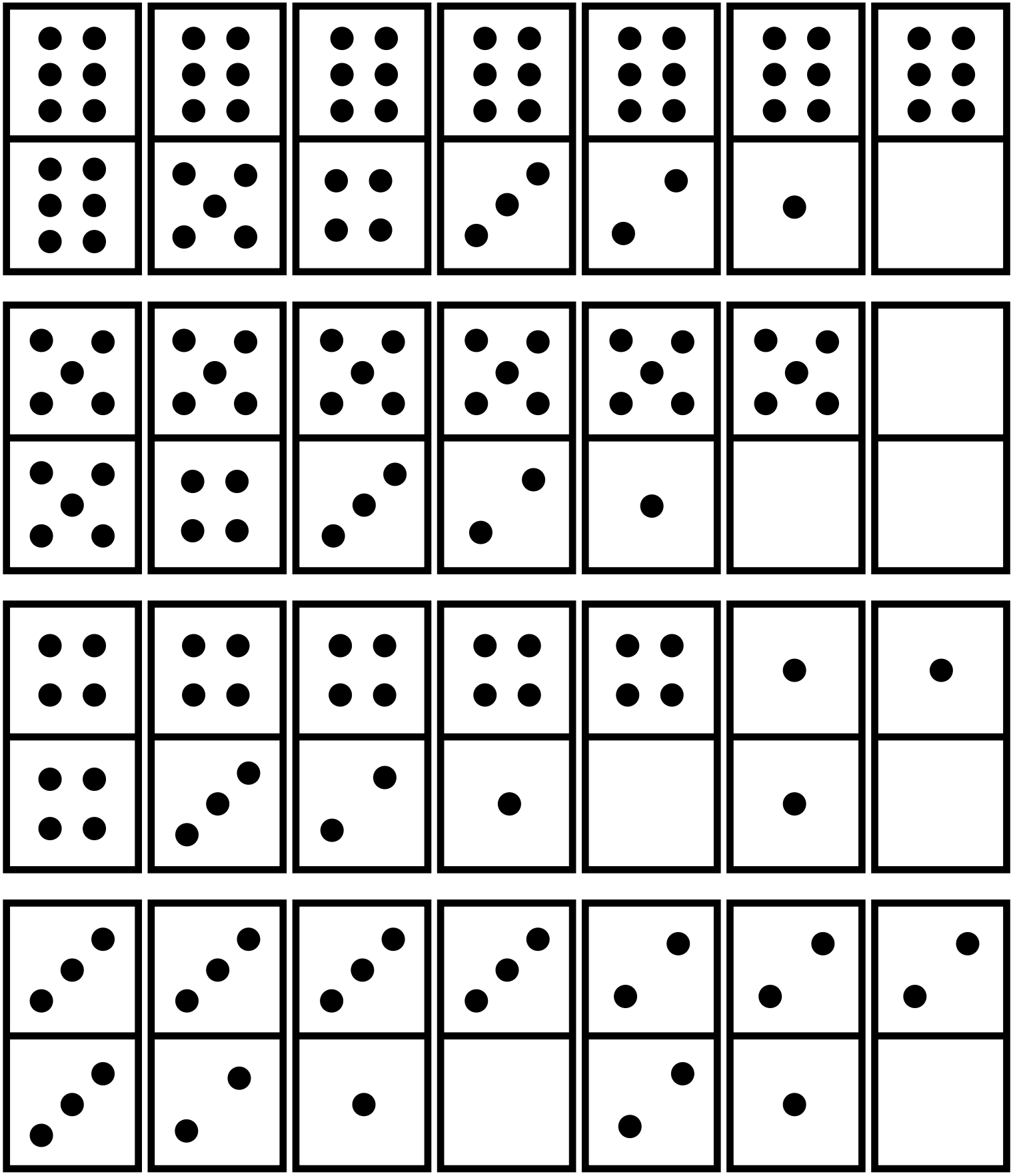
Version 1: Print and cut out the 28 dominoes below



Activity 10

Domino Windows

Version 2: Print and cut out the 28 dominoes below



Activity 12

Factors and Multiples Game

Use one grid for each game you play.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Activity 17

Gabriel's Problem

Print and cut out the 36 numbers below.

1	2	3
4	5	6
7	8	9

1	2	3
4	5	6
9	10	12

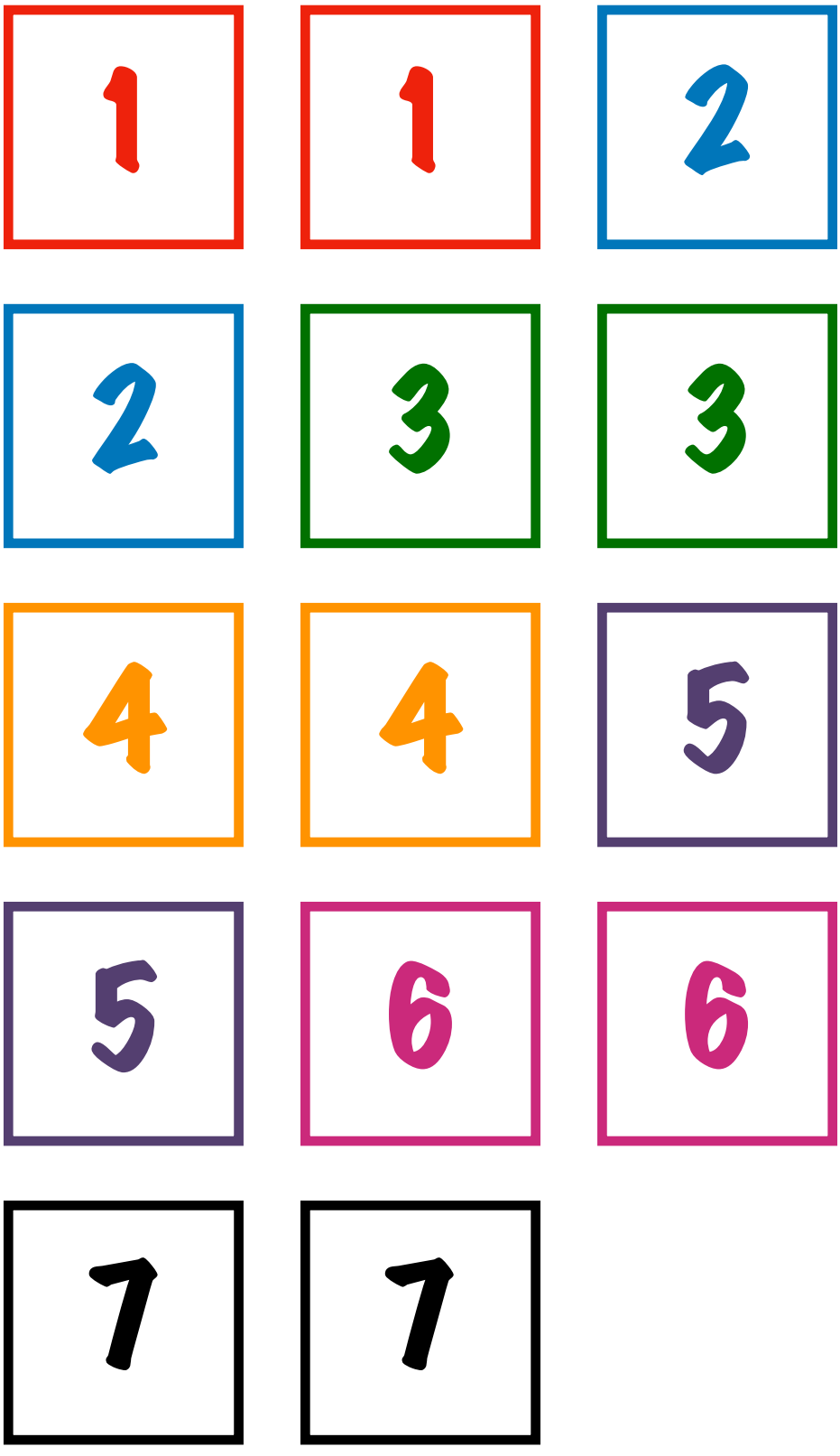
1	2	3
4	5	6
7	8	9

1	2	3
4	5	6
7	8	9

Activity 28

Sandwiches

Print and cut out the 14 numbers below:



Activity 30

Sticky Numbers

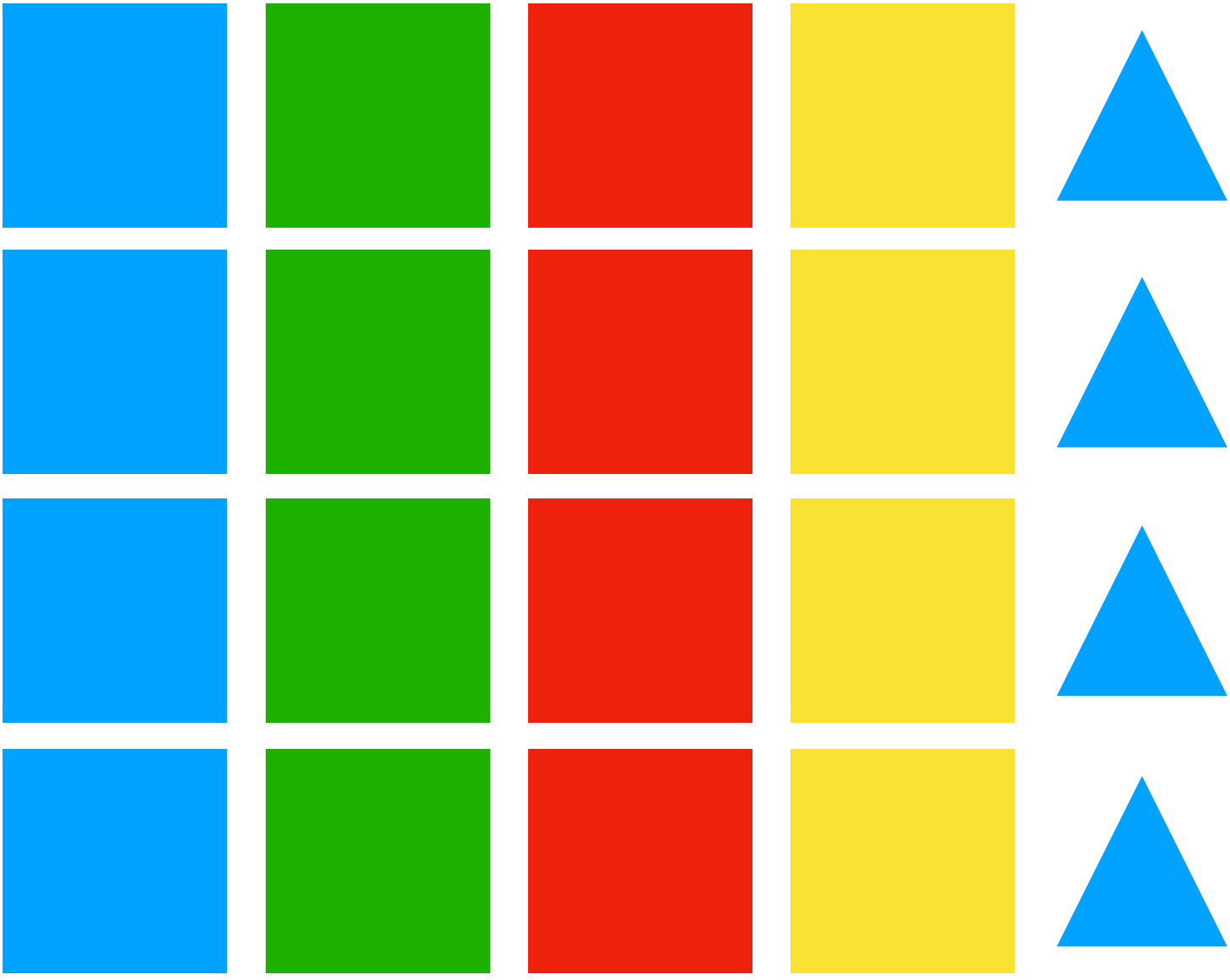
Print and cut out the 17 numbers below

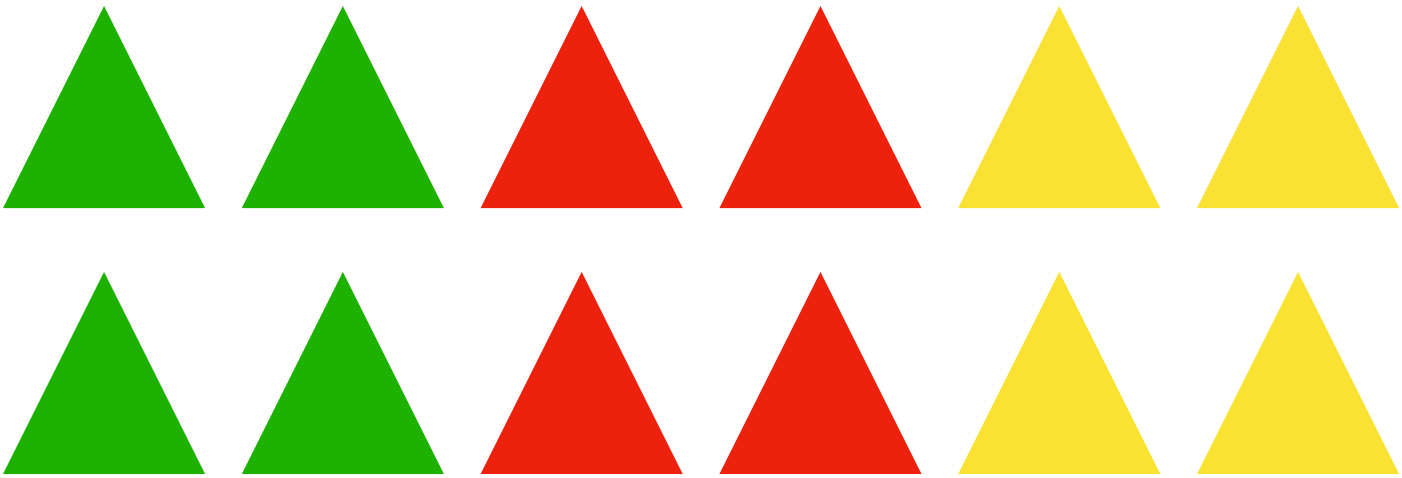
1	2	3
4	5	6
7	8	9
10	11	12
13	14	15
16	17	

Activity 32

Teacups

Version 1: For those with less time for cutting out.

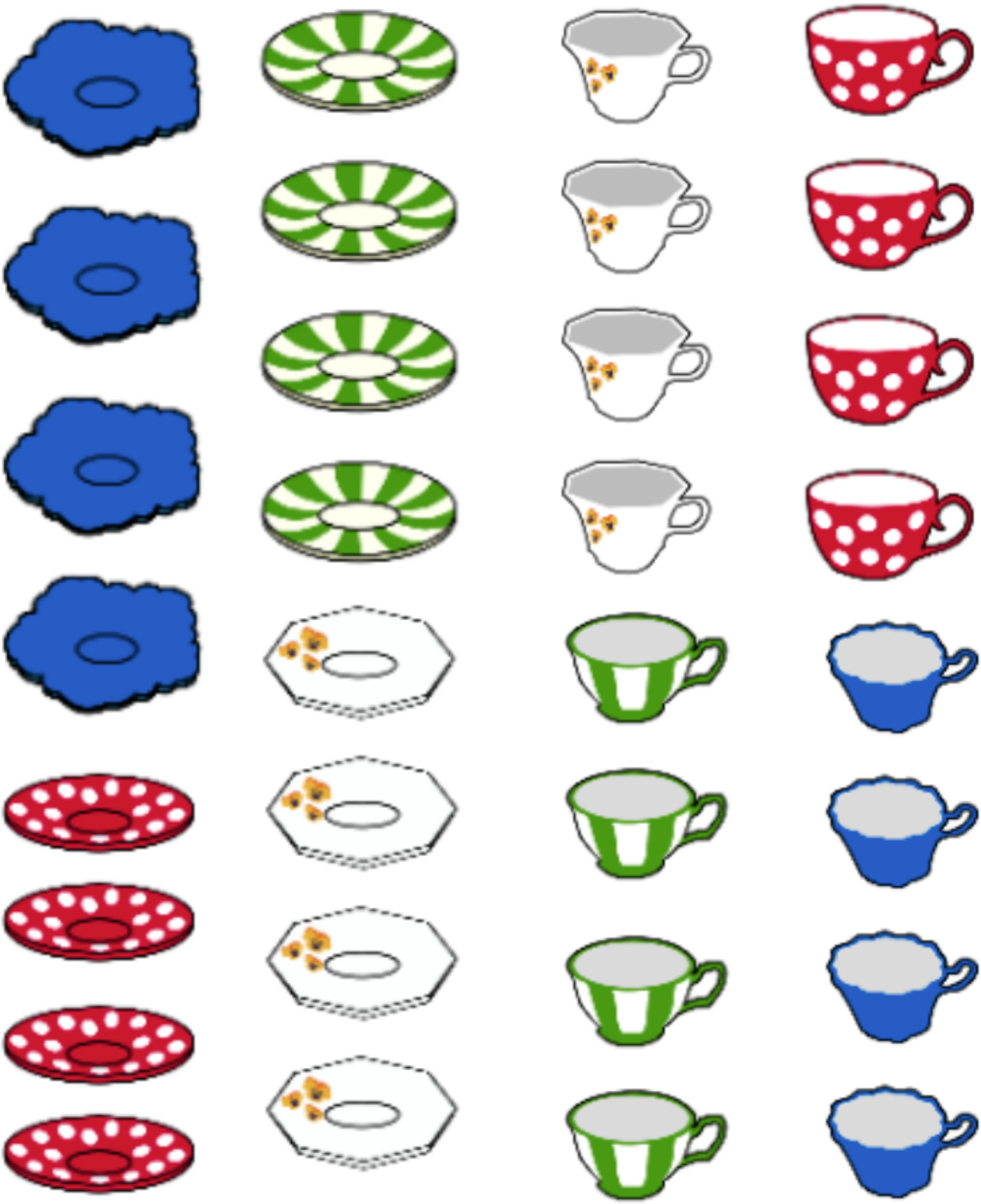




Activity 32

Teacups

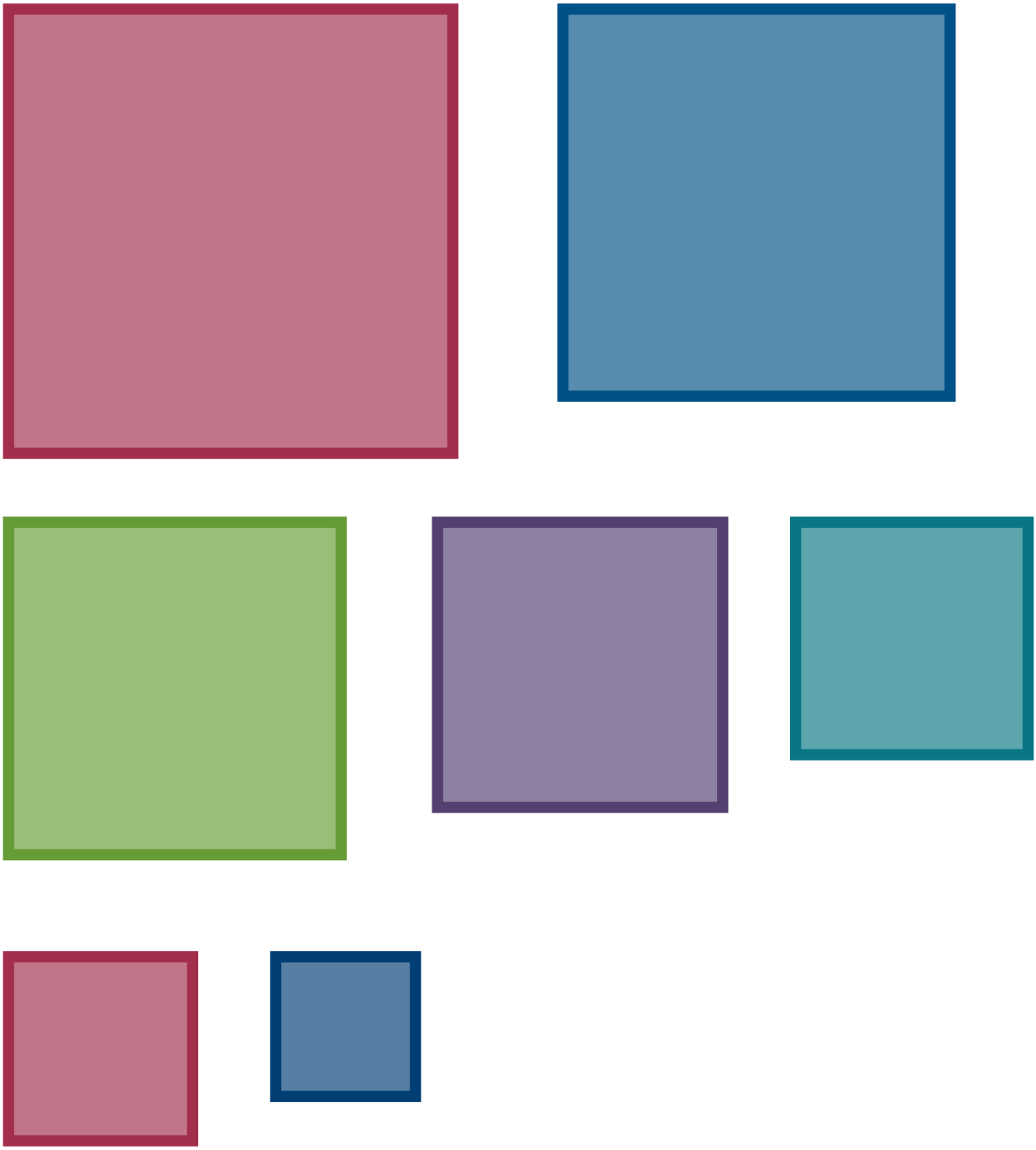
Version 2: For those with a little more time for cutting out.



Activity 35

The Tower of Hanoi

Print and cut out all the 7 pieces below



Activity 40

Who's Who

Print and cut out the 13 names below:

Alan	Anna
Barney	Bella
Charlie	Ciara
Daniel	Daphne
Ed	Emily
Frank	Fiona
	Gill