

RULES:

This game is like Bingo but each player makes their own gamecard by drawing a 5 by 5 grid and choosing 25 numbers between 0 and 100 to write on their gamecard. They cannot repeat any numbers or change the numbers once they are written on their gamecard.

Each round the caller randomly chooses 2 numbers between 1 and 10 and makes a note of the numbers so the winning card can be checked. If drawing cards from a bag, the first card is replaced before drawing the second.

Players try to make some of the numbers on their board by combining the two numbers called using one of the operations +, -, × or ÷. If they succeed, they mark the numbers on their gamecard e.g. 5 and 10 make 15, 5, 50 and 2.

HOW TO WIN:

The winner is the first player to get 5 numbers in a line and to explain how the numbers were calculated.

<h1>MATHGO</h1>				
Players choose 25 numbers to write on their gamecards.				
Pick 2 numbers each round.				
Combine numbers by +, -, × or ÷.				
For example, 8 and 4 give 12, 4, 32 and 2.				
Some numbers, like 46 and 65, cannot arise.				



Pen and paper.

1 to 10 spinner,
or a D10 dice
or a set of cards
numbered 1
to 10 in a bag.



RECORD THE RESULTS

Numbers called	Results:			
	Sum	Difference	Product	Quotient
8 and 4	12	4	32	2
9 and 10	19	1	90	-

FOR YOUNG LEARNERS

<h1>ADDITION MATHGO</h1>				
Players choose 16 numbers to write on their gamecards.				
Pick 3 numbers each round.				
Combine the numbers by addition. If the sum is a number on your card mark it.				
4 in a line wins.				

3 standard dice for Addition Mathgo.

Players draw grids to make

HELP:

Simple versions of Mathgo can be played with a 4 by 4 grid and one operation, either addition or multiplication, or with a 5 by 5 grid and one operation.

To make a good choice of numbers for a Mathgo gamecard, find out which numbers cannot be formed by combining randomly chosen numbers. For example, are prime numbers a good choice to write on your card?

Are larger numbers more likely to arise than smaller numbers or less likely?

In the 5 by 5 Mathgo game it is possible to make a line of 5 numbers on 5 vertical, 5 horizontal and 2 diagonal lines. When you find a number that occurs frequently it's good strategy to put it at the centre when you set up your board.

HOLDING VARIANT:

This version of the game can only be played when there is a small number of players.

You can miss a turn and hold a pair of numbers in reserve until the next turn. If you hold numbers in reserve, you must use 3 numbers at the next two turns. You can combine the three numbers in any order using any of the four operations.

MATHGO

THEME: WHOLE NUMBER CALCULATIONS

NOTES FOR TEACHERS

Why play Mathgo in lessons

The game will motivate learners to think mathematically in order to construct their own gamecard that will give them a good chance of winning. Some older learners may be able to write a computer program to find the frequency of occurrence of the results so that they can decide on the best numbers to put on their gamecard, and the best arrangement of those numbers. Younger learners should be able to work out the 4 results that occur when two particular cards are drawn.

The Mathgo games offer drill and practice in mental maths in addition, subtraction, multiplication and division. The games help learners to learn number bonds and multiplication tables. Learners are encouraged to estimate, calculate and then double check answers.

Learning objectives

- fluency in mental maths, both in estimation and calculation;
- numeracy in finding and using all possible results of combining by $+$ $-$ \times \div numbers chosen from 1 to 10;
- strategic thinking about the best way to choose and position numbers when creating their own gamecard.

Starter Activity for All

ADDITION MATHGO



Resources: 4 by 4 blank grids and 3 standard dice.

8	3	13	6
17	18	4	14
5	10	16	9
15	12	7	11

This game is like Bingo. The winner is the first player to get a line of 4 numbers.

Each player or team first creates their own gamecard by writing the numbers 3 to 18 on their 4 by 4 grid without repeating any of the numbers. An example is shown here but it is not the optimal card.

Each round the caller throws 3 dice and calls out the numbers. The players add the 3 numbers and mark the total on their card.

The dice shown give $6 + 1 + 5 = 12$.

This game only involves addition of whole numbers but there is a challenge for older learners to find the optimal positioning of the numbers on the gamecard.

Early Years

Start by throwing 3 dice and counting the spots. The player with the largest total wins the round.

Lower Primary

Play a simpler 3 by 3 version of the Addition Mathgo Game with the whole class split into 2 teams. Use the red and blue gamecards shown here and 2 standard dice. Call the numbers on the dice. Players must add the numbers and mark the sum on their gameboard. The first team to get a line of 3 numbers wins the game. This will give the learners practice in addition and remembering number bonds.

3	6	4
9	12	2
10	5	11

8	10	9
3	7	11
5	4	6

After playing a few times ask if red or blue wins most often, and if so why. Is this a fair game? Start a discussion about which numbers come up most often which will lay the foundation for future learning about probability. They may notice that 7 and 8 are missing from the red board and these numbers occur most frequently, whereas 7 and 8 are on the blue board and 2 and 12 are missing which are numbers that don't occur often.

Then suggest that the learners make their own 3 by 3 gamecards and play the game with the whole class.

Upper Primary

As a lesson starter play the **4 by 4 Addition Mathgo Game with 3 dice** for the whole class. Give out blank 4 by 4 grids and ask the learners to write 16 different numbers from 3 to 18 anywhere, one in each of the 16 squares. Then play the game and keep a record of the winning lines. Repeat this several times over a period of a few weeks. This will give the learners practice in recognising and remembering number bonds.

Learners can progress to the **4 by 4 or 5 by 5 Multiplication Mathgo Game** to help them to learn their multiplication tables. Play this as a whole class game at first with 2 standard dice giving products 1 to 36 and later with a 1 to 10 spinner or two D10 giving products 1 to 100. Players choose numbers for their gamecards that arise as the product of the numbers that come up on the two dice or in two spins of the spinner.

Lower Secondary

Play the Mathgo Game for the whole class on 5 by 5 gamecards using a 1 to 10 spinner, 2 D10 dice or a set of cards numbered 1 to 10. (See page 1 for the rules). Give the learners 5 by 5 grids and tell them to choose any 25 numbers from 0 to 100 to write on their cards, and they cannot repeat any numbers or change the numbers once they are written on their gamecard.

On each round 2 numbers are produced at random and players add, subtract, multiply and divide the 2 numbers. If they have any of the resulting numbers on their gamecard then they mark them. They should record all the results (see the table for results on page 1).

You can suggest that they will have a better chance of winning if they use numbers on their gamecards that come up most often, so it's worth trying to discover the number of ways each result from 0 to 20 occurs for the sum, the difference and the quotient and the number of ways that the results from 1 to 100 occur for the products.

Play the game a few times as a lesson starter. As a class discuss how to find all the ways a number can arise from adding, subtracting, multiplying or dividing the numbers on two cards. Discuss the example of the 15 ways that the number 9 can arise shown in the table below.

	SUM								DIFFERENCE		PRODUCT			QUOTIENT	
1 st card	1	2	3	4	5	6	7	8	10	1	10	1	5	9	1
2 nd card	8	7	6	5	4	3	2	1	1	10	1	10	2	1	9
	1+8	2+7	3+6	4+5	5+4	6+3	7+2	8+1	10-1	10-1	1×9	9×1	3×3	9÷1	9÷1

Suggest that the learners work in pairs to find out how many ways there are of getting each total from 1 to 100.

To share the work involved by working as a team, give each pair a few numbers to check then share the results as a class. Alternatively, divide the class into 4 sections. One section should list the sums, another the differences, another the products and the fourth section the quotients. This provides the opportunity for differentiation and inclusion as you can assign the 4 distinct tasks accordingly. Put the 4 lists on the board so that the learners can copy the results. Share the results to share the work.

Then ask questions to encourage learners to think strategically when they create their gamecards:

- Which numbers cannot arise as the sum, difference, product or quotient of two numbers from 0 to 10?
- Do some totals appear more often than others? If so which ones?
- Do some totals appear less often than others? If so which ones?
- Which squares have 4 lines of 4 going through them? Which have 3? Which have 2?
- Which totals should you put in the squares that have the most lines of 4 through them?
- Which totals should you put in the squares that have fewer lines of 4 through them?

8	24		10	6
	4			16
23		25	22	
	12		18	
20	36	15		30

Here are some numbers on a 5 by 5 grid. Are the numbers in this grid in good positions for the 4 operations Mathgo game or would you change the numbers or change their positions? What other numbers would you put in the empty squares?

Then suggest that the learners work in pairs and use this information to make up a gamecard that will have a good chance of winning. Then have a championship tournament to find the champion pair.

HOLDING VARIANT

This version of the game can only be played with a small number of players.

Players can choose to miss a turn and hold a pair of numbers in reserve until the next turn. If you hold numbers in reserve, you must use 3 numbers at the next two turns. You can combine the three numbers in any order using any of the four operations.

Upper Secondary

Play the 4 by 4 and 5 by 5 Addition Mathgo Games and the 5 by 5 Four Operations Game. The challenge is to design the ideal gamecards that will give you the best chance of winning these games.

To have the best chance of winning you need to know the frequencies with which each number occurs when combining the numbers called. You need to place the most frequently occurring numbers in the squares that have the most lines going through them.

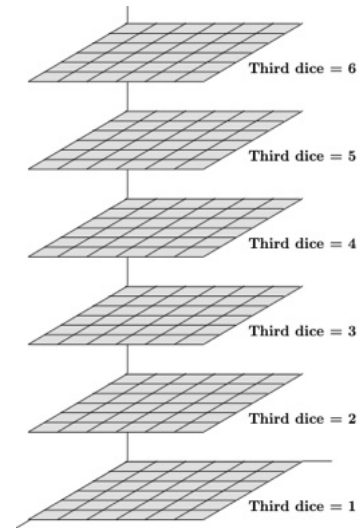
4 by 4 and 5 by 5 Addition Mathgo Games

For the sum of the numbers on the 3 dice, can you find the frequencies of occurrence of the numbers 3 to 18? There is a total frequency of 216 because, for each of the 6 numbers on the blue dice there are 6 numbers on the green dice making 6×6 combinations of numbers on those 2 dice given in a 2-way contingency table. For each number on the third yellow dice there is a corresponding 2-way table giving altogether $6 \times 6 \times 6 = 216$ combinations for the totals on all 3 dice.

Because all the numbers 1 to 18 are written on the gamecard this is largely a game of chance. The only advantage arises from the positioning of the numbers. Numbers like 10 that can occur in 27 different ways should be in good positions on the gamecard which lie on 3 or 4 of the lines. Other numbers like 18 that can occur in only 1 way can be placed in positions where they lie on only 2 of the lines.

5 by 5 Mathgo Game with 4 operations

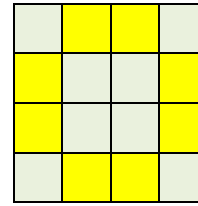
Each round the caller randomly chooses 2 numbers between 1 and 10, and all the choices of two numbers are equiprobable. For each number from 1 to 100, can you find the frequency, that is the number of calls that will result in that number when you add, subtract, multiply and divide the pairs of random numbers called? To design the best possible gamecard for the 5 by 5 game with 4 operations, you need to find these frequencies. Some numbers don't occur at all and other numbers occur only once, but other numbers occur many times and it's these numbers you want on your gamecard. Once you know these frequencies you can choose which numbers to put on your gamecard and the best positions on the gamecard to put them in.



Solutions

Addition Mathgo Game (4 by 4 grid, 3 numbers from 1 to 6, addition)

Results	Frequency of results	Triples with the number of permutations given in brackets
3	1	111(1)
4	3	112(3)
5	6	113(3) 122(3)
6	10	114(3) 123(6) 222(1)
7	15	115(3) 124(6) 133(3) 223(3)
8	21	116(3) 125(6) 134(6) 224(3) 233(3)
9	25	126(6) 135(6) 144(3) 234(6) 252(3) 333(1)
10	27	136(6) 145(6) 226(3) 235(6) 244(3) 334(3)
11	27	146(6) 155(3) 236(6) 245(6) 335(3) 434(3)
12	25	156(6) 264(6) 363(3) 345(6) 444(1) 552(3)
13	21	166(3) 256(6) 346(6) 355(3) 445(3)
14	15	662(3) 653(6) 644(3) 554(3)
15	10	663(3) 654(6) 555(1)
16	6	664(3) 655(3)
17	3	665(3)
18	1	666(1)
Total	216	

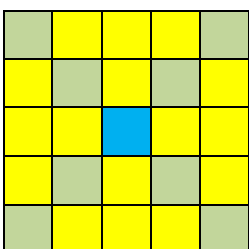


Notice that the squares shaded green have 3 lines of 4 through them and the squares shaded yellow have only 2 lines of 4 through them.

To have the best chance of winning players should put the totals 7 to 14 (occurring with the highest frequencies) in the green squares and the totals 3 to 6 and 15 to 18 in the yellow squares.

Mathgo Game (2 numbers from 1 to 10, 4 operations)

Frequencies of results of combining numbers on the cards						Frequencies of results of combining numbers on the cards							
Results	Sum	Difference	Product	Quotient	Total	Results	Sum	Difference	Product	Quotient	Total		
0		10			10	27			2		2		
1		18	1	10	29	28			2		2		
2	1	16	2	10	29	30			4		4		
3	2	14	2	6	24	32			2		2		
4	3	12	3	4	22	35			2		2		
5	4	10	2	4	20	36			3		3		
6	5	8	4	2	19	40			4		4		
7	6	6	2	2	16	42			2		2		
8	7	4	4	2	17	45			2		2		
9	8	2	3	2	15	48			2		2		
10	9		4	2	15	49			1		1		
11	10				10	50			2		2		
12	9		4		13	54			2		2		
13	8				8	56			2		2		
14	7		2		9	60			2		2		
15	6		2		8	63			2		2		
16	5		3		8	64			1		1		
17	4				4	70			2		2		
18	3		4		7	72			2		2		
19	2				2	80			2		2		
20	1		4		5	81			1		1		
21			2		2	90			2		2		
24			4		4	100			1		1		
25			1		1								
					Total for 1 - 25	297						Total for 26-100	47
												Total for 0 - 100	344



Notice that the square shaded blue has 4 lines of 5 through it, the squares shaded green have 3 and the squares shaded yellow have only 2 lines of 5 through them.

To have the best chance of winning players should put the total 1 or 2 (occurring with the highest frequencies) in the blue square, totals between 1 and 9 in the green squares and, in the yellow squares, the totals 0, 10 to 18, 20, 24, 30, 36, 40 and one other number with a frequency of 2.