Azim Premji University

At Right Angles

A RESOURCE FOR SCHOOL MATHEMATICS

Azim Premji University

ACTIVITIES THAT CELEBRATE MATHEMATICS

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A publication of Azim Premji University

ACTIVITIES THAT CELEBRATE MATHEMATICS

In the Features section of this issue, we have looked at the Why and How of the celebration of a Mathematics Day. This pullout focuses on the **What:**

- What are the different strands which are featured in the stalls set up for the day?
- What are some tried and tested activities that work well for each strand?
- What are the materials needed?

Keywords: Mathematics day, exposition, content domains, visualisation, reasoning.

Here we give you the details arranged strand-wise.

Numbers

General advice: Having multiple sets of the material is useful at each of these stalls to accommodate more players at a time.

1. Prime Magic

Materials for each set: One grid card of (3 × 3) size with an extra column and row as shown in Figure 1. 1 set of number cards (1 to 9)

No. of players: 1

Task: Place the numbers 1, 2, 3,..., 9 on each square of the 3 by 3 grid so that each of the rows and columns adds up to a prime number.

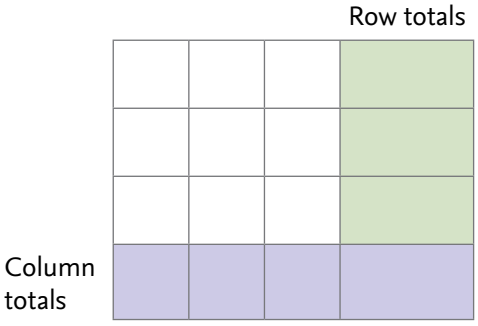


Figure 1

2. Sandwich Numbers

(Sourced from nrich.maths.org)

Materials: 2 sets of Number cards (1 to 7)

No. of players: 1

In this arrangement there is one number sandwiched between the two "1" cards, two numbers sandwiched between the two "2" cards, and three numbers sandwiched between the two "3" cards.

Make a complete sandwich with 1, 1, 2, 2, 3, 3, 4, 4.

Challenge: Make a sandwich using pairs of ones, twos, threes, fours, fives, sixes and sevens.

3. Number Tiklis!

Materials: Number pairs (chosen from numbers 1 to 9) written out on chits and three true statement cards that go with each pair. These can be pitched at varied levels, as shown in the example. (**Note:** The number chits are the tiklis (bindis). Self-adhesive post-it notes can be cut in interesting shapes to make these tiklis.)

No. of players: 2

Number pair example: 4 and 7.

Level 1 Statement card: The product of the numbers is 28.

Level 2 Statement card: When the numbers are arranged in fraction form, the fraction obtained is 12/21.

Level 3 Statement card: The sum of the squares of the numbers is 65.

The two players face each other. One number chit each is stuck on their forehead (by the student presenter at the stall) so that each player can see the number of the other person but does not know his/her own number.

The stall presenter selects any one of the statements (as per the mathematical knowledge of the players) and reads it out.

Each player has to work out what the number on their own tikli is, based on what is written on the other person's tikli and the statement that has been read out by the student presenter.

4. Get Close

Materials: 2 sets of Number cards (0 to 9), Six Instruction Cards with different target numbers

No. of players: 2

Operations allowed: Addition

Sample Instruction Card: 'Place the four digits to make 2 two-digit numbers, the sum of which is as close to 100 as possible.'

Note: As the phrase 'close to 100' may be interpreted as just the proximity to 100, numbers less than, equal to, or greater than 100 may be accepted. For example, 101 is a better answer than 96.

Both the players take turns to play the game. Let the first player pick 4 number cards without looking at the numbers on the card. The second player chooses an instruction card. The first player should try to come close to the instruction given on the card. The second player will see if he or she can come up with a better arrangement. (Zero cannot be a leading digit in forming two-digit numbers.)

Figure 2 shows the number cards picked and how they are to be placed.

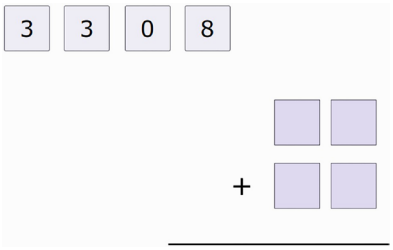


Figure 2

Higher level: The game can be made more challenging by having varied instruction cards and allowing for both addition and subtraction operations.

5. Squares all the Way: How long can you keep it going?

Materials: Paper, pencil

No. of players: No restriction

The presenter initially gives 4 numbers to be placed at the player's discretion at the four corners of a square. The player needs to write the difference between the larger and the smaller number of each pair that forms, at the mid-point of the corresponding side of the square. Join the midpoints to form a new square. Repeat the process till the difference becomes zero along all four sides.

The players can try with other numbers and see how long the process takes. They can predict choices which lead quickly to the answer.

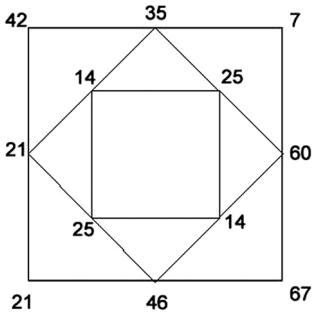


Figure 3

6. Challenge

Material: One flash card with the sequence 10, 15, 21, 4, 5

No. of players: No restriction

The presenter can pose the question 'What is special about this number sequence?'

10, 15, 21, 4, 5

If the participants are not able to spot any special feature, the presenter can explain.

'Each pair of adjacent numbers adds up to a square number.'

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

Task: The task is to now try to arrange the numbers 1 to 17 in a row in the same way, so that each adjacent pair adds up to a square number.

Mathematics through Visuals

1. Who's Who?

Groups of friends are represented by the graphs shown in Figures 4 and 5.

Each node represents a person. An edge (shown with a black line) joins two nodes (shown with yellow circles) if and only if those two people are friends.

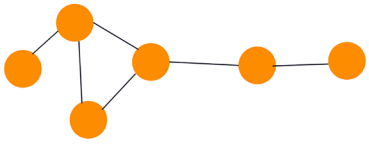


Figure 4

Can you work out who's who in Figure 4 using the clues below?

1. Anu has 3 friends: Bharath, Chandru, and Durga.
2. Bharath and Eela are both friends with Chandru.
3. Eela is Farha's only friend.

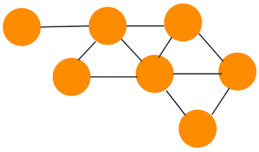


Figure 5

Figure 5 shows another graph depicting another group of friends.

Use the clues below to figure out who's who in Figure 5.

Bali and Clara are friends

Eesha and Clara are not friends

Bali is Fatima's only friend

Anu has more friends than anyone else

Dobe has three friends

Gopi and Dobe are not friends

Eesha has two friends.

2. Names Please!

Mintu, Bholu, Chotu, Gola, Ragi are here in Figure 6

Figure 6

Mintu and Ragi are smiling.

Ragi has big eyes.

Bholu and Mintu have big noses.

Chotu is sad.

3. Four Questions

Materials: Shape chart

No. of players: Either 2 or a group of 4 to 6

This activity is modelled on the same lines as the well-known game of 'Twenty Questions. '

In this game, Player 1 selects one card (Shape). The other players can ask questions to which the reply will be either 'Yes' or 'No'.

The players have to identify the shape in less than or equal to 4 questions.

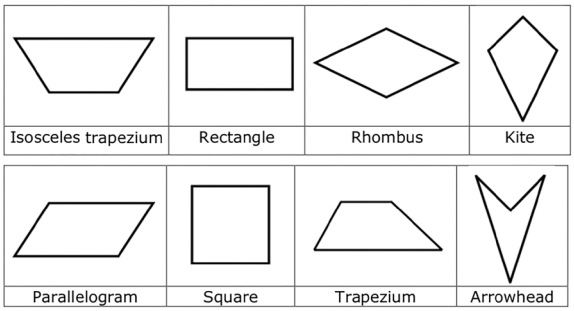


Figure 7

Shapes: Isosceles trapezium, Parallelogram, Rectangle, Square, Rhombus, Trapezium, Kite, Arrowhead.

Players need to figure out the questions that can help them to eliminate some of the choices.

Higher level: Can the players identify the shape after asking just three questions?

4. Planting Seeds!

Materials: 36 seeds and a (3 × 3) grid sheet with the middle square blanked out.

Plant the 36 seeds in the empty squares in the garden so that the top and bottom rows and left and right columns each add up to 18 seeds

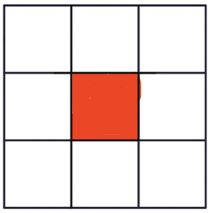


Figure 8

Plant 36 seeds in the empty squares in the garden so that the top and bottom rows and left and right columns each add up to 14 seeds.

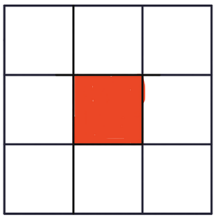


Figure 9

Measures and Estimation

1. Object Hunt

Materials: Balance, Rulers

How to Play

1. Challenge the participants to find objects that meet certain criteria. For example: An object that is approximately 15 cm long.
2. An object that weighs 50 g.
3. Check how close their estimate was with appropriate measuring instruments (A balance, a tape measure, etc.).

2. My Body!

Materials: Rulers and measuring tapes.

No. of players: 2

The presenter asks, 'Do you have any idea how long your head is?' (from the chin to the top of the head)

Let each player make a guess and then measure the length of each other's heads.

(**Note:** Data of this nature can be recorded and used later in a math class to get a sense of the variations of head length and to calculate the average.)

A study can be done to see if there is any difference between males and females. It is known that the length of a human head, from chin to the top of the head, is typically 8-9 inches (20-23 cm) for adults. Does the finding made by the students match this information?

3. Jugs!

There are many nice problems that involve unmarked jugs to measure out a required quantity.

Here is one such problem.

You have two jugs. One holds seven litres and the other holds five litres.

How can you measure out exactly 4 litres using these two jugs?

Figure 10

Geometry

1. How many Squares!

Materials: Picture card

No. of players: No restriction

How many squares are here?

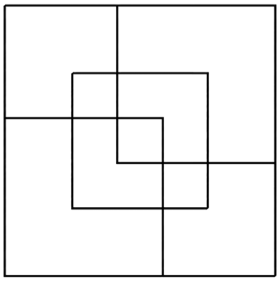


Figure 11

2. More Squares!

Materials: Tangram set

No. of players: 1

Can you make five differently sized squares by using all or some of the pieces of a tangram set?

(**Note:** Some solutions are given in Figure 27 at the end of the pullout.)

3. Sharing Land

Materials: Drawing of the shape on grid paper (1 drawing per person).

No. of players: No restriction

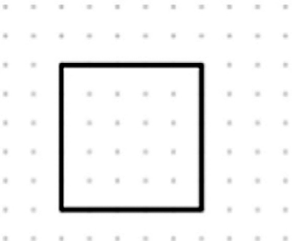


Figure 12

Figure 12 shows an old land sharing problem. Can you share this square piece of land into 5 equal parts in such a way that one person has no access to any of the four sides?

(**Note:** A solution is given in Figure 28 at the end of the pullout.)

4. Build

Materials: Models of 3D shapes, straws and connector set

No. of players: 2

3D shapes: It is only in the recent past that construction of 3D shapes has become part of the syllabus. Most adults would not have had a chance to build 3D shapes.

Display Models or pictures of the models. Provide straws and connectors and ask the participants to form regular 3D shapes such as a tetrahedron or an octahedron.

Games

1. Leapfrog

This is a well-known problem which works very well in any fun festival.

Materials: Cardboard strip with 5 circles (Figure 13a)

No. of players: 2 per strip

Figure 13a

The problem can start at a simple level with two brown frogs and two green frogs.

Setting: Series of 5 tiles with 2 green frogs on one end and 2 brown frogs on the other end with an empty circle in between. This is the start position. (Figure 13b)

Rules: A frog can slide from its position to the adjacent empty tile or jump over one frog to land in an empty tile. It can slide and jump both forwards and backwards. However, it cannot jump over more than one frog.

Figure 13b

Challenge: Can we swap the positions of the green and brown frogs? Did a frog have to move backward? What is the minimum number of moves needed to do so?

Extension: Try with an increased number of frogs (3 green and 3 brown). Can we swap the positions of the three green and three brown frogs? Did a frog have to move backward? What is the minimum number of moves needed to do so?

Figure 14a

Figure 14b

On a math festival day the aim might be to figure out if it can be done in the minimum number of moves. However, the problem can be explored further to notice a pattern in the sequence of moves. They could even attempt to explain the pattern and come up with a method for swapping frogs in the minimum number of moves.

On one occasion, when we presented this game using boards and counters, a group of senior students who were intrigued by the challenge, drew a figure on the floor outside the venue and used chappals and shoes to represent the two types of frogs! They ended up collecting a huge encouraging crowd around them as they tried to figure out the solution. Street Math!

2. Block!

(Sourced from nrich.maths.org)

Materials: Large figure card

No. of players: 2

This game is for two players. Each player needs two counters (or buttons, or stones) to put on the board below.

Place two stones at the top and two at the bottom as shown in Figure 15. (At the start of the next game the players should swap positions.)

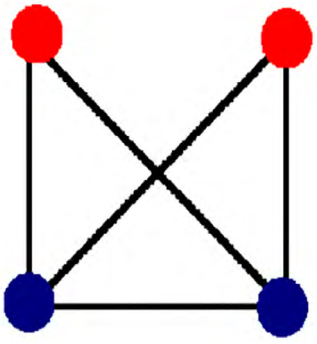


Figure 15

The players take turns at sliding one stone along a line to an empty spot. (So, the first move will always be to the middle.)

To win, you have to block the other player so he or she can't move.

In China this game is known as Pong hau k'i and in Korea it is called Ou-moul-ko-no.

3. Jump and Leave One

Materials: Numbered counters (1 to 10)

No. of players: 1

Arrange ten counters (1 to 10) in a triangle shape as shown in Figure 16. Remove coin numbered 9 to make a space. Now the remaining coins can jump over one another. Jump one coin over another coin into an empty space. You can now remove the coin you jumped over.

Challenge: Jump the coins one at a time so that there is only one coin left.

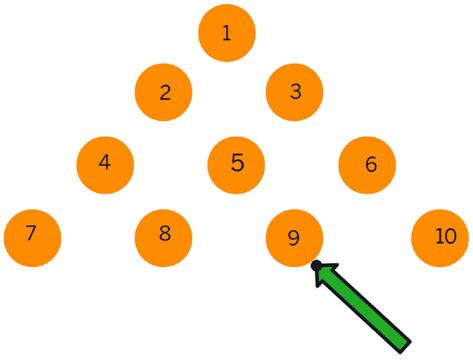


Figure 16

4. Stools Apart!

Materials: 8 stools to be arranged on the ground in the form given in Figure 17; big number cards.

This challenge is for a group of 8 students. Each student is given a number card (1 to 8) and they have to sit in such a way that no two consecutive numbers can be next to each other either horizontally, vertically or diagonally.

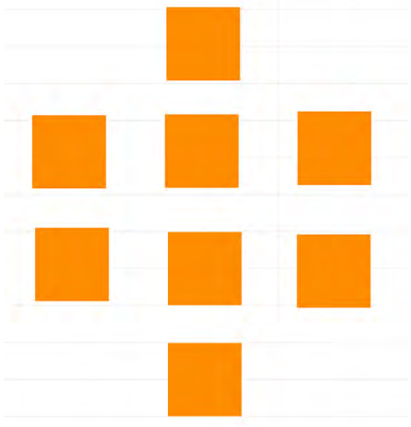


Figure 17

Puzzle space or workshop space

No Mathematics Day celebration can be complete without playing around with stimulating puzzles. One can use well known puzzles such as:

- Tangram
- Soma cube
- Brahma's tower of discs
- Pentominoes
- Matchstick puzzles

1. Dissection Puzzles

Shape dissections can be given with the actual outline of the assembled puzzle drawn on a paper.

But another task that is more challenging, is to give the pieces and specify the expected shape to be made. In this case, it is a T shape.

Figure 18

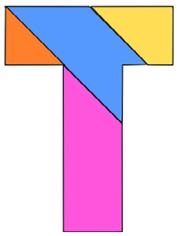


Figure 19

The pink, orange, blue and yellow shapes in Figure 19 have been fitted together to form a T. Can the same pieces be fitted together to form the shape shown in Figure 20?

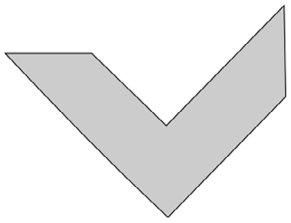


Figure 20

2. Tiling Challenges

Source: Polypad https://polypad.amplify.com/p

Materials: Tiling piece (at least 10 copies)

Provide several copies of an irregular tiling piece and ask the participants to tile a table with it.

Figure 21: The tile and the beginning of the tiling process.

3. River Puzzle and Bridge Puzzles

a) A man has a lion, a sheep and a basket of cabbages. He wants to take the animals and the cabbages to the other side of a river on a boat, but there is a problem. The man can carry with him only one of the three at a time on the boat.
   - If he leaves the lion alone with the sheep at one side, the lion will eat the sheep.
   - Similarly, the sheep will eat the cabbage if they are left alone.

How can he solve the problem?

b) There are 4 people (A, B, C, and D) who want to cross a bridge at night.
   - A takes 1 minute to cross the bridge.
   - B takes 2 minutes to cross the bridge.
   - C takes 5 minutes to cross the bridge.
   - D takes 8 minutes to cross the bridge.

There is only one torch with them and the bridge cannot be crossed without the torch. There cannot be **more than** two persons on the bridge at any time, and when two people cross the bridge together, they must move at the slower person's pace. Can they all cross the bridge in 15 minutes?

4. Mind Readers!

A mind reader stall holds great attraction for an audience. A mathemagician (dressed in an interesting attire) can perform a magic trick. The trick is based on a mathematical process that will produce a pre-determined result. The audience will be intrigued by the trick and may try to figure out how the trick works setting the audience on an unravelling mission.

Several puzzles of this type can be found easily. Here are some samples.

Mind-Reader Trick 1. Give the following instructions to the audience:

1. Pick any double-digit positive number.
2. Sum the digits.
3. Subtract the sum from your original number.
4. If the difference is a double-digit number, sum the digits again. Now, do you have a one-digit number?

Now pretend to think and then declare: 'Hmmmmm....., Let me see what your number is! It is 9!'

For a few two-digit numbers, Step 4 will be needed.

Can the student figure out why this trick works? It is simple algebra!

(**Note:** The solution is given at the end of the pullout.)

Mind Reader Trick 2: In this trick, the participant thinks of a number between 1 and 63. The student in the stall gives the participant the 6 cards shown in Figure 22, and the participant returns the card/s having her / his number to the student. The student figures out what the number is and reveals the number that was thought of.

1	3	5	7	9
11	13	15	17	19
21	23	25	27	29
31	33	35	37	39
41	43	45	47	49
51	53	55	57	59
61	63			

2	3	6	7	10
11	14	15	18	19
22	23	26	27	30
31	34	35	38	39
42	43	46	47	50
51	54	55	58	59
62	63			

4	5	6	7	12
13	14	15	20	21
22	23	28	29	30
31	36	37	38	39
44	45	46	47	52
53	54	55	60	61
62	63			

8	9	10	11	12
13	14	15	24	25
26	27	28	29	30
31	40	41	42	43
44	45	46	47	56
57	58	59	60	61
62	63			

16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	48	49	50	51
52	53	54	55	56
57	58	59	60	61
62	63			

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			

Figure 22

Why does it work?

(**Note:** The solution is given at the end of the pullout.)

5. Another enjoyable one from Jaadui Pitara, NCERT

The vanishing frog

Figure 23 (https://ncert.nic.in/dee/pdf/Jaadui_Pitara_User_Manual_English.pdf)

Workshops

Mathematics Days can also be used as a time for holding small workshops on art forms with mathematical connections. Some examples are Rangolis (Kolams), Islamic Art, Weaving and Knitting.

The school can invite a parent to hold a Rangoli making workshop.

Rangolis of varying complexity can be introduced.

Simple ones that can be made on a square dot grid using straight lines.

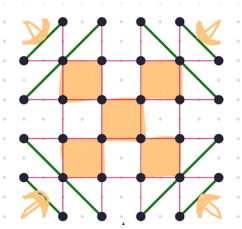


Figure 24

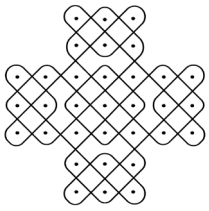


Figure 25

Slightly complex ones on dot paper (or on a black board), that are connected by a curved line that loops across dots in a continuous manner.

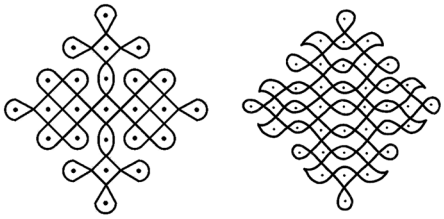


Figure 26

Finale: The day can end with a stimulating mathematics quiz or an engaging mathematical film. Some suggestions are given below:

1. Flatland https://share.google/images/qUevj2MkURQgE1GDv
2. Weird Numbers https://youtu.be/pSO66sL9SmY?feature=shared
3. Number Devil https://youtu.be/qJHc54IG5R8?feature=shared

Solutions to Selected Puzzles

More Squares: Problem 2 in the Geometry section

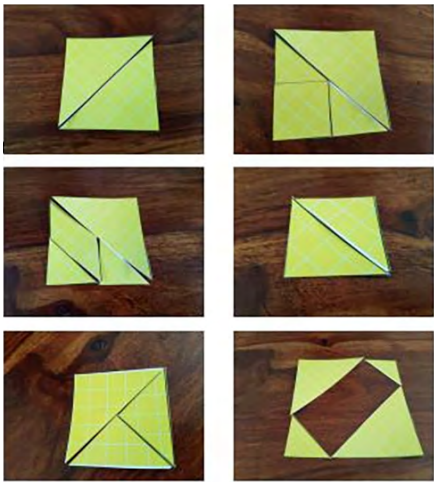


Figure 27

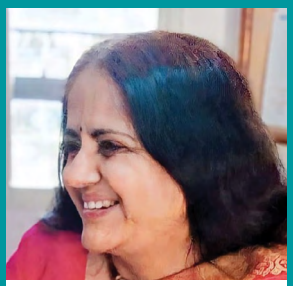
Land Sharing: Problem 3 in the Geometry section

Figure 28

Mind Reader Trick 1: The steps are as follows:

1. Let the chosen number be $10a + b$
2. Sum of the digits is $a + b$
3. $10a + b - (a + b)$ which will give $9a$
4. The digits of any multiple of 9 will always add up to 9
5. The answer will always be 9.

Mind Reader Trick 2: The numbers on the cards are written such that the student facilitator just needs to add the first numbers in the cards handed to him/her to guess the number thought of.



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