Volcano
INDUSTRIES

TRAIN YOUR BRAIN
WITH CHALLENGING GAMES AND PROBLEMS

RECRUITMENT PACK

Find out more about the ALL-NEW, IMPROVED Volcano Industries

Volcano INDUSTRIES

SO YOU WANT TO WORK FOR THE NEW, IMPROVED VOLCANO INDUSTRIES?

Awesome. We need creative thinkers, logical programmers, and most importantly, people who are willing to stretch their brains around tricky challenges.

In this pack, you'll find more information about our Artificial Intelligence systems, plus loads of games and challenges.

Have a go at the activities you find most interesting, and let us know what you discover. Fill in the postcard at the back of the pack and send it to our new Vice-President in Charge of Brain Training, Dr Ernest Volcano. He'll get back to you as soon as possible.

We look forward to hearing from you!

Dr Dikita Dey
President,
Volcano Industries

Dr Bernard Fenugreek
Head of the
Hoover Department

QUIZ: WHO SAID THAT?

Did you know that every time you struggle with a problem, you are growing your brain, making new connections? Our staff struggle with new problems all the time. We wanted to know how it felt for them – and for other grown-ups who use maths in their jobs.

We talked to lots of grown up mathematicians and scientists, and lots of ten year olds. We asked them how they felt when they got stuck in maths.

Can you guess who said what? (answers on page 15).

Draw a line from each statement below to who you think said it.

THIS IS MATHS BECAUSE...

This is maths because mathematicians get stuck loads. All that struggling grows their brains!

YOU'LL NEED:

- A pen or pencil

"Most of the time I am stuck."

"I feel as if it is a bit of personal challenge: like when someone dares you to climb an enormous tree."

"Stressed, but I don't give up!"

"Often, confused."

"Annoyed, but confident to try again."

"I don't like it because I think I'm good at maths"

"Angry"

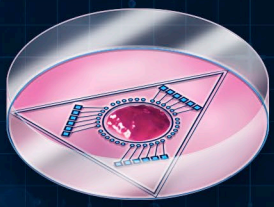
"Frustrated"

Grown up scientists and mathematicians

Ten year olds

Volcano INDUSTRIES

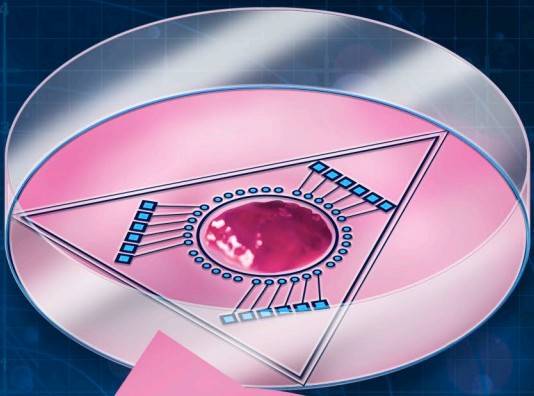
EXTRAORDINARY NEURON-COMPUTER HYBRID



Our amazing robots are created by connecting living human brain cells to computer systems.

We can do that because brain cells communicate with each other using electrical signals – and so do computers.

also called NEURONS



REAL SCIENCE BEHIND THE FICTION

Madeline Lancaster was the first scientist to work how to grow brain organoids. Read about her work and see pictures of organoids here: http://bit.ly/1DEEbdv

Left: Madeline Lancaster © Regina Hügli

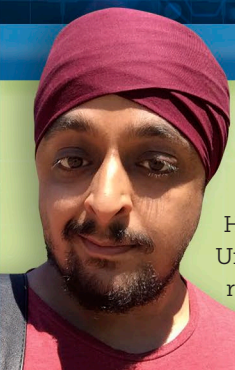
Our robots can learn, because those brain cells are growing and changing all the time, in response to signals from each other, from the central mainframe, and from the outside world.

When a robot ^ (or you) learns something new, it grows more and stronger connections between brain cells. The more often neurons talk to each other, the better they get at it!

BRAIN STRETCHER

- If you worked for Volcano Industries, what would you teach our robots to do?
- Would you programme in any rules to keep the robot's human users safe?
- How do you feel about using living human cells in this way?
- Would you be happy for some of your skin cells to be turned into brain organoids?

REAL SCIENCE BEHIND THE FICTION



RAT BRAIN ROBOTS?!

Deppo uses maths to figure out how brain cells communicate with each other, and with computers. He works in the Brain Embodiment Laboratory, University of Reading. Take a look at one of their robots in action here: http://bit.ly/1ZTuphz

"Ha! Their robots are much less good-looking than ours!"

Photo © Deppo Singh Juneja

DANCE LIKE VOLCANOBOT

YOU'LL NEED:

- Some floor space
- Pencil
- Paper and blutack, or post-it notes
- String, masking tape or a pair of tights
- Someone to play with
- Music

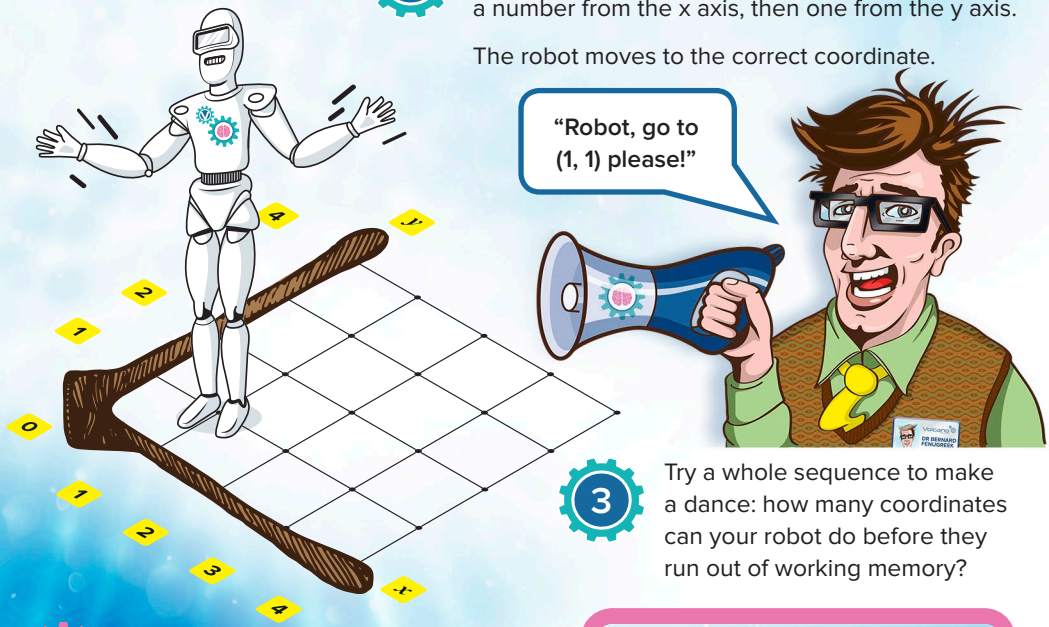
1. Set up your first number line (the x axis). You could use a piece of string, some masking tape, or an old pair of tights (ask permission before sticking anything to the floor!). Write out some numbers and put them along the line. Don't forget to start at 0.

   Then add your backwards-forwards line (the y axis), starting at 0 again.

   Turn on the music!

2. One of you is the robot, one of you is the scientist. The scientist calls out coordinates: a number from the x axis, then one from the y axis.

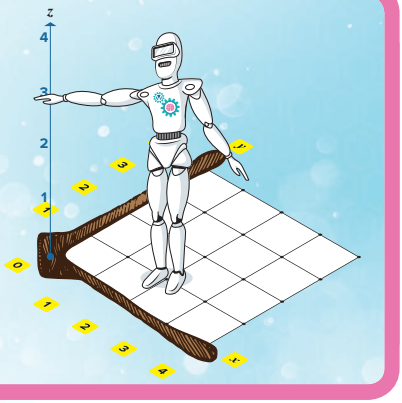
   The robot moves to the correct coordinate.



3. Try a whole sequence to make a dance: how many coordinates can your robot do before they run out of working memory?

BRAIN STRETCHER

- If you imagined a third number line coming up from the ground at zero, could you use that to control the robot's hands?
- You could try, "Robot, move your hand to (0, 0, 3) please".



MAKE YOUR OWN ROBOT

YOU'LL NEED:

- Pens or pencils
- Scissors
- Glue or tape

1. Choose which robot face you'd prefer, and colour in that side of the robot.
2. Cut out along the blue lines.
3. Crease the pink lines.
4. Use glue or tape to stick down the tabs – 1 then 2.

Cut Crease

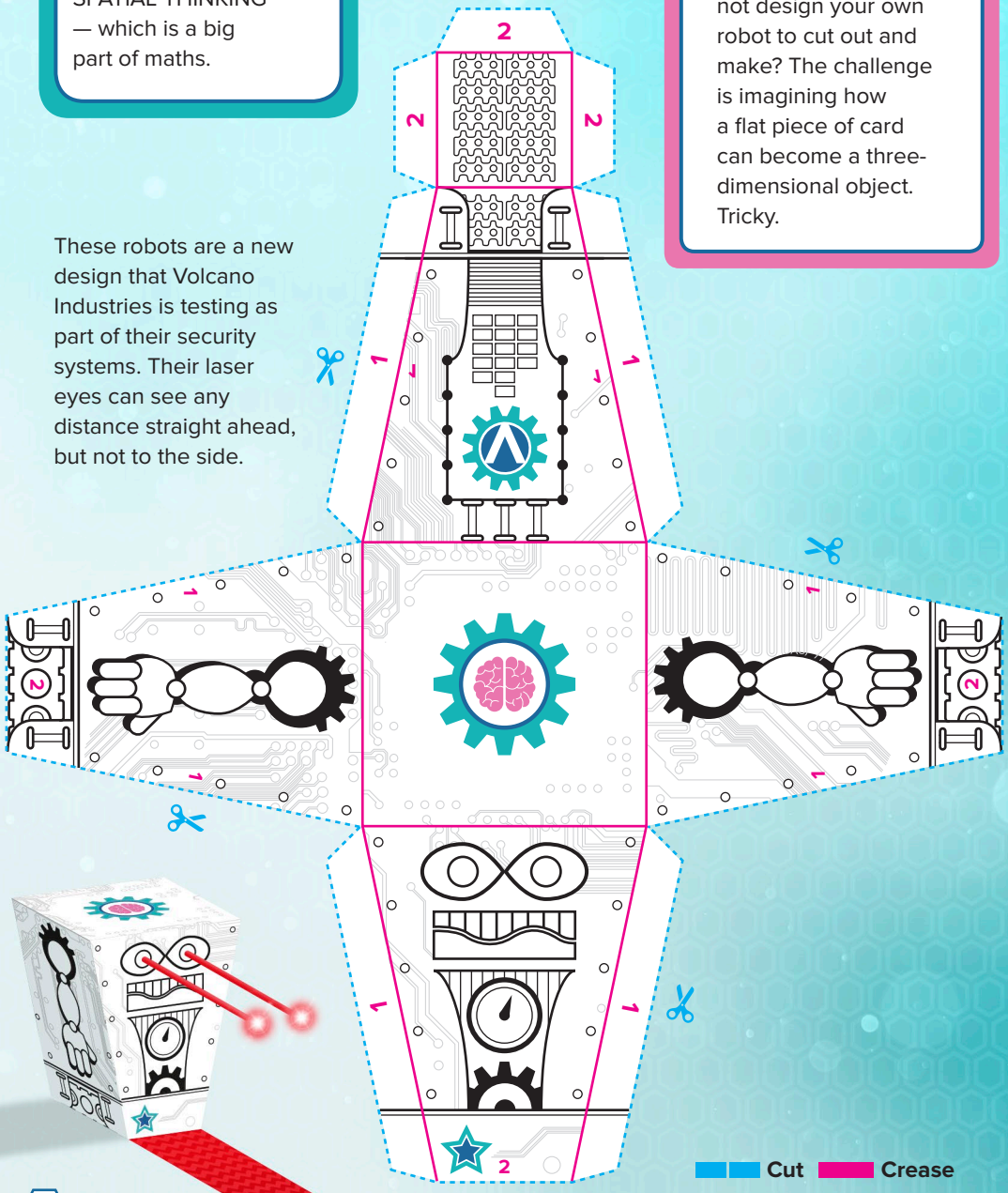
THIS IS MATHS BECAUSE...

Putting this robot together helps train your brain in SPATIAL THINKING — which is a big part of maths.

BRAIN STRETCHER

If you want to stretch your brain further, why not design your own robot to cut out and make? The challenge is imagining how a flat piece of card can become a three-dimensional object. Tricky.

These robots are a new design that Volcano Industries is testing as part of their security systems. Their laser eyes can see any distance straight ahead, but not to the side.



TEST YOUR STEALTH!

FOR 1 PLAYER

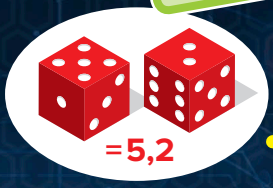
YOU'LL NEED:

- A cut out robot
- Something to use as a counter
- 2 dice

Dr Dey wants you to test how secure their new security robots really are. Use the grid on page 11 and the robot on page 7.

1. Throw two dice, and use the two numbers you get to make a coordinate. If you get **(1,1)**, **(5,5)** or **(6,6)** throw again.

   Put the corner of the robot with the star on this coordinate, facing you.



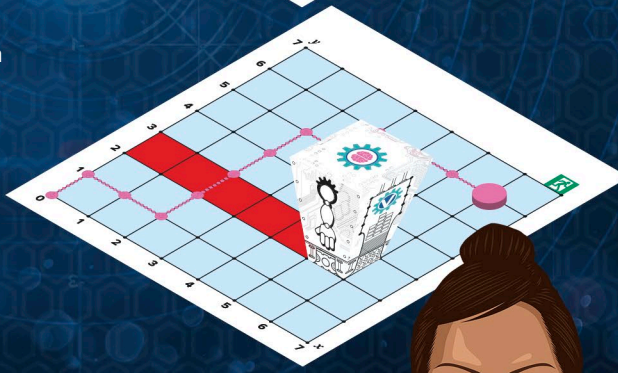
Why do you have to throw again if the dice land on (1,1) (5,5) or (6,6)?

2. The security robot sits in the square and doesn't move squares, just rotates **90 degrees** clockwise each turn.

3. Put your counter on **(0,0)**. You can move along the lines in any direction, one space per turn.

4. Win by getting to the opposite corner first without being seen by the security robot. It can only see along the two lines stretching out in front of it.

5. Easy, right? Now make it harder with two security robots at **(2,1)** and **(5,4)** (you can use any toy with a face for a second robot).



BRAIN STRETCHER

- Can you write a set of instructions for Dr Dey about how to place two robots on the grid so they're impossible to get past?
- How many robots would you need to make a 14x14 grid secure?

ROBOT HIDE AND SEEK

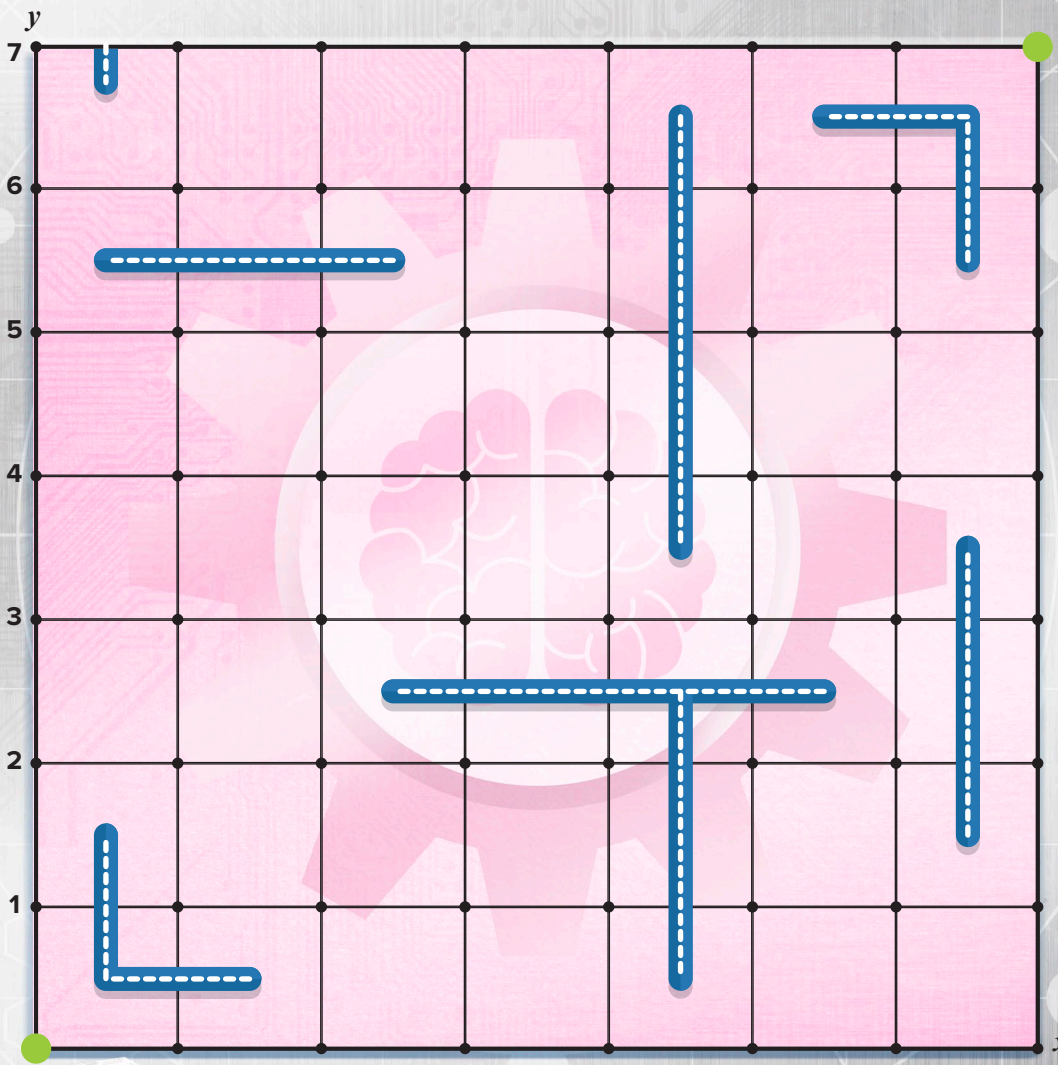
FOR 2 PLAYERS

One robot starts at **(0,0)**, the other at **(7,7)**.

Take turns to move **three blocks each**. You can use one of your moves to turn **90 degrees**, otherwise your robot should stay facing the same way. Your objective is for your robot to see the other robot without being seen itself. If they come face to face it's a draw.

The heavy lines are barriers – robots can't move or see past them.

The robots move along the lines and sit on the intersections, not inside the squares.



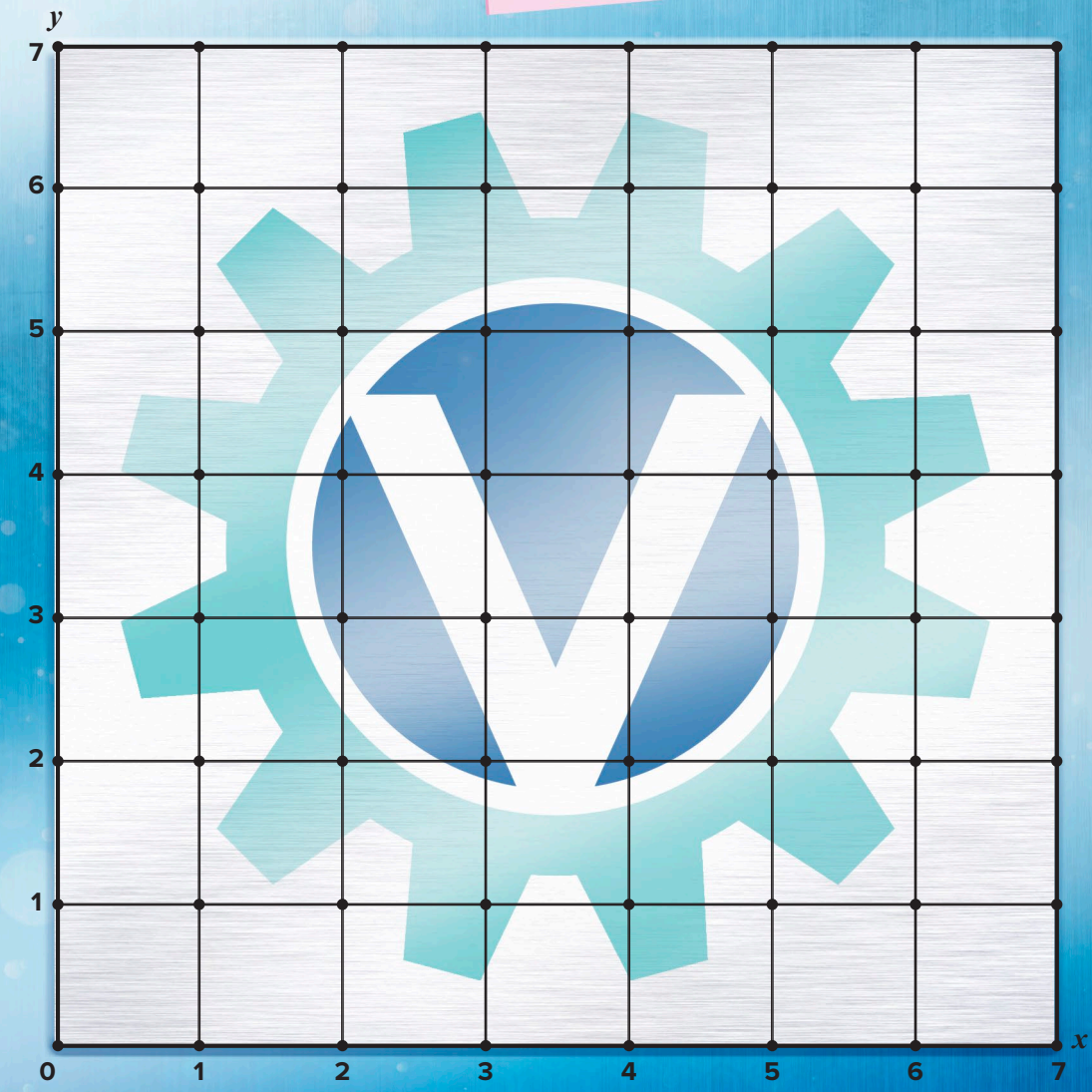
THIS IS MATHS BECAUSE...

You have to think spatially about where the robots are (and will be) on the grids.

See page 9 for how to use the grid to help test security robots.

I made a terrible mistake cutting out my first robot.

Luckily, you can download more robot plans at www.mathsontoast.org.uk/volcano



WHAT DO YOU DO WHEN YOU DON'T KNOW WHAT TO DO?

I used to never do any maths or anything hard myself – I'd always get someone else to do it. Now I'm trying more. It's tempting to give up when I get stuck – but it turns out there are loads of other things to try. Here's my top five so far.

- GET CROSS. Then stop. Breathe slowly till I feel calmer.
- Explain the problem to someone – often when I explain it out loud, things get clearer. People often ask useful questions, too.
- Have a go, even in a way I'm sure won't work, then look at the answer and see why it's wrong. Except if it isn't.
- Check I understand what the problem actually is.
  Like, sometimes I think it's about dancing but actually it's about shapes. Or the other way round.
  And sometimes I don't know what the words all mean.
- Draw a picture of the problem.

Have you got any better ones?
Let me know by sending me a postcard!

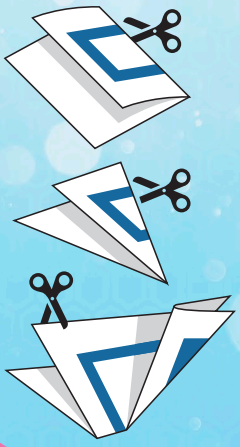
YOU'LL NEED:

- Pencil
- Sheets of paper
- Scissors

FOLDING CHALLENGE!

The SUPER HARDEST problem I have tried so far is this one. Me and Bernard and Dikita have been working on it for three weeks and six days so far. Can you figure it out?

1. Get a piece of paper.
   Draw a rectangle on it, somewhere in the middle.
2. Now, fold the piece of paper as many times as you like. Your challenge is to fold it so you can cut the rectangle out with just **ONE** straight line cut.



HINT: Try with a square first, then try some other rectangles.

BRAIN STRETCHER **Try a scalene triangle**

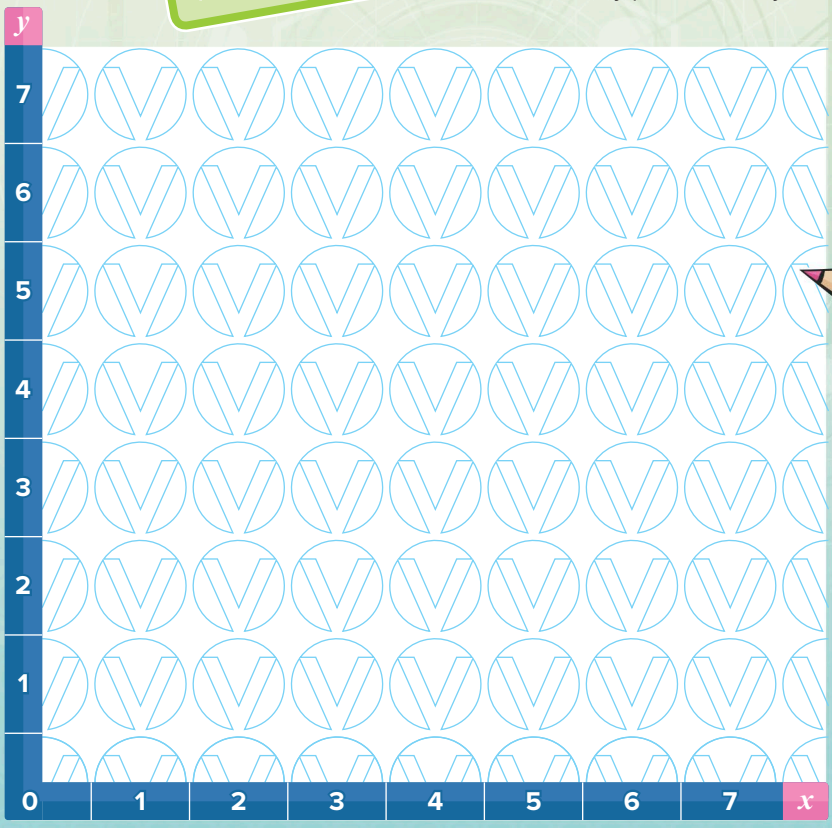
DISCOVER BY COLOURING

When I got cross with the folding challenge, Dikita suggested I try this one instead. It's a lot more relaxing. Apparently it's maths too because it's all about patterns. Don't forget: with coordinates, it's always across first, then up.

YOU'LL NEED:

- Colouring pencils

1. Colour in the circles on the coordinates where both numbers are even – like (6,2) or (0,4). There are lots of them. What pattern do you discover?'
2. Find a different colour. Colour all the circles where the coordinates add up to seven – like (7,0) and (5,2). What pattern do you spot?
3. Make up your own rule for colouring! What about... the circles with coordinates that add up to six? The circles where both coordinates are odd numbers? How many patterns can you discover?



Download another grid from www.mathsontoast.org.uk/volcano

SECURITY CHALLENGE! CAN YOU HELP?

YOU'LL NEED:

- Pencil
- Paper
- Someone to play with

1. Test out the system Volcano Industries is using to protect the High Security Area.

One of you is the computer: decide which of these numbers is the passcode – **but don't tell**.

One of you is the Professor: you have five questions to discover the passcode.

Remember: the computer can only answer **YES** or **NO**.

19	23	38
42	51	64
75	86	90

2. Did you manage to work out the code? Could you do it in just four questions? How about three? Try!

3. If the grid has only nine numbers, what's the least questions you need to definitely figure out the code? What makes you sure?

BRAIN STRETCHER

- I want to make it harder to break into the High Security Area. How could we do that?
- Test out your ideas: draw new grids with new numbers, and play again.
- Find out more about the maths of security systems at **https://nrich.maths.org/2197**

Send Dr Volcano a postcard, to help him with his new job as Vice President In Charge of Brain Training. It's free to post, and he promises to reply!

If you'd like to send Dr Volcano a drawing or more about your ideas and discoveries, you'll need to get an envelope, copy the address carefully from the postcard and add a stamp. Please make sure you include your postcard in the envelope.

WHO SAID THAT? – ANSWERS

Grown-up scientists said:
Most of the time I am stuck; Often, confused; I feel as if it is a bit of personal challenge: like when someone dares you to climb an enormous tree.

Ten year olds said:
Annoyed, but confident to try again; Stressed, but I don't give up!; I don't like it because I think I'm good at maths.

Both grown-up scientists and ten year olds said:
Angry; frustrated.

Are you surprised by that?

Cut along here

Name: **Professor** _____

Age: _____ Girl/Boy: _____

Address (so we can reply): _____

_____

_____ Postcode: _____

I visited Volcano Industries on (date): _____

In this pack, I most enjoyed having a go at: _____

_____

_____

The trickiest bit was: _____

_____

_____

and I spent _____ days/hours/minutes trying to figure it out.

When I get stuck on a hard problem, I find it most useful to: _____

_____

_____

One Tenth Human and China Plate present

WE'RE STUCK!

By Sarah Punshon

Commissioned by Shoreditch Town Hall and Z-arts. Originally developed with Maths On Toast

This activity pack was developed alongside the production by Maths on Toast, Sarah Punshon, Sophie Sampson and China Plate. Design by Velcrobelly.

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Looking for more fun family maths? Visit www.mathsontoast.org.uk

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2

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