

Rich Task for Mathematics

Rich Tasks for Mathematics



A collection of investigations designed to get students investigating real problems, in a real way.



Introduction

The idea behind these investigations is to give students a puzzle to solve.

They can solve the simple version of the puzzle, and find an answer, or they can delve deeper into the reasoning behind the answer, and can then take it even further, and prove their answer.

The only limit is their imagination.

Along the way, they might find they need to introduce a new skill to their current toolbox of maths, in order to get past the next step. For example, they might need to use similar triangles, Pythagoras, trigonometry or simple angle facts to look into the first problem.

Problems could be revisited in more depth once they have learned the necessary skills further down the line, or time taken out to teach them the skill immediately. Either way, the idea is that a thirst for knowledge, and an enthusiasm for solving the problem, will drive the learning of these skills.

I can't find my ruler!



I need to make some different sized squares for my origami project, but I can't find my ruler anywhere!

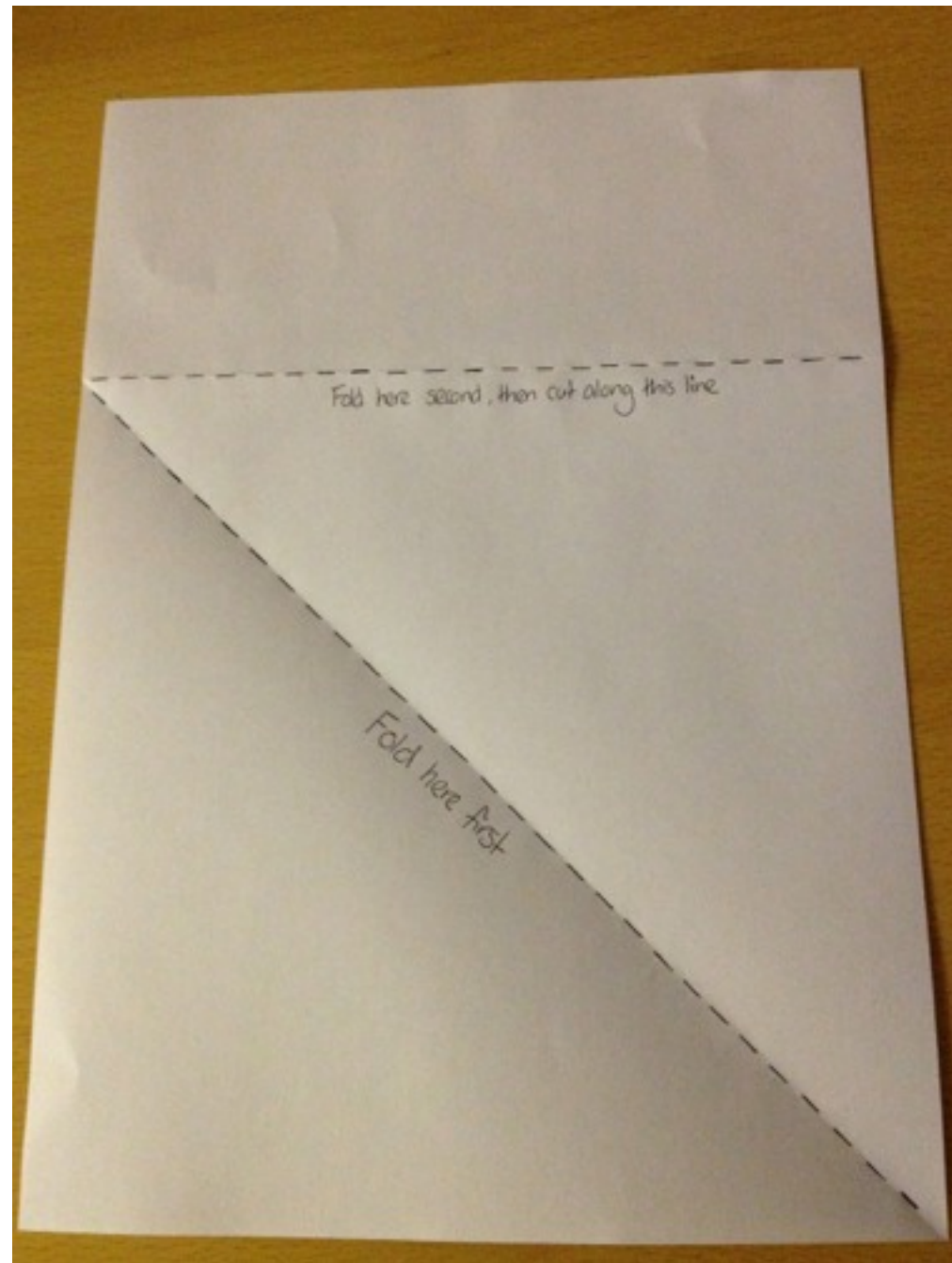
What different sized squares can I make from my pieces of A4 paper, without needing a ruler to measure them?

I'll need a diagram to show me how to do each one, or I'll get confused...

(I will need to know how big each one is too.)

How big is A4 paper?

My first square is 210mm x 210mm



How many more can you find?

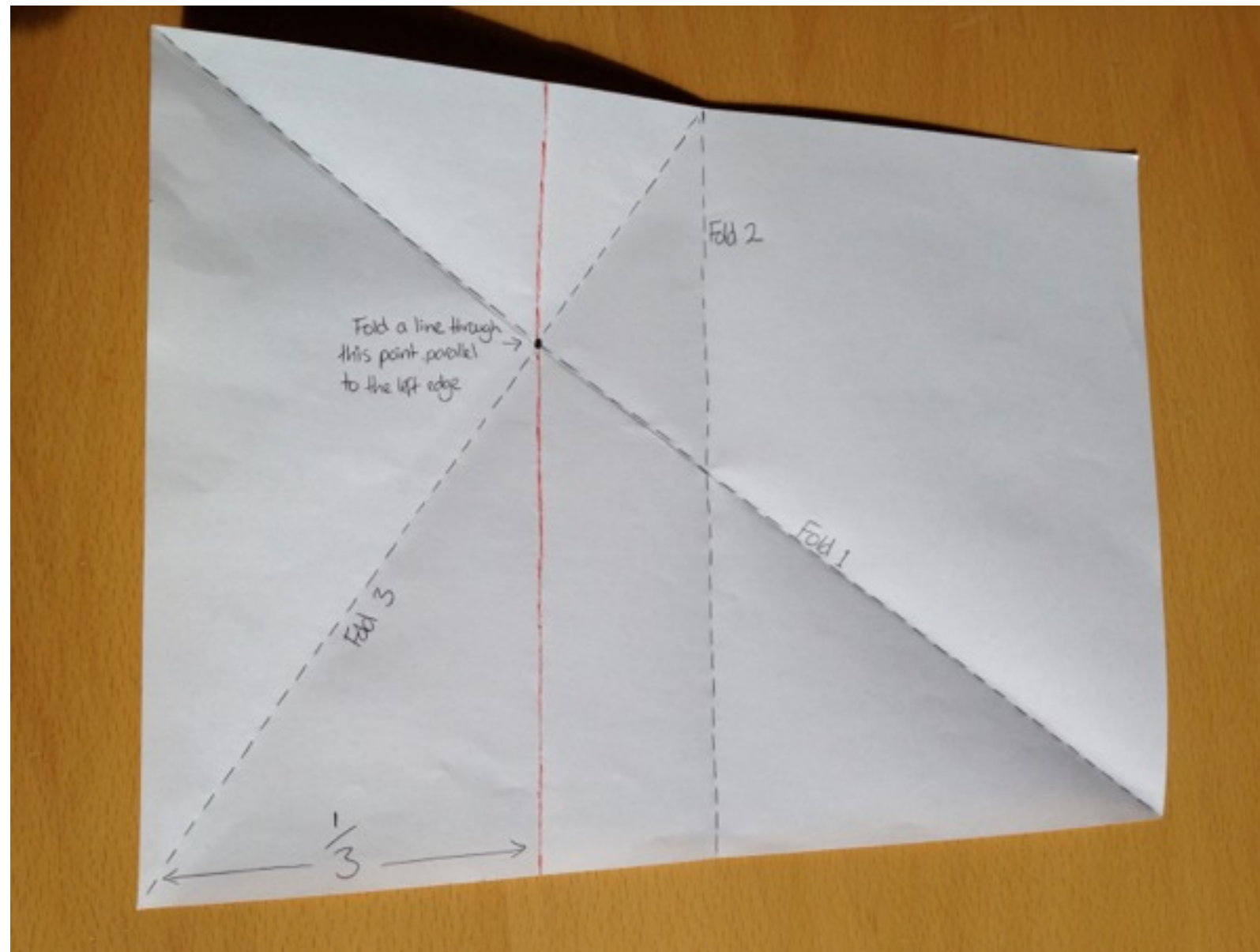
How would you make one that is 70mm x 70mm?

Challenge 2: This method shows how you can accurately fold a rectangle into thirds.

Can you prove why it works with A4 paper?

How about if you know that the ratio of the short side to the long side of A4 is $1:\sqrt{2}$?

Folding a rectangle into thirds (accurately)



[YouTube video of how to do it...](#)

Magic Sums

$$\begin{array}{r} 864 \\ - 468 \\ \hline 396 \\ + 693 \\ \hline 1089 \end{array}$$

Take a 3-digit number.

Reverse it.

Take the smaller one away from the bigger one.

Now reverse the answer and add it to the original answer.

Try some other numbers.

What do you notice?

What happens if you start with a 4-digit number instead?

Think of a number

Add 6

Double it

Take away 4

Halve it

Take away the number you started with.

The answer is 4!

WHY???





Safest Bet?

The rules of a new gameshow are:

Choose which game you want to play, and place your bet. If you are right, you win £10,000!

Game 1: You flip a coin 5 times. You bet how many times it will land on tails.

Game 2: You flip a coin 4 times. You bet on what the biggest **number of tails in a row** will be.

Which **game** do you choose to have the
‘safest bet’?

What **bet** do you make?



Congratulations!

You've made it to the final!

You can now choose to spread your bet
and cover two numbers...

(for example, you could bet it's either a run of 2 or 3 tails)

If you choose to do this, the prize goes down to £3,000.

Would you spread your bet, or stick to one bet for £10,000?

Why?



A cake-related problem



I baked this delicious Cinammon & Nutella cake ([recipe](#)) to share at work, but I don't have a round cake tin. I only have this rectangular tub.

My cake tin is 7 inches across, and 2.5 inches deep.

The cake fills it completely.

The tub is 20cm by 12cm, and is 10cm deep.



Can I fit the whole cake into the tub?

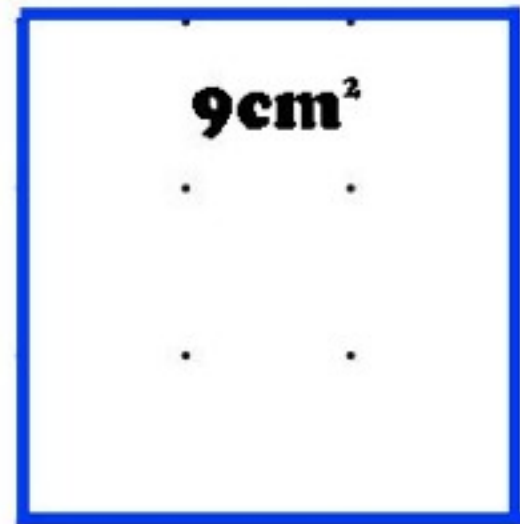
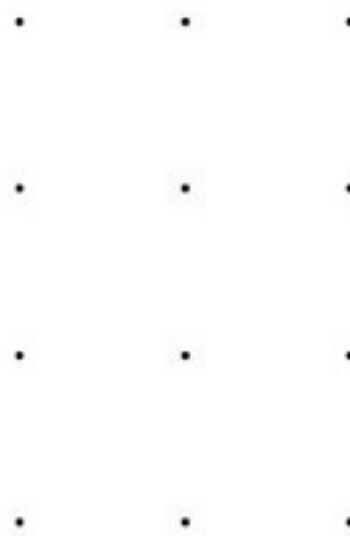
How would I cut it to make sure it fits?

If it won't fit, how much will be left over? (I suppose I'd just have to eat it...!)

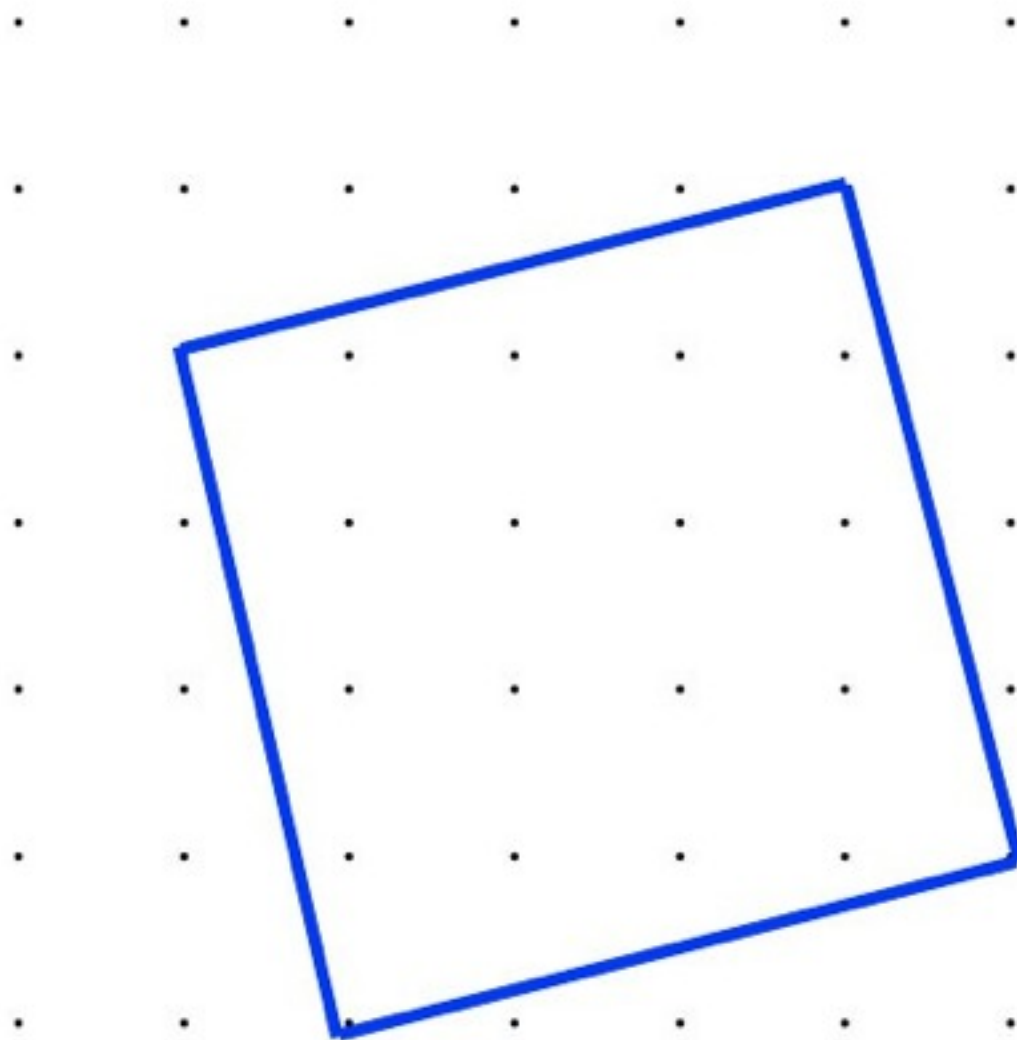


Can you make a square with area 10...?

The squares shown
have areas of 4 and 9.



Can you find a square
of area 10?



What area does this square have?

How do you know?

How could you describe how to draw this square to someone?

What other area squares can you make?

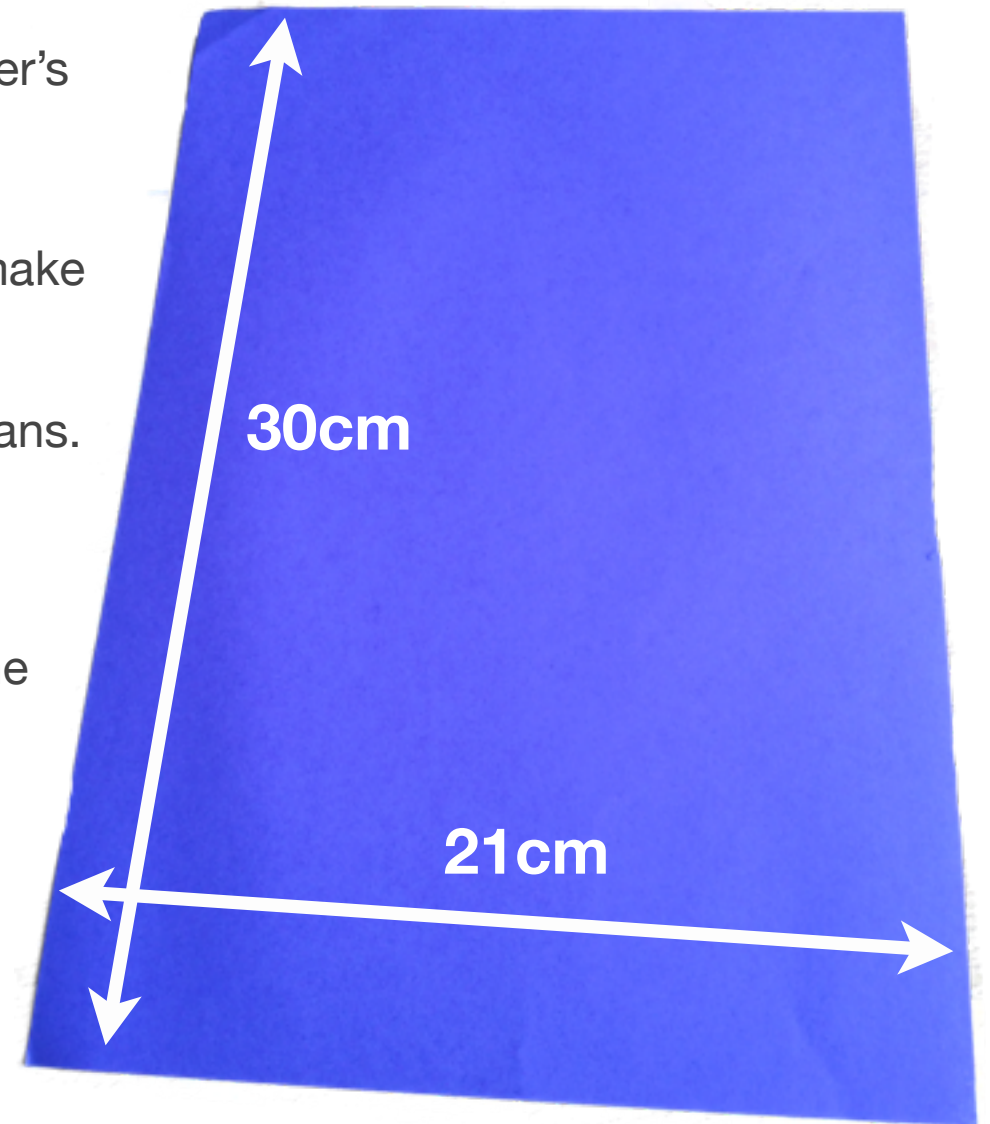
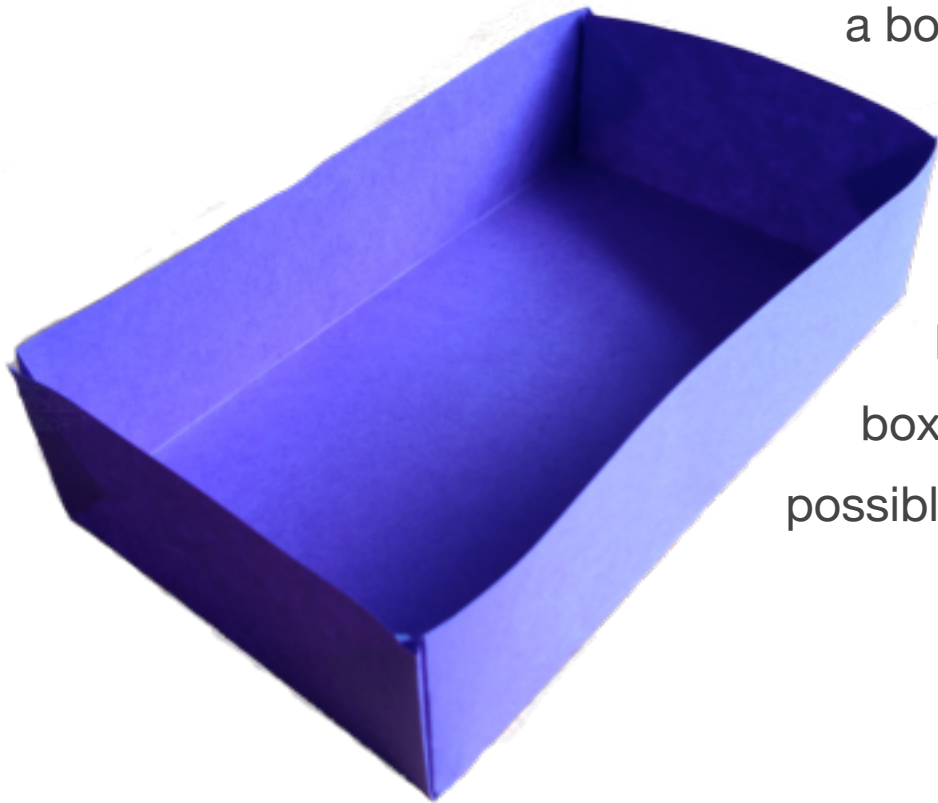
Are there any numbers that aren't possible?

Jellybean box

Bob is in trouble. He has forgotten to buy anything for Mother's Day, and the shops have shut.

He decides to use a piece of card that he has found to make a box with no top, which he will decorate and fill with jellybeans.

He wants to make sure that the box holds the most jellybeans possible.



How can he fold/cut the card to make the biggest box possible?



A jellybean is roughly
3.4 cubic cm in volume

How many jellybeans can Bob fit into the box?

How to win a jar of sweets



This is a very popular competition to run at fundraising events. I've stopped entering them because I never seem to win. Maybe just guessing isn't the best way to do it....

What strategies could I use to work out how many sweets are likely to be in the jar?

What information do you need to help you?

Is it easier to work out when all the sweets are the same size?



Simple shapes

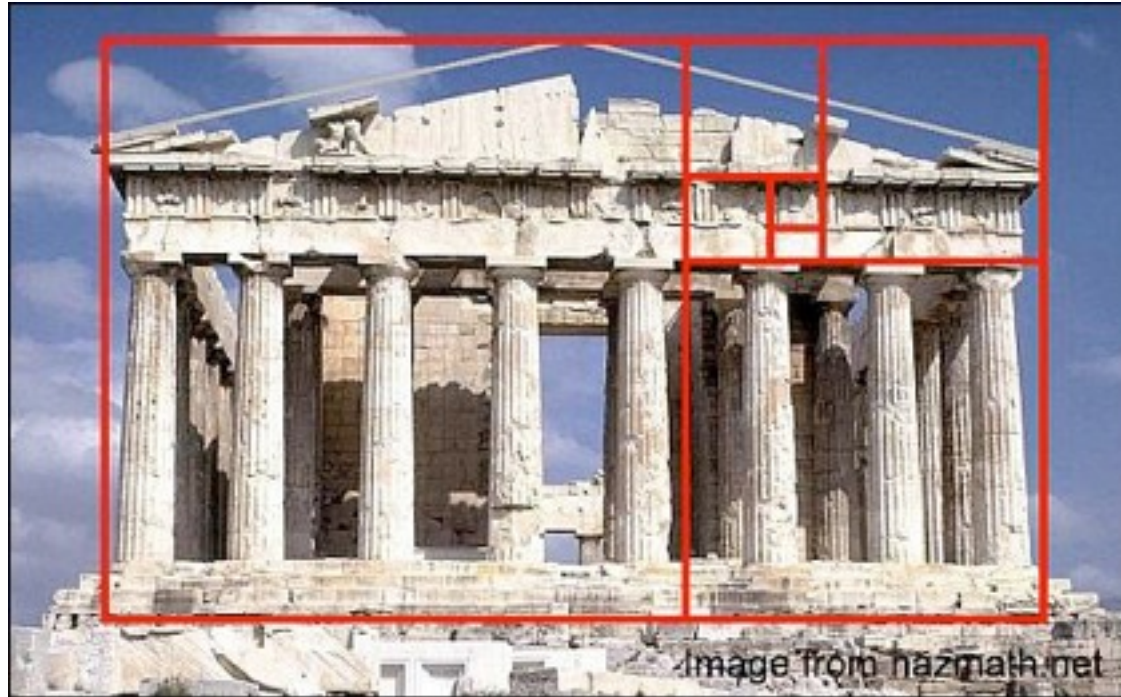
We all like our shapes to be simple, right?

Imagine if your shape had the same area and perimeter, then you wouldn't have to remember which is which!

What rectangles can you find that have the same area and perimeter?

How about triangles?

What's perfect?



The Parthenon in Athens is a good example of 'perfection' in architecture. There are lots of examples of the golden ratio throughout the structure.

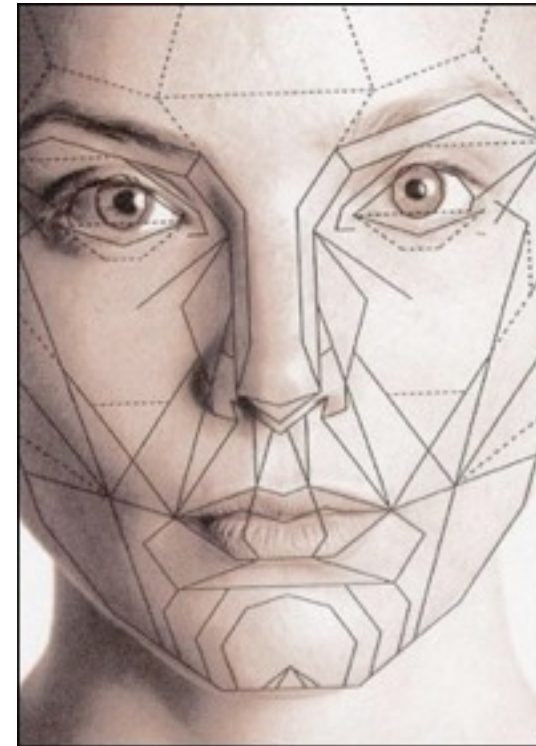
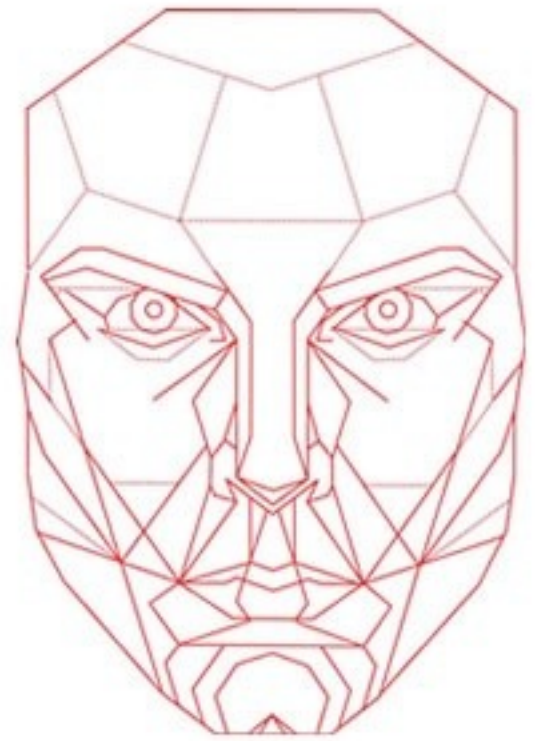
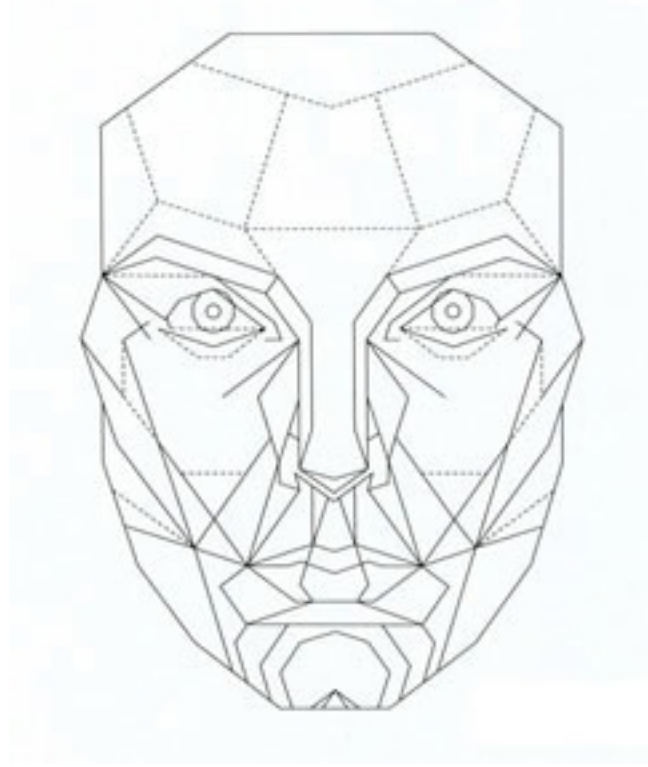
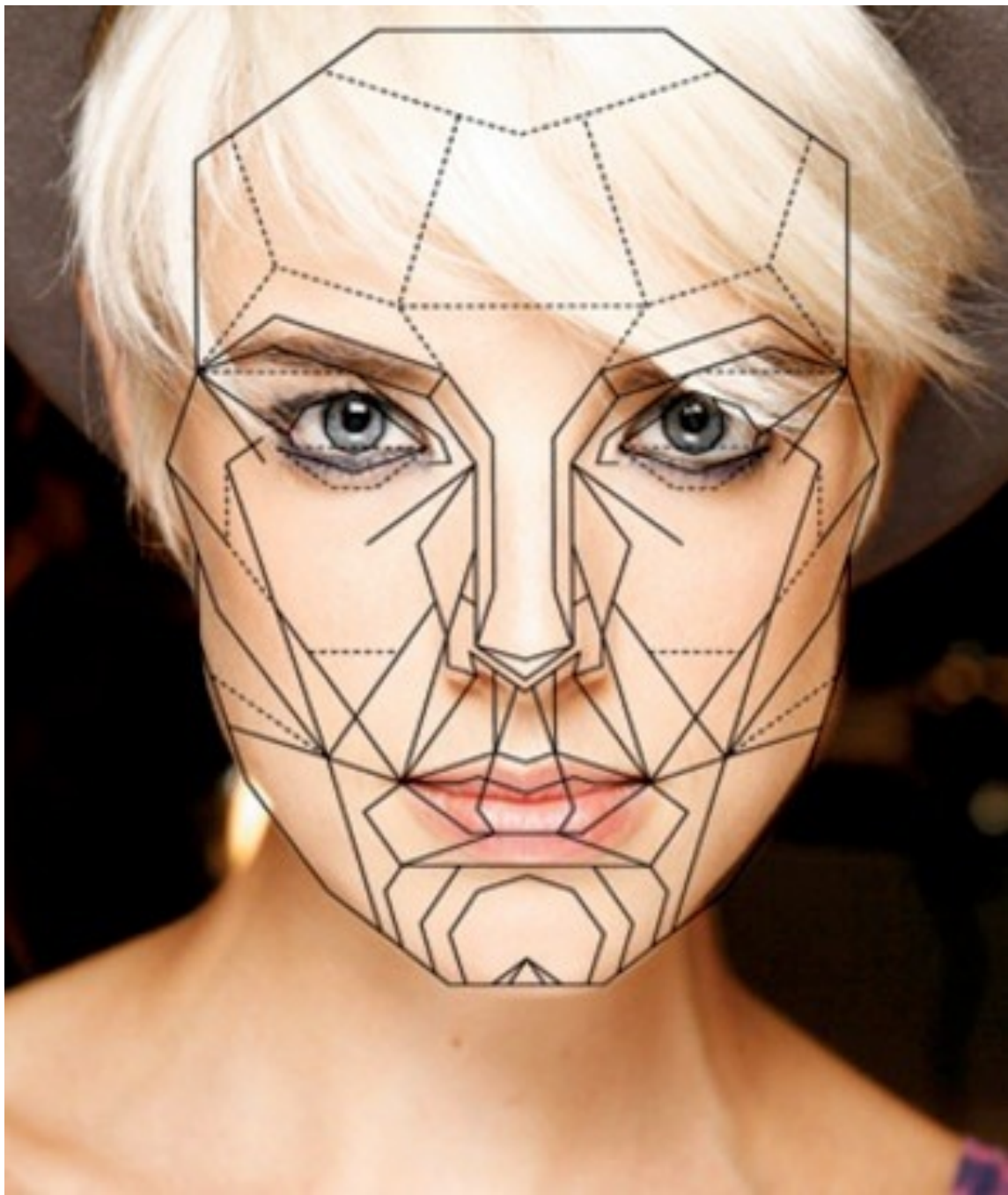
If you look at the ratio of the width to the height of the Parthenon, you'll find it's very similar to the ratio of the width to height of each of the rectangles made between pillars. It is also very similar to the ratio of the rectangular plot of land the Parthenon is built on...etc....etc...

Try some measurements from the picture if you like - you'll see what I mean!

This 'golden ratio' is thought to relate to beauty in other ways too. It has been suggested that we judge how beautiful people are based on this ratio too!

On the next couple of pages, you'll be able to see how different measurements of your face can be compared to see how closely they match the golden ratio.

You can find the golden ratio in the Fibonacci sequence too - check out the ratio of one term to the next - it keeps getting closer to the golden ratio. 1, 1, 2, 3, 5, 8, 13, 21, 34....



Click [here](#) to see a video of the difference the golden ratio makes!

Take these measurements from your partner:

a = Top of head to chin

b = Top of head to pupil

c = Pupil to noisetip

d = Pupil to lip

e = Width of nose

f = Outside distance between eyes

g = Width of head

h = Hairline to pupil

i = Noisetip to chin

j = Lips to chin

k = Length of lips

l = Noisetip to lips

Now, find the following ratios:

a/g

e/l

b/d

f/h

i/j

k/e

i/c

How close are they to the golden ratio?

Which of you has the
most 'perfect' face?

You can also find the golden ratio in the body - try finding the following ratios:

Navel (bellybutton) to floor : top of head to floor

Fingertip to elbow : wrist to elbow

Shoulder line to top of head : head length

Navel to knee : knee to end of foot

What others can you find?

Let's make some money!

Jim is starting his own business. He has bought a giant block candle for £30.

The plan is then to melt it down, and then add his own dyes to colour the wax.

He then plans to use his own moulds to make smaller candles, and sell them.

How much wax does Jim have if the giant candle is 30cm by 20cm by 20cm?



He has the following moulds:

Each candle sells for:

small cube (4cm x 4cm x 4cm)

£2.75

small cylinder (10cm high, radius 1cm)

£1.25

cone (7cm high, radius 3cm)

£3.50

large sphere (radius 3cm)

£6.50

Which mould should he use to make the most money?

What profit will he make?



All Tied Up

Take a piece of string (around 50cm long), and measure how long it is exactly.

Now tie a knot in it. How long is it now?

Tie another knot. How long now?

What can you predict about how many knots you can tie in your piece of string?

Can you predict how long the string will be after you've tied 10 knots?

Try some of the different types of knots [here](#) - do you get the same results?



Pointy Pyramids



Kate Nowak: f(t)

Make your own 3-D pyramid/cone.

You can choose what kind of base you want (square is probably easiest).

You must then write out a report, with as much of the following information about your pyramid/cone as you can:

Base Area

Surface Area

Volume

Height

Slant Height

Radius (cones only)

Base Side Length

Why not collect together all the finished shapes, and make a pointy wall display?

Vedic Squares

	1	2	3	4	5	6	7	8	9
1									
2									
3				3					
4									
5									
6									
7									
8									
9									

To complete a vedic square, you multiply together the numbers, but instead of putting in the answer, you find the digital root of the answer.

To find the digital root of a number, you just add together the digits until you only end up with 1 digit. For example:

$4 \times 3 = 12$ (this has 2 digits, so we add them together)

$1 + 2 = 3$ (1 digit - we now have the digital root of 12)

$7 \times 7 = 49$ (this has 2 digits, so add them together)

$4 + 9 = 13$ (this still has 2 digits, so add them together)

$1 + 3 = 4$ (1 digit - we now have the digital root of 49)

What patterns do you notice in the grid?

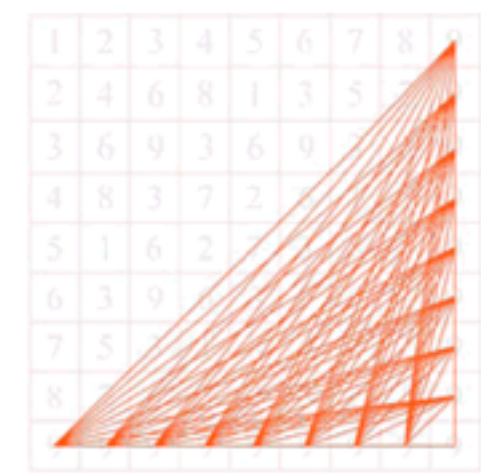
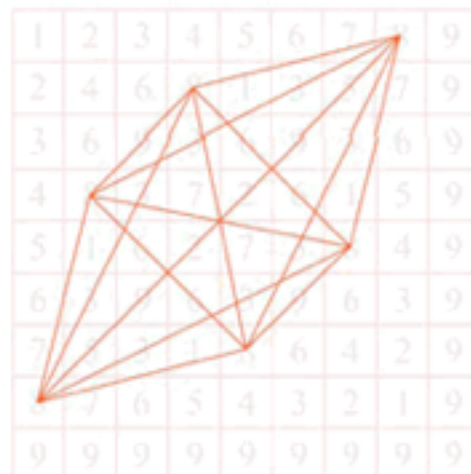
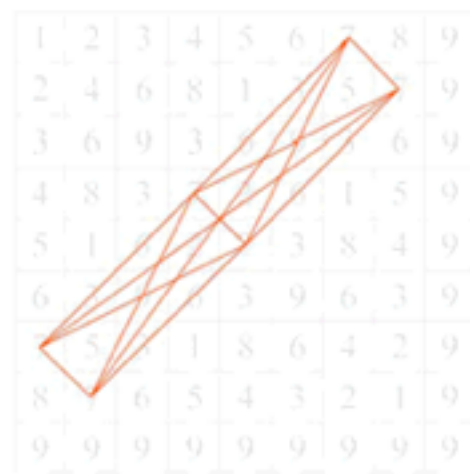
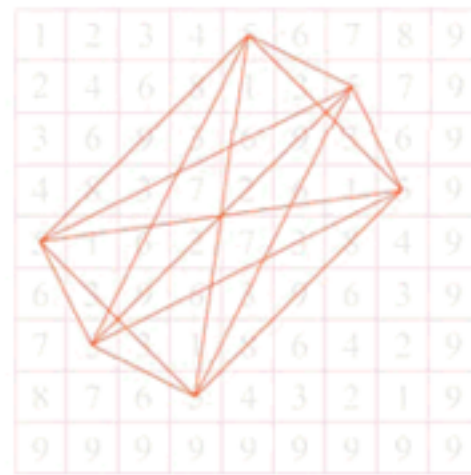
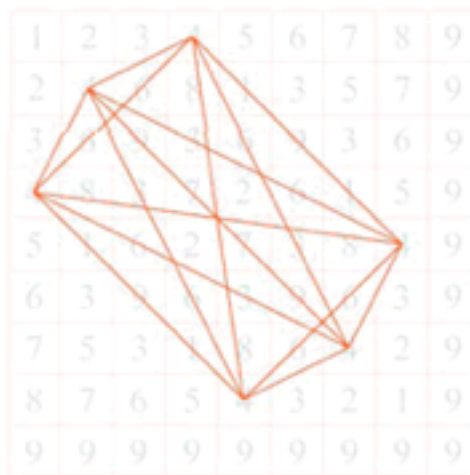
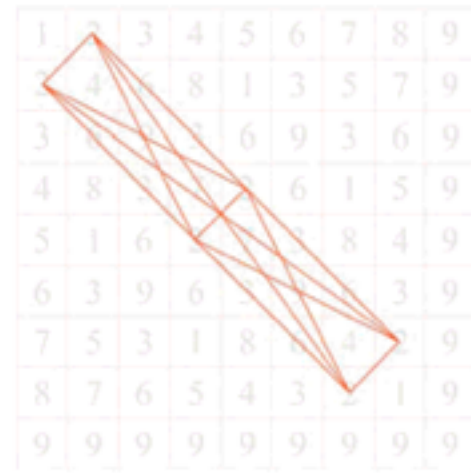
What do you think they mean?

Now you have your completed vedic square, what patterns can you make?

Try joining up certain numbers - what happens when you join all the 3's to each other?

Try it for different numbers too!

	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9
2	2	4	6	8	1	3	5	7	9
3	3	6	9	3	6	9	3	6	9
4	4	8	3	7	2	6	1	5	9
5	5	1	6	2	7	3	8	4	9
6	6	3	9	6	3	9	6	3	9
7	7	5	3	1	8	6	4	2	9
8	8	7	6	5	4	3	2	1	9
9	9	9	9	9	9	9	9	9	9



From mathormagic.com