



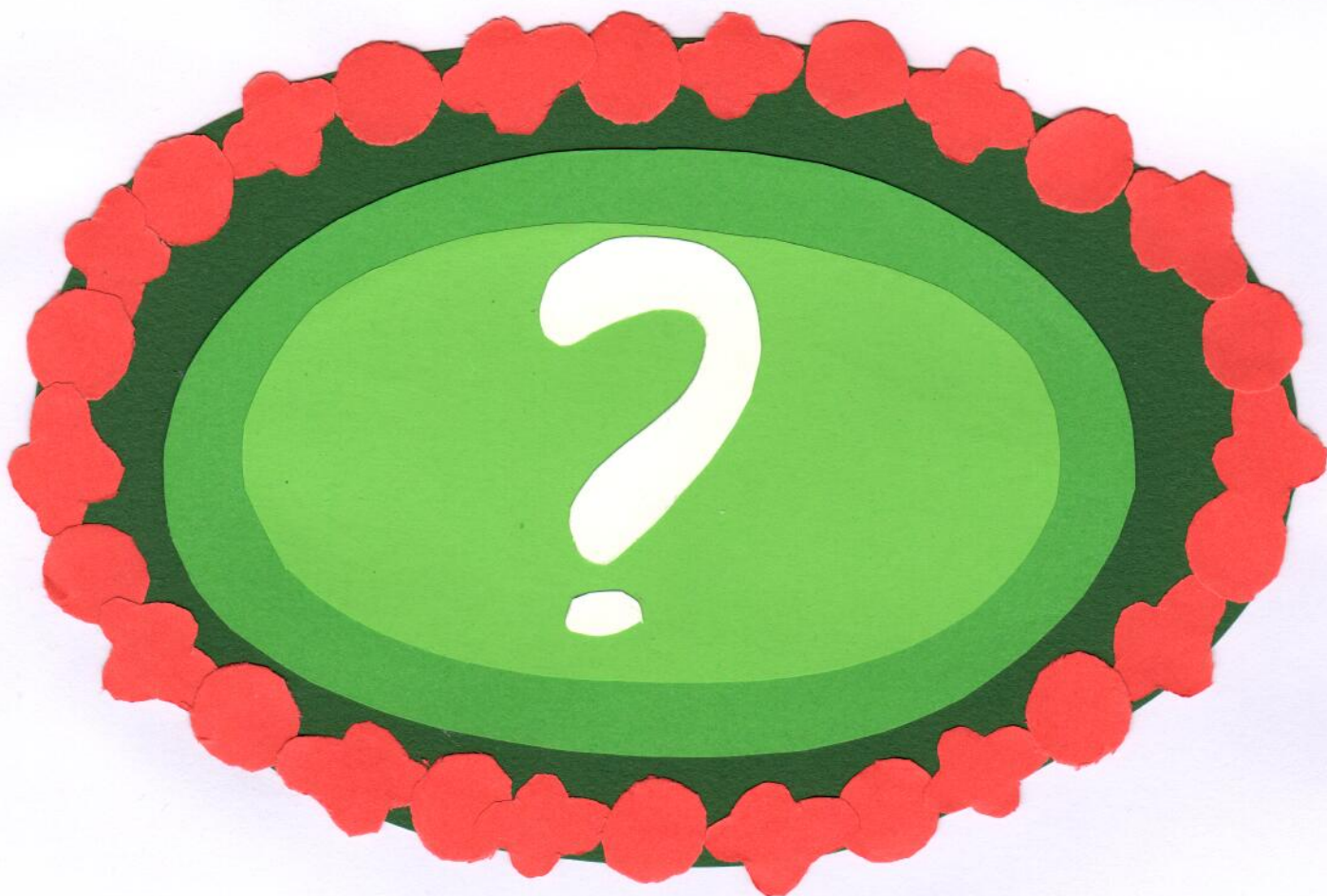
Zeus' Birthday

By Jolie Shen

The Garden

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It is soon going to be Zeus' approximate 3,600th birthday. The Ancient Greek gods have decided to create a beautiful garden as a gift. The problem comes when they are trying to figure out the shape of the garden.



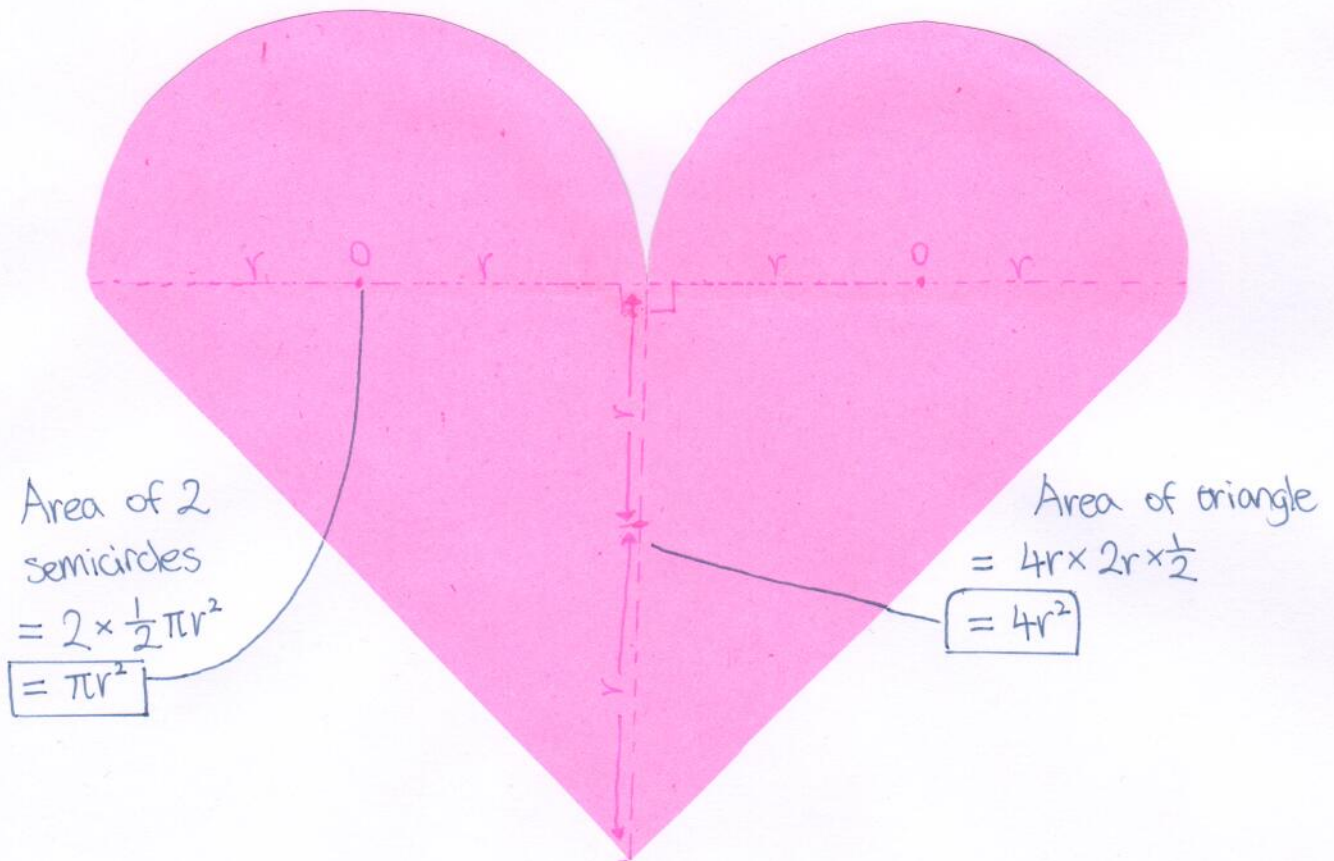
It is settled that the area of the garden will be 400,000 square kilometres. Artemis said she would be in charge of the flowers which are supposed to line the perimeter of the garden. But she is very busy and wishes to do less work.

So, in order to plant less flowers, the Greek gods have to work out the shape which has smaller perimeter with the same area (400,000 km²).

Aphrodite suggests to make it into the shape of a heart. This consists of two semi-circles with the same radius and an isosceles triangle with a base equals to 2 diameters of the circle and a height 1 diameter.

In order to calculate the perimeter, they have to know the radius of the circle.

Let r be the radius.



$$\text{Area Heart} = 2 \text{ semicircles} + \text{triangle} = 400\,000$$

$$\pi r^2 + 4r^2 = 400\,000$$

$$r^2(4 + \pi) = 400\,000$$

$$r^2 = 56009.91535\dots$$

$$r \approx 237 \text{ km}$$

(Round to the nearest whole number)

$$\text{Perimeter} = \text{circumference of circle} + 2 \text{ equal sides of triangle}$$

$$= 2\pi r + \sqrt{(2r)^2 + (2r)^2} \times 2$$

$$= 2\pi r + r \sqrt{8} \times 2$$

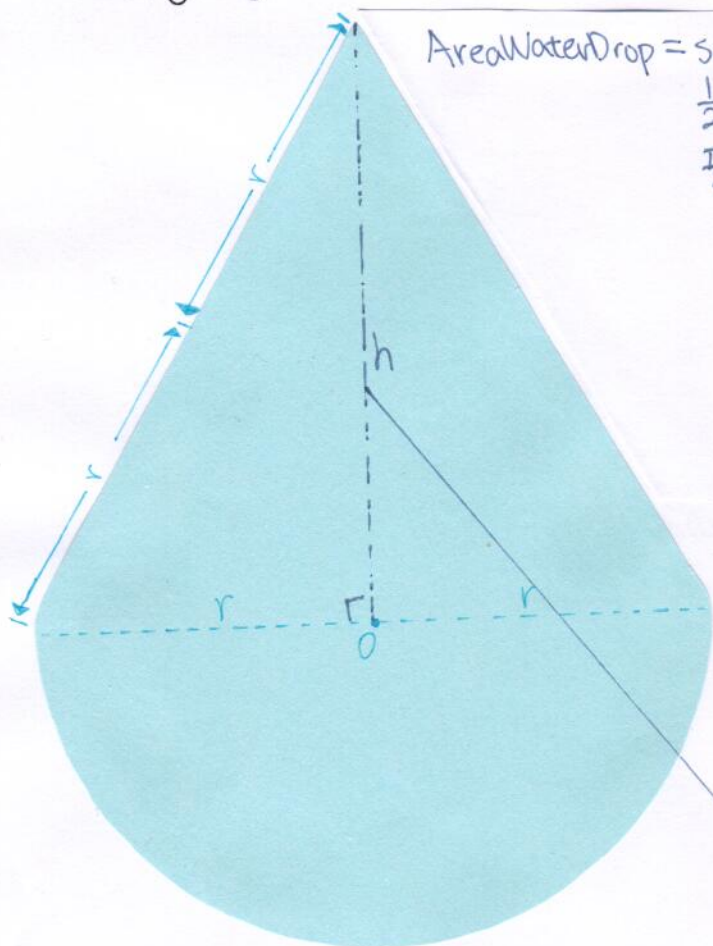
$$= 2\pi \times 237 + 237 \sqrt{8} \times 2$$

$$\approx 2830 \text{ km (Round to the nearest whole number)}$$

Water Drop

Poseidon joins in and suggests them to make the garden in the shape of a water drop. This is made of a semi-circle with an equilateral triangle attached that has sides the same length of the diameter of the circle.

Still, let r be the radius. We can calculate the radius with a little help from the Pythagoras theorem.



$$\text{Area Water Drop} = \text{semicircle} + \text{triangle} = 400\,000$$

$$\frac{1}{2}\pi r^2 + \frac{1}{2} \cdot 2r \cdot \sqrt{(2r)^2 - r^2} = 400\,000$$

$$\frac{\pi}{2}r^2 + r \cdot r \cdot \sqrt{3} = 400\,000$$

$$\frac{\pi}{2}r^2 + r^2\sqrt{3} = 400\,000$$

$$r^2\left(\frac{\pi}{2} + \sqrt{3}\right) = 400\,000$$

$$r^2 = 121\,107.6334\dots$$

$$r \approx 348 \text{ km}$$

(Round to the nearest whole number)

Pythagoras Theorem

$$a^2 + b^2 = c^2$$

$$r^2 + h^2 = (2r)^2$$

$$r^2 + h^2 = 4r^2$$

$$h^2 = 3r^2$$

$$h = r\sqrt{3}$$

Let $r = 348 \text{ km}$.

Perimeter = 2 sides of triangle + $\frac{1}{2}$ circumference

$$= 2 \times 2r + \frac{1}{2} \times 2\pi r$$

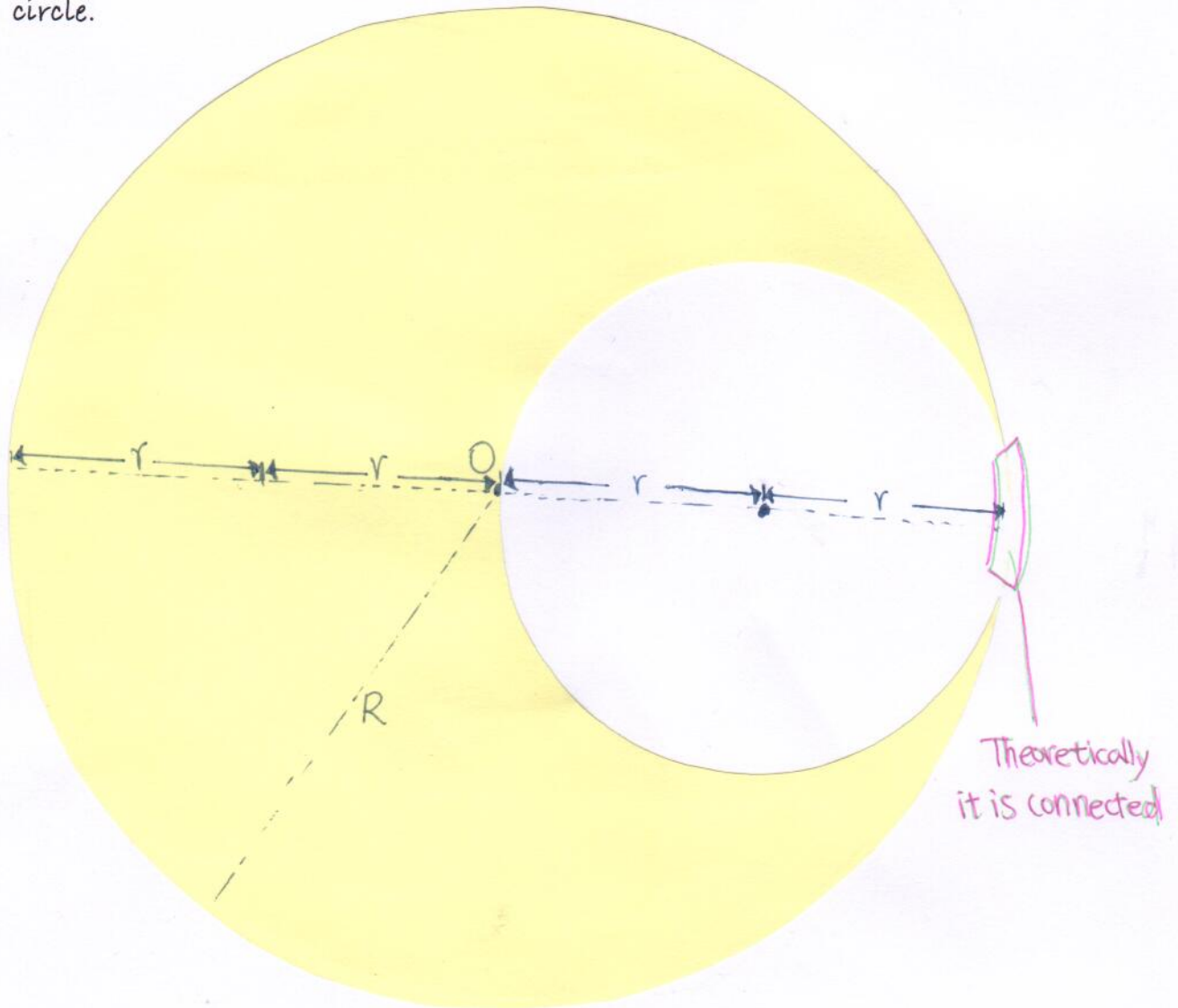
$$= 2 \times 2 \times 348 + \frac{1}{2} \times 2 \times \pi \times 348$$

$$= 1392 + 348\pi$$

$$\approx 2485 \text{ km (Round to the nearest whole number)}$$

Crescent

So, it turns out: fewer flowers are needed to be planted if they make the garden into the shape of a water drop than a heart! As the one in charge of the flowers, Artemis herself also has a suggestion. That is to make the garden into the shape of a crescent. This is basically a small circle carved out of a huge circle. The diameter of the small circle equals to the radius of the large circle.



$$\text{Area Crescent} = \text{Huge Circle} - \text{Small circle} = 400\,000$$

$$\pi(2r)^2 - \pi r^2 = 400\,000$$

$$4\pi r^2 - \pi r^2 = 400\,000$$

$$3\pi r^2 = 400\,000$$

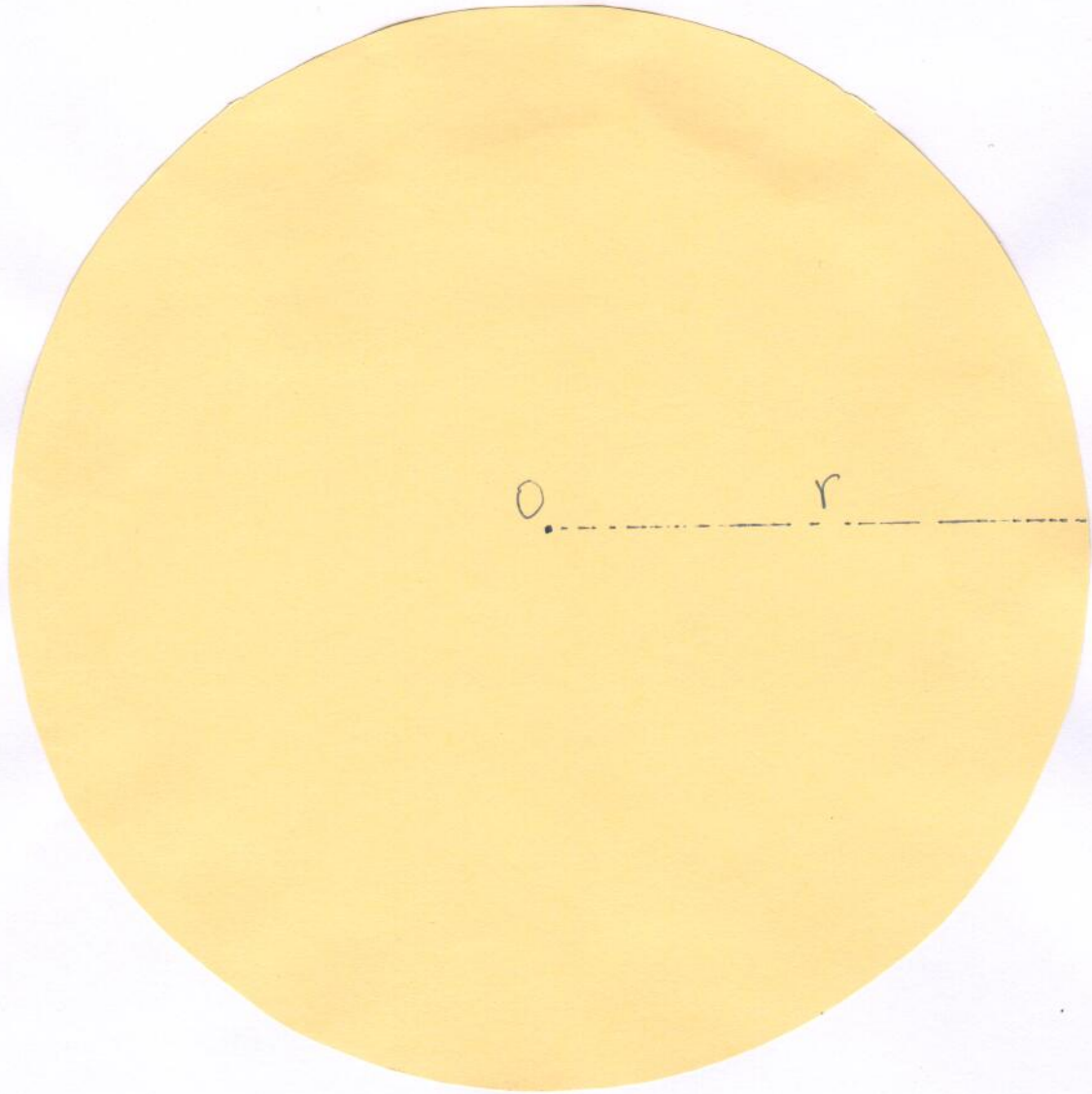
$$r^2 = 42441.31816\dots$$

$$r \approx 206 \text{ km (Round to the nearest whole number)}$$

$$\text{Perimeter} = 2\pi r + 2\pi(2r) = 2\pi \times 206 + 2\pi \times 2 \times 206 = 1236\pi \approx 3883 \text{ km (Nearest whole number)}$$

Sun

Apollo jumps in and suggests to just make it in the shape of the sun which is a circle. 'Simple and magnificent' so he says.



$$\text{Area Circle} = \pi r^2 = 400\,000$$

$$r^2 = 127\,323.9545\dots$$

$$r \approx 357 \text{ km}$$

(Round to the nearest whole number)

$$\text{Circumference} = 2\pi r$$

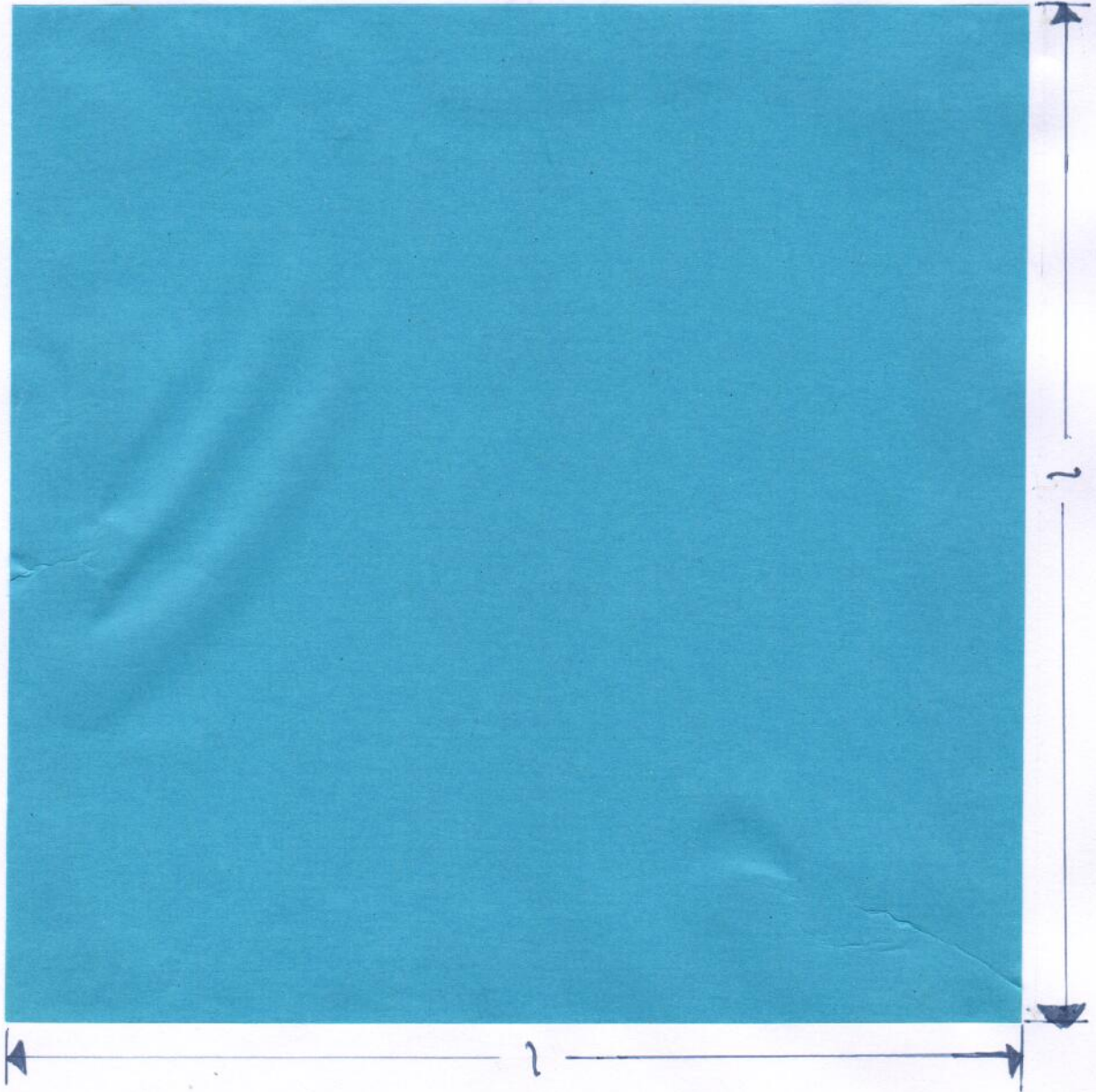
$$= 2\pi \times 357$$

$$= 714\pi$$

$$\approx 2243 \text{ km (Round to the nearest whole number)}$$

Square

Then the gods get tired of calculating all the perimeters. They say, 'why not just make it a square? That's much simpler!' And, so they calculate the perimeter of the square needed to compose a garden of $400,000 \text{ km}^2$.



$$\text{Area Square} = l \times l = 400\,000$$

$$l^2 = 400\,000$$

$$l \approx 632 \text{ km (Round to the nearest whole number)}$$

$$\text{Perimeter} = 4 \times l =$$

$$= 4 \times 632$$

$$= 2528 \text{ km}$$

(Round to the nearest whole number)

Conclusion: Heart = 2830 km

Water Drop = 2485 km

Crescent = 3883 km

Sun = 2243 km

Square = 2528 km

Sun < Waterdrop

< Square < Heart

< Crescent

Finally

It turns out that a circle's circumference is actually smaller than the perimeter of the square! The gods start arguing, saying their own designs are better and blaming Artemis for being lazy.

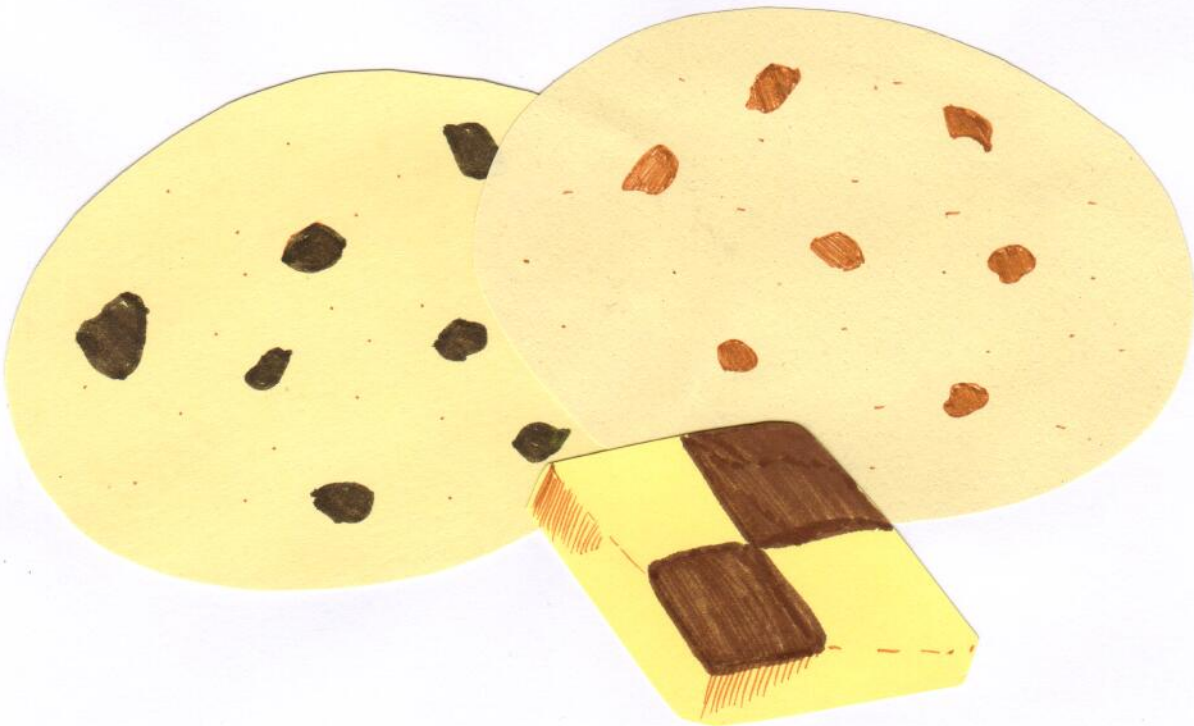
As the world is collapsing because of the fight, Hera joins the chat. She clears her throat and says, 'DEAR ALL, I think we all agree that cookies are to be made for Zeus' birthday.'

There comes an awkward silence.

'I would just like to say please stop fighting before all the other gods join in. It is lucky that we don't have Ares and others in this room. Let's quickly get this over with and celebrate.'

The gods are all so tired of doing Maths and look at Hera in admiration. Indeed, she deserves to be the Queen of the Gods, always holding the family together.

Hera inhales deeply. Dignified in manner, she finally says, 'NOW WHO WANTS TO BE IN CHARGE OF CALCULATING THE AMOUNT OF FLOUR WE NEED?!'



There is never a quiet day on Mount Olympus ever since...

BLURB

Zeus' birthday is coming up and the gods are preparing presents for it. They decided to create a whole new garden and line the perimeter of it with beautiful flowers.

However, with limited time and resources, they have to figure out what shape of garden would be the most interesting and requires ~~fewer~~ flowers to be planted.

As time passes by, the gods become more and more impatient and tired of doing Maths. What will they do?

ABOUT THE AUTHOR



Hello everyone, I hope you enjoy this Maths picture book!

I am the author of the book, Jolie. I am now 14, attending Dulwich College Beijing in China.

The character part of my ideas of the story comes from the Ancient Greek Mythology which I know from reading a really fantastic and lovely series of fictional books.

The other part comes from my love for shapes and perimeters. Hahaha just kidding!