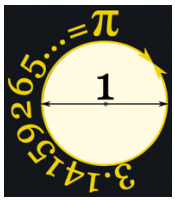
Discovering Pi

Draw a circle with a diameter (all the way across the circle) of 1. Then the circumference (all the way around the circle) is 3.14159265... which is a number known as Pi

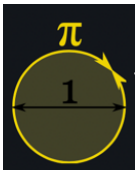


Pi (pronounced like "pie") is often written using the greek symbol π

The definition of π is $\frac{circumference}{diameter}$

The circumference divided by the diameter of a circle is always π, no matter how large or small the circle is!

To help you remember what π is ... just draw this diagram.



Draw a circle, or use something circular like a plate. Measure around the edge (the circumference):

I got 82 cm

Measure across the circle (the diameter):

I got 26 cm

Divide:

$$\frac{82}{26} = 3.1538...$$

That is pretty close to π. Maybe if we measured more accurately?

We can use π to find a Circumference when we know the Diameter

Circumference = π × Diameter

The radius is half of the diameter, so we can also say for a circle with a radius of 1, the distance half way around the circle is π = 3.14159265...

π is approximately equal to 3.14159265358979323846.... The digits go on and on with no pattern. π has been calculated to over 100 trillion decimal places and still there is no pattern to the digits.

It is enough to just remember the digits "3.14159". To help this you can also count the letters of:

"May I have a large container of butter today"
3 1 4 1 5 9 2 6 5

A quick and easy approximation for π is $\frac{22}{7}$

$\frac{22}{7}$ = 3.1428571...

But as you can see, $\frac{22}{7}$ is not exactly right. In fact, π is not equal to the ratio of any two numbers, which makes it an irrational number.

A really good approximation, better than 1 part in 10 million, is:

355/113 = 3.1415929...

(think "113355", slash the middle "113/355", then flip "355/113")

Summary:

$$\frac{22}{7} = 3.1428571...$$
$$\frac{355}{113} = 3.1415929...$$
$$\pi = 3.14159265...$$

Calculating π Yourself:
There are many special methods used to calculate π and here is one you can try yourself: it is called the Nilakantha series (after an Indian mathematician who lived in the years 1444–1544).
It goes on for ever and has this pattern:

$$3 + \frac{4}{2 \times 3 \times 4} - \frac{4}{4 \times 5 \times 6} + \frac{4}{6 \times 7 \times 8} - \frac{4}{8 \times 9 \times 10} + \cdots$$

(Notice the + and − pattern, and also the pattern of numbers below the lines)

It gives these results:

Term	Result to 12 decimals
1	3
2	3.166666666667
3	3.133333333333
4	3.145238095238
...	...etc!...

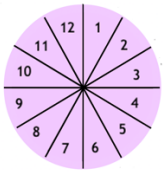
Get a calculator (or use a spreadsheet) and see if you can get better results.

Activity: Find an Approximate Value For Pi

You will need:

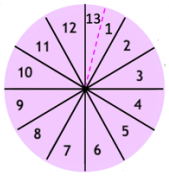
- A piece of card
- A compass and pencil
- A protractor
- A ruler
- A pair of scissors
- Glue and paper

Step 1
Draw a circle on your card. The exact size doesn't matter, but let's use a radius of 5 cm (centimetres).
Use your protractor to divide the circle up into twelve equal sectors.



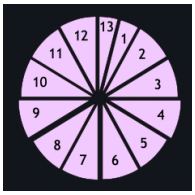
What is the angle for each sector? That's easy – just divide 360° (one complete turn) by 12:
360° / 12 = 30° . So each of the angles must be 30°

Step 2
Divide just one of the sectors into two equal parts – that's 15° for each sector. You now have thirteen sectors – number them 1 to 13:

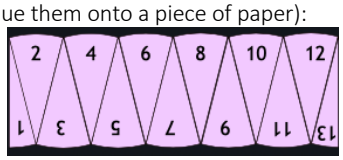


cut one sector in half

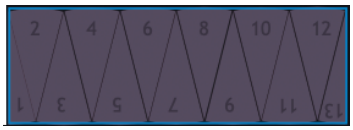
Step 3
Cut out the thirteen sectors using the scissors:



Step 4
Rearrange the 13 sectors like this (you can glue them onto a piece of paper):



Now that shape resembles a rectangle:



Step 5
What are the (approximate) height and width of the rectangle?

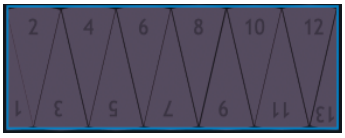
- Its height is the circle's radius: just look at sectors 1 and 13 above. When they are in the circle they are "radius" high.
- Its width (actually one "bumpy" edge), is half of the curved parts around the circle ... in other words it is about half the circumference of the original circle. We know that:

  Circumference = 2 × π × radius

  And so the width is:

  Half the Circumference = π × radius

  And so we have (approximately):



radius

π × radius

With a radius of 5 cm, the rectangle should be:

- 5 cm high
- about 5π cm wide

Step 6
Measure the actual length of your "rectangle" as accurately as you can using your ruler.

Divide by the radius (5 cm) to get an approximation for π

Put your answer here:

Rectangle width	Divide by 5 cm ≈ π

Remember π is about 3.14159... how good was your answer
Note: You could probably get a better answer if you:

- used a bigger circle
- divided your circle into 25 sectors (23 with an angle of 15° and 2 with an angle of 7.5°).