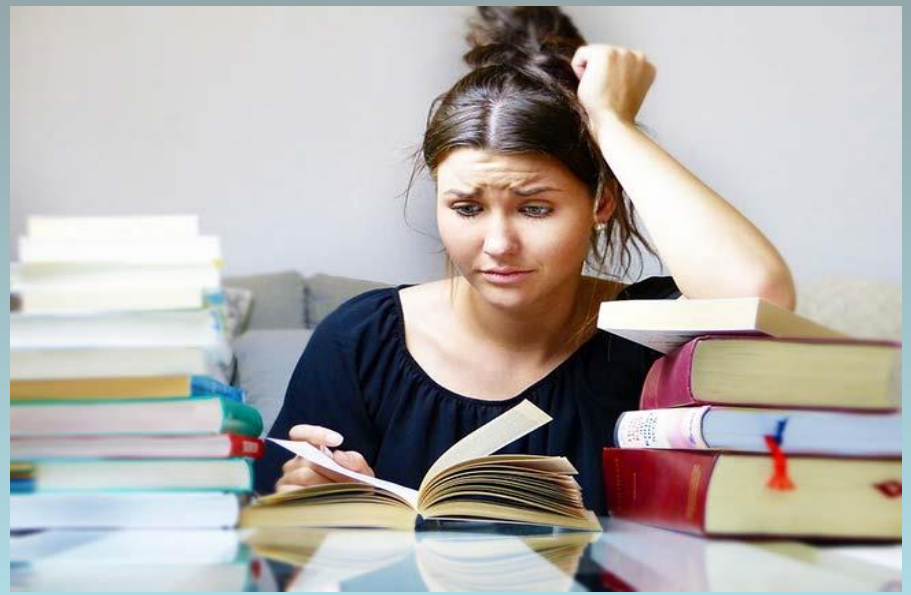
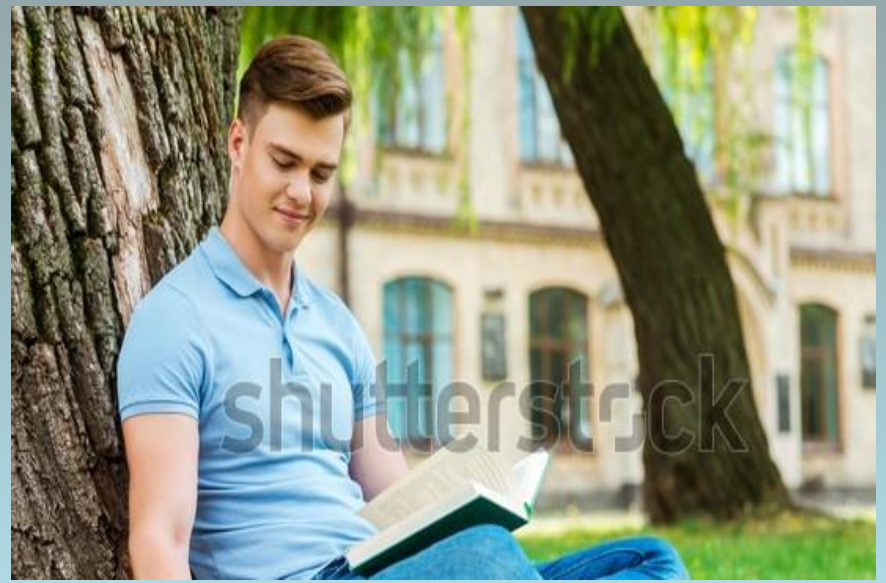
The ‘Sting’ in STEM

How can we increase girls' uptake of maths and physics A-level? (IFS (2018)





A*/A Girls and Boys

A majority of girls report enjoying maths and physics, but some find the content and assessment methods off-putting, and are less happy with the quality of physics than maths teaching

Low confidence, especially in physics, appears to be a factor explaining girls' reluctance to take maths and physics at A-level

Girls perceive STEM careers to be well-remunerated but male-dominated; they are also concerned about taking STEM subjects at A-level and university because few other women do so

Possible Conflating Factors…..

QUALITY OF TEACHING

SOCIAL CONDITIONING

‘DEFICIT’ MODEL - Girls and boys differ in how they explain success/failure (Dweck, 2000 ; Wiliam, 2018).

Attitudinal .....

…….[??????] are more likely to dismiss their own achievements and are less likely to attribute any success to ability and talent, even when they outperform [????]

(Stetsenko et al., 2000)

Girls and boys and practical science

Isobel J. Robertson (2007)

A critical examination of the evidence from the literature suggests that there are more similarities than differences between the performances of girls and boys on practical laboratory tasks……

By neglecting the assessment of practical work, there has been a failure to capitalize on the generally favourable attitudes of pupils, particularly those of girls, to this component of science courses……

The Way Forward…… Getting Practical

Masters: ‘Putting the Sting into Stem’

Feedback…..

‘Fascinating – I really enjoyed it’

‘I was nervous about doing this module because of the science, but ended up loving it..’

‘Learned so much by doing the practicals – I learned by doing’

‘This is so applicable to the primary classroom – my P5 class would really get into it!’

‘So much better! Much more useful than just reading about stuff in the literature and summarising it for an assignment’

‘This has given me lots of ideas for simple experiments to do with my class’

Workshop …… STEM TASKS
1^{st} Task

If you never cut or filed your nails from the day you were born, estimate how long would they be today?

Workshop…….Kitchen Science
2^{nd} Task - Blown Away!!

Using objects commonly found in the home, can you devise and record/photograph an experiment that illustrates the phenomenon of pressure and pressure difference?

(you have ten minutes)

Workshop…… Stem Tasks
3^{rd} Task

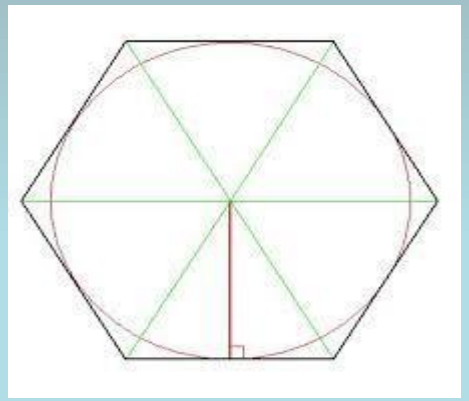
There are 20 people gathered in a hall.
Each person wants to shake hands with everyone else.

Question:

- How many handshakes will there be altogether?
- Is there a quick way to get the answer? (you can use a calculator)
- Find the ‘general’ expression for the number of handshakes; that is for any number (‘N’ people) in the room.

Workshop…… Stem Tasks

4^{th} Task: The search for π



Circumference C of 'circle'

'Radius' = R

R can be found with trigonometry

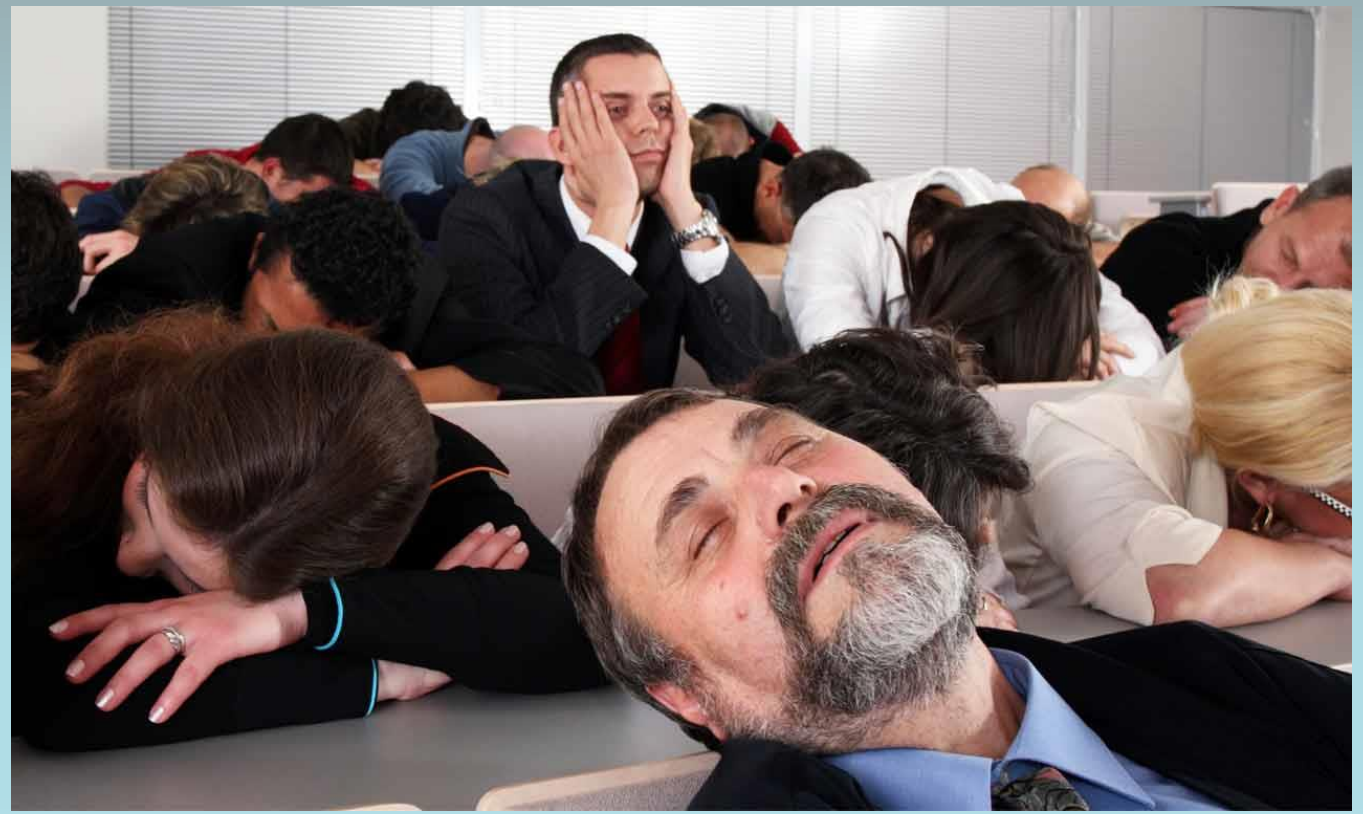
$\pi = 6 \tan(180° \div 6)$

The result can be generalised to any regular polygon.

Can you find the expression for π for an n-sided regular polygon?

What happens to the value of π as n gets bigger? What do you notice happening to this value, as n approaches infinity?

Thanks For listening – Any Questions?



1st STEM task – Answer

Use an example:

Consider a 50 year old person.

- Assume nail growth is the same for men and women
- Assume all fingernails grow at similar rate
- Assume growth rate averages at around 3 mm a month
- Calculation: Total growth (in mm) 3 x12 = 36 mm per year
- Total growth (in mm) (in 50 years) = 36 x 50 = 1800 mm
- = 1.8 m

- World record (recorded in 2018) for longest nail on the hand.
- Shridhar Chillal in India – longest nail was the thumbnail ~ 1978mm

2nd Task Answer: Kitchen Science – Pressure Demonstrations

The water (dyed blue) is drawn into the flask as the candle begins to go out. Why?
Answer: Due to pressure difference. The candle is running out of oxygen for combustion and so the flame begins to burn less brightly and diminish. The gases inside the flask cool rapidly, contract and hence the pressure inside the flask drops below the air pressure outside the flask.
This pressure difference pushes the water in the tray into the flask until pressure is equalised.

3rd STEM task: Answer

Number of people	Number of handshakes
1	0
2	1
3	3
4	6
5	10
6	15
7…….	21……

What's the pattern?

Ans: The number of handshakes follows the triangular numbers; hence the general formula is given by $\frac{n(n-1)}{2}$

Try it – test it works!. So 20 people in the room, gives 190 handshakes.

Homework Answer: searching for The Value of Pi….

Regular hexagon:

Number of sides = 6

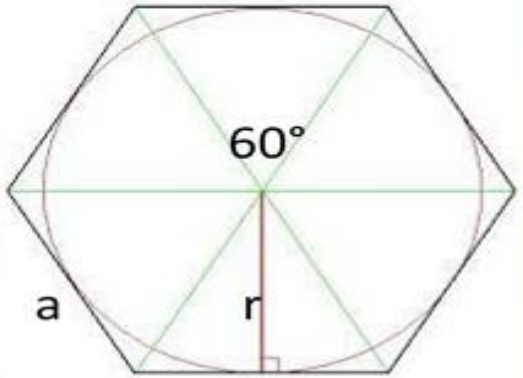
Circumference C of 'circle' = 6a

'Radius' of 'circle' = r

r can be found from trigonometric relationship, tan, where

$\tan(30°) = \tan(180° \div 6) = 0.5a \div r$

$r = 0.5a \div \tan(180° \div 6)$



Using $C = 2\pi r$

π = Circumference $\div$ (2r) = $6a \div (2 \times 0.5a \div \tan(180° \div 6))$

$\pi = 6 \tan(180° \div 6)$

The result can be generalised to any regular polygon with n sides.

General result:

*** $\pi = n \tan(180° \div n)$**

Homework Answer:
Searching for The Value of Pi….(continued)

The search for Pi (using area instead of circumference)

Notice: the polygon is inscribed within the circle

Number of sides = 6

Side length = A

Area of each triangle = $\frac{1}{2}A^2 \sin(\frac{360}{6})$

Total area (of all 6 triangles) = 6 X $\frac{1}{2}A^2 \sin(\frac{360}{6})$ = area of our 'circle'

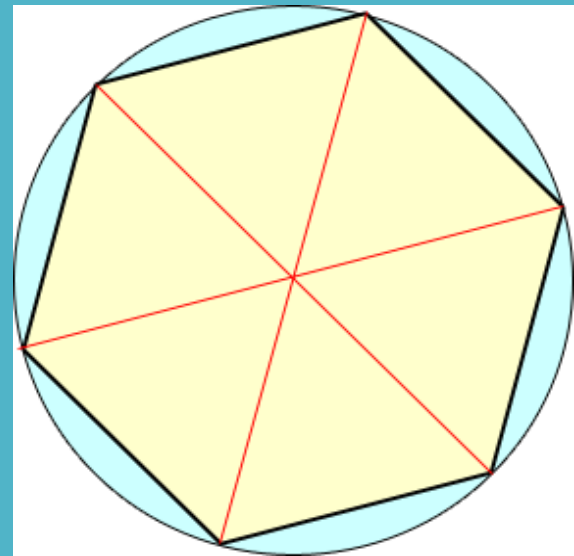
Using the formula for the area of a circle (πR^2) where the radius is represented by A, we obtain:

$\pi \sim 6 \text{ X } \frac{1}{2} \sin(\frac{360}{6})$

General formula for n-sided polygon (inscribed within circle)

$\pi \longrightarrow n \text{ X } \frac{1}{2} \sin(\frac{360}{n})$ (where n approaches infinity)

This equation (or the one on the previous page) can be 'programmed' onto an Excel sheet to observe the approach (from above or below) to Pi.



Search for pi.xlsx - Excel

File Home Insert Page Layout Formulas Data Review View Tell me what you want to do...

PivotTable Recommended PivotTables Table — Tables
Pictures Online Pictures — Illustrations
Store My Add-ins — Add-ins
Recommended Charts PivotChart — Charts
3D Map — Tours
Line Column Win/ Loss — Sparklines
Slicer Timeline — Filters

I6

	A	B	C	D	E	F
1						
2			Number of sides	Angle	~ to π	% change
3			3	1.0471975512	5.20	
4			4	0.7853981634	4.00	23.0199641080
5			5	0.6283185307	3.63	9.1821839993
6			6	0.5235987756	3.46	4.6414633250
7			7	0.4487989505	3.37	2.6869674688
8			8	0.3926990817	3.31	1.7001914265
9			9	0.3490658504	3.28	1.1460389651
10			10	0.3141592654	3.25	0.8100523849
11			11	0.2855993321	3.23	0.5941634266
12			12	0.2617993878	3.22	0.4489659636
13			13	0.2416609734	3.20	0.3476433242
14			14	0.2243994753	3.20	0.2747501523
15			15	0.2094395102	3.19	0.2209487801
16			16	0.1963495408	3.18	0.1803613097
17			17	0.1847995679	3.18	0.1491588765
18			18	0.1745329252	3.17	0.1247729486
19			19	0.1653469818	3.17	0.1054358936
20			20	0.1570796327	3.17	0.0899036835
21			21	0.1495996502	3.17	0.0772832615
22			22	0.1427996661	3.16	0.0669220943
23			23	0.1365909849	3.16	0.0583357718
24			24	0.1308996939	3.16	0.0511595082
25			25	0.1256637061	3.16	0.0451150115
26			26	0.1208304867	3.16	0.0399874484
27			27	0.1163552835	3.16	0.0356091680
28			28	0.1121997376	3.15	0.0318480314
29			29	0.1083307812	3.15	0.0285989288
30			30	0.1047197551	3.15	0.0257775388
31			31	0.1013416985	3.15	0.0233156813
32			32	0.0981747704	3.15	0.0211578227
33			33	0.0951997774	3.15	0.0192584194
34			34	0.0923997839	3.15	0.0175798815