Storytelling and Creativity in Mathematics

Presented by:
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40TH ANNIVERSARY
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JANUARY 14 - 17, 2020
MIAMI BEACH CONVENTION CENTER
MIAMI, FLA.

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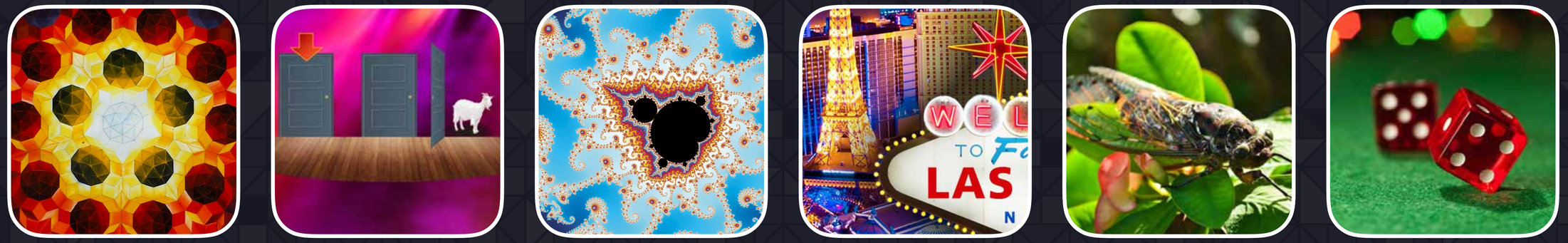
www.FETC.org

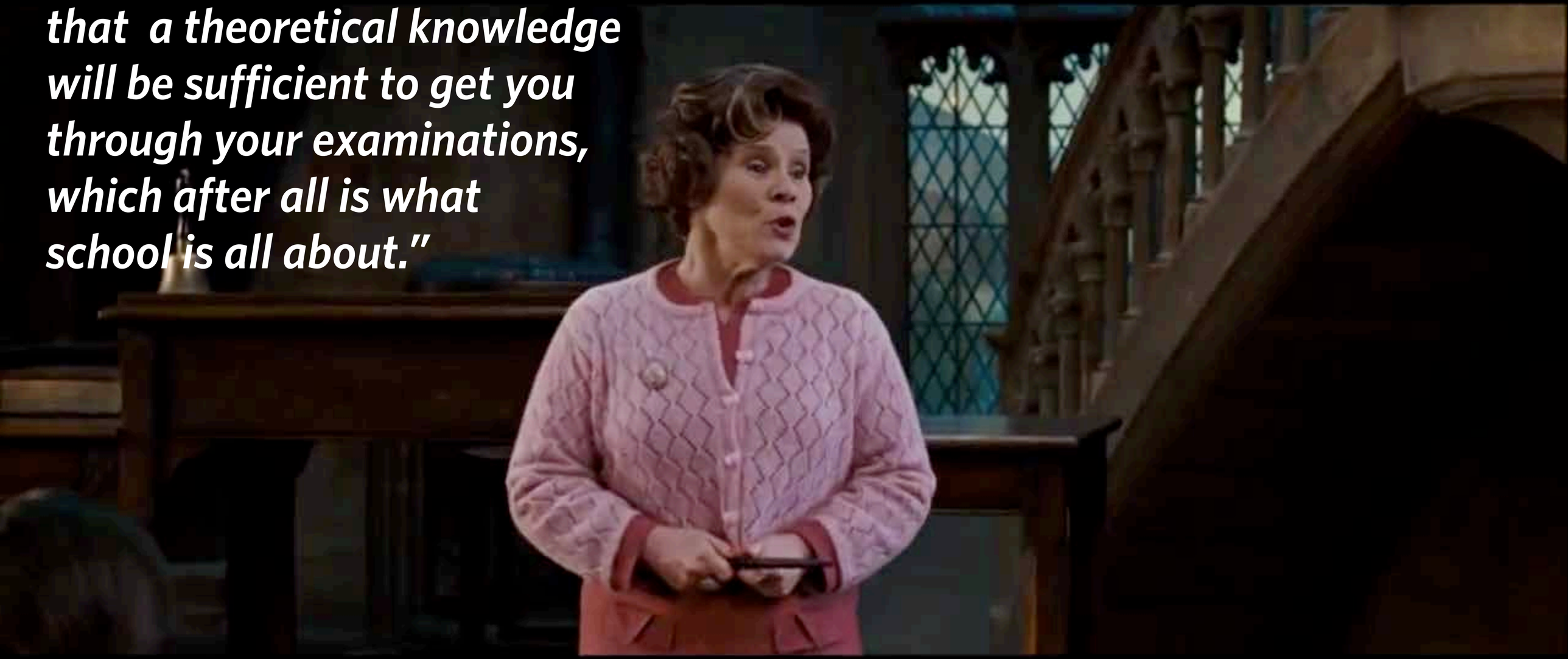
Mathigon.org



Storytelling and Creativity in Mathematics

Philipp Legner – @MathigonOrg

“It is the view of the ministry that a theoretical knowledge will be sufficient to get you through your examinations, which after all is what school is all about.”

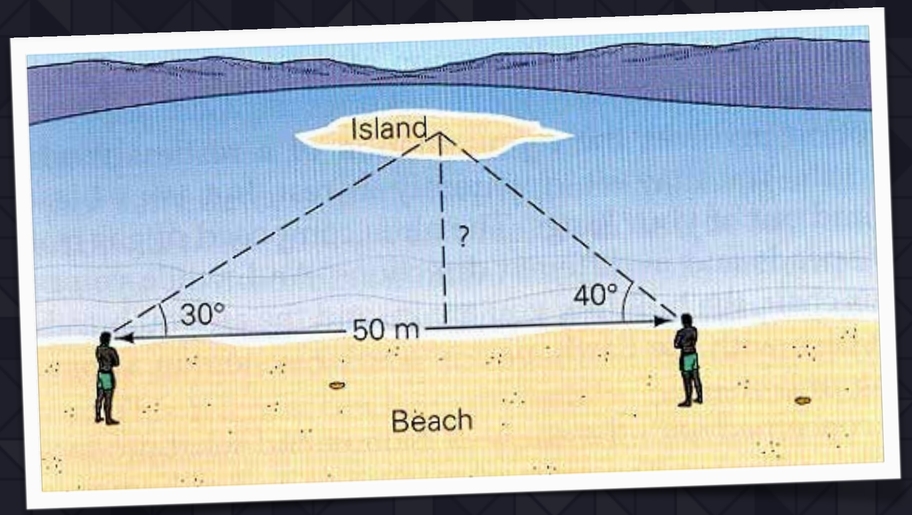


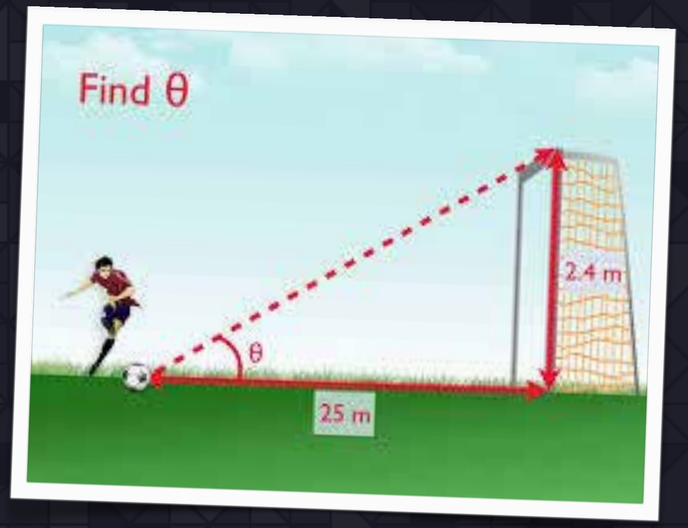
Problem Solving

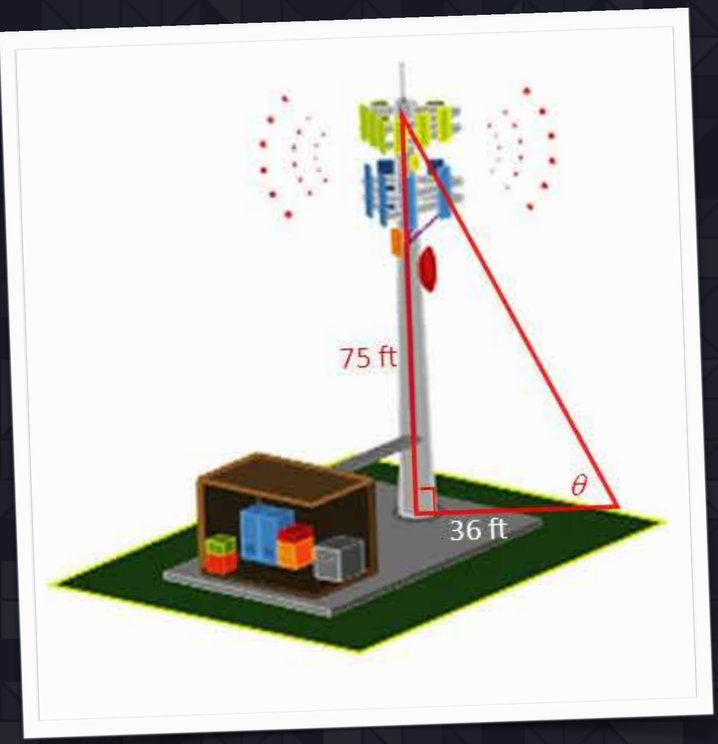
Creativity

Critical Thinking

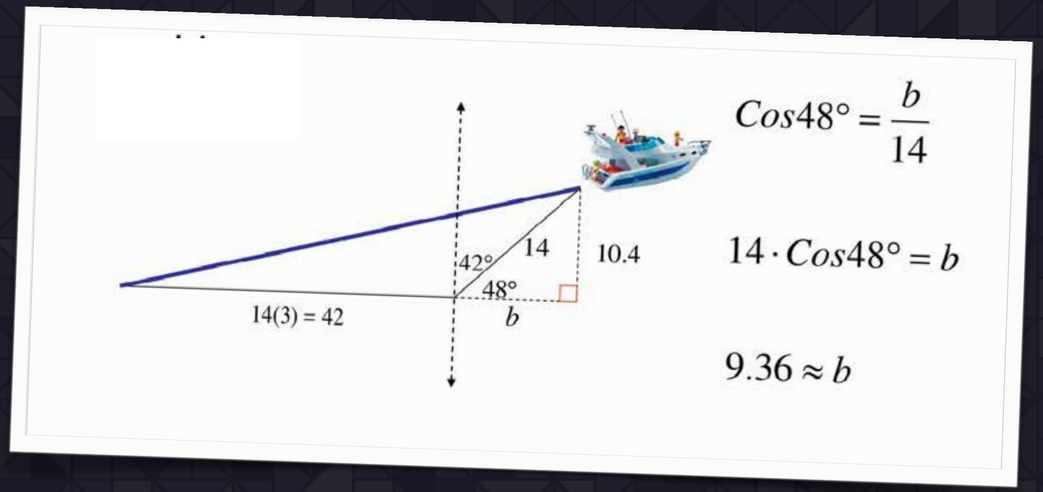

Storytelling

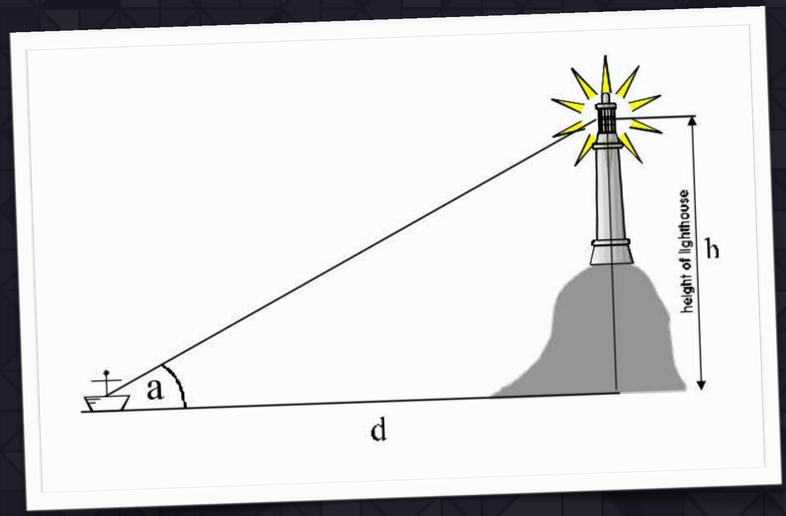


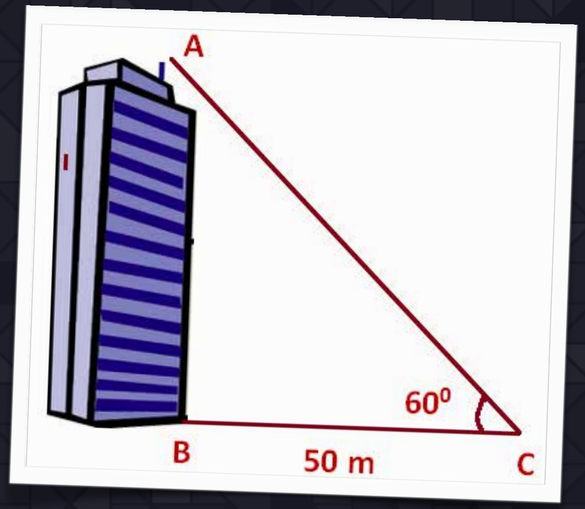


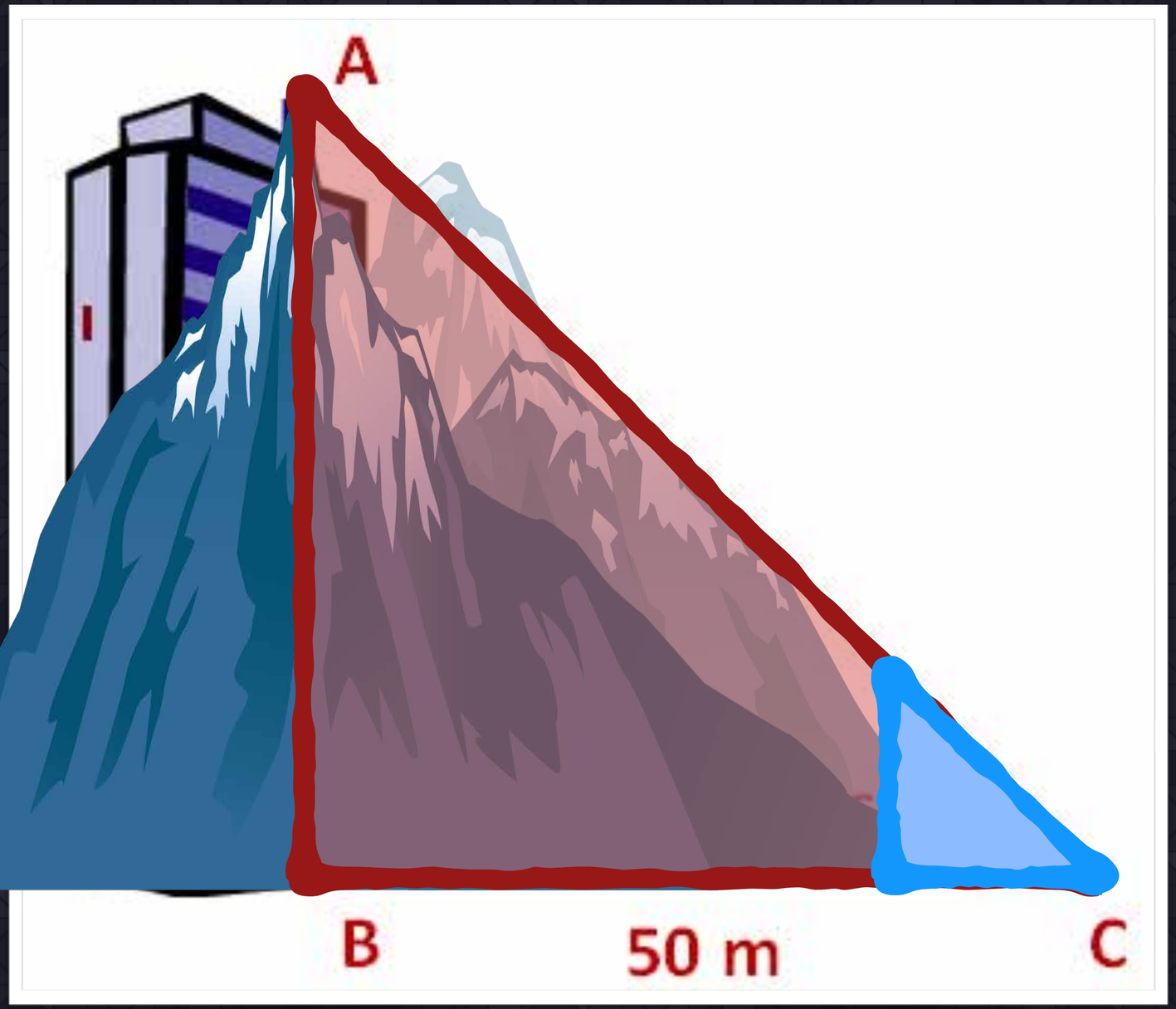


Trigonometry

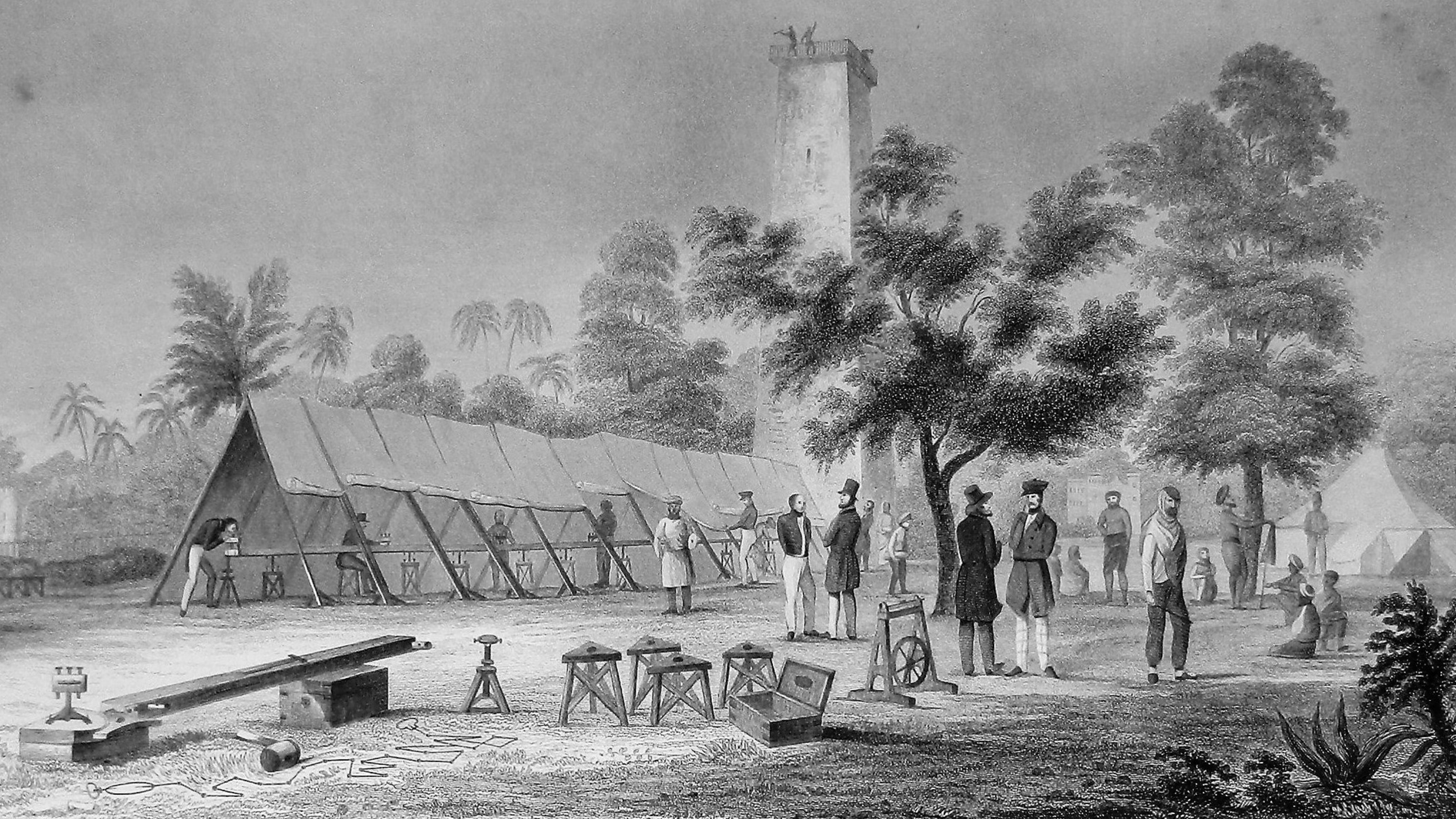


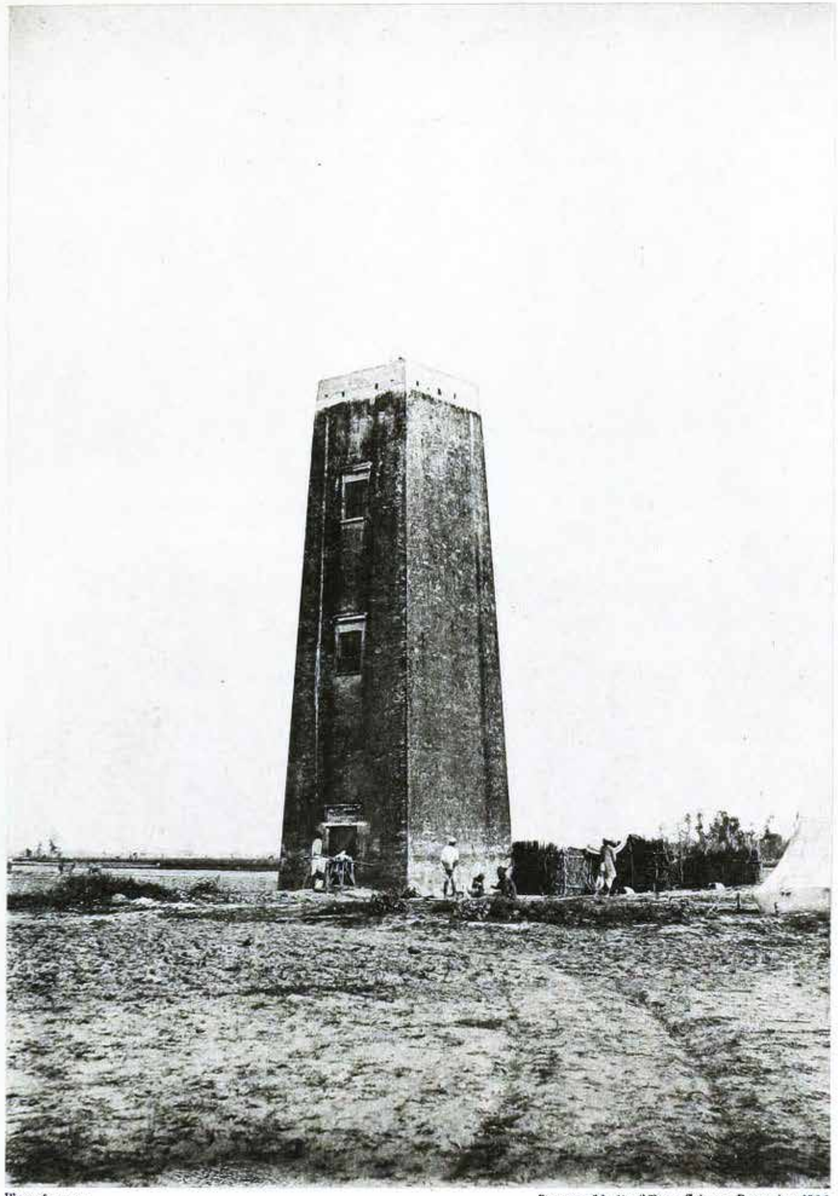





A
B
50 m
C


ARABIAN SEA
BAY OF BENGAL
BOMBAY
MADRAS
CALCUTTA
CEYLON
INDEX CHART
TO THE
GREAT TRIGONOMETRICAL SURVEY
OF
INDIA
SHOWING COLONEL LAMBTON'S KEE WORK OF TRIANGULATION IN SOUTHERN INDIA.
THE MERIDIONAL AND LONGITUDINAL CHAINS OF PRINCIPAL TRIANGLES.
THE BASE LINES MEASURED WITH THE COLBY APPARATUS.
THE LINES OF THE SPIRIT LEVELLING OPERATIONS.
THE ASTRONOMICAL PENDULUM & TIDAL STATIONS.
THE LONGITUDINAL ARCS.
AND THE SECONDARY TRIANGULATION TO FIX THE PEAKS OF
THE HIMALAYAN & THE SULIMAN RANGES
AND THE POSITIONS OF RANGOON, MANDAHAR &c.
Completed to 31st December 1913.





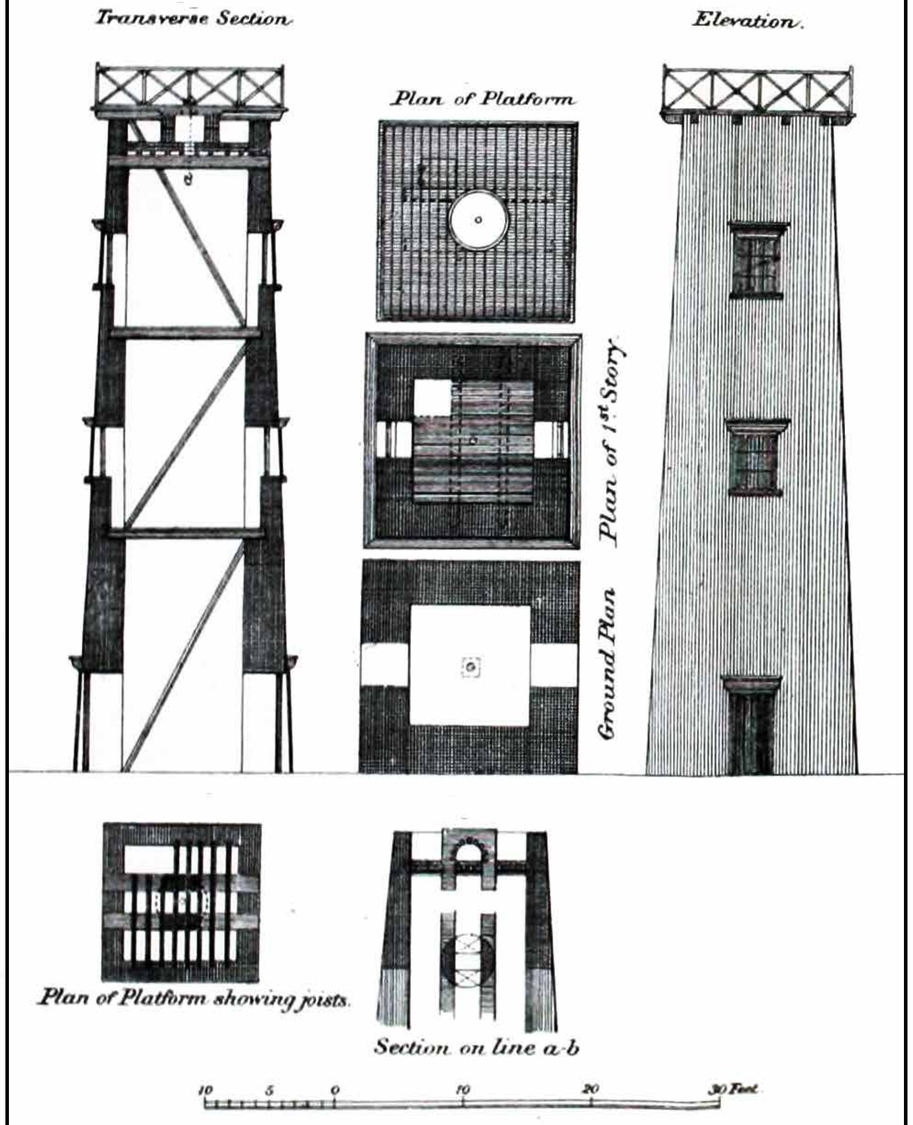
Photogravure — Survey of India Offices, Calcutta, December, 1906.

NOJLI TOWER.

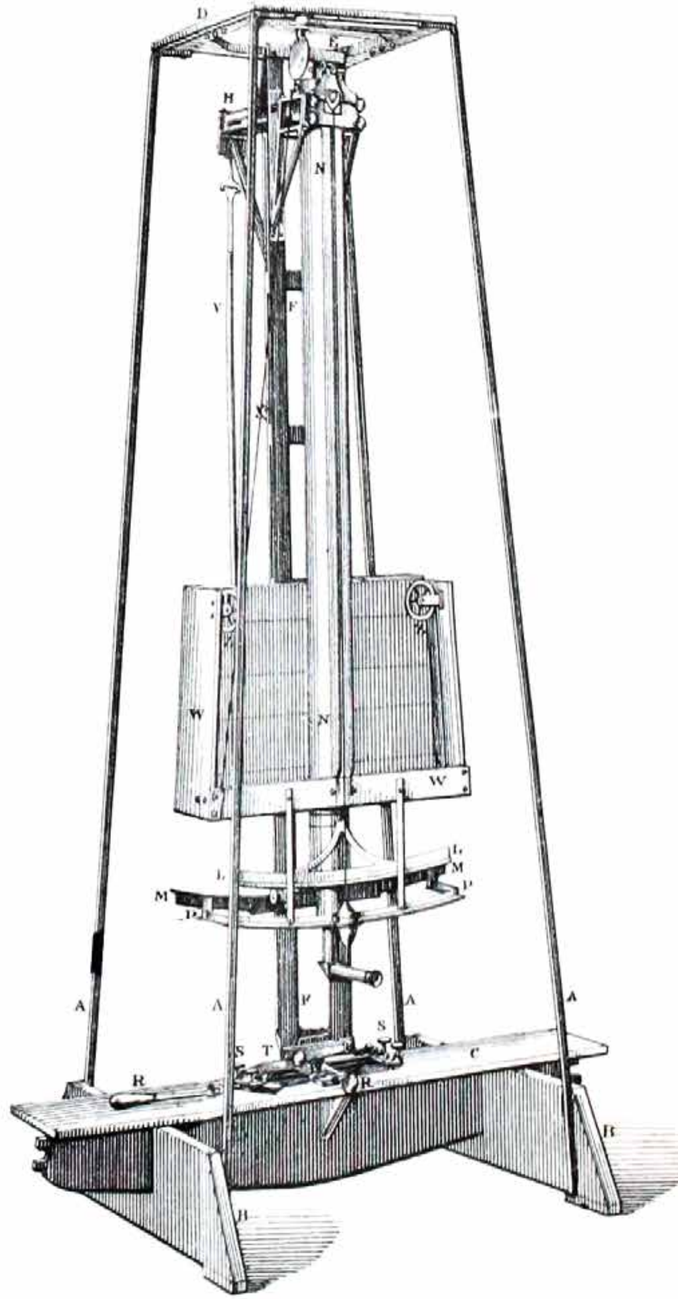
A STATION OF THE GREAT TRIGONOMETRICAL SURVEY, BUILT IN THE PLAINS OF UPPER INDIA NEAR ROORKEE,
ND FROM WHICH THE HIMALAYAN PEAKS OF BADRINATH, KEDARNATH, JAONLI AND BANDARPUNCH HAVE BEEN OBSERVED
FROM A PHOTO BY C.D. SIMONS.

ELEVATION, SECTIONS & PLANS,

Illustrative of Colonel Everest's Towers on the Great Arc.



OLD ZENITH SECTOR, (RAMSDEN'S)



Radhanath Sikdar

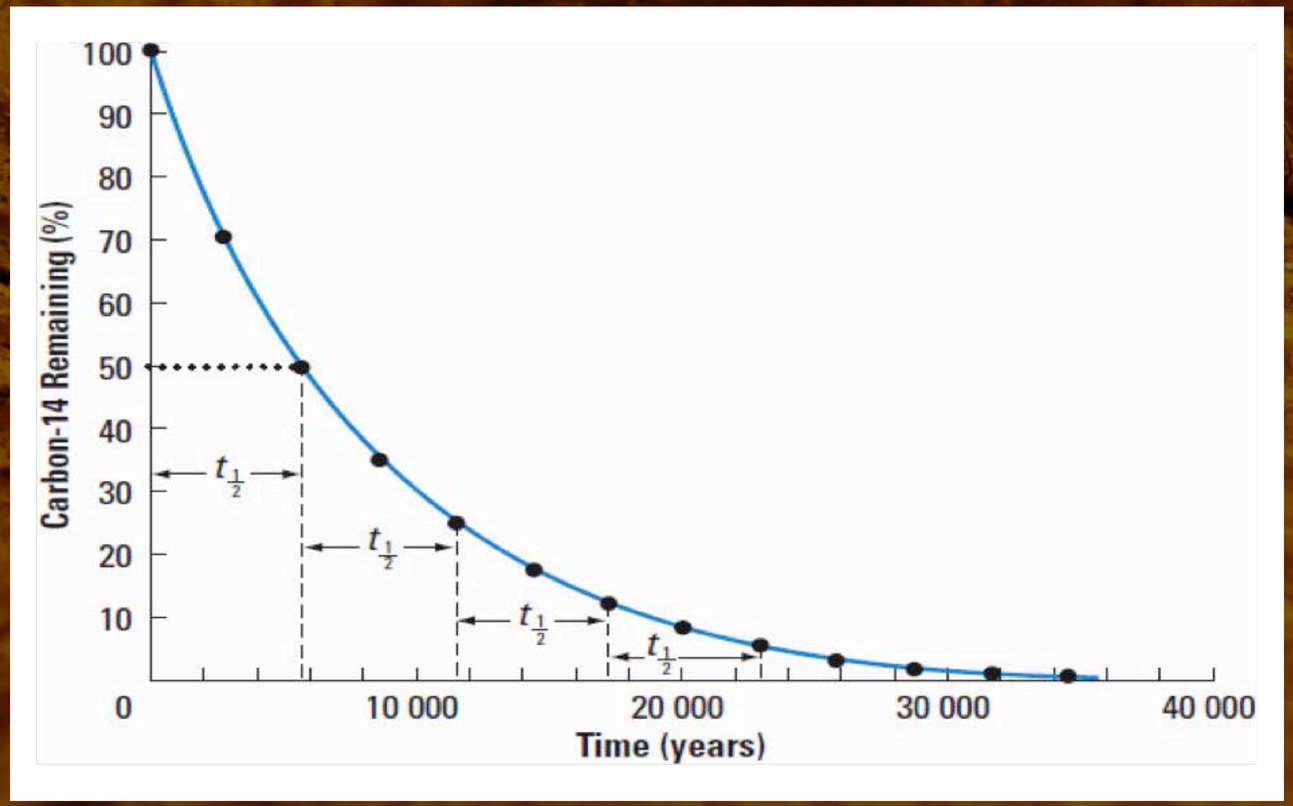
Roller Coasters

Roller Coasters

Cicadas

Cicadas

Carbon Dating



Carbon Dating

Monopoly

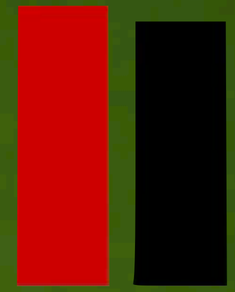

MONOPOLY
The Fast-Dealing Property Trading Game
COMMUNITY CHEST
CHANCE
GO
COLLECT ₩200 SALARY AS YOU PASS
OLD KENT ROAD
₩60
COMMUNITY CHEST
WHITECHAPEL ROAD
₩60
INCOME TAX
PAY ₩200
KINGS CROSS STATION
₩200
THE ANGEL, ISLINGTON
₩100
CHANCE
EUSTON ROAD
₩100
PENTONVILLE ROAD
₩120
JUST VISITING
IN JAIL
PALL MALL
₩140
ELECTRIC COMPANY
₩150
WHITEHALL
₩140
NORTHUMRL'D AVENUE
₩160
MARYLEBONE STATION
₩200
BOW STREET
₩180
COMMUNITY CHEST
MARLBOROUGH STREET
₩180
VINE STREET
₩200
FREE PARKING
STRAND
₩220
CHANCE
FLEET STREET
₩220
TRAFALGAR SQUARE
₩240
FENCHURCH ST. STATION
₩200
LEICESTER SQUARE
₩260
COVENTRY STREET
₩260
WATER WORKS
₩150
PICCADILLY
₩280
GO TO JAIL
REGENT STREET
₩300
OXFORD STREET
₩300
COMMUNITY CHEST
BOND STREET
₩320
LIVERPOOL ST. STATION
₩200
CHANCE
PARK LANE
₩350
SUPER TAX
PAY ₩100
MAYFAIR
₩400
PARKER

2	3	4	5	6	7	8	9	10	11	12
1 + 1	2 + 1	3 + 1	4 + 1	5 + 1	6 + 1	6 + 2	6 + 3	6 + 4	6 + 5	6 + 6
		2 + 2	4 + 2	5 + 2	6 + 2	6 + 3	6 + 4	6 + 5	6 + 6	
		3 + 2	4 + 3	5 + 3	6 + 3	6 + 4	6 + 5	6 + 6		
			5 + 3	5 + 4	6 + 4	6 + 5	6 + 6			
				5 + 4	6 + 5	6 + 6				
					6 + 6					


0
32
15
19
4
21
2
25
17
34
6
27
13
36
11
30
8
23
10
5
24
16
33
1
20
14
31
9
22
18
29
7
28
12
35
3
26

Roulette

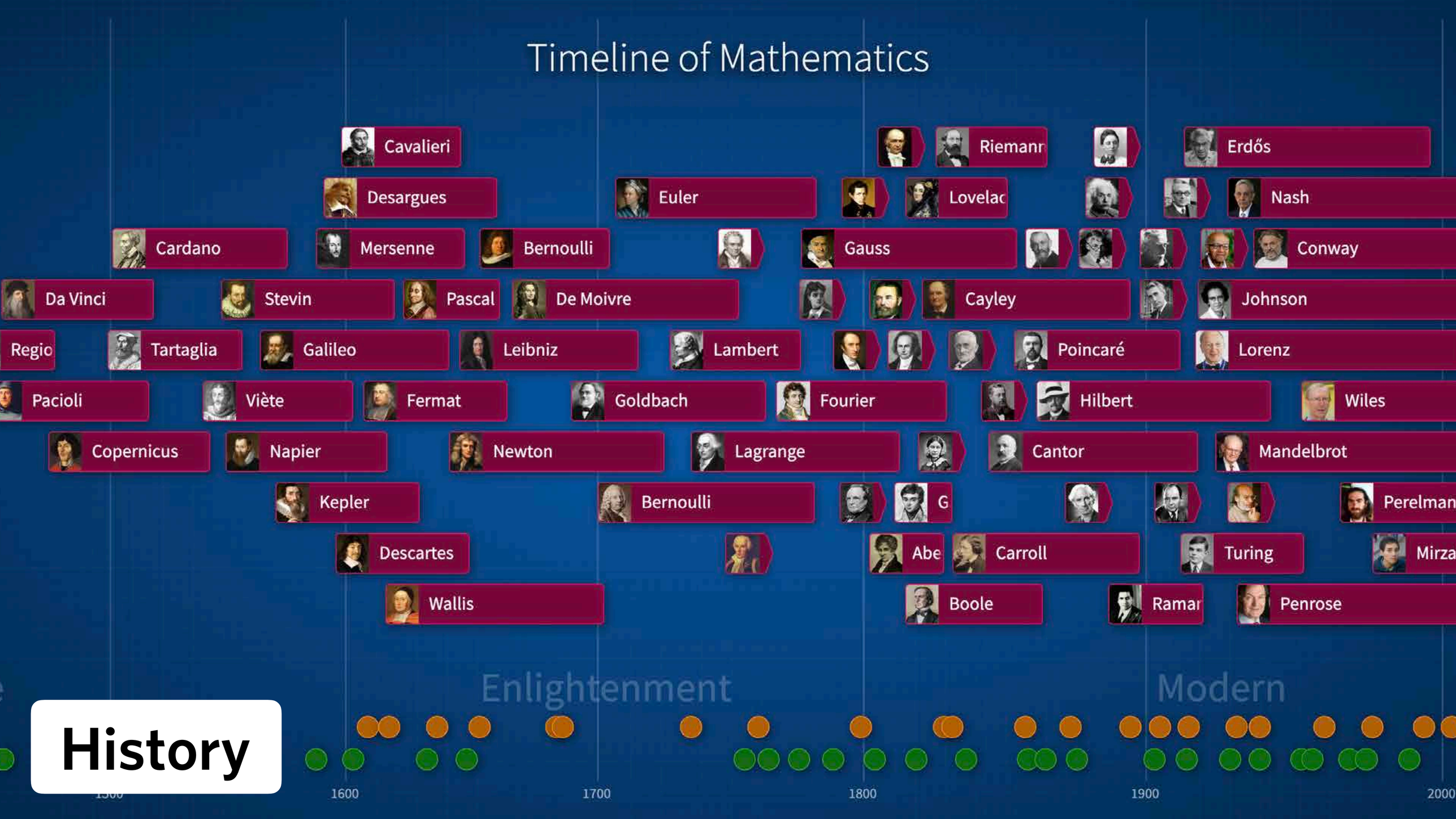
Roulette

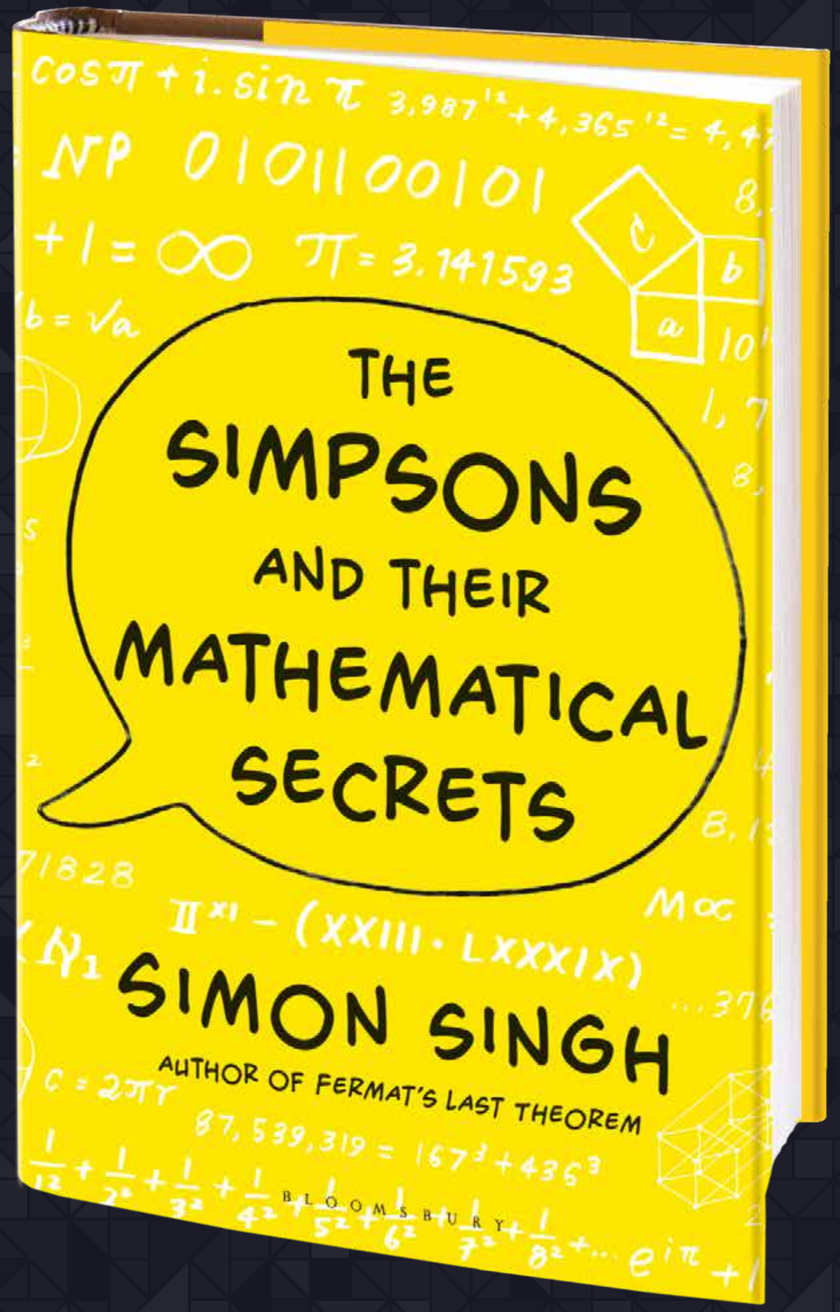


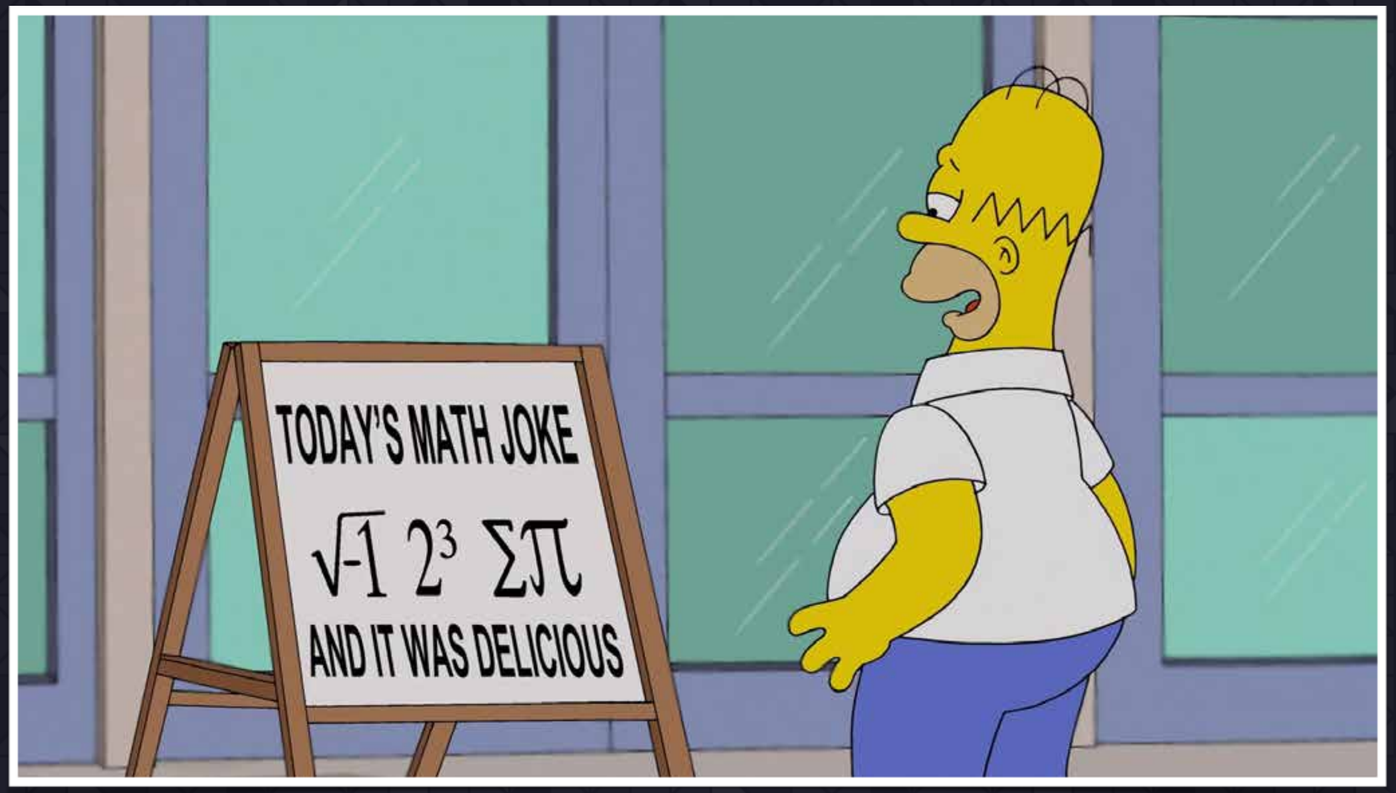
Red Black

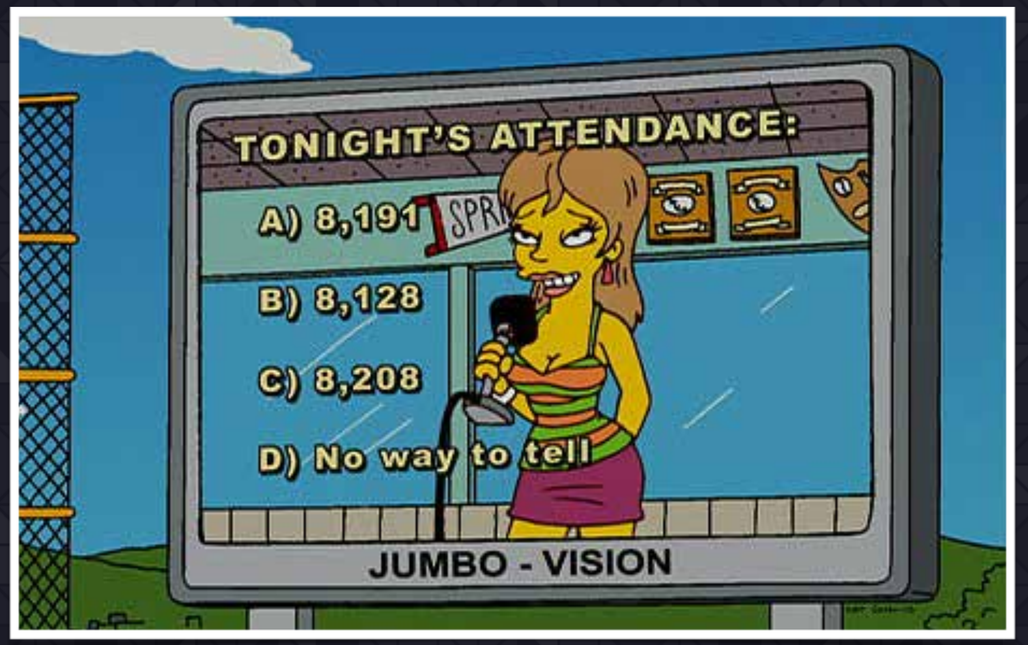
RR RB BR BB

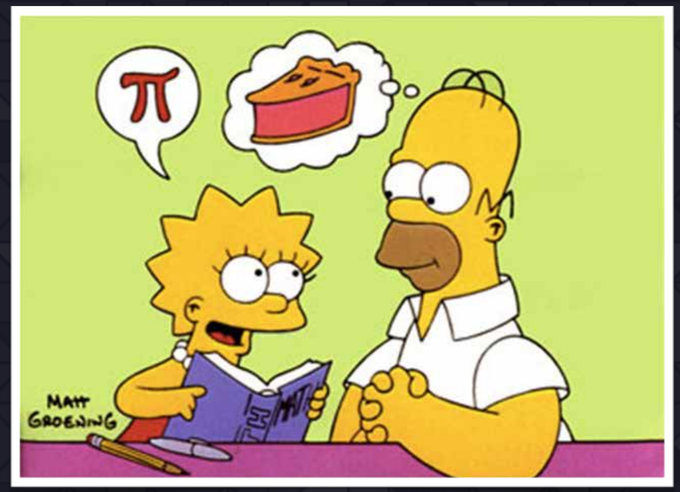
RRR RRB BRR RBR BRB BBR RBB BBB


Timeline of Mathematics
Cavalieri
Riemann
Erdős
Desargues
Euler
Lovelac
Nash
Cardano
Mersenne
Bernoulli
Gauss
Conway
Da Vinci
Stevin
Pascal
De Moivre
Cayley
Johnson
Regio
Tartaglia
Galileo
Leibniz
Lambert
Poincaré
Lorenz
Pacioli
Viète
Fermat
Goldbach
Fourier
Hilbert
Wiles
Copernicus
Napier
Newton
Lagrange
Cantor
Mandelbrot
Kepler
Bernoulli
G
Perelman
Descartes
Abe
Carroll
Turing
Mirza
Wallis
Boole
Ramar
Penrose
Enlightenment
Modern
History
1600
1700
1800
1900
2000

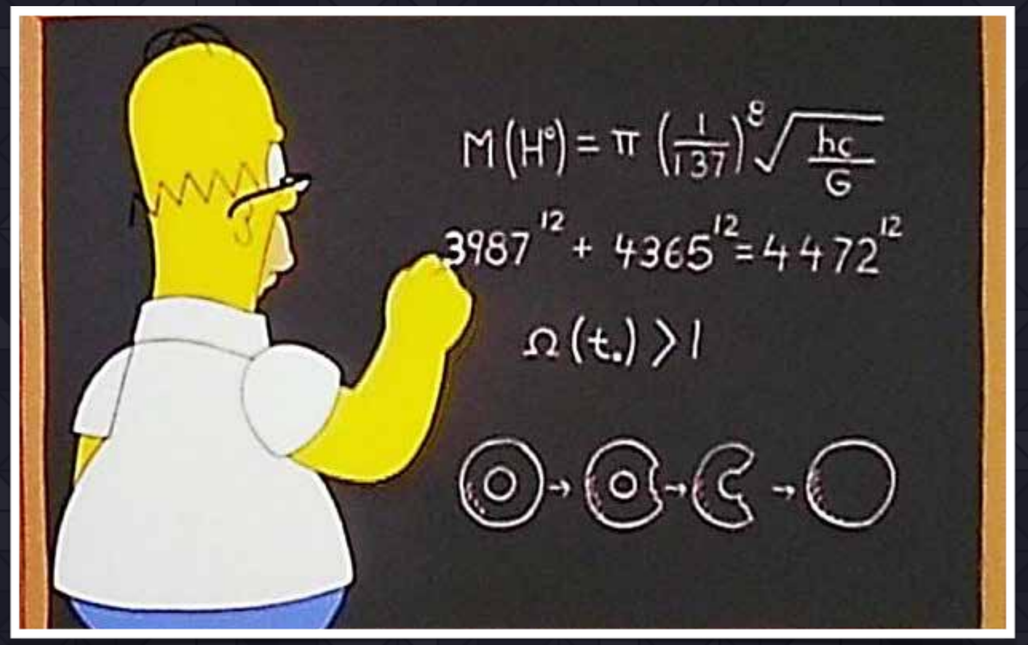

THE
SIMPSONS
AND THEIR
MATHEMATICAL
SECRETS
SIMON SINGH
AUTHOR OF FERMAT'S LAST THEOREM
BLOOMSBURY


TODAY'S MATH JOKE
√-1 2³ Σπ
AND IT WAS DELICIOUS


TONIGHT'S ATTENDANCE:
A) 8,191
B) 8,128
C) 8,208
D) No way to tell
JUMBO - VISION


π
MATT GROENING


DODECAHEDRON


$M(H^0) = \pi \left(\frac{1}{137}\right)^8 \sqrt{\frac{hc}{G}}$
$3987^{12} + 4365^{12} = 4472^{12}$
$\Omega(t_0) > 1$

Mathematics is full of stories!

Applications

Science and Nature

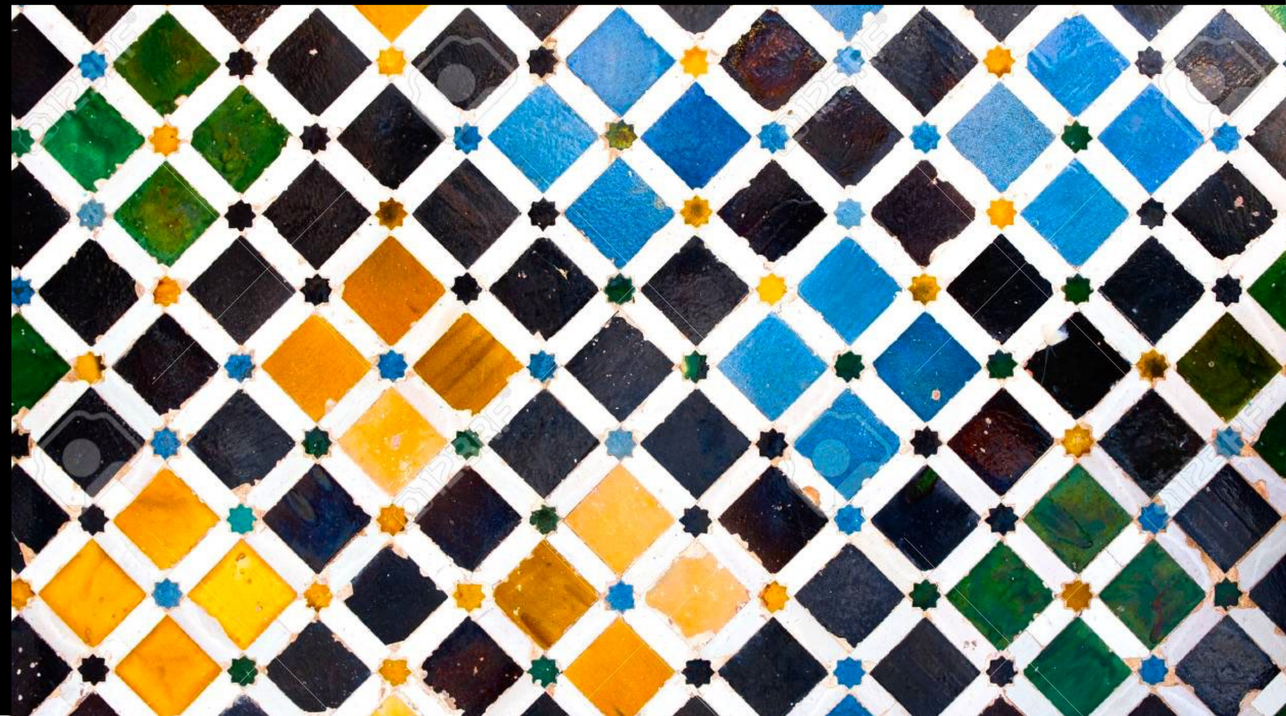
Games and Puzzles

History and Mathematicians

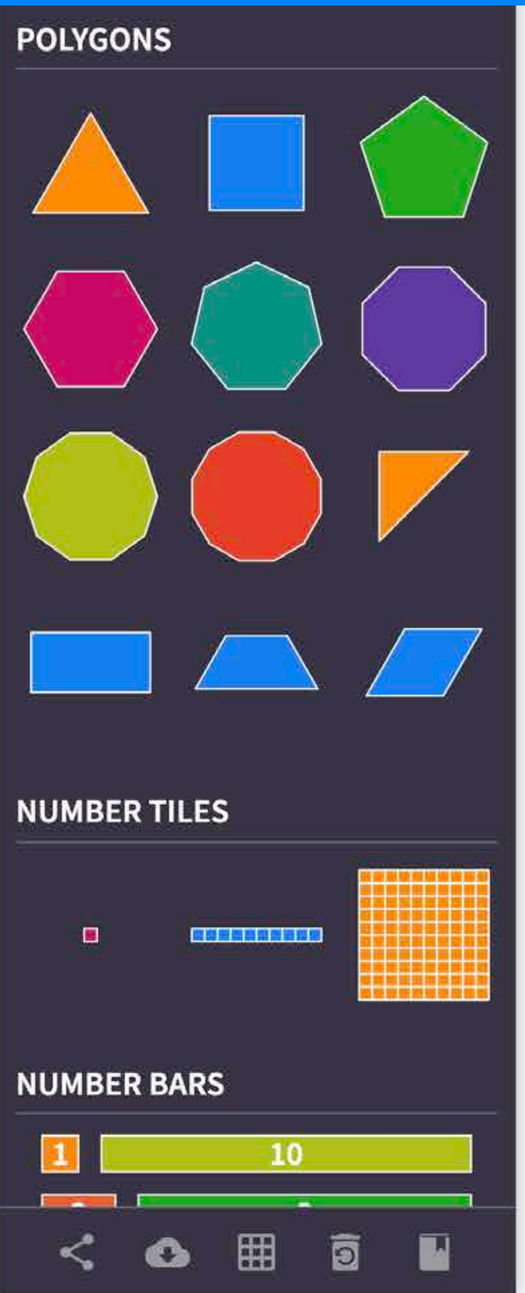
Fiction

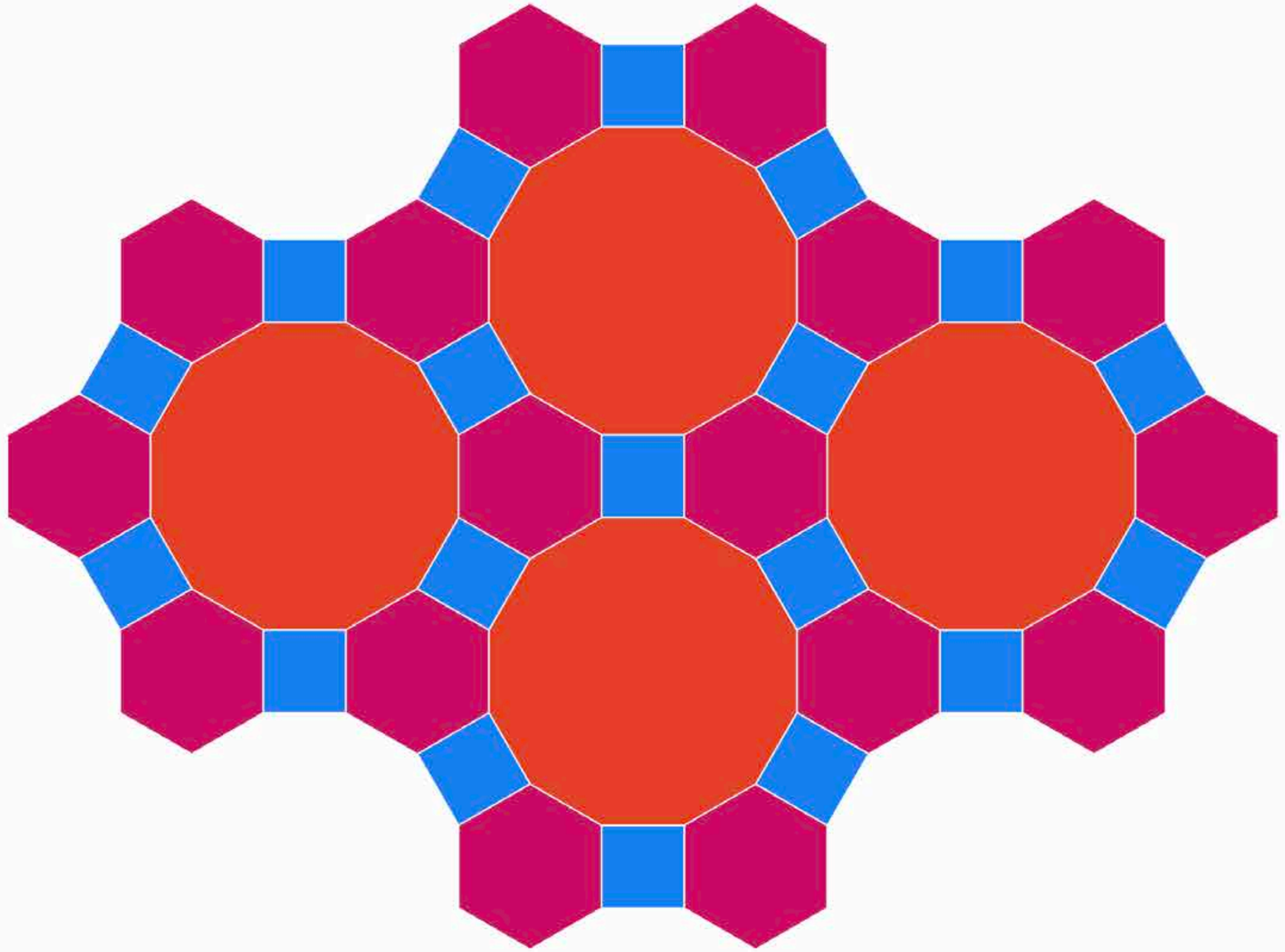

Creativity

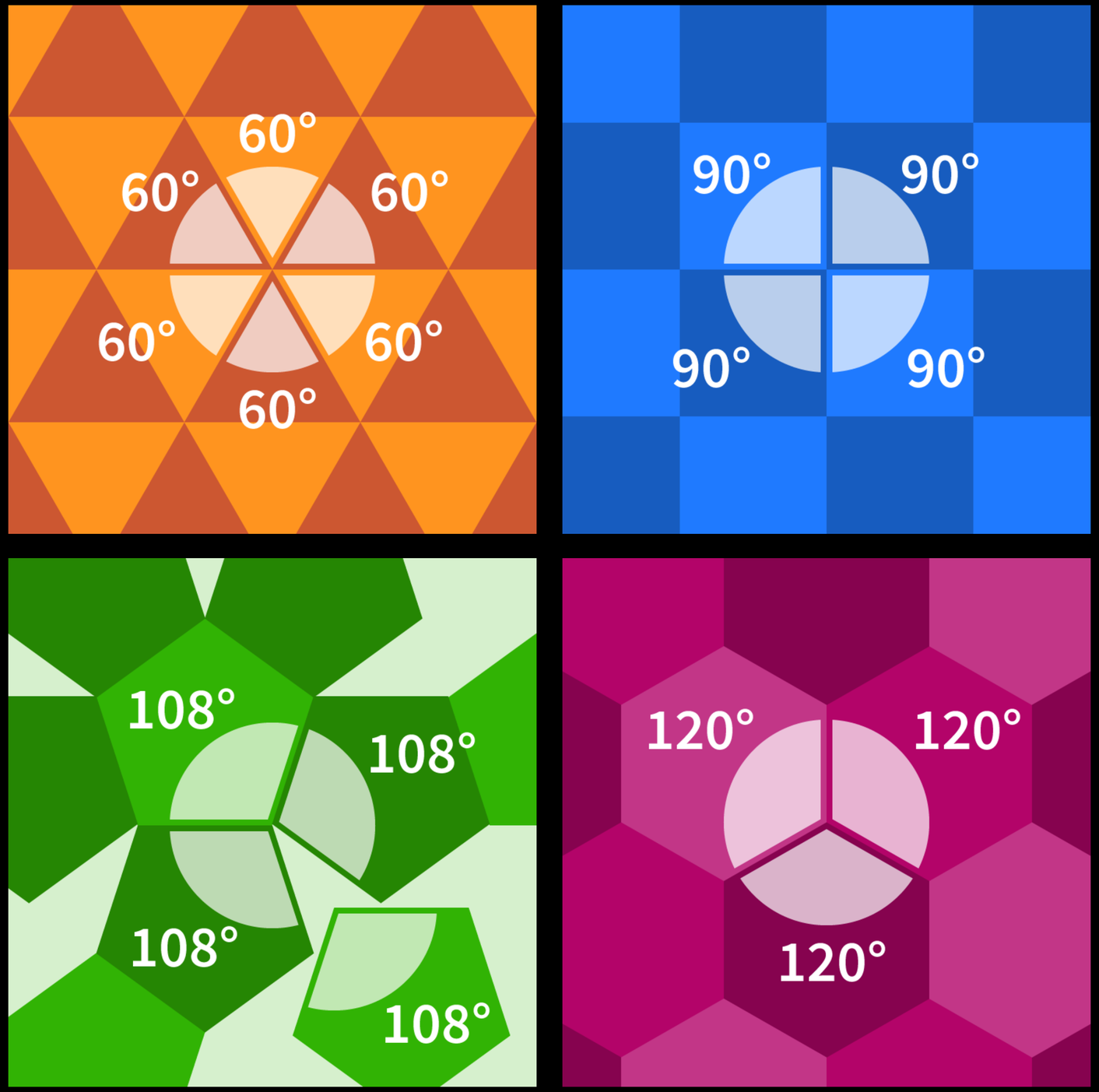
Tessellations

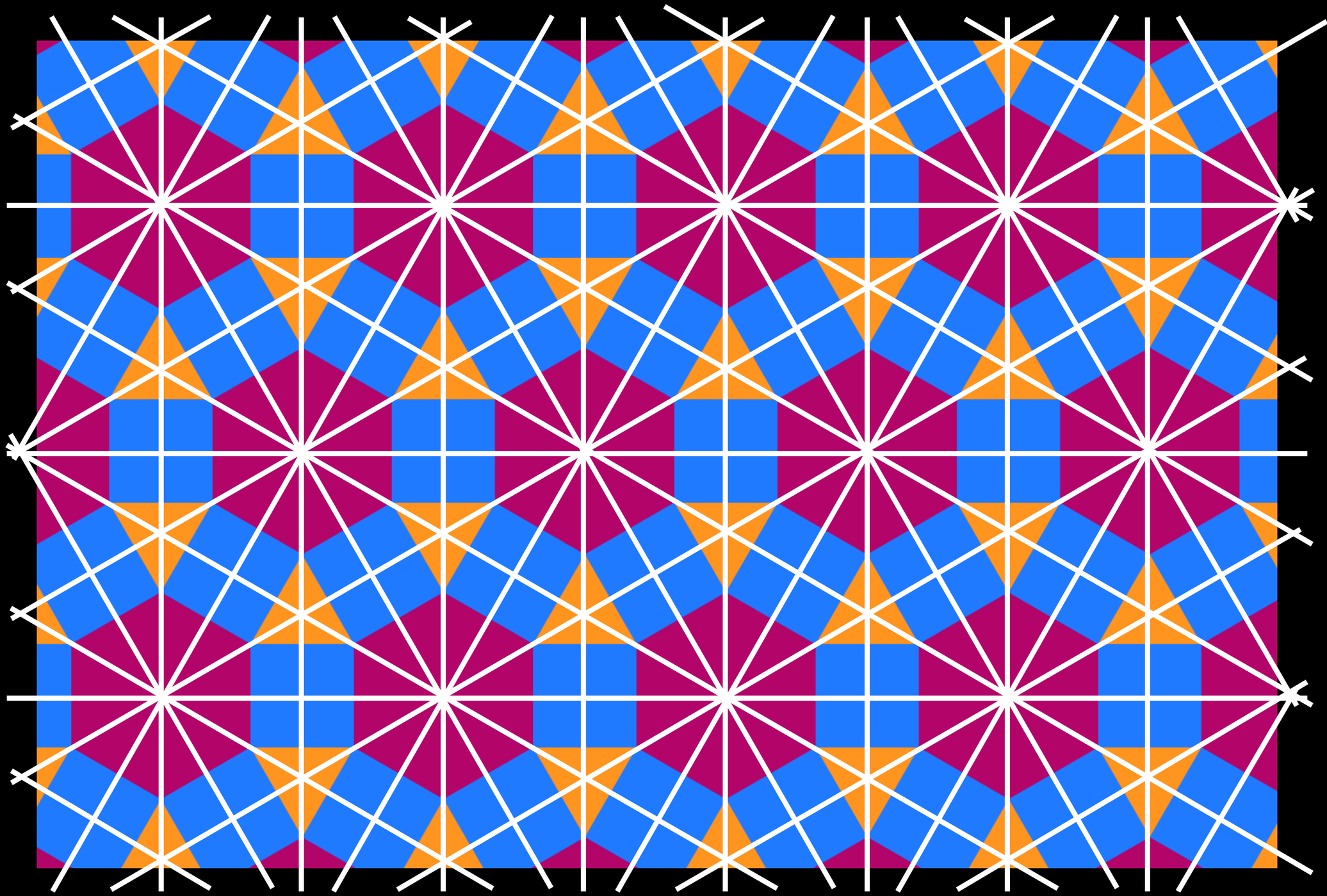


mathigon.org/polypad



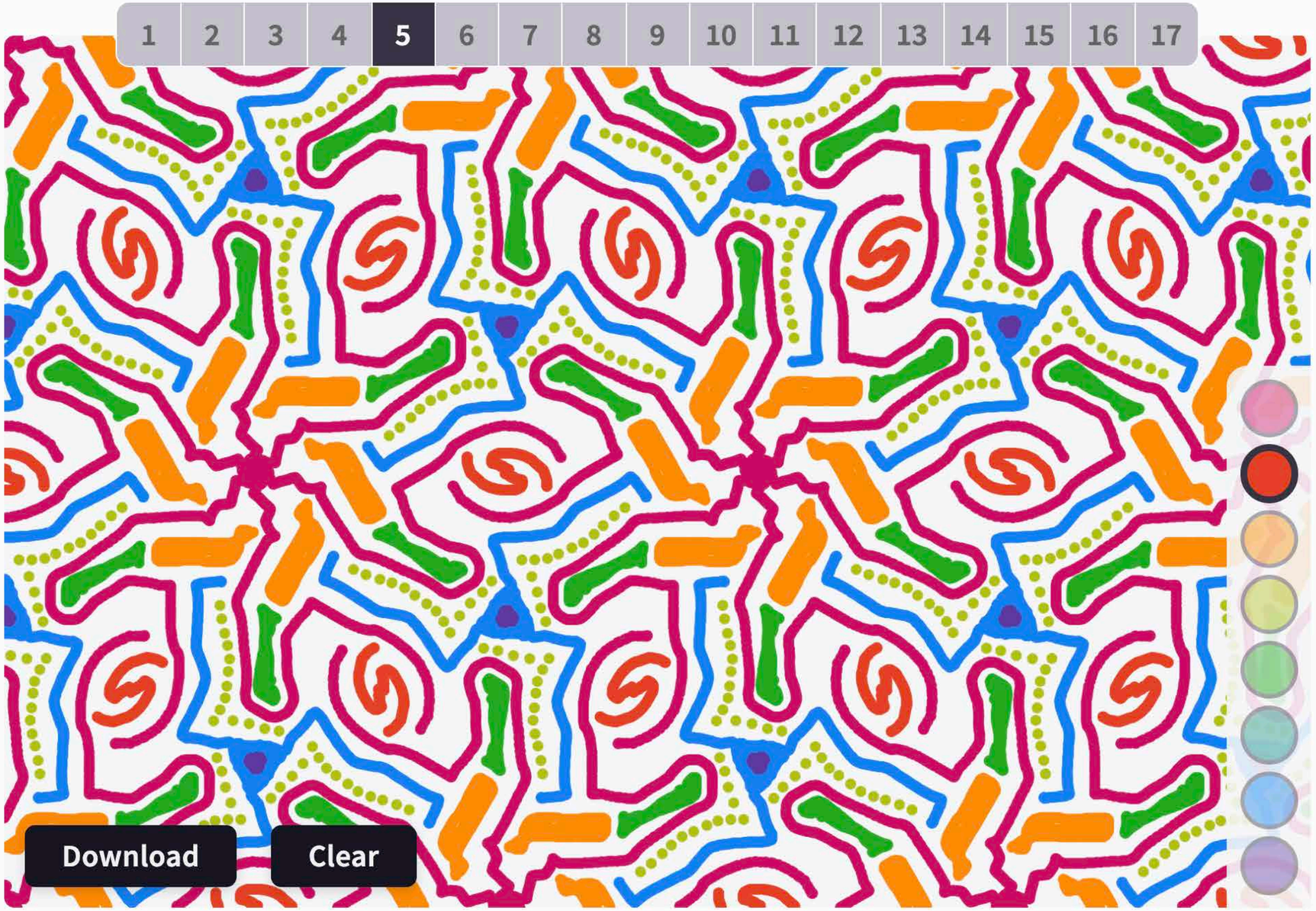



60°
60°
60°
60°
60°
60°
90°
90°
90°
90°
108°
108°
108°
108°
120°
120°
120°

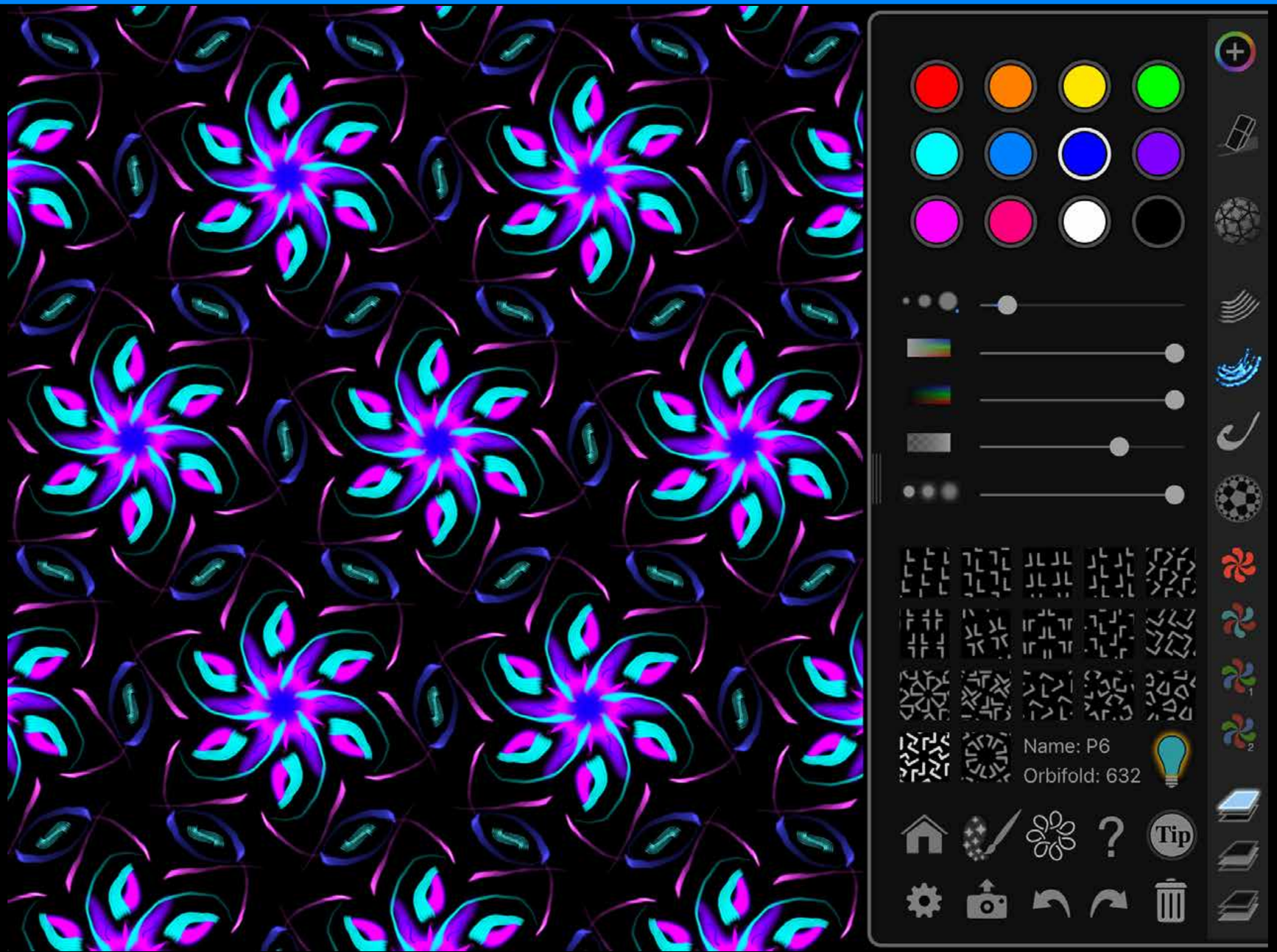


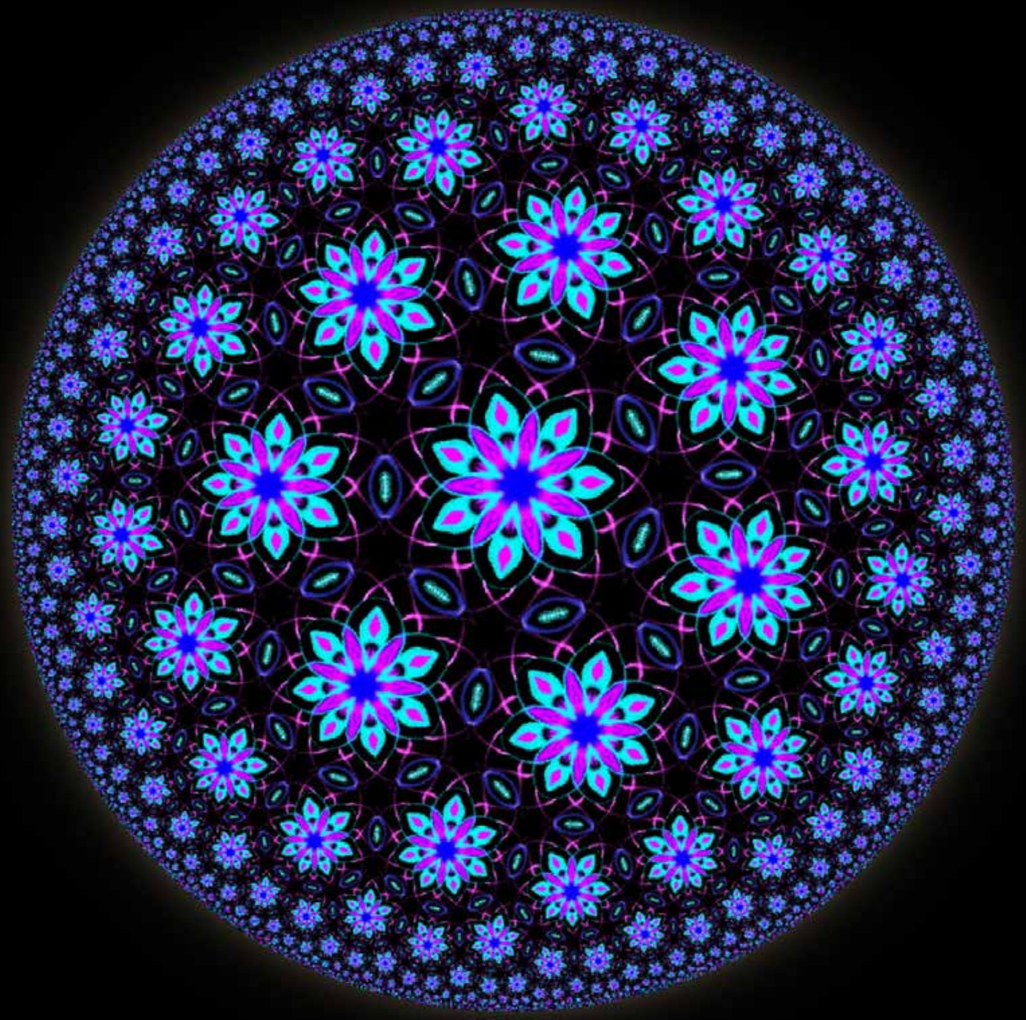

17 Wallpaper Groups

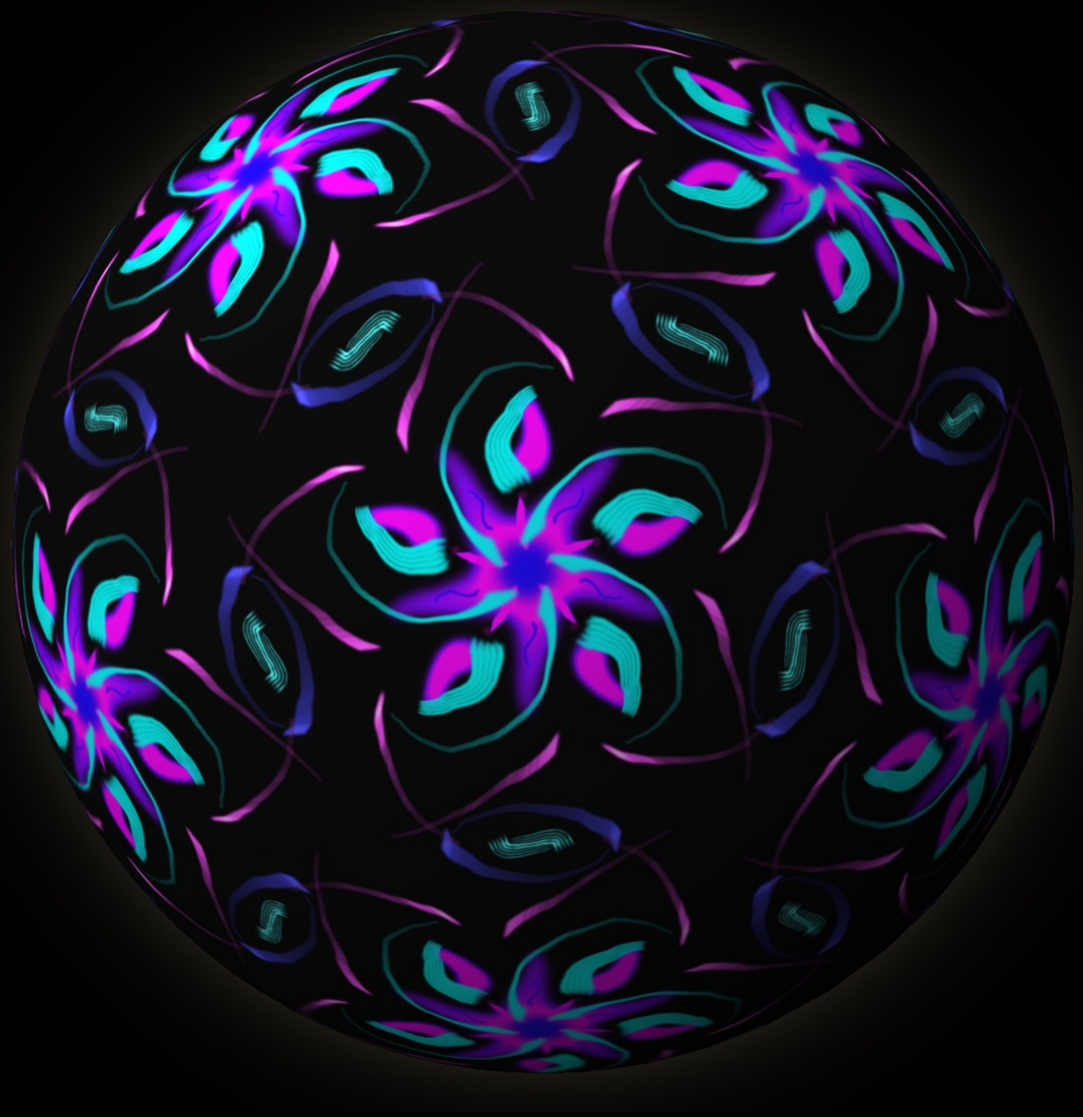
mathigon.org/go/wallpaper

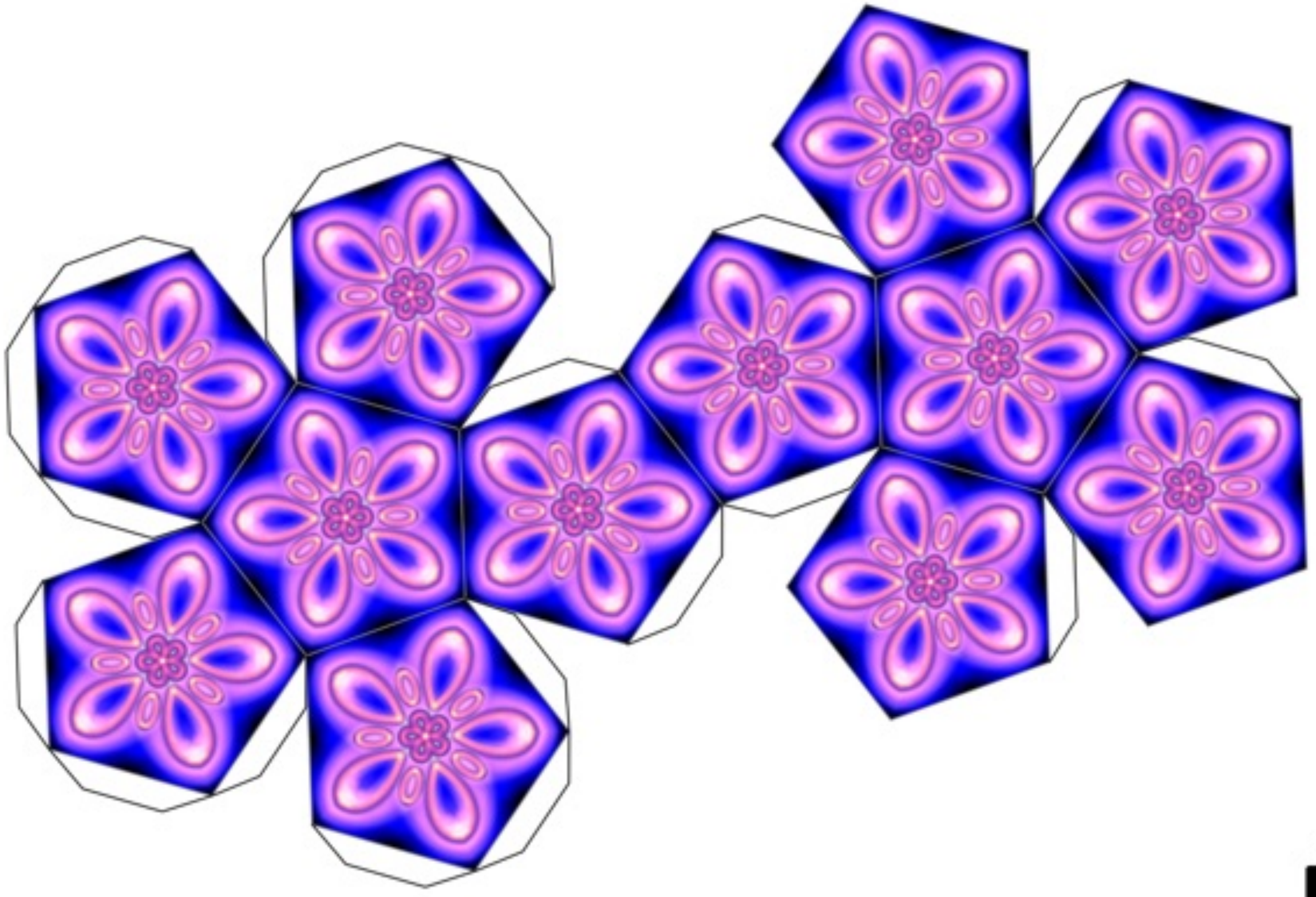


science-to-touch.com









Polyhedra

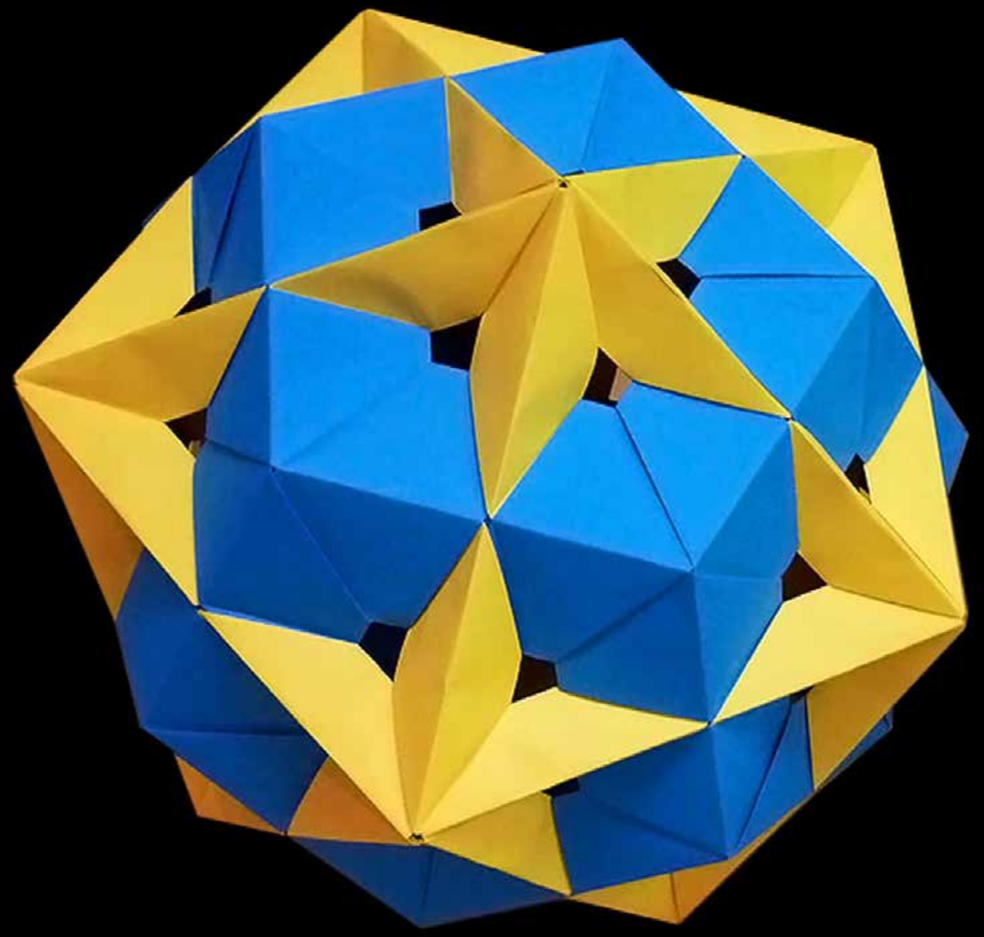
Volume

Surface Area

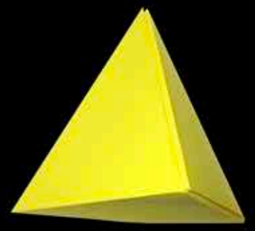
Nets/Cross Sections

Euler's Formula

5 Platonic Solids



mathigon.org/origami


Tetrahedron

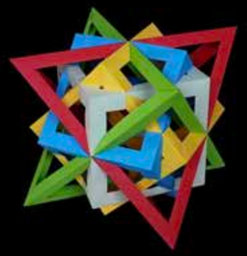

Cube


Octahedron


Dodecahedron

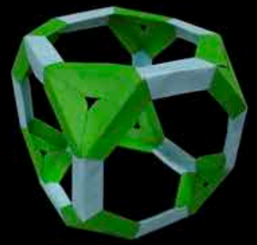

Icosahedron


Intersection of Four Cubes


Three Cubes and Two Tetrahedra


Truncated Tetrahedron


Cuboctahedron


Truncated Hexahedron


Truncated Octahedron


Rhombicuboctahedron


Intersecting Tetrahedra


Intersecting Cubes


Truncated Cuboctahedron


Snub Cube


Icosidodecahedron


Truncated Icosidodecahedron


Snub Dodecahedron


Intersecting Dodecahedra


Intersecting Planes

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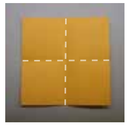
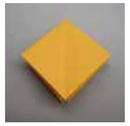
MATHIGON ORIGAMI
DRAGONS
★★★

more on mathigon.org/origami/

This model requires one quadratic sheet of paper.


Crease horizontally and vertically along centre.

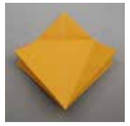

Flip over and fold along both diagonals.


Put two opposite corners on top of each other, to create a smaller square.


Fold the bottom edges towards the centre.


Repeat previous step on opposite side.


Fold top triangle down.


Unfold the previous three steps.


Fold the bottom corner upwards.


Repeat previous step on opposite side.


Fold top two edges towards the centre.


Repeat previous step on opposite side.


'Close' the front two sides and repeat on the back.


Rotate by 180° and fold the first wing.


Fold top edges towards centre as shown.


Repeat previous two steps to create the second wing.


Fold up the neck of the dragon.


Fold neck twice in opposite directions for the head.

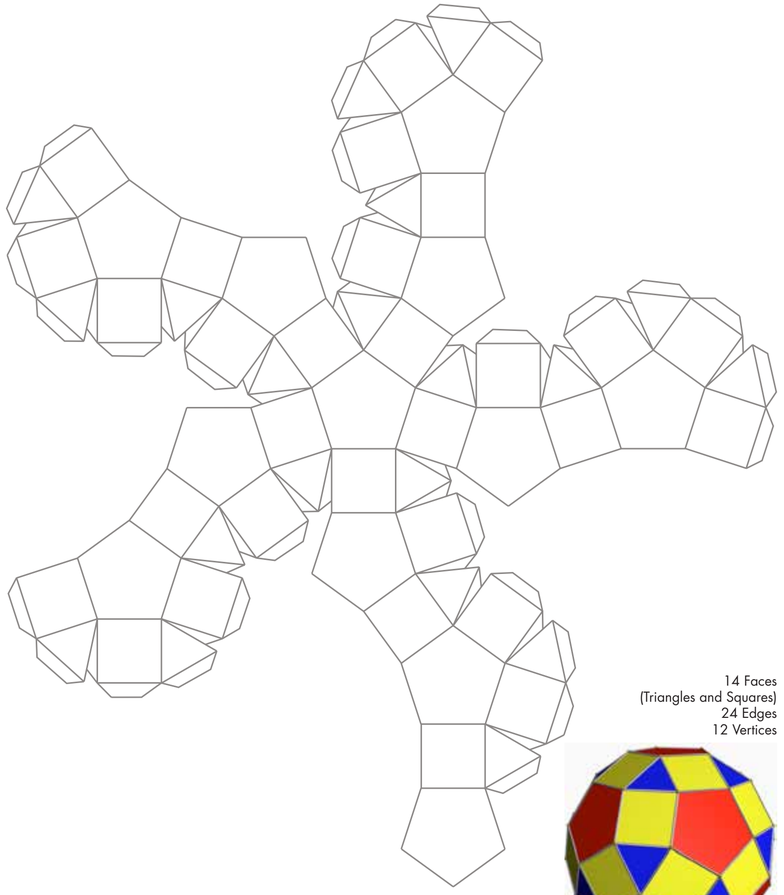

Fold the tail upwards.


Add additional creases to both wings.


This is the final Origami Dragon.

MATHIGON ORIGAMI
RHOMBICOSIDODECAHEDRON

more on mathigon.org/origami/



14 Faces
(Triangles and Squares)
24 Edges
12 Vertices

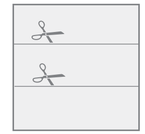
MATHIGON ORIGAMI
5 INTERLOCKING TETRAHEDRA
★★★★

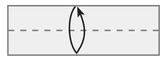
more on mathigon.org/origami/

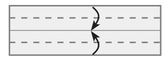
This model consists of the interlocking frames of five tetrahedra. It is one of the most difficult models on Mathigon.org, but also the most impressive.

Every tetrahedron is made out of six strips of paper with dimensions in the ratio 1:3. These can be created by cutting a square into three parts. We recommend that you use different colours for every tetrahedron, which means you need two squares in each of five colours.

Once you have created all 5 × 6 = 30 strips, they each need to be folded as follows:



1

Fold along centre, then unfold.

2

Fold both edges towards centre, don't open.

3

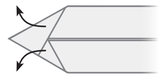
Fold both edges towards centre again, unfold.

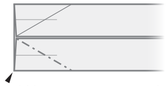
4

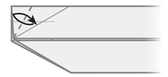
Fold bottom corner onto line in centre of top half.

5

Repeat for top corner.

6

Unfold.

7

Fold bottom corner inwards.

8

Fold top corner as shown.

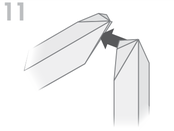
9

Rotate unit and repeat steps 3 to 8 at opposite end.

10

Fold entire unit along its centre.

Each of these 30 units will form the edge of one tetrahedron. At every vertex, three units link together:

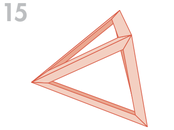
11


12


13


14


Now start connecting all units colour by colour, to form the five interlocking tetrahedra.

15

Connect all 6 units in any one colour to make the first tetrahedron.

16

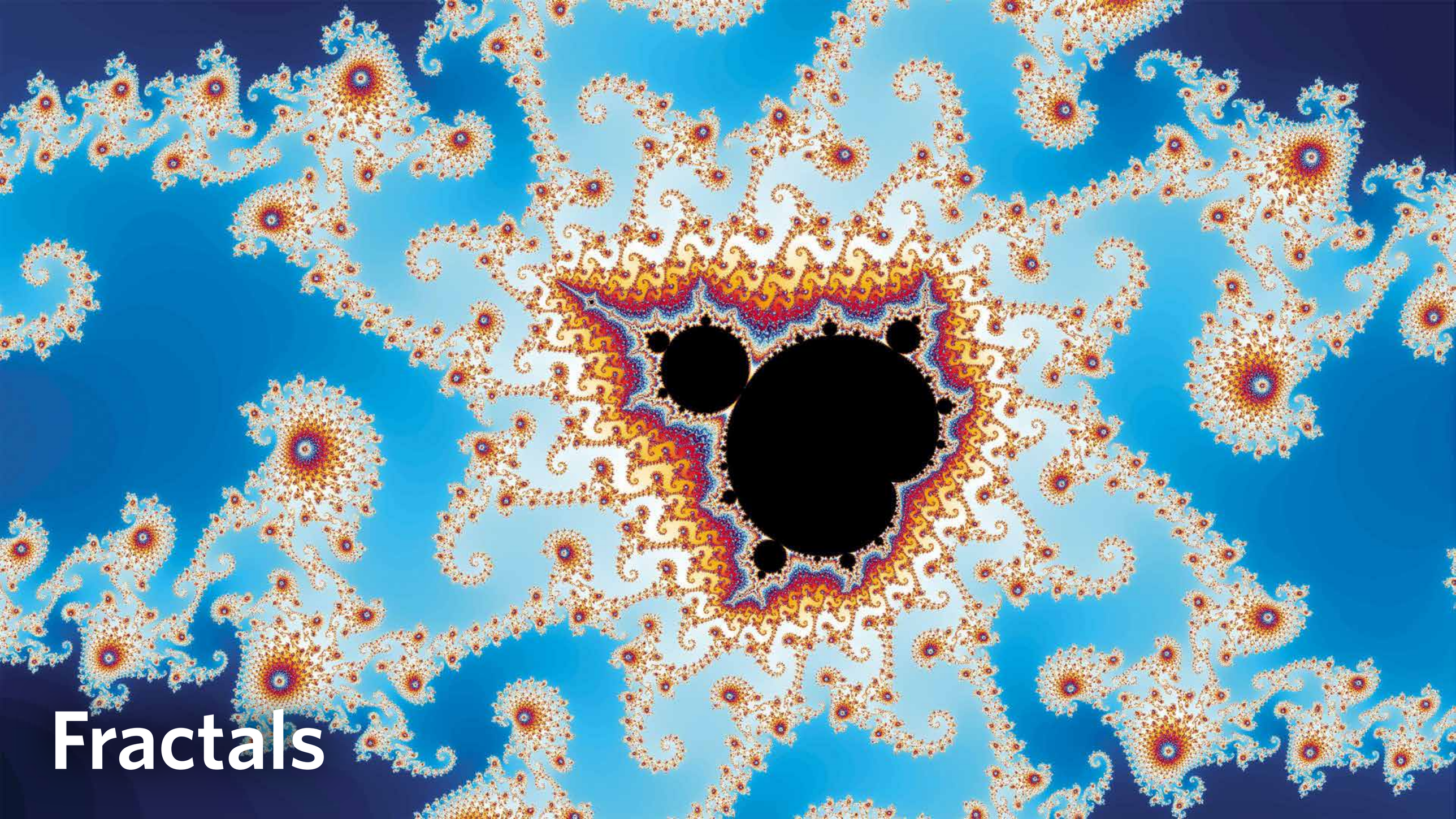

17

For the second and third tetrahedra, first create one corner ('tripod') and interlink it with the existing shape. Then lock it in place using the remaining three edges of that colour.

18

Add the fourth and fifth Tetrahedra in a similar way.

Modular Origami

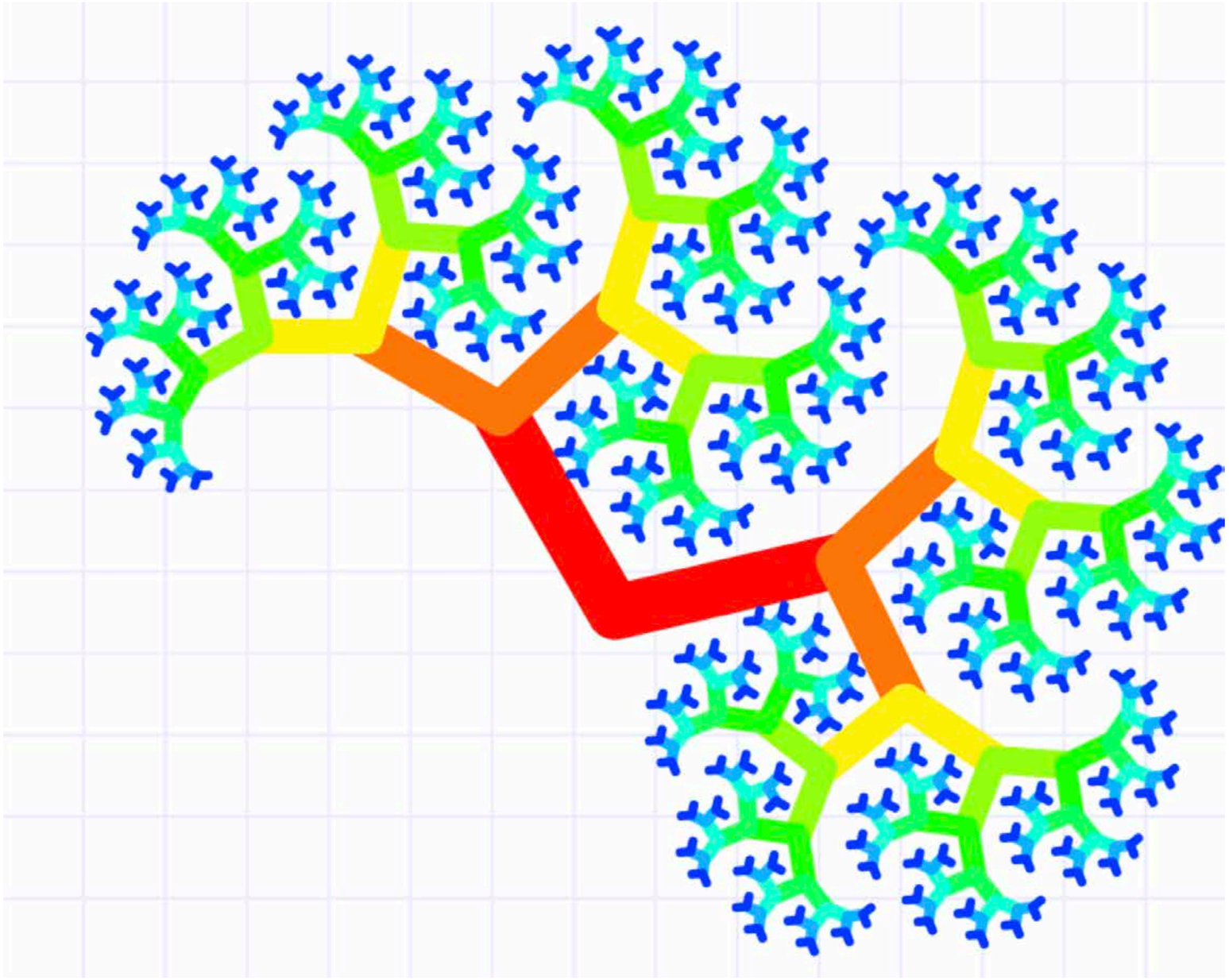


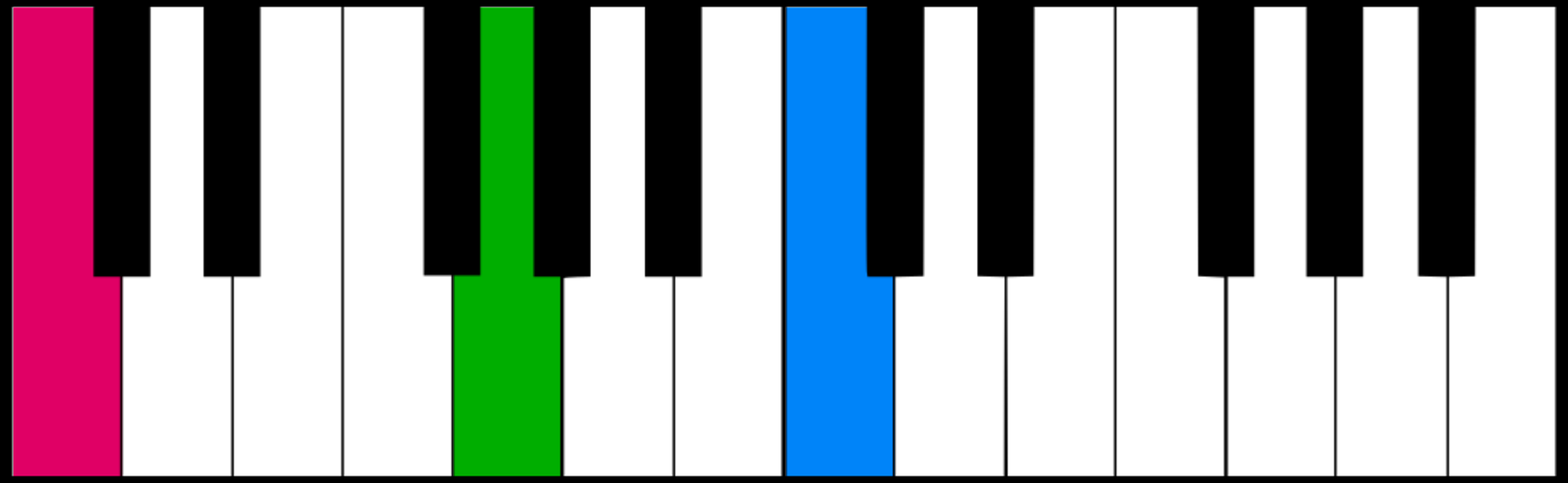
Fractals

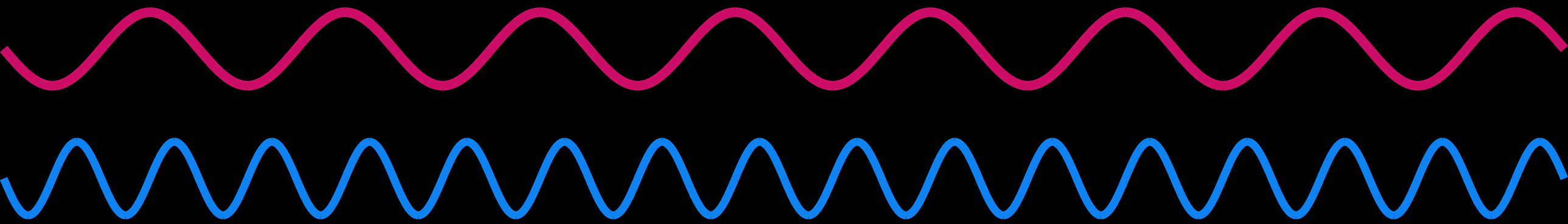
```
MandelComp = Compile[
    {{c, _Complex}},
    Module[{num = 1},
    FixedPoint[(num++;#^2 + c)&, 0, 8191, SameTest->(Re[#]^2 + Im[#]^2>=4&)];
    num],
    CompilationTarget->"C",
    RuntimeAttributes->{Listable},
    Parallelization->True
];

Mandelbrot[x_, y_, m_]:=ArrayPlot[
    MandelComp[Table[a + I b,
        {b, y - 2.7 * 2^-m, y + 2.7 * 2^-m, 0.005 * 2^-m},
        {a, x - 4.8 * 2^-m, x + 4.8 * 2^-m, 0.005 * 2^-m}(*0.002*)
    ]] / 8192,
    ColorRules->{1->Black},
    ColorFunction->MandelColor ,
    ColorFunctionScaling->False,
    Frame->False,
    PixelConstrained->1
];
```

visnos.com/demos/fractal

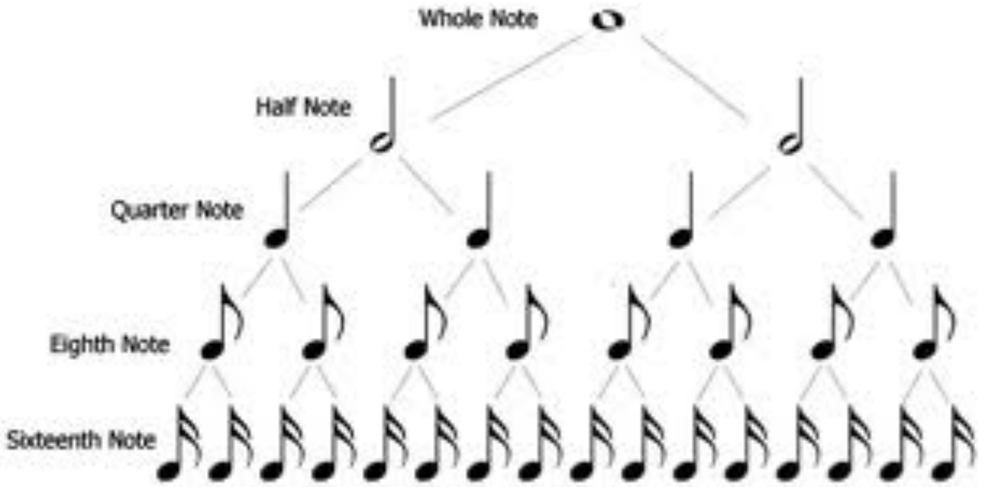






$$\sqrt[12]{2}$$

$1.49830707\ldots \approx 1.5$



RHYTHM ADDITION LEVEL 1

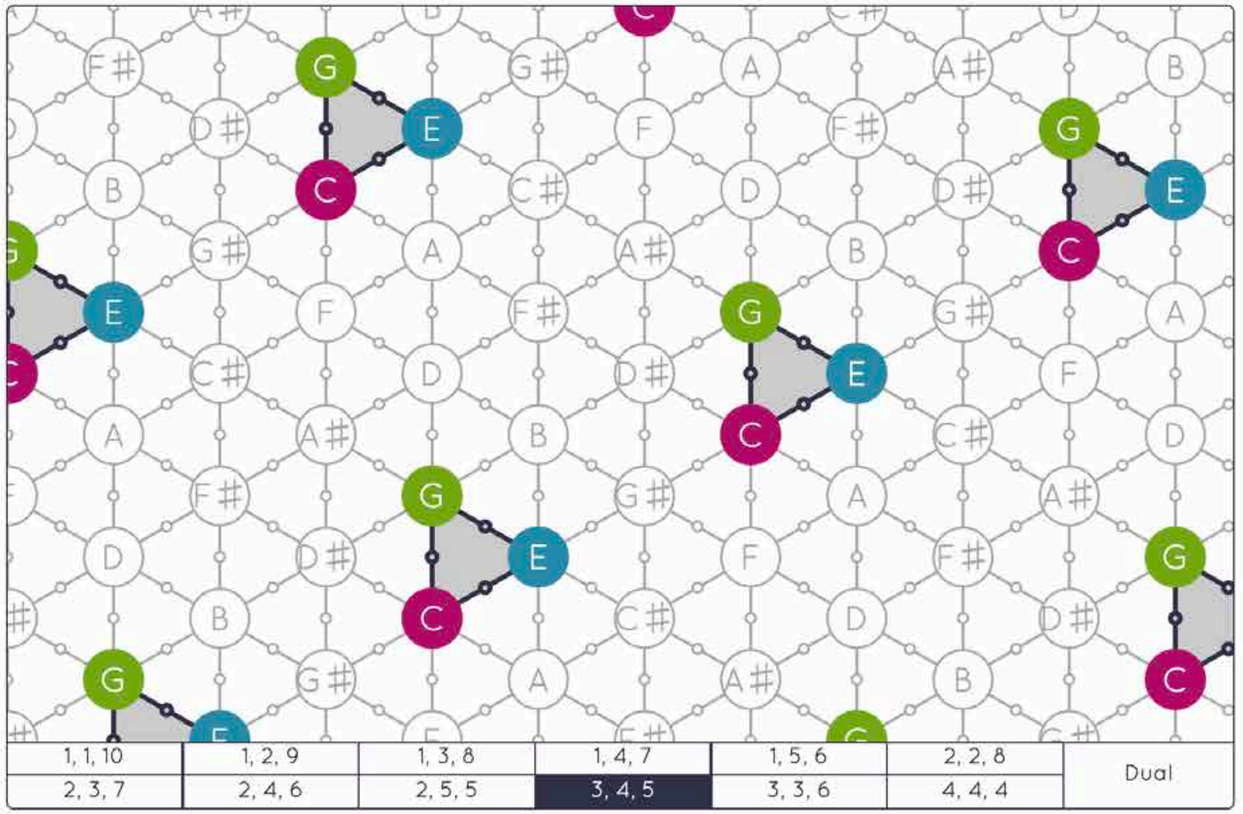
Directions: add the total number of beats in each problem.

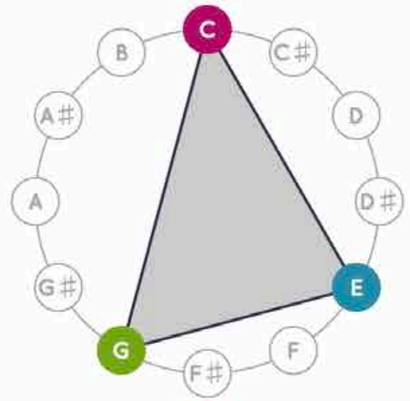
Name _____ Class _____

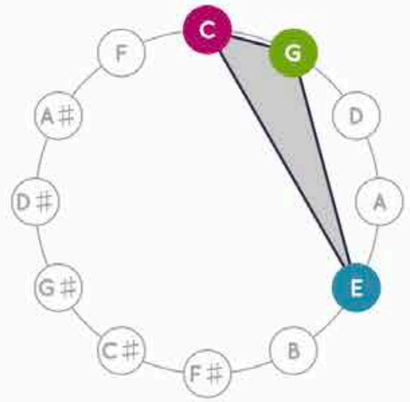
1. ♩ + ♩ = ☐	6. ♩ + ♩ + ♩ = ☐
2. ♩ + 𝄽 = ☐	7. 𝄽 + 𝄽 + 𝄽 = ☐
3. ♫ + ♩ = ☐	8. ♫ + ♫ + ♫ = ☐
4. 𝄽 + 𝄽 = ☐	9. ♫ + ♩ + 𝄽 = ☐
5. 𝄽 + ♫ = ☐	10. ♩ + ♫ + ♩ = ☐

Rhythm

imaginary.github.io/web-hexachord/







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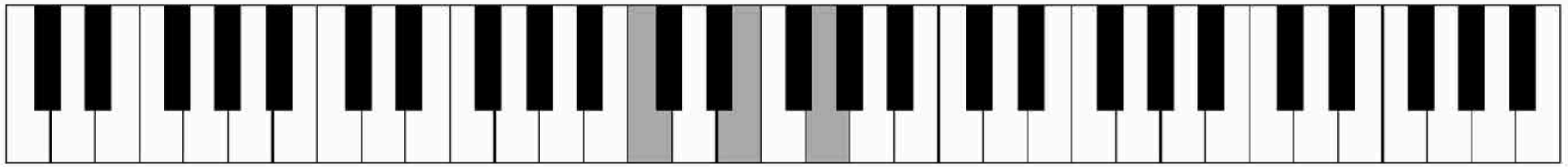

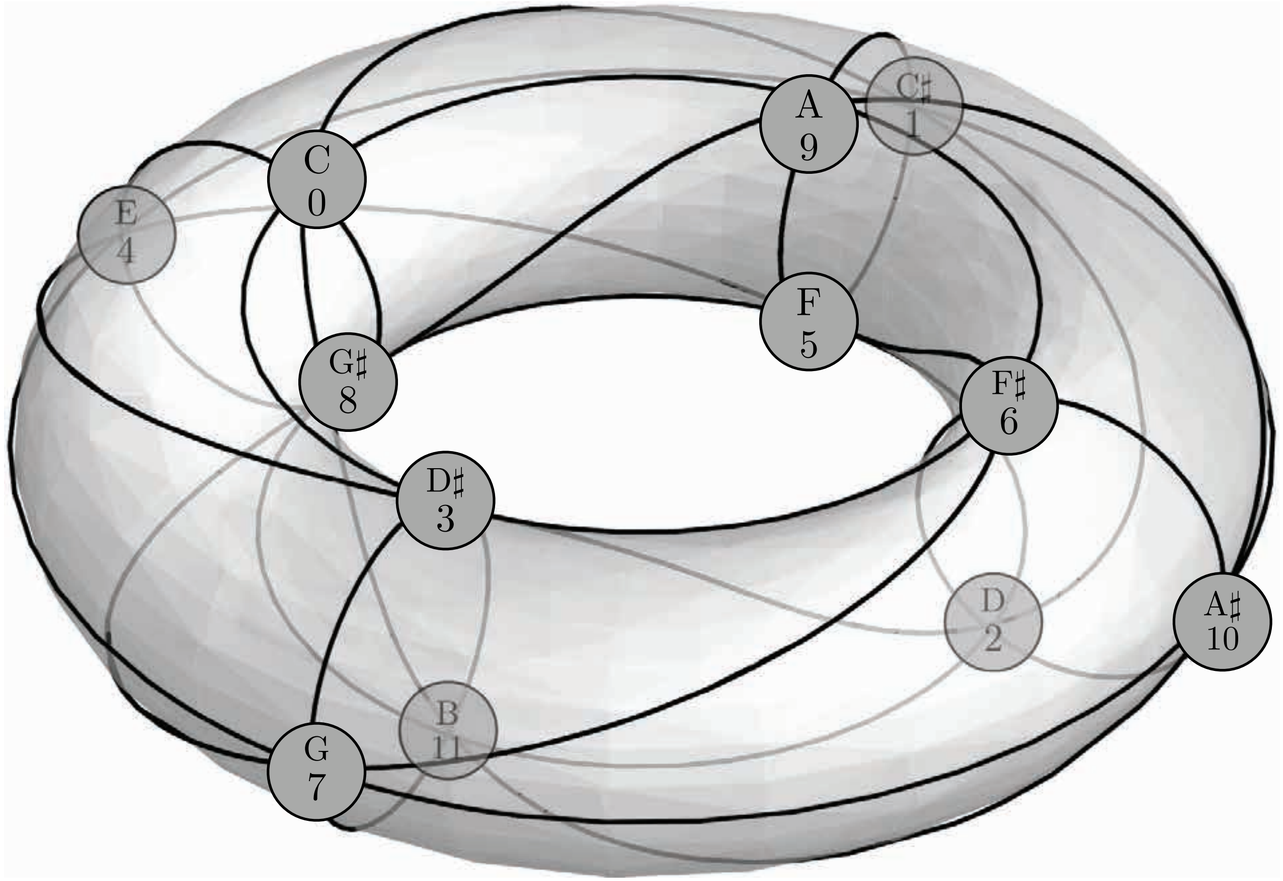
A
9
C♯
1
C
0
E
4
F
5
G♯
8
F♯
6
D♯
3
D
2
A♯
10
B
11
G
7


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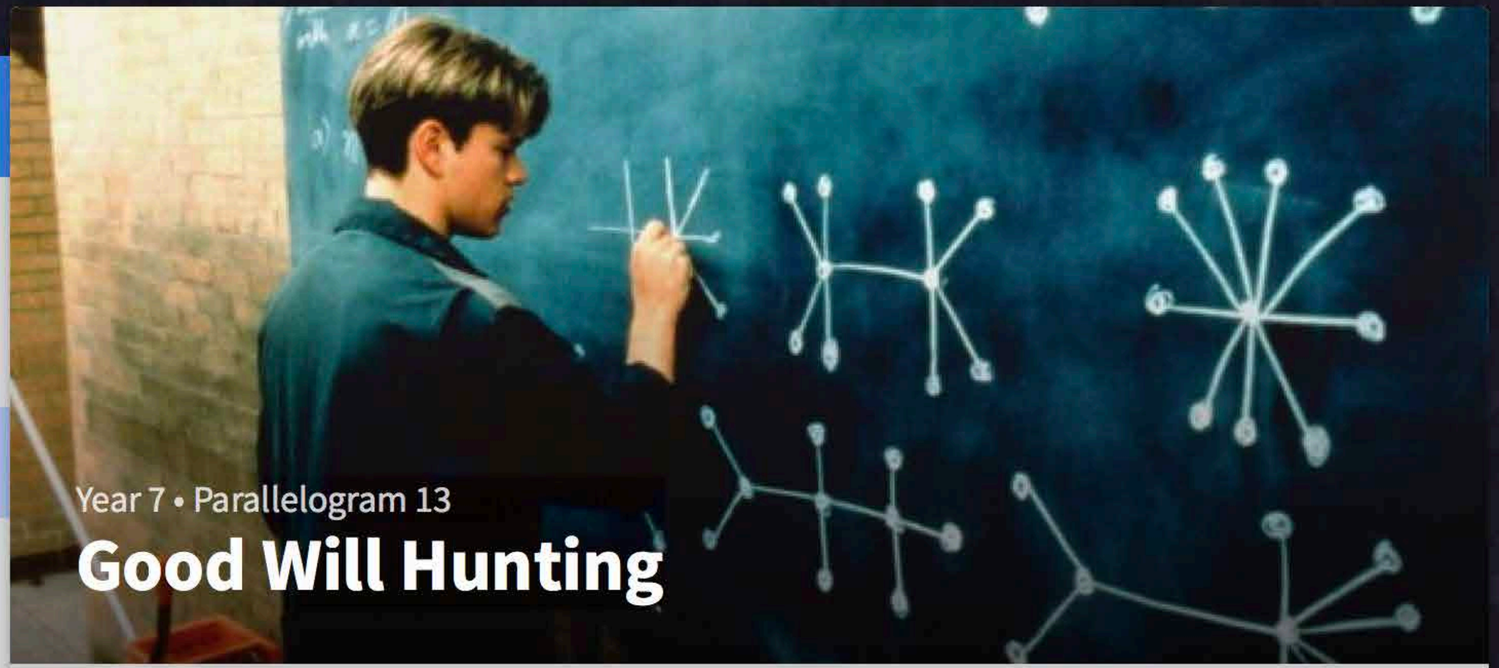

Year 7 • Parallelogram 13

Good Will Hunting

Noun: Parallelogram **Pronunciation**: /ˌparəˈlɛləgram/

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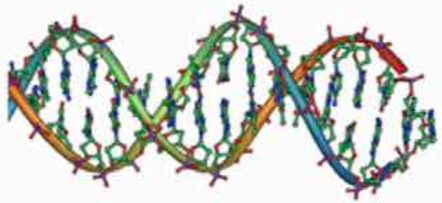

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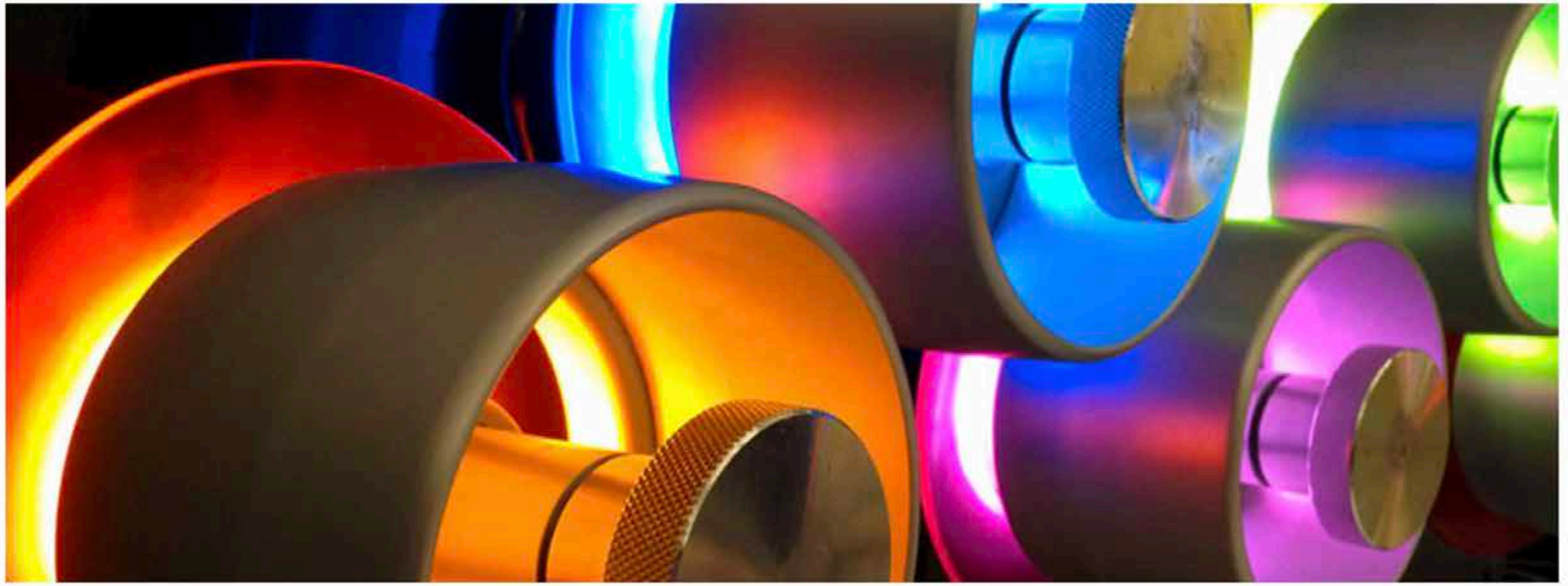

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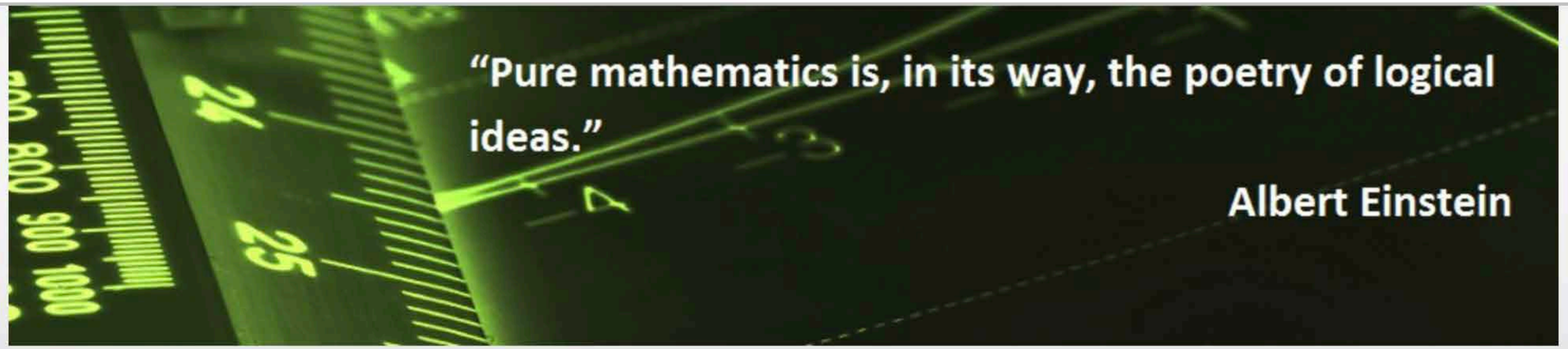

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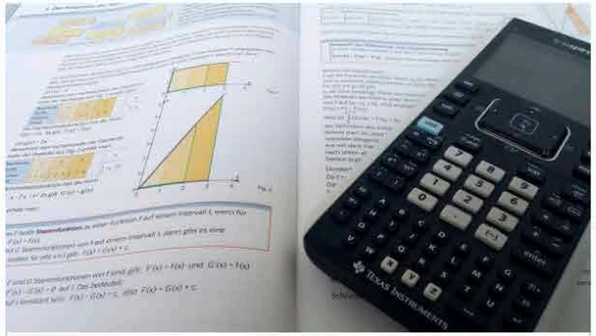

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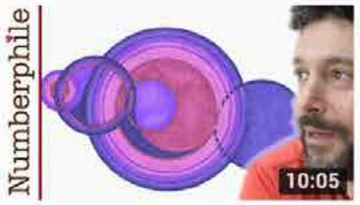

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