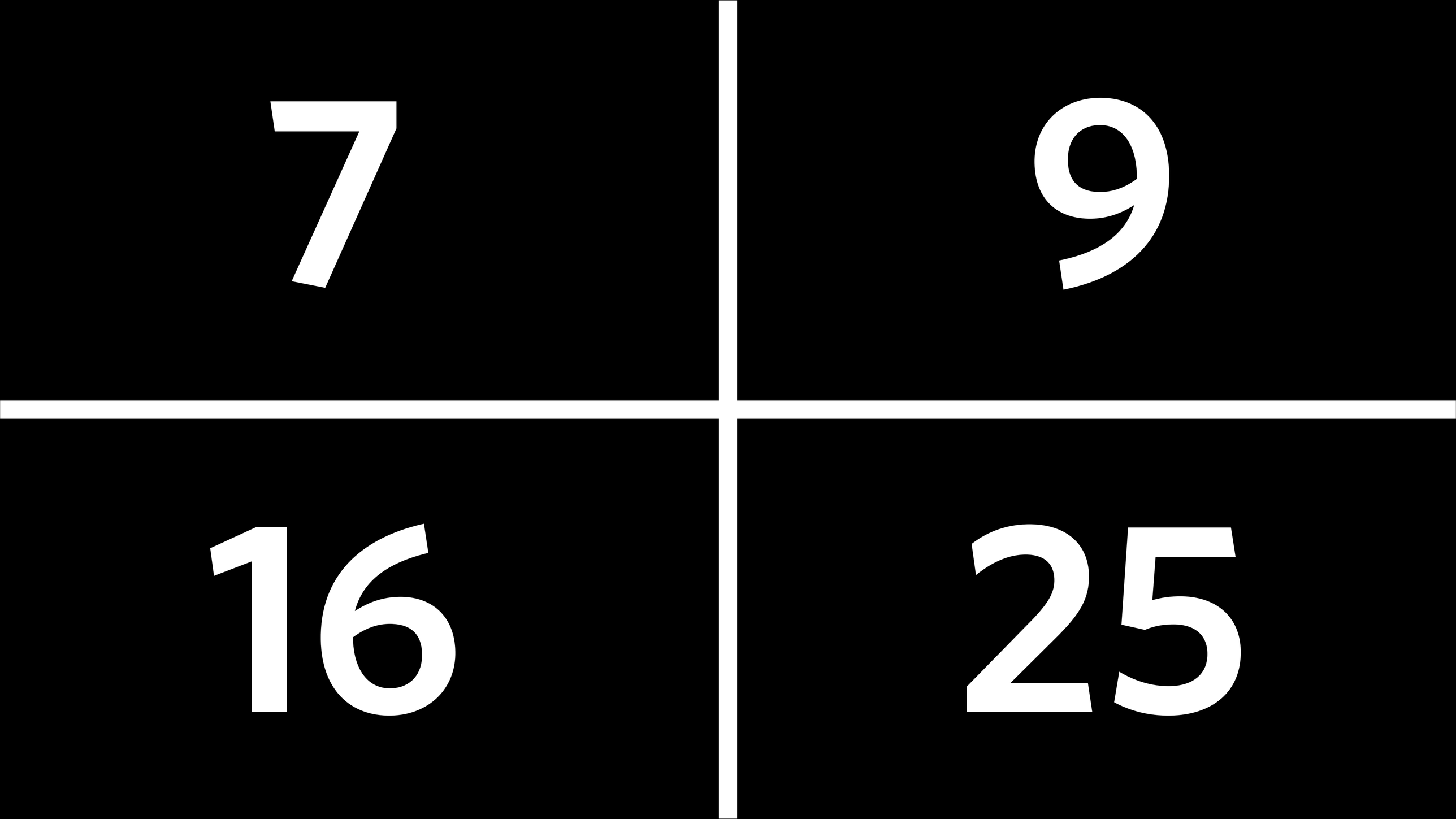
Mathematical Creativity

LaSalle MathsConf – 12 October 2019

Philipp Legner, @MathigonOrg

Mathigon.org


7
9
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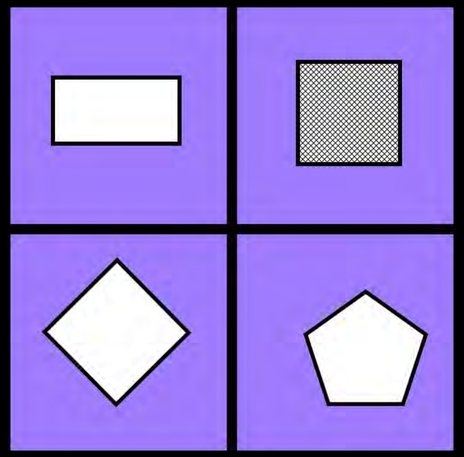
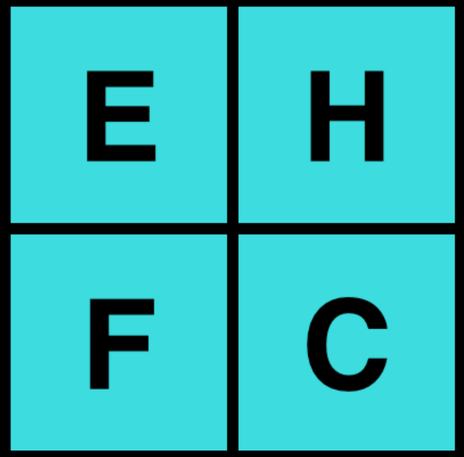
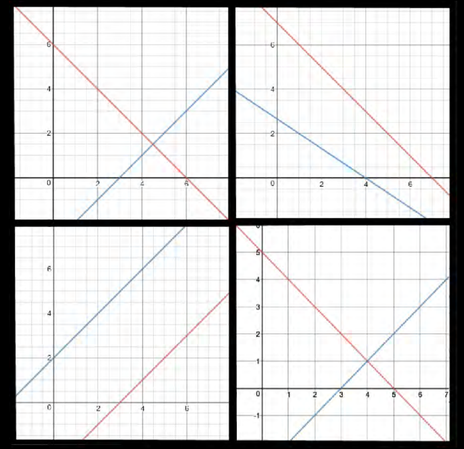
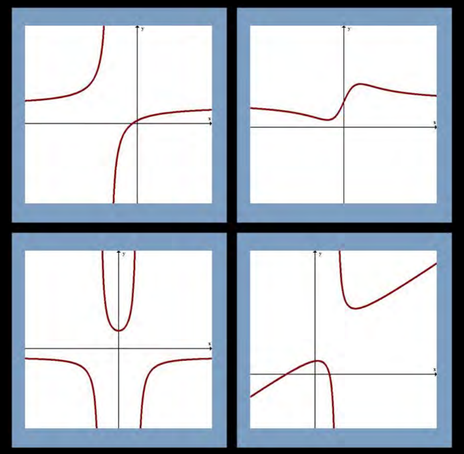
25

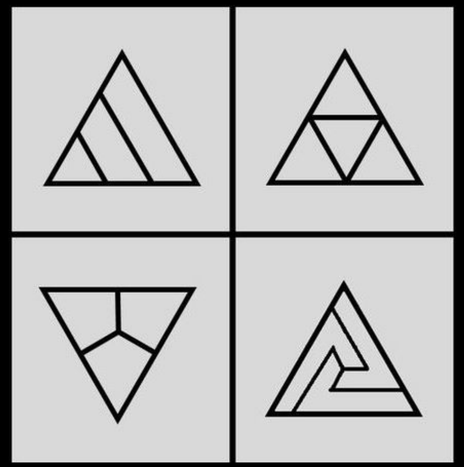
wodb.ca

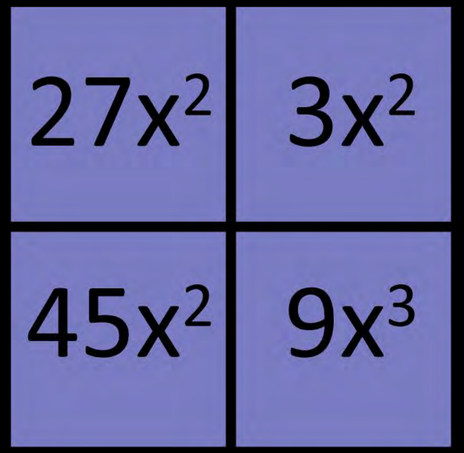








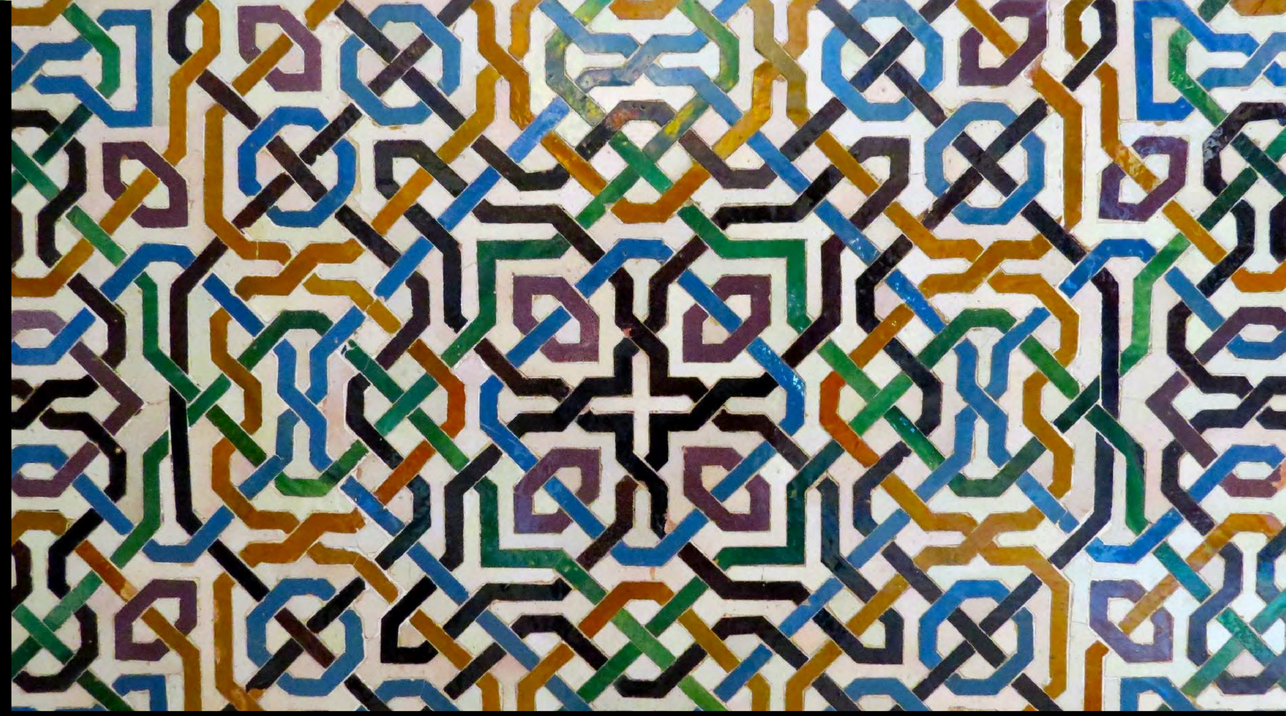


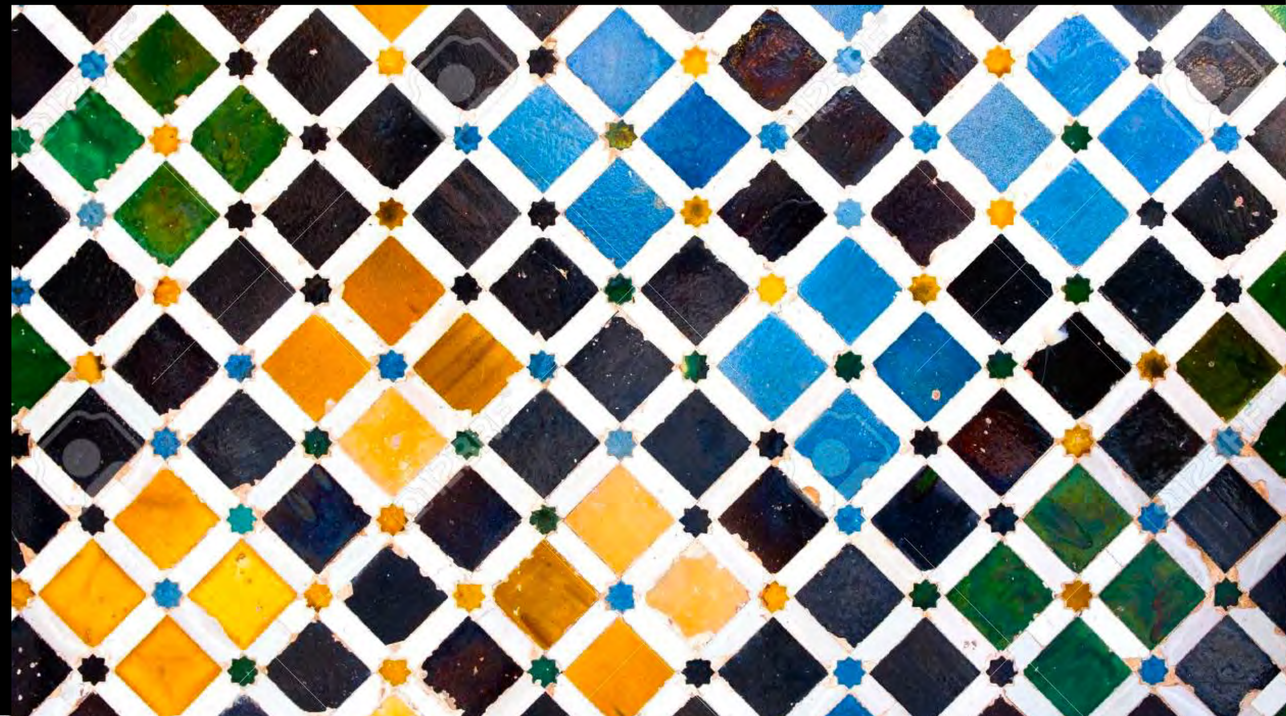



彩虹活動中心

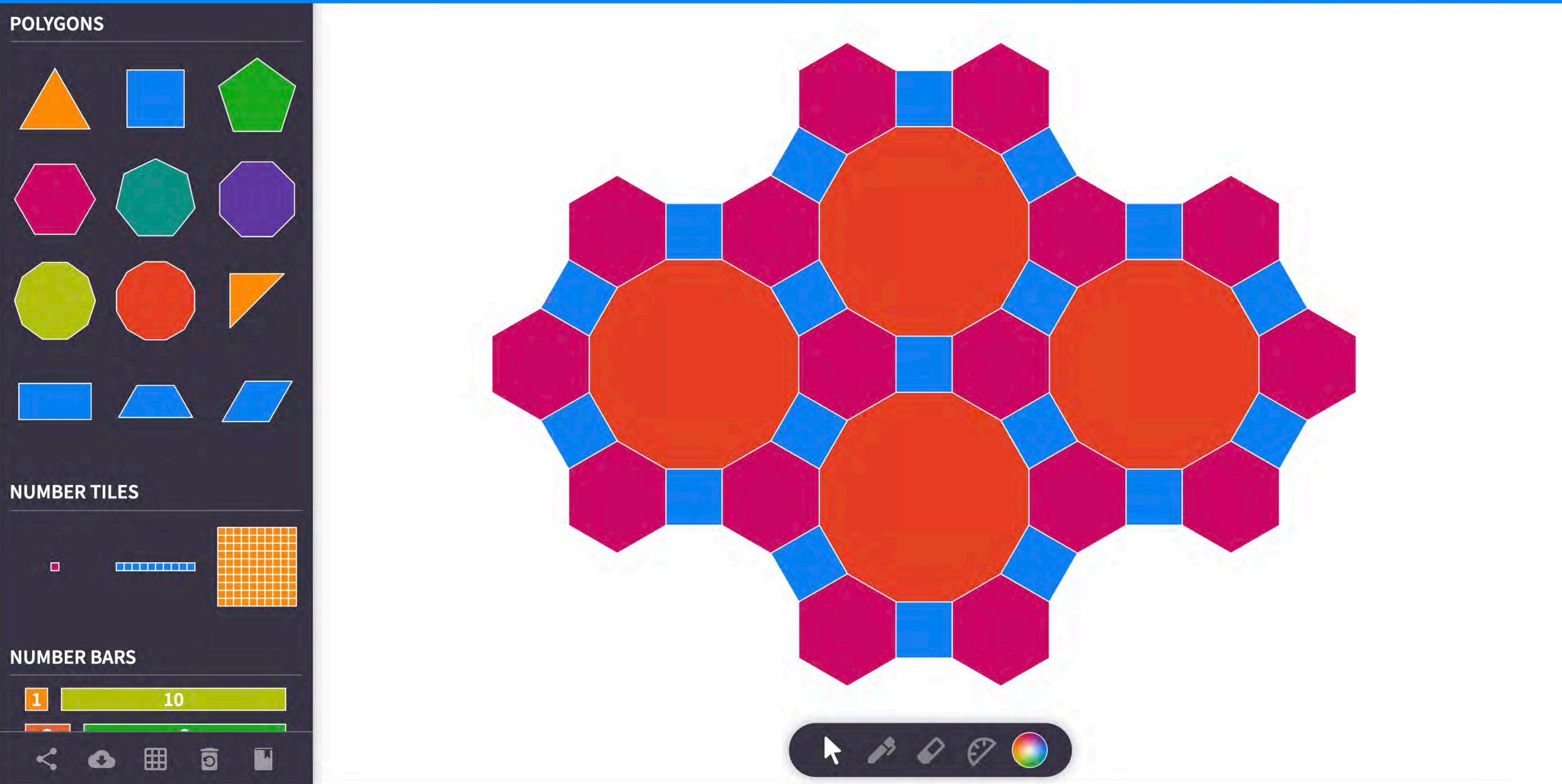

(1) Creative Arts

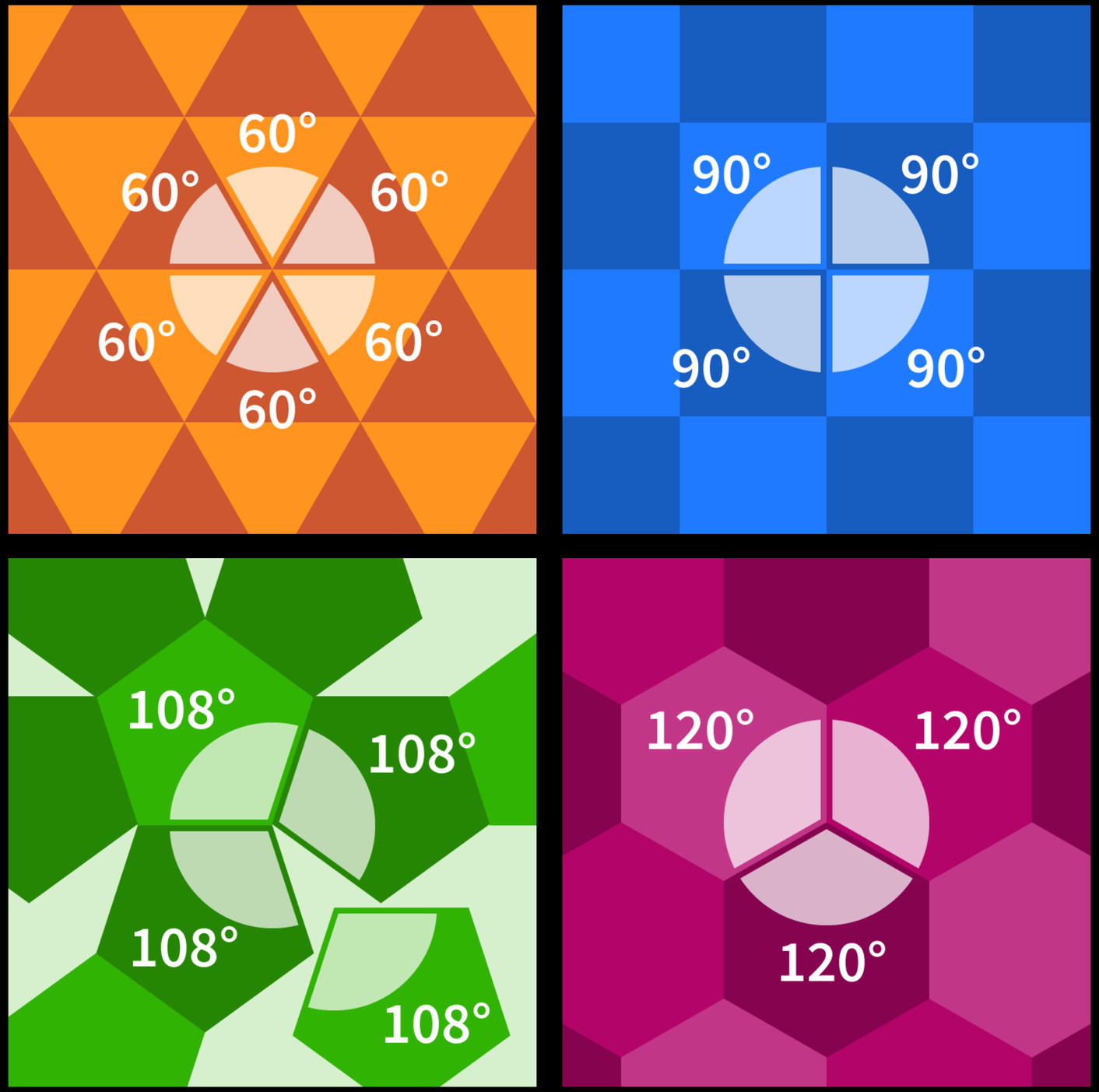
Tessellations



mathigon.org/polypad




60°
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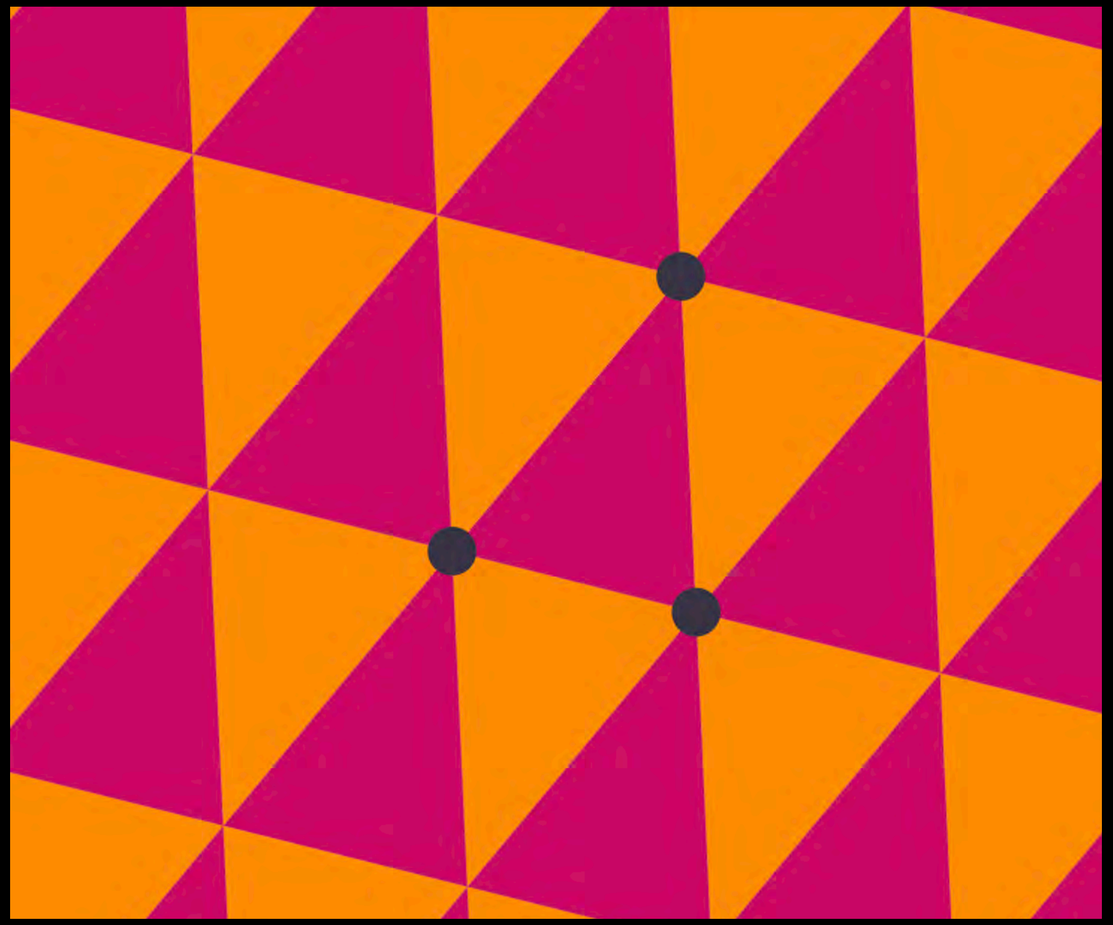
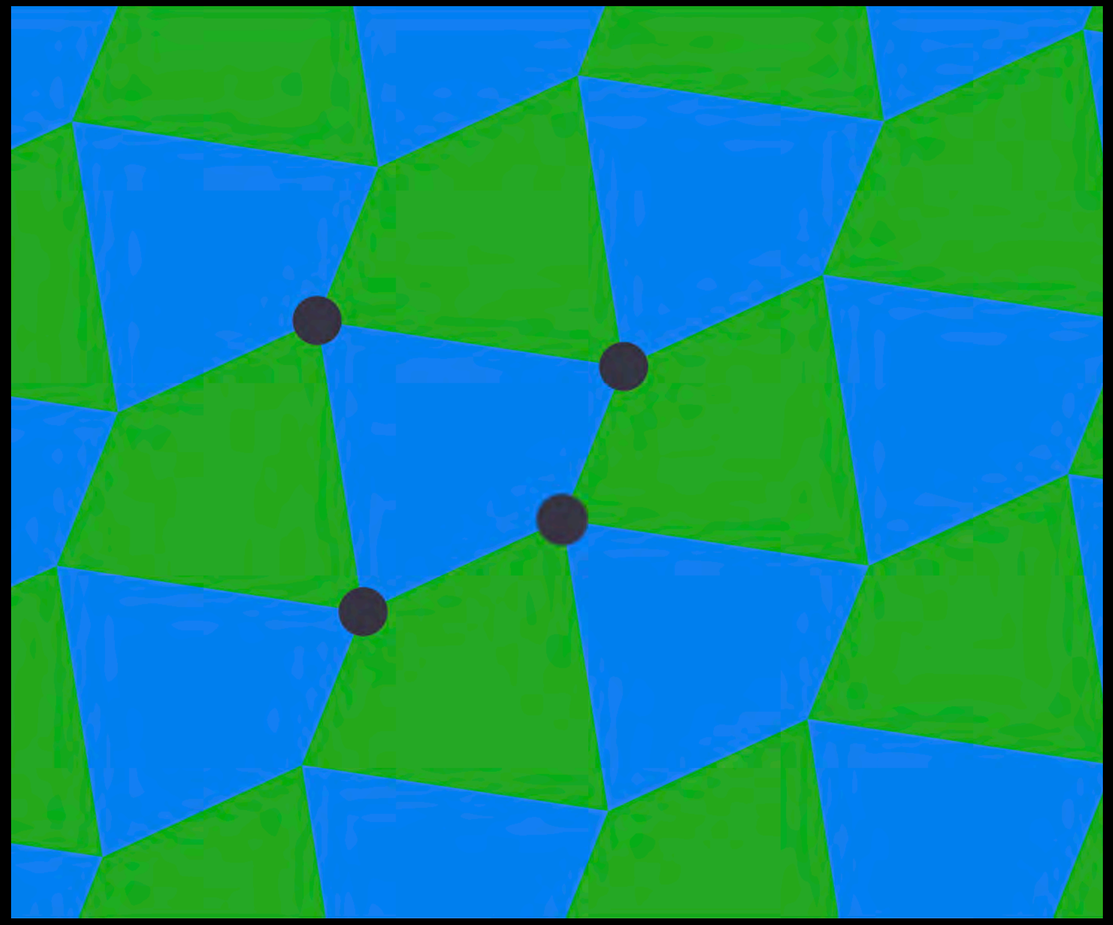
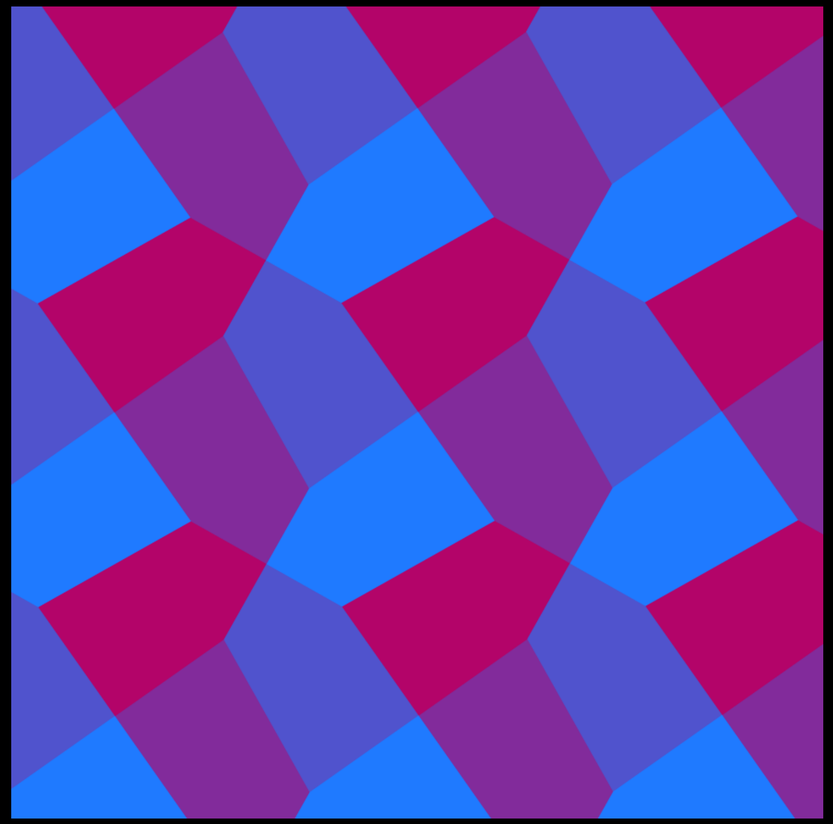
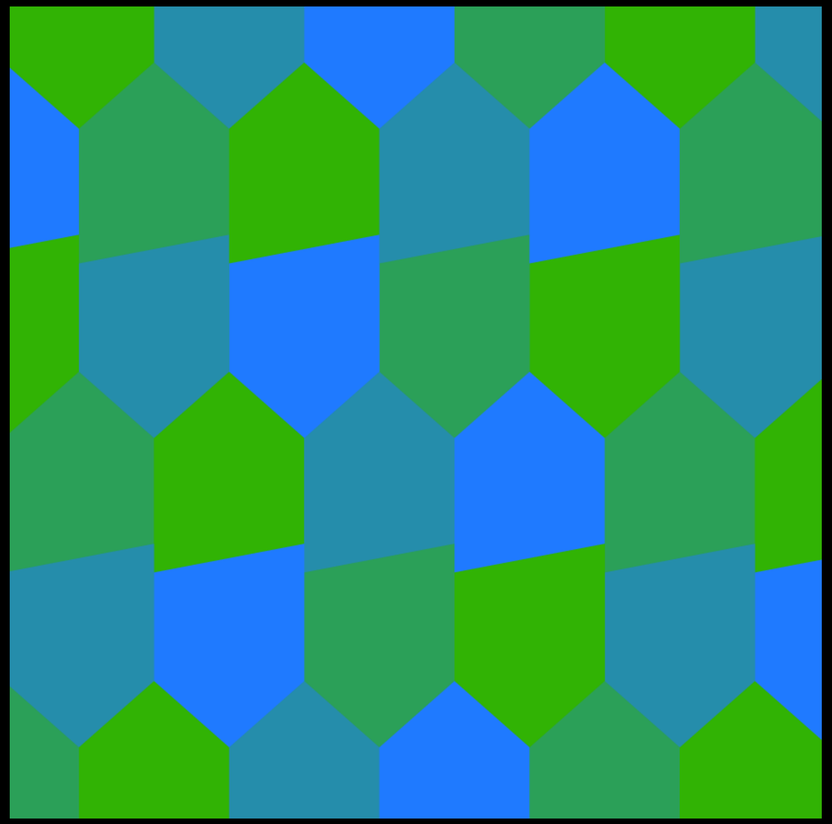
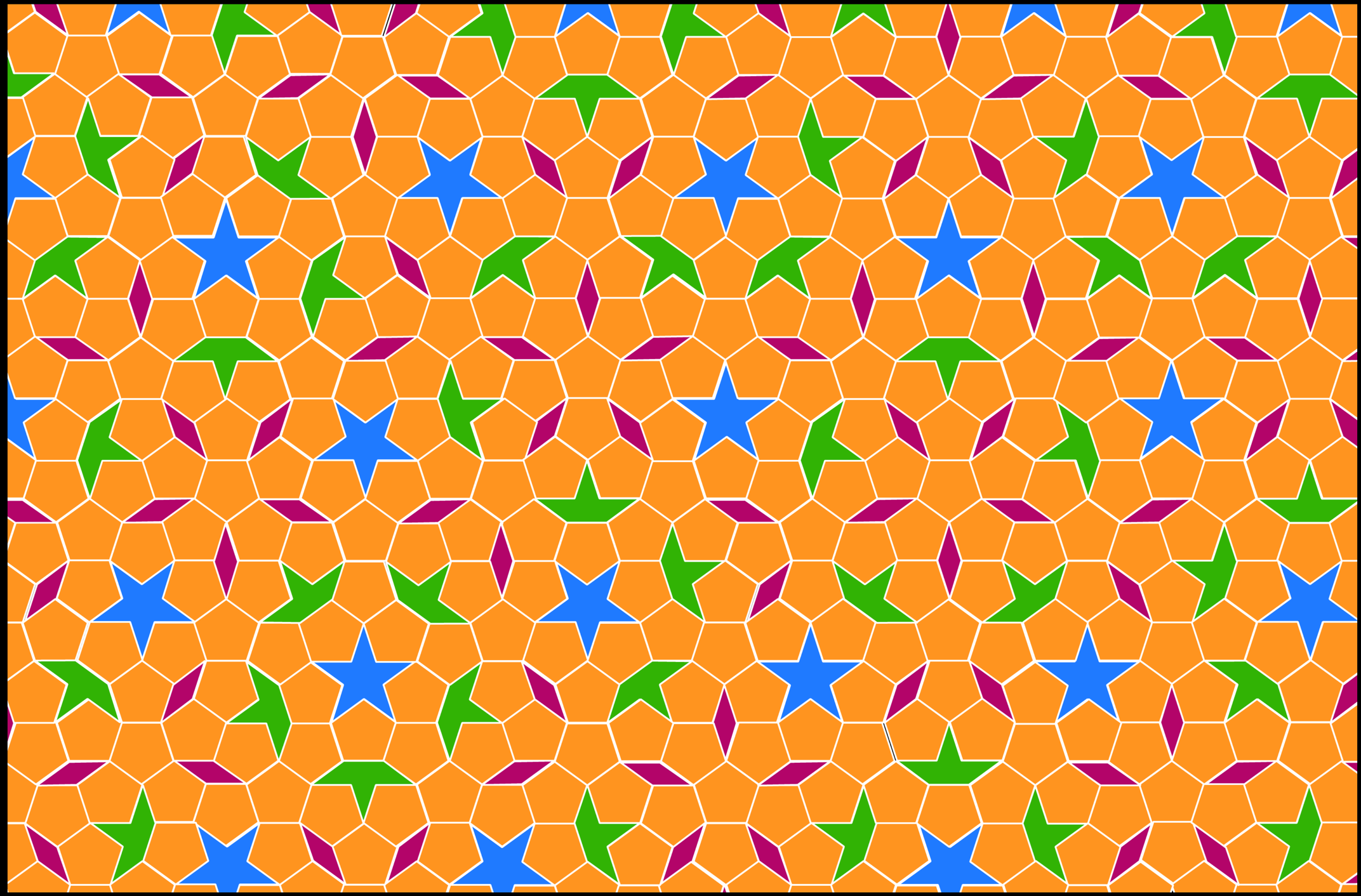
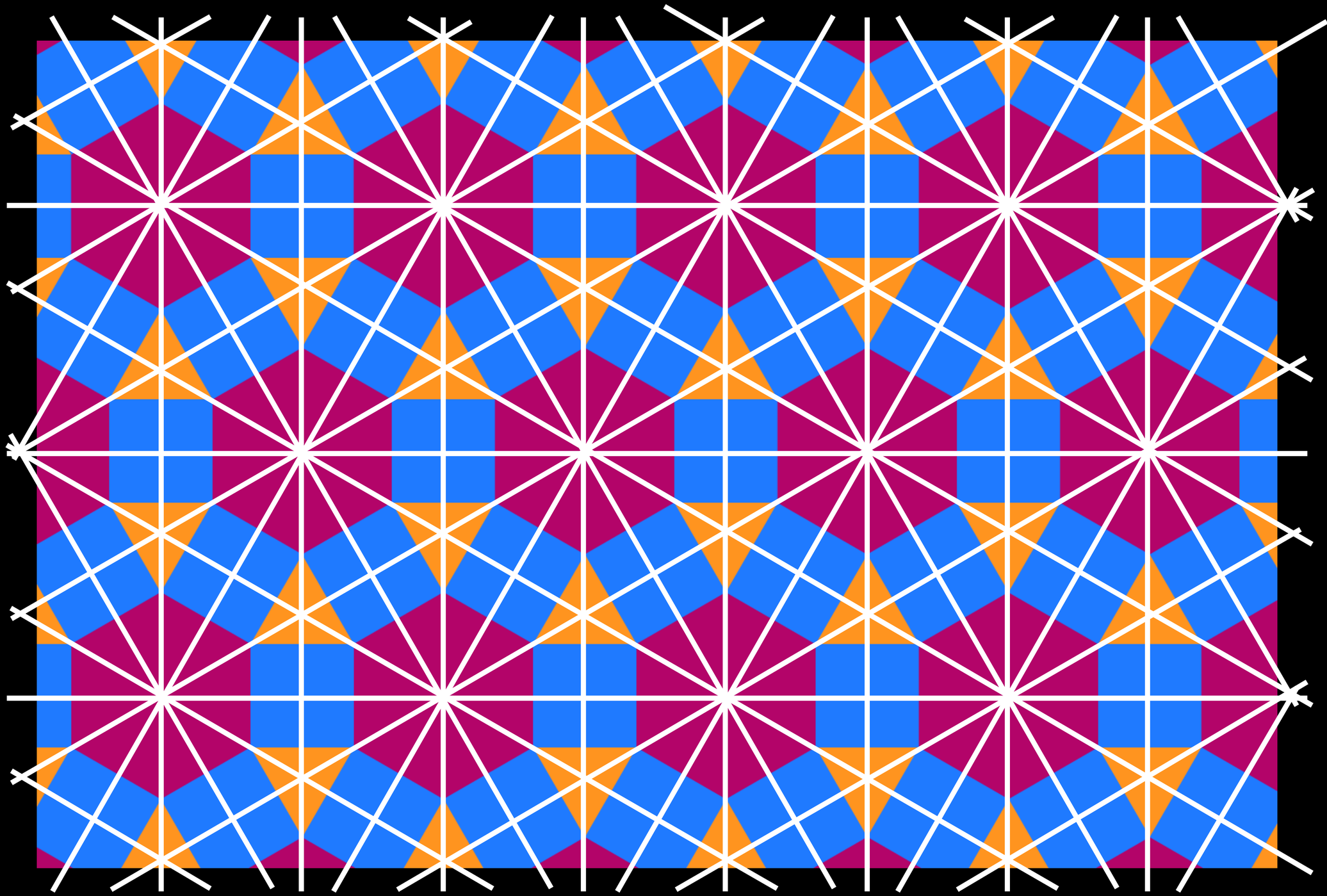






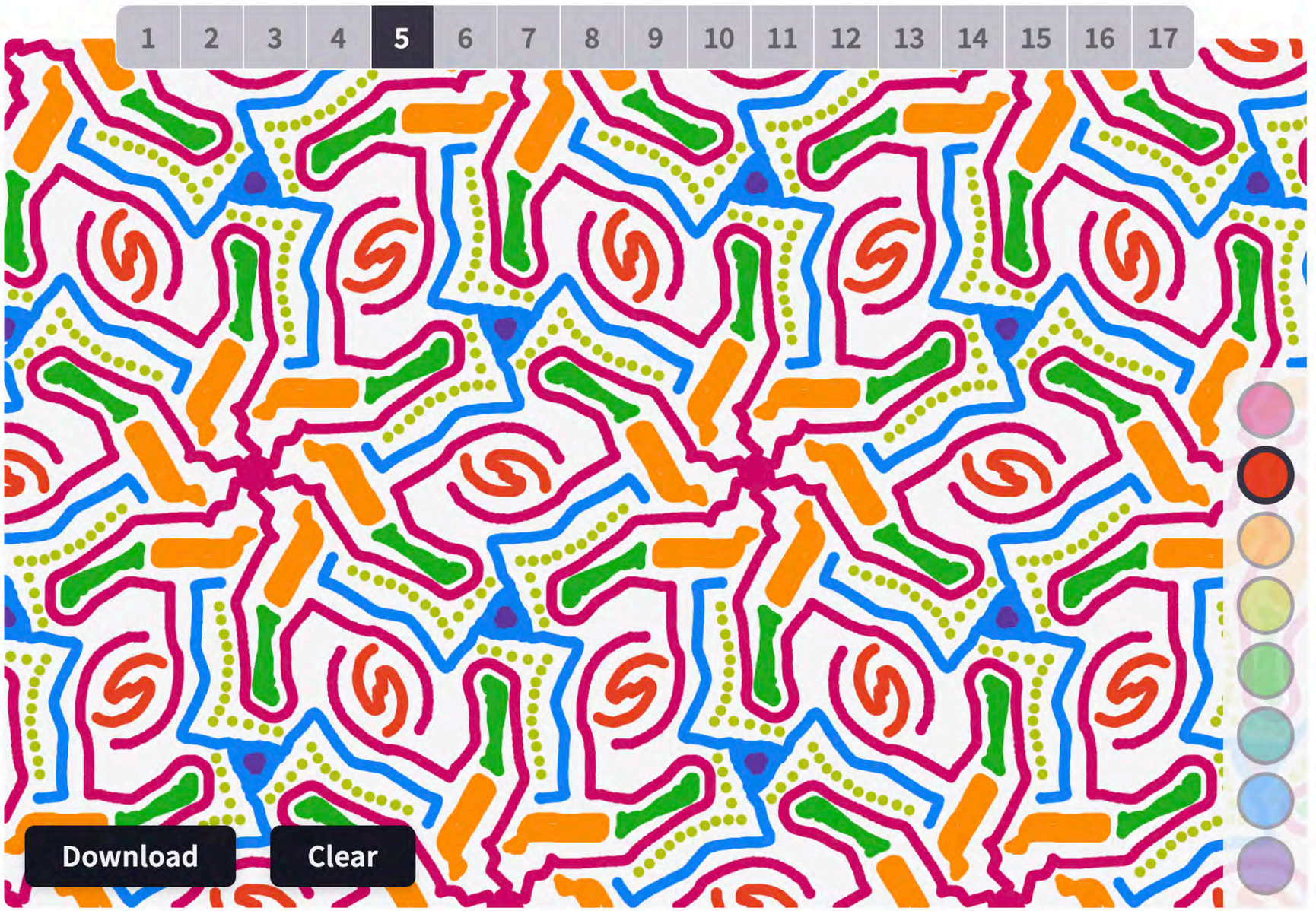




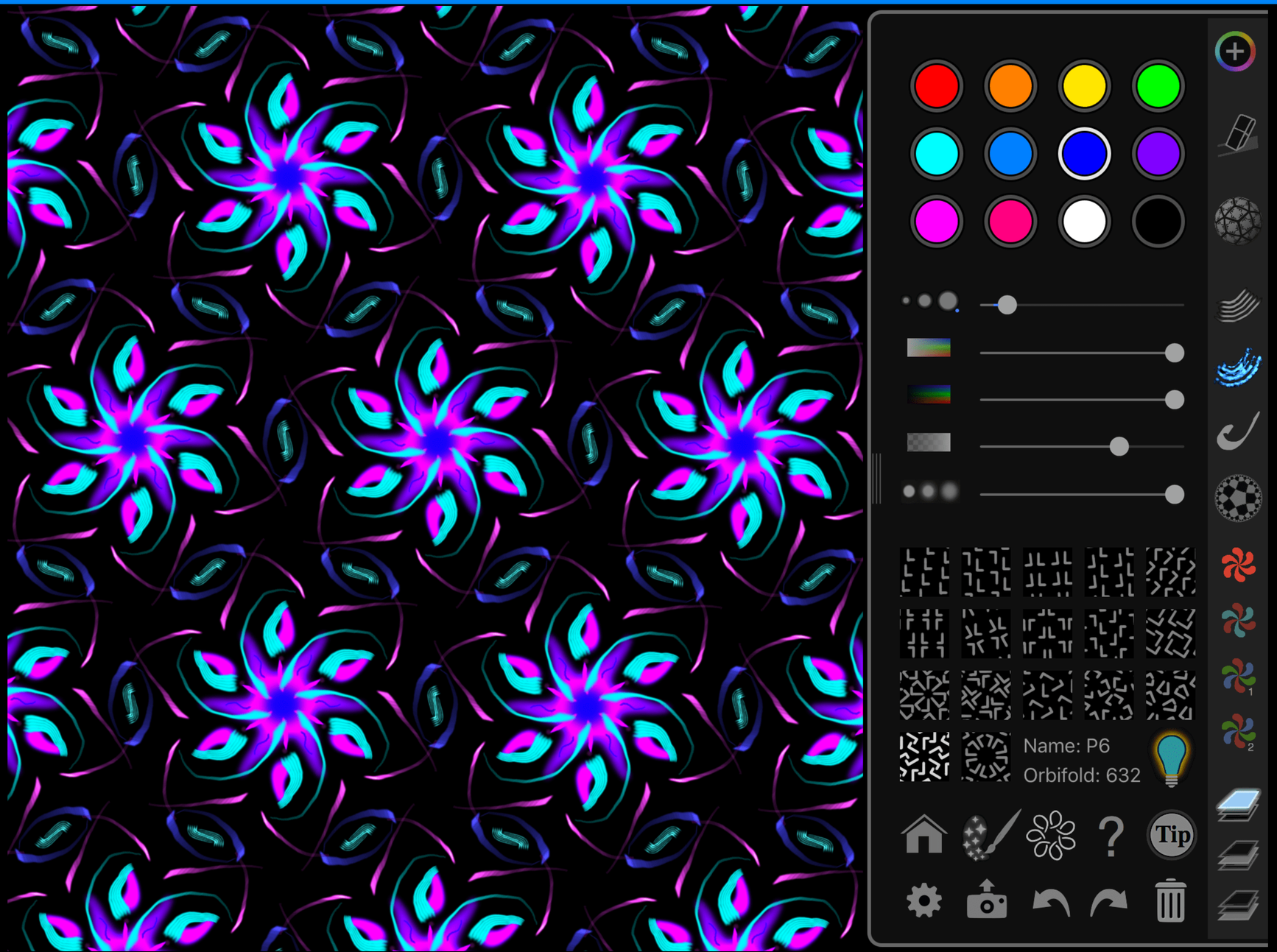


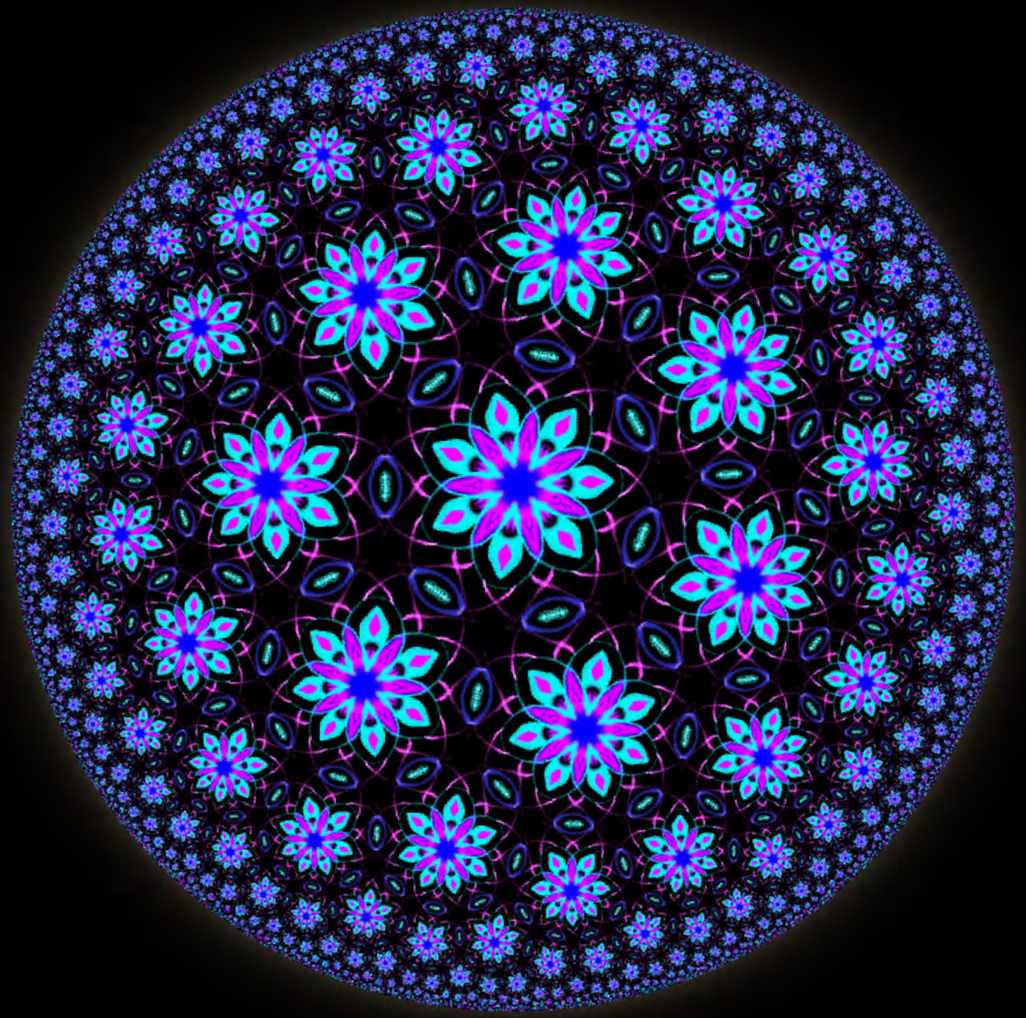

17 Wallpaper Groups

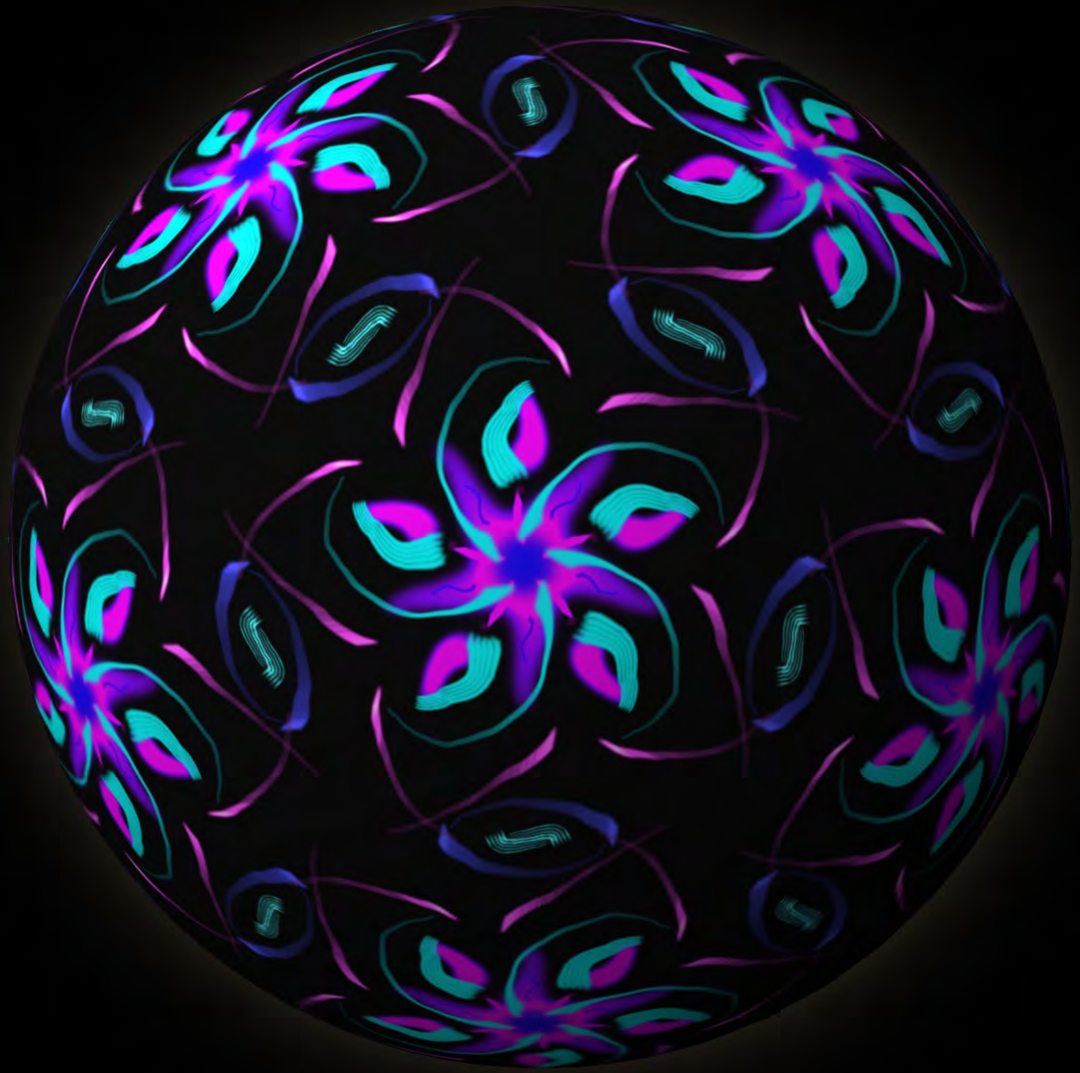
mathigon.org/go/wallpaper

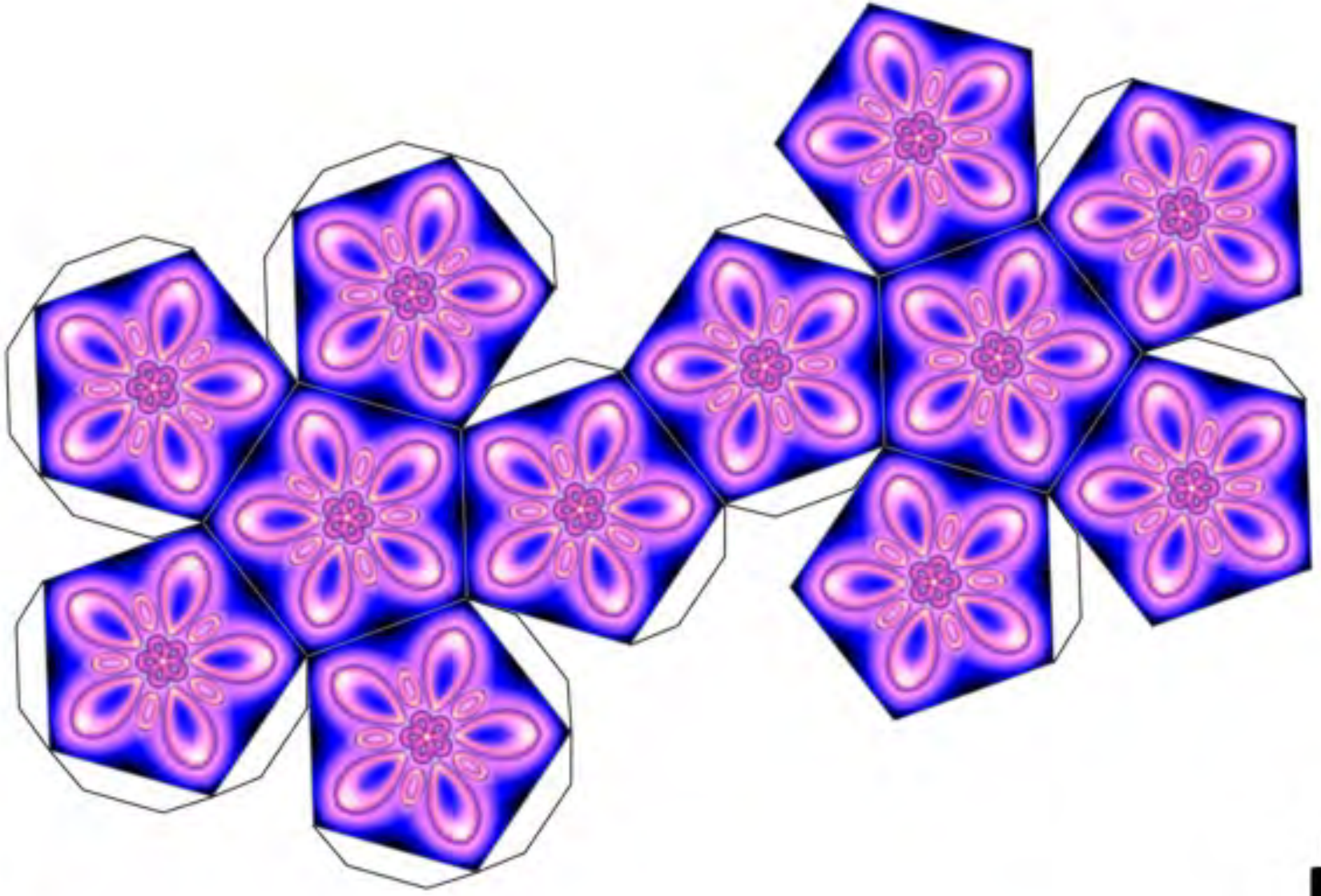


science-to-touch.com









Polyhedra

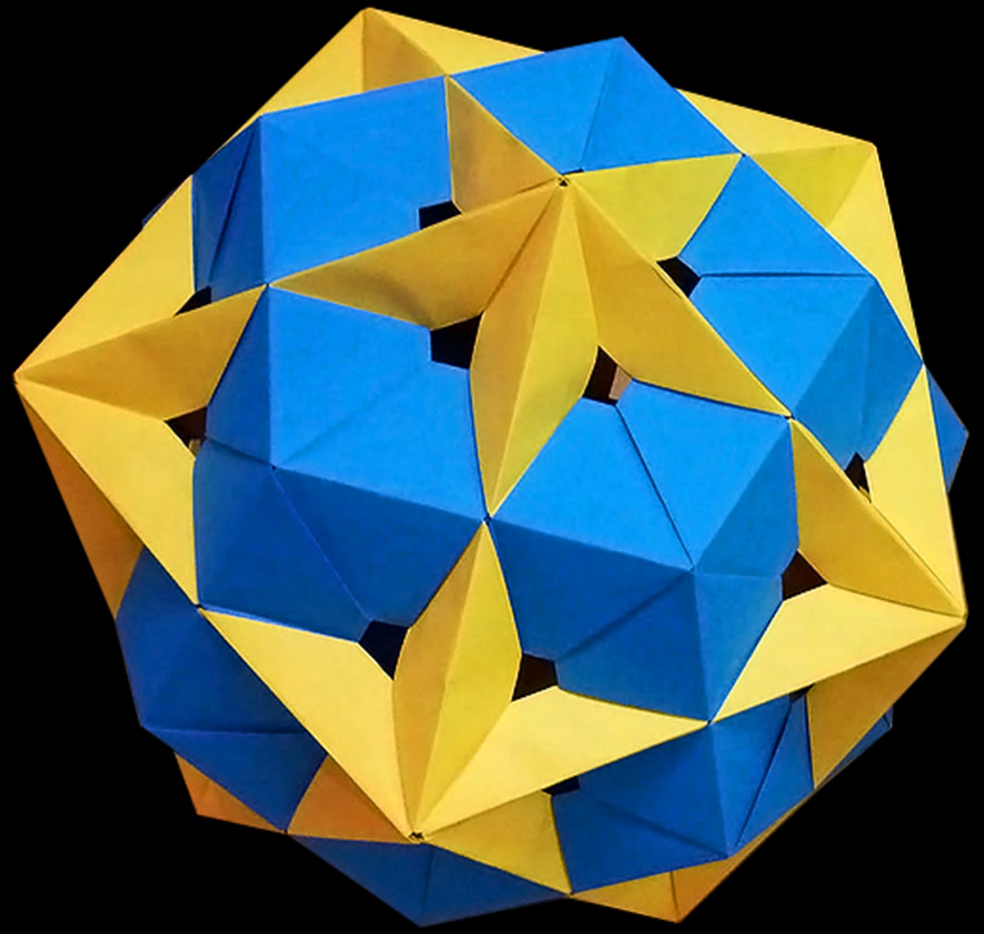
Volume

Surface Area

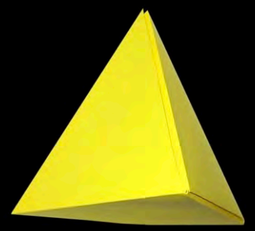
Nets/Cross Sections

Euler's Formula

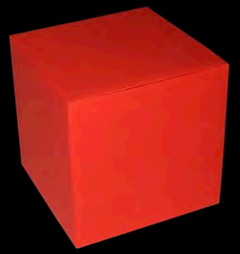
5 Platonic Solids



mathigon.org/origami



Tetrahedron

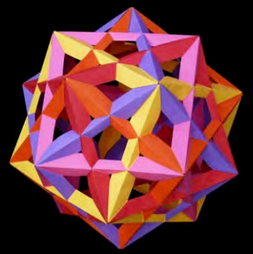


Cube

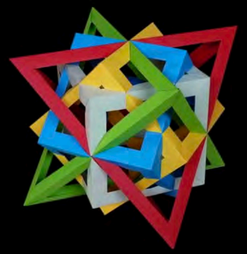
Octahedron

Dodecahedron

Icosahedron

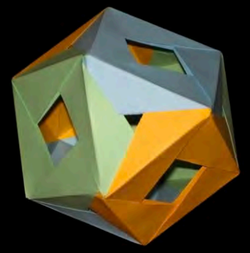


Intersection of Four Cubes

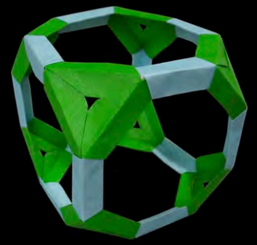


Three Cubes and Two Tetrahedra

Truncated Tetrahedron



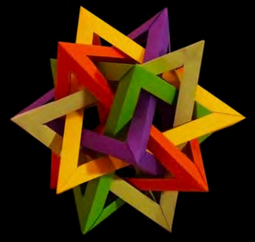
Cuboctahedron



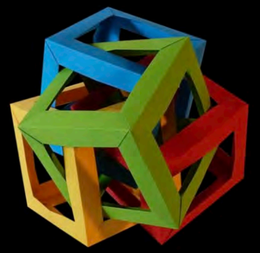
Truncated Hexahedron

Truncated Octahedron

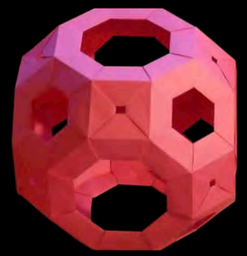
Rhombicuboctahedron



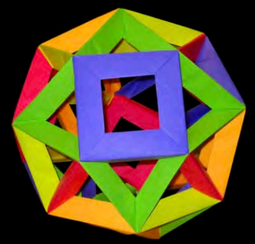
Intersecting Tetrahedra



Intersecting Cubes

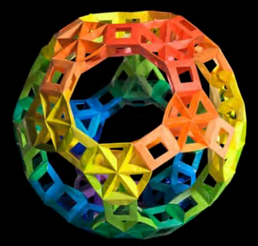


Truncated Cuboctahedron



Snub Cube

Icosidodecahedron



Truncated Icosidodecahedron

Snub Dodecahedron

Intersecting Dodecahedra

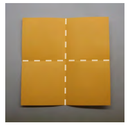
Intersecting Planes

mathigon.org/origami

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.

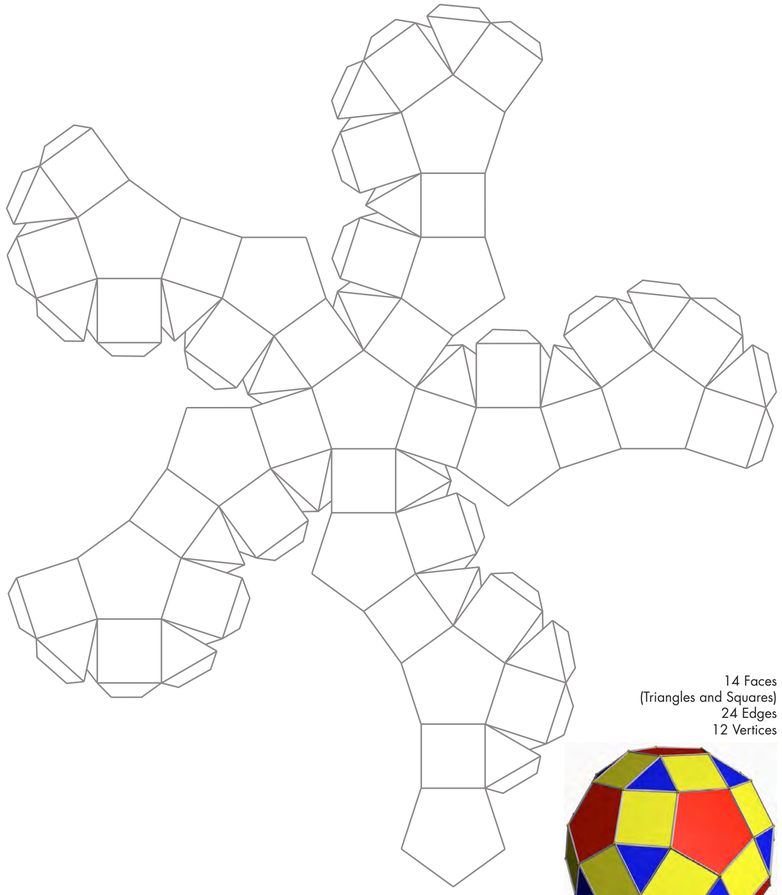

Fold the tail upwards.


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

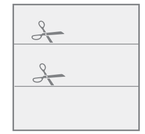
MATHIGON ORIGAMI
5 INTERLOCKING TETRAHEDRA
★★★★

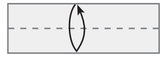
more on mathigon.org/origami/

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

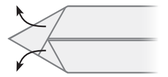
Fold both edges towards centre again, unfold.

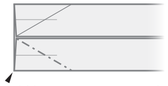
4

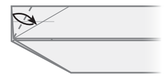
Fold bottom corner onto line in centre of top half.

5

Repeat for top corner.

6

Unfold.

7

Fold bottom corner inwards.

8

Fold top corner as shown.

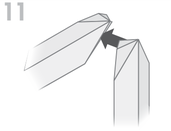
9

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:

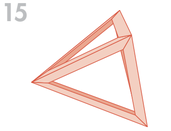
11


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

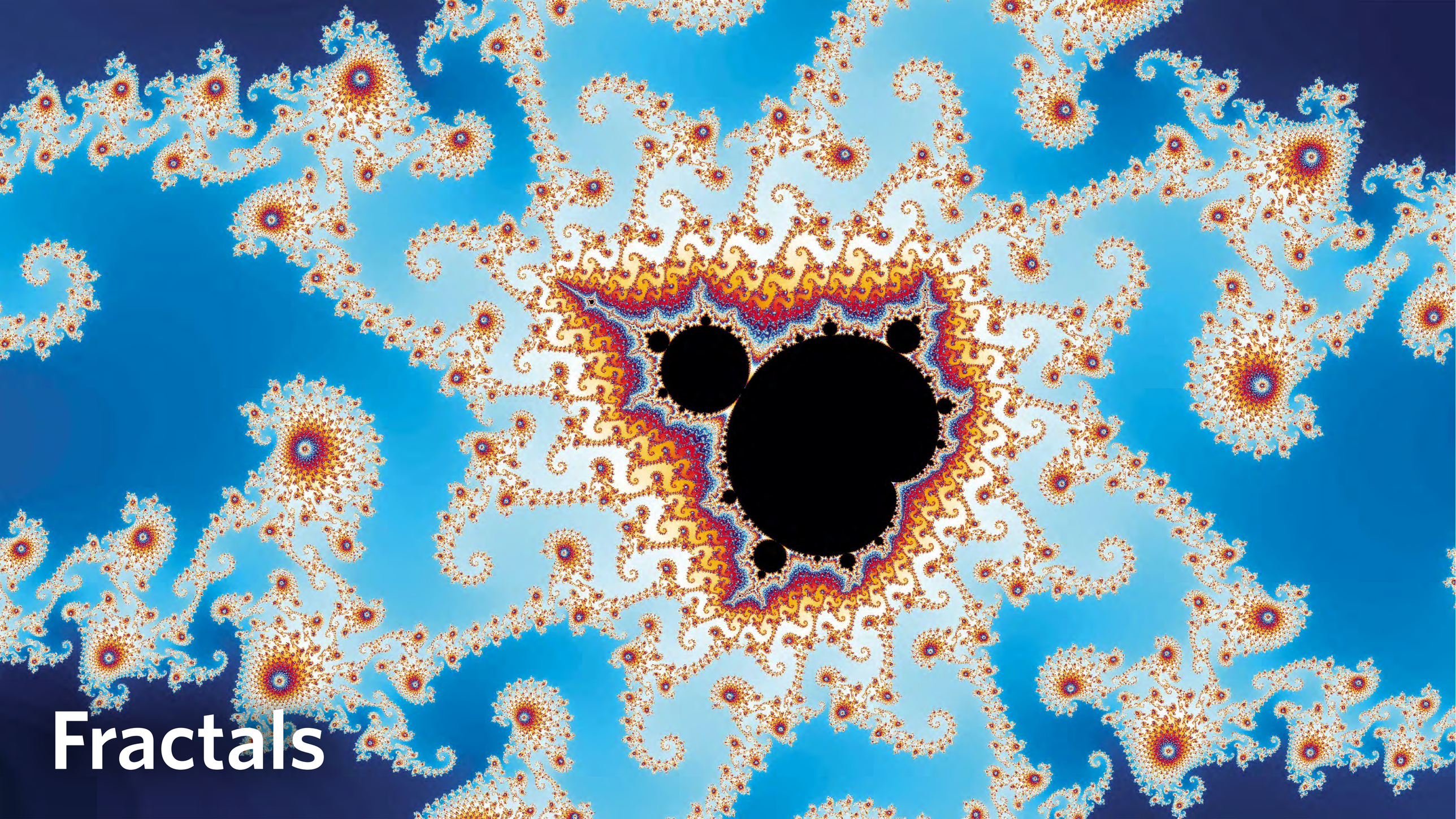
For the second and third tetrahedra, first create one corner ('tripod') and interlink it with the existing shape. Then lock it in place using the remaining three edges of that colour.

18

Add the fourth and fifth Tetrahedra in a similar way.

Modular Origami

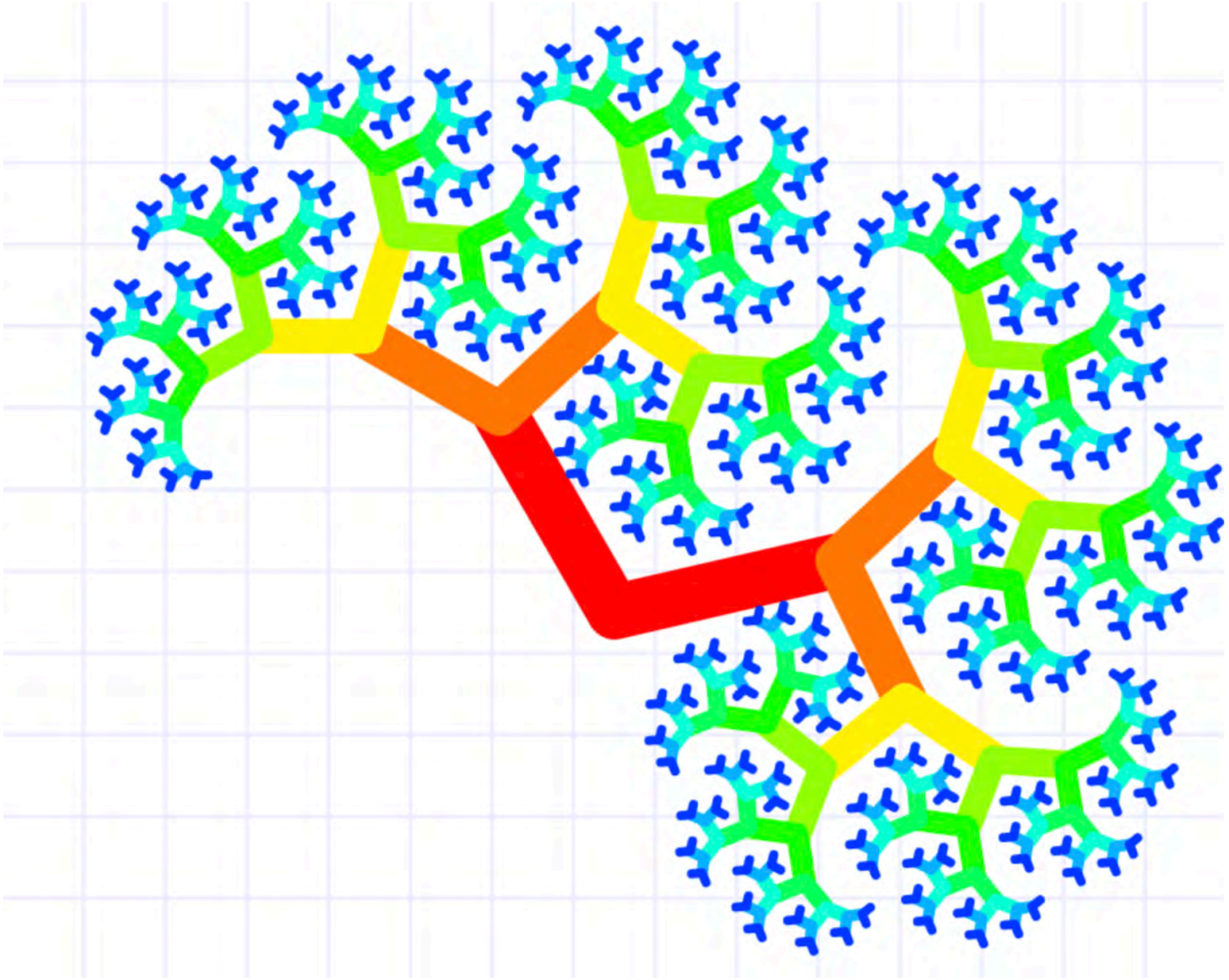

PLEASE CHECK
YOUR RECEIPT
4



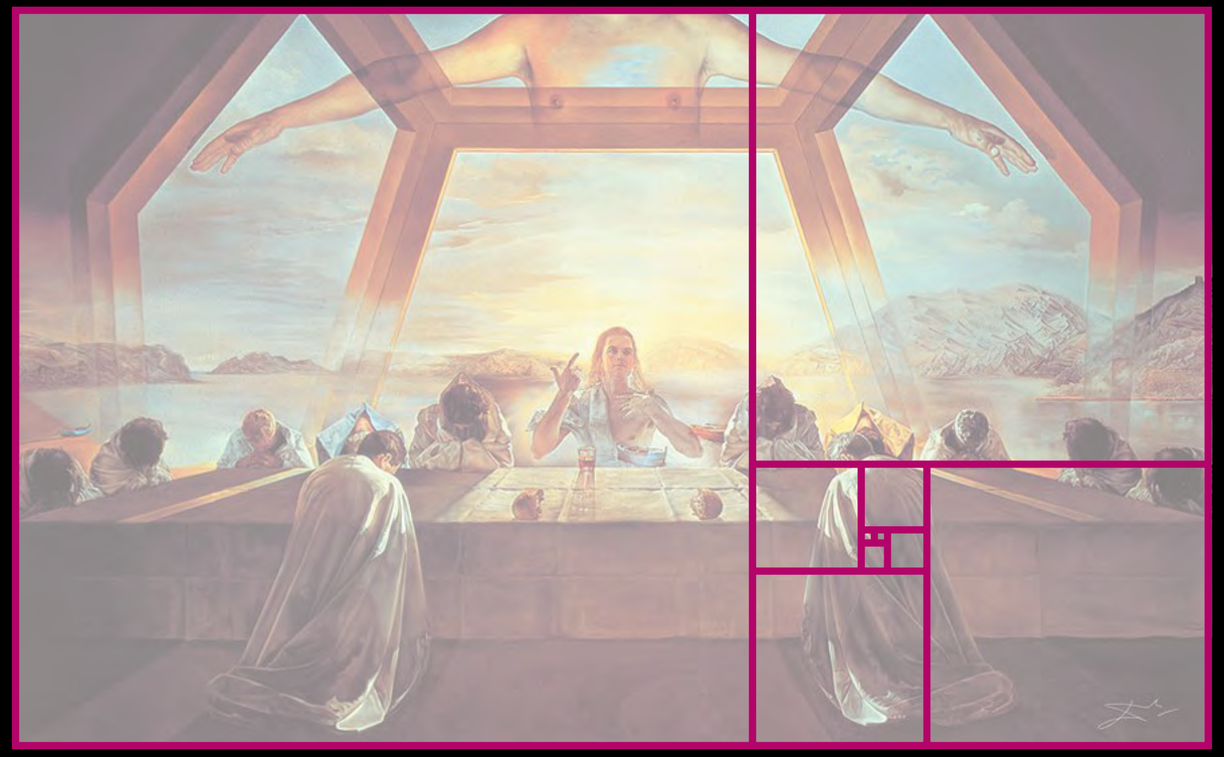
Fractals

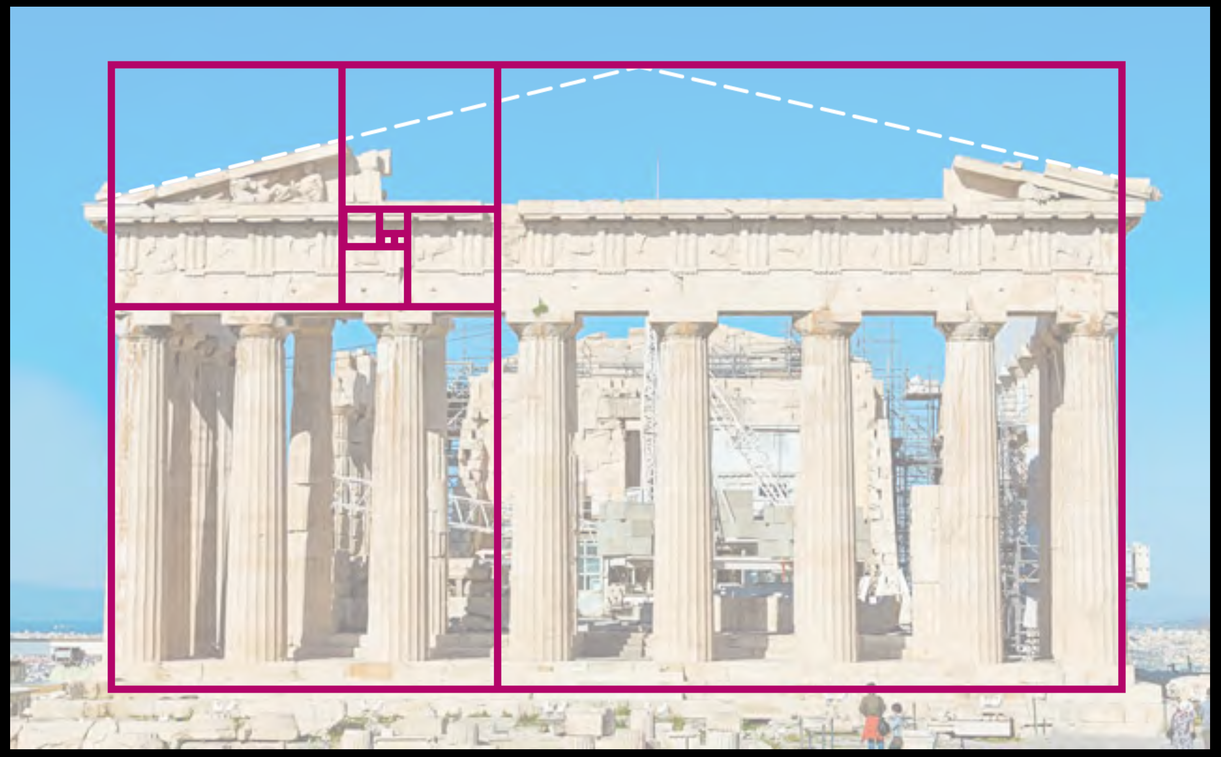
```
MandelComp = Compile[
    {{c, _Complex}},
    Module[{num = 1},
    FixedPoint[(num++;#^2 + c)&, 0, 8191, SameTest->(Re[#]^2 + Im[#]^2>=4&)];
    num],
    CompilationTarget->"C",
    RuntimeAttributes->{Listable},
    Parallelization->True
];

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

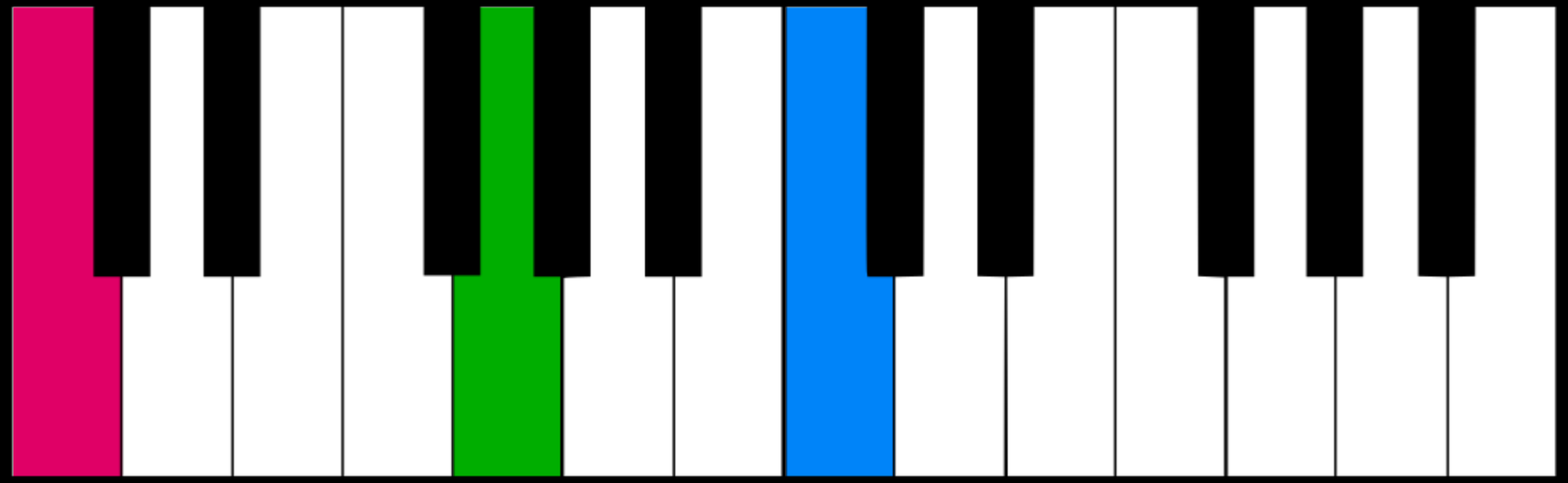


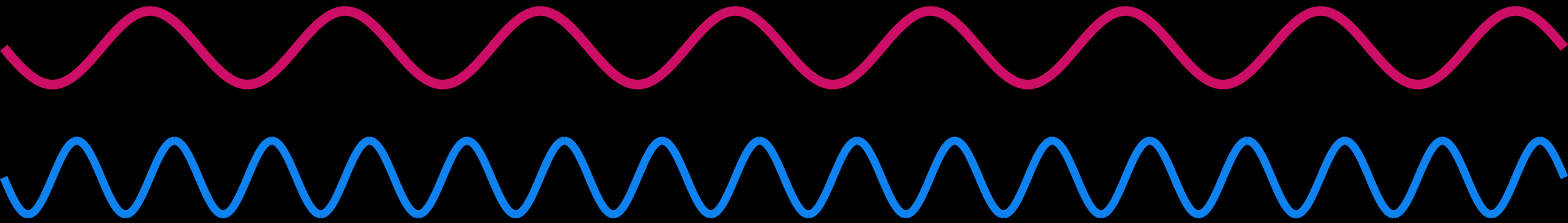
Golden Ratio





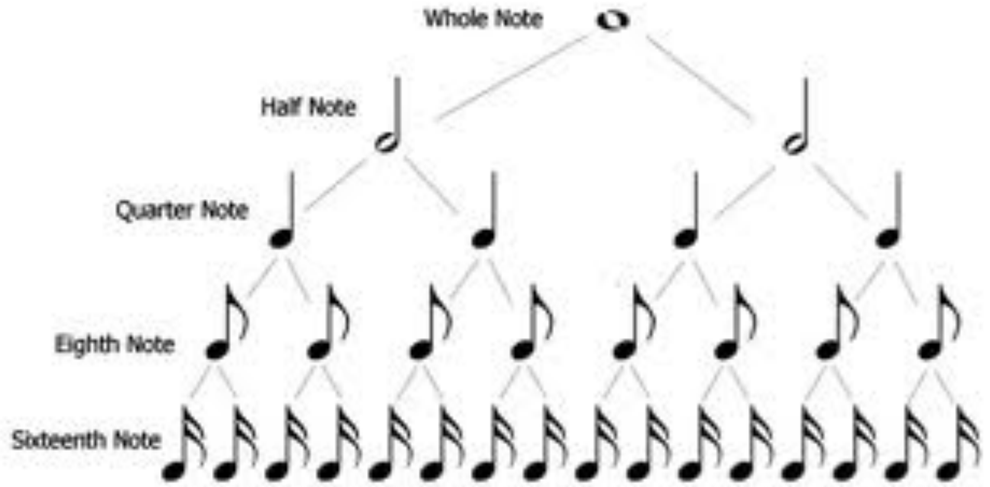
Perspective Drawing





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

$1.49830707\ldots \approx 1.5$



RHYTHM ADDITION LEVEL 1

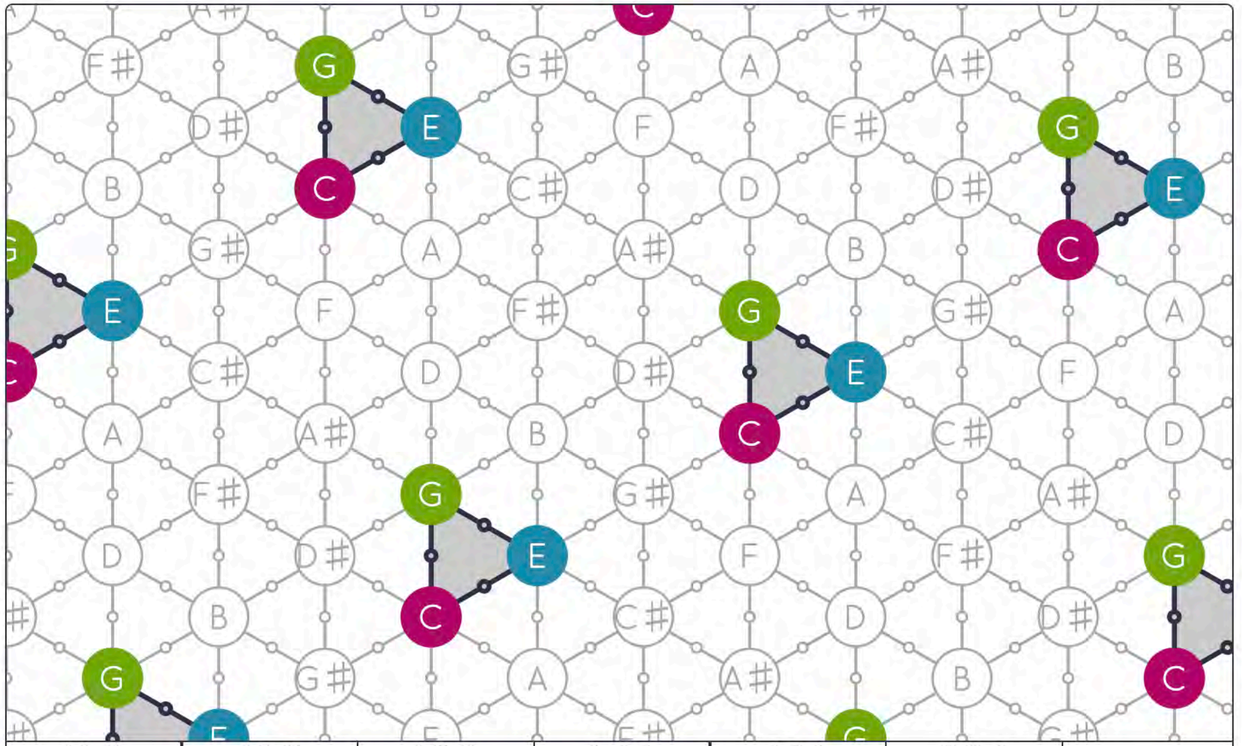
Directions: add the total number of beats in each problem.

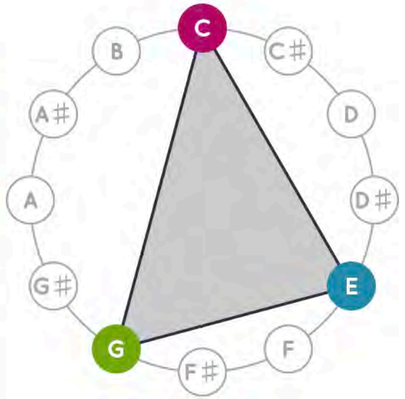
Name _____ Class _____

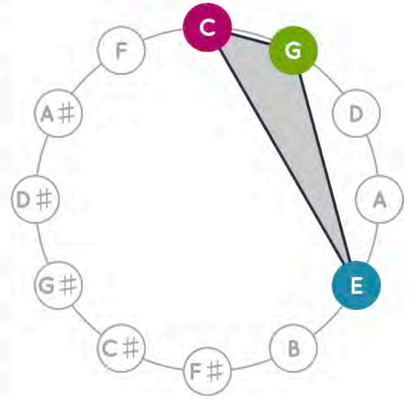
1. ♩ + ♩ = ☐	6. ♩ + ♩ + ♩ = ☐
2. ♩ + 𝄽 = ☐	7. 𝄽 + 𝄽 + 𝄽 = ☐
3. ♫ + ♩ = ☐	8. ♫ + ♫ + ♫ = ☐
4. 𝄽 + 𝄽 = ☐	9. ♫ + ♩ + 𝄽 = ☐
5. 𝄽 + ♫ = ☐	10. ♩ + ♫ + ♩ = ☐

Rhythm

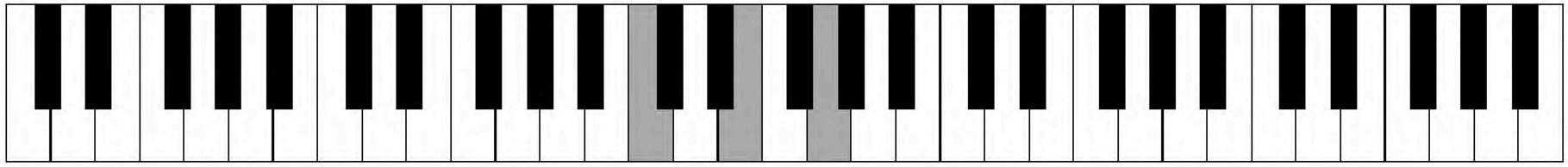
imaginary.github.io/web-hexachord/

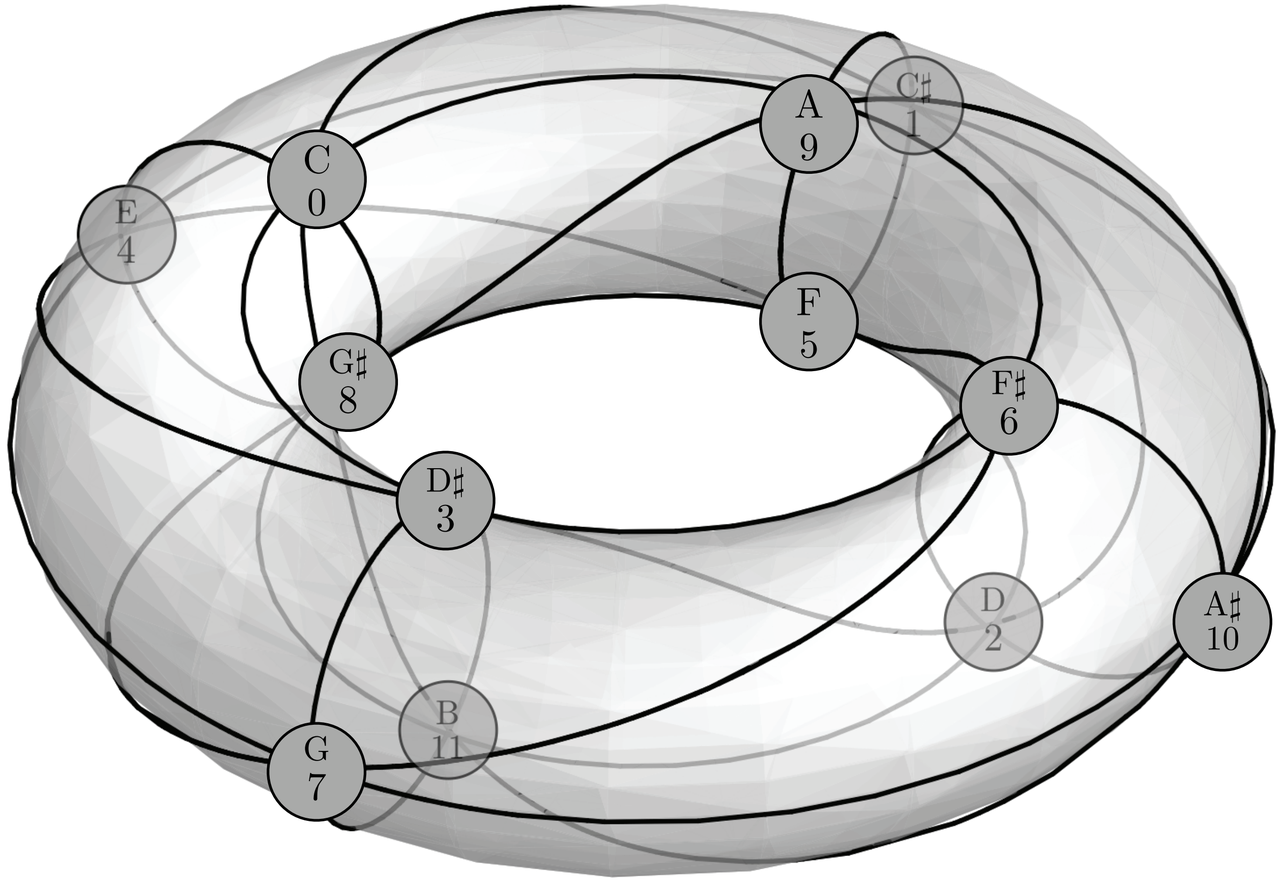






Load Midi File Start Recording




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


THE TONNETZ
ONE KEY – MANY REPRESENTATIONS
AKG
AKG

(2) Problem Solving

Reduce complex problems to their essentials and discover patterns.

Express situations using new or different representations.

Recognise implicit assumptions and think outside the box.

Combine tools and results from different parts of mathematics.

You break a stick in two different places, uniformly at random. What is the probability that the three resulting pieces form a triangle?

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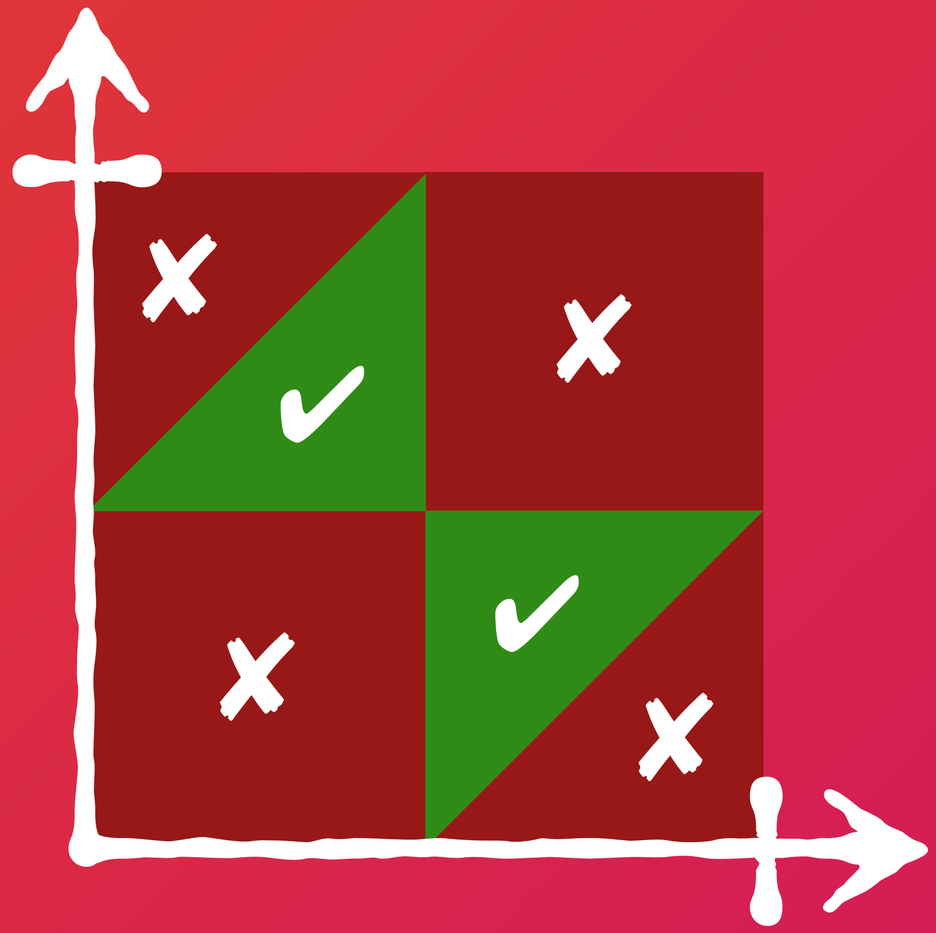

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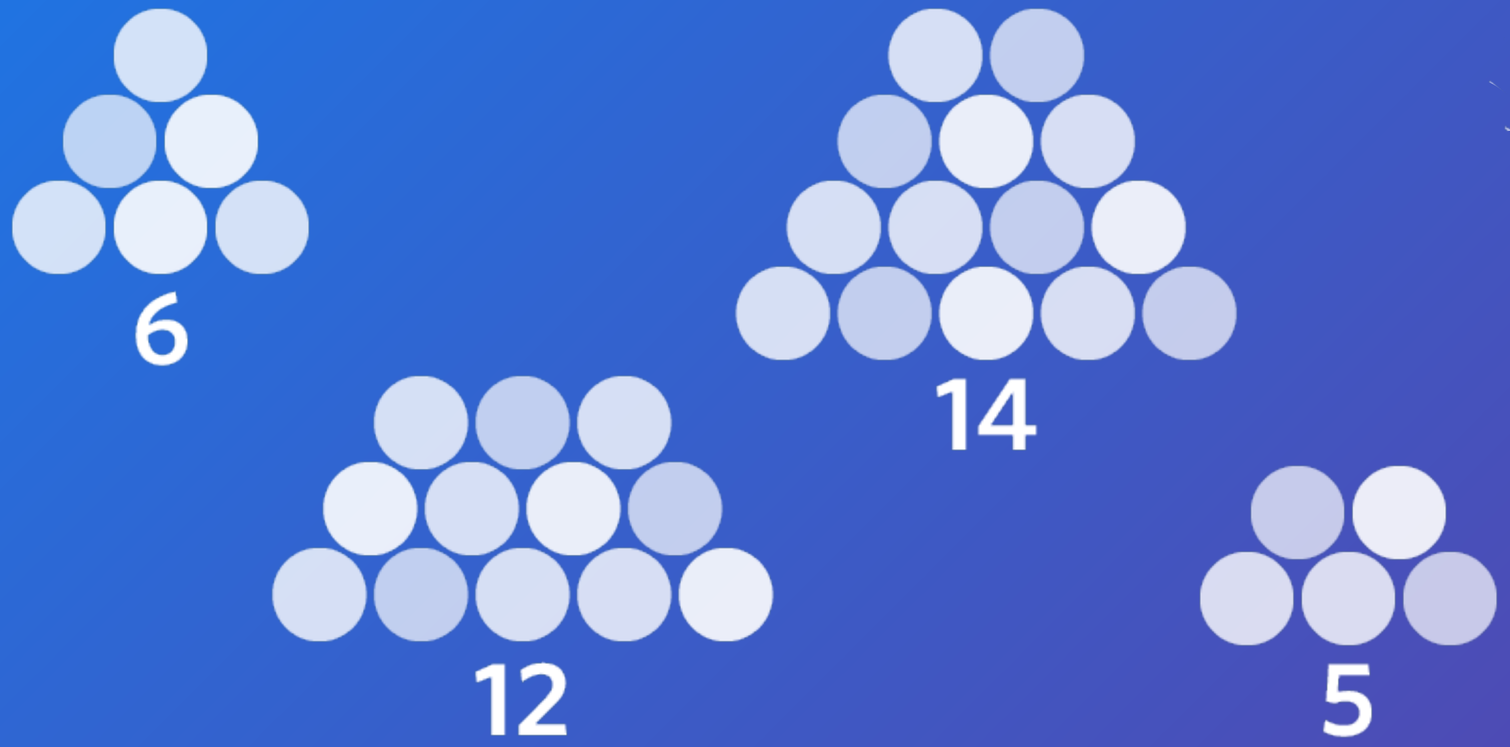
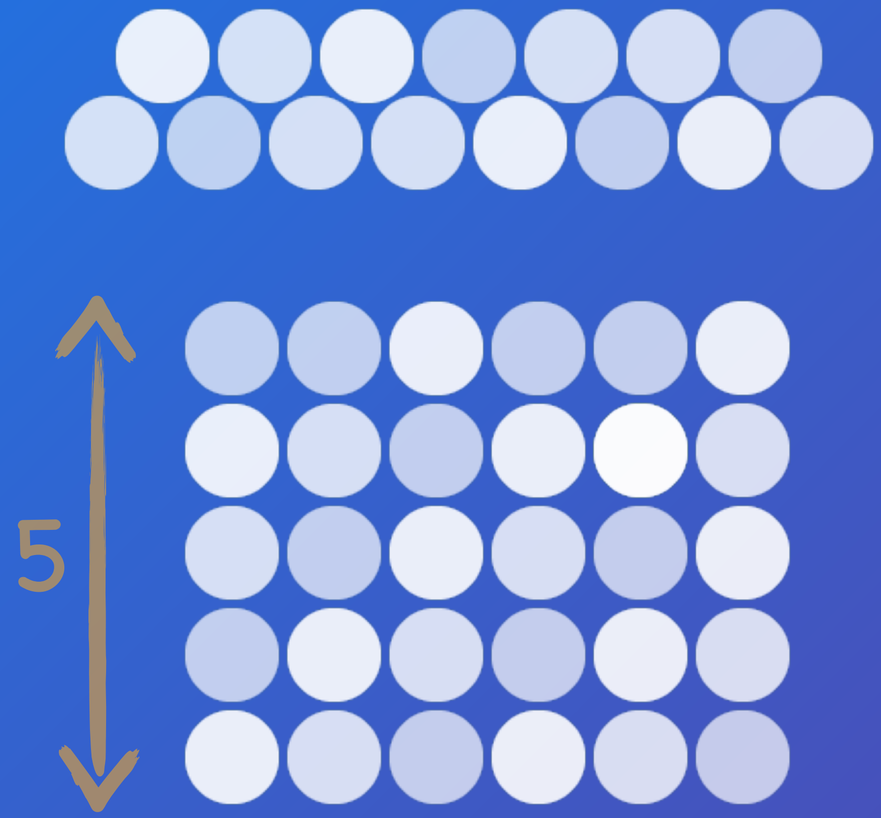


Here are some *Trapezium Numbers*. There is just one number between 1000 and 2000 that *doesn't* form a Trapezium. Which one?



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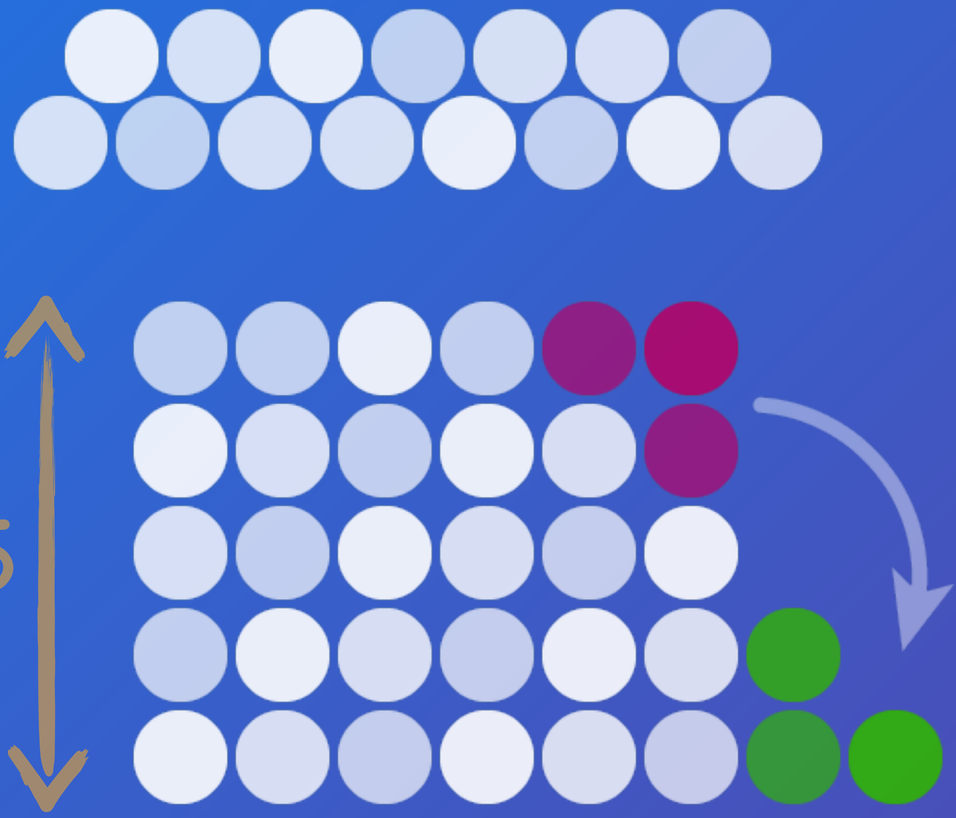

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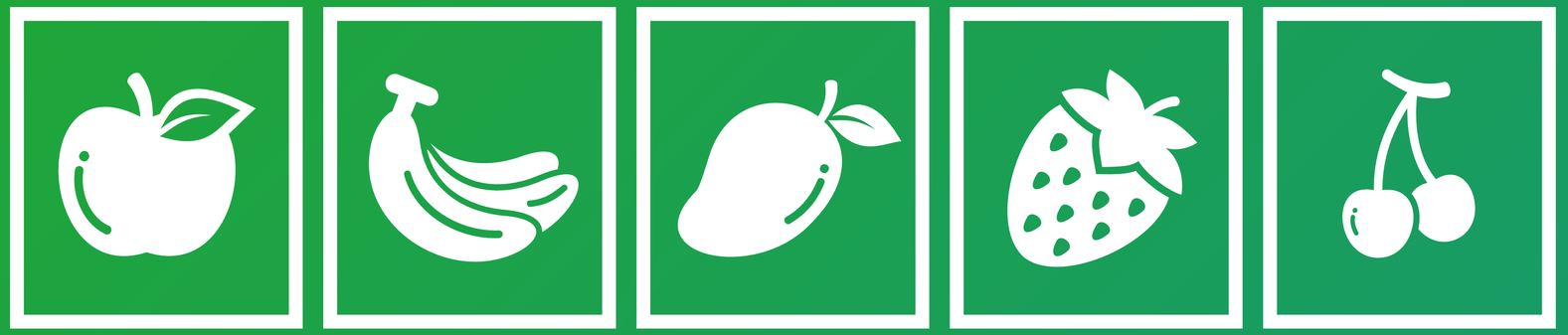
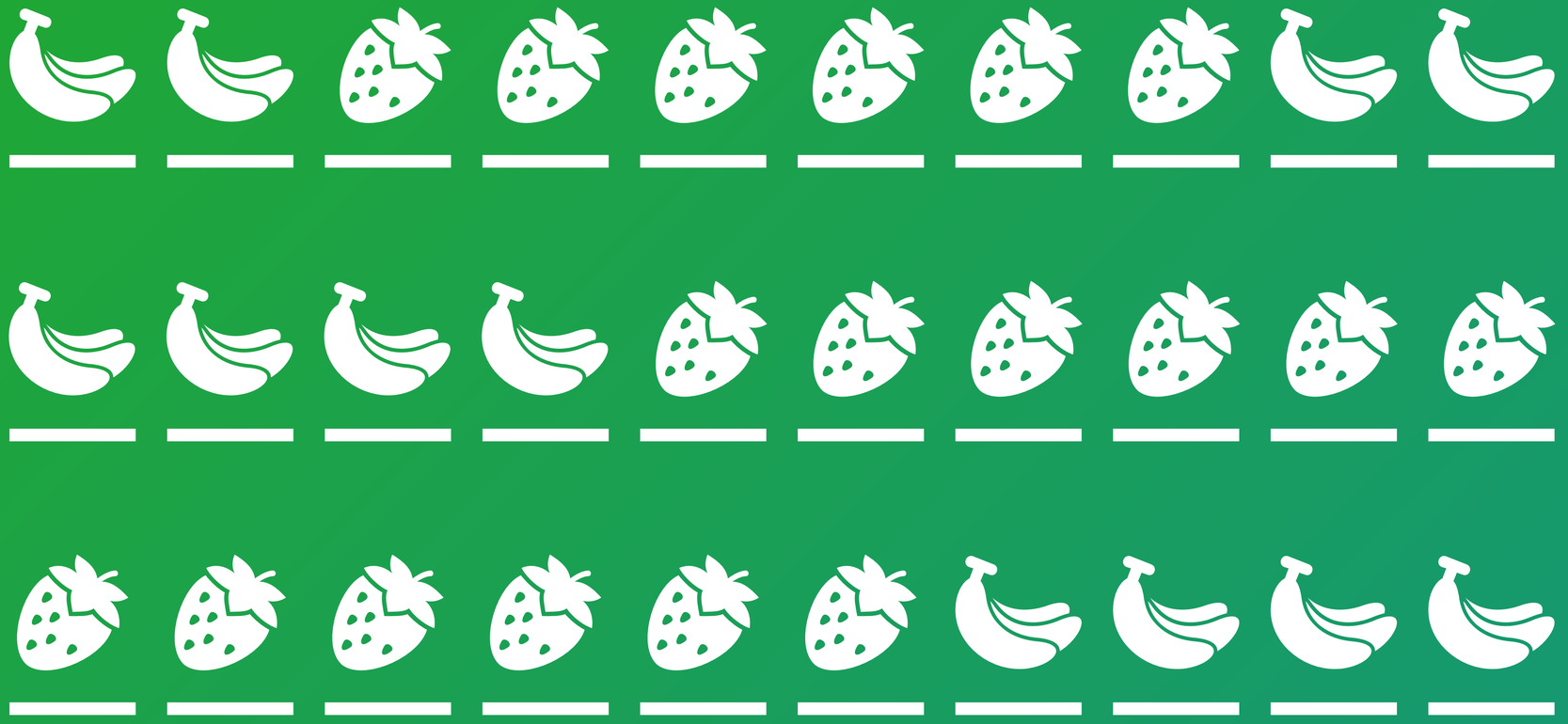


A market stall sells five kinds of fruit. I want to buy ten items. How many possible combinations are there?



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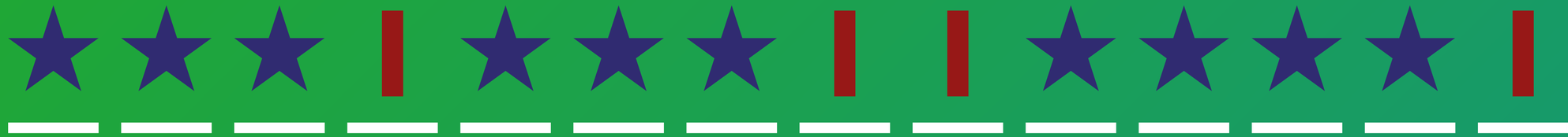

14C4 = 1001

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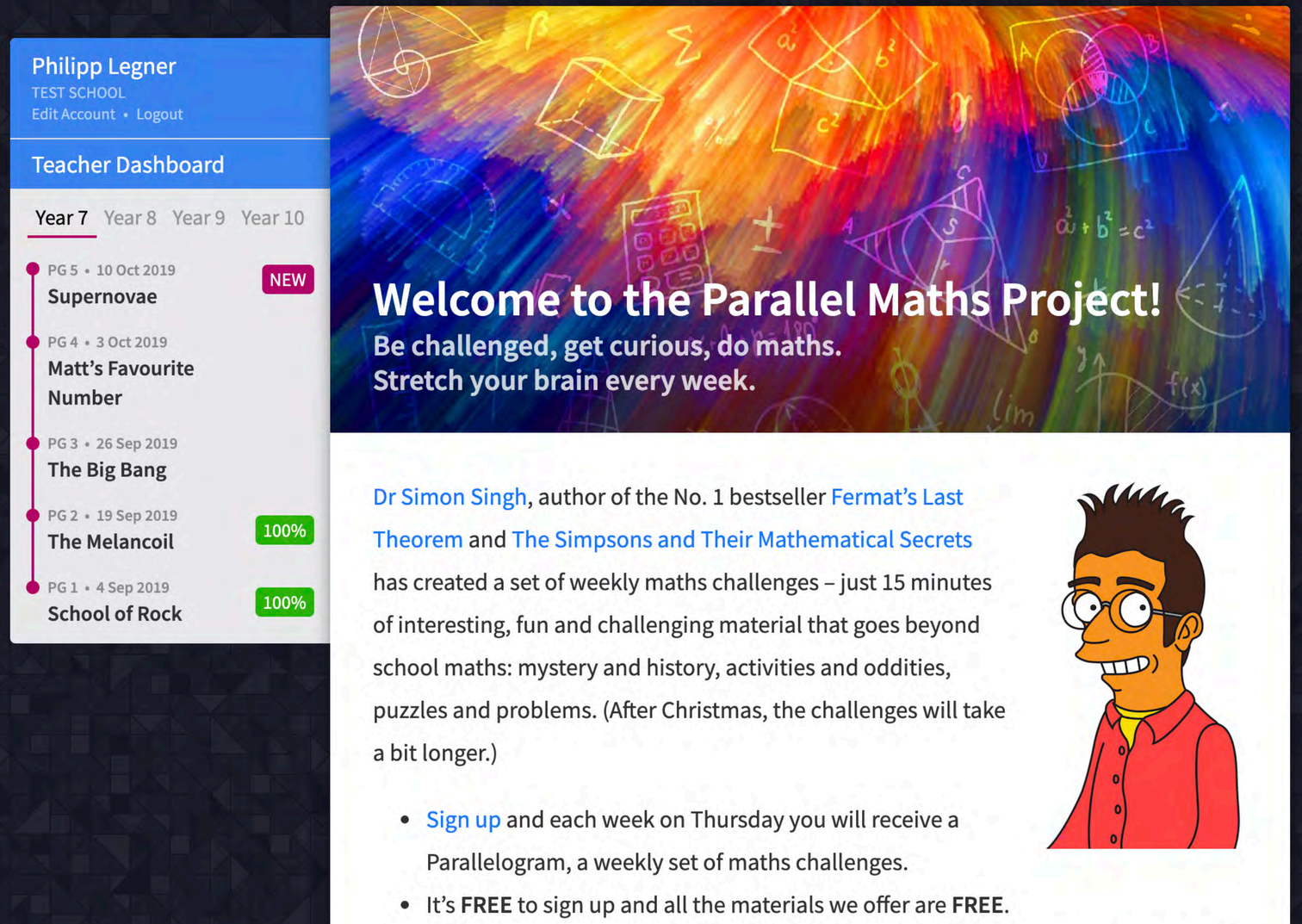
parallel.org.uk

parallel
by Simon Singh



Dr Simon Singh, author of the No. 1 bestseller Fermat's Last Theorem and The Simpsons and Their Mathematical Secrets has created a set of weekly maths challenges – just 15 minutes of interesting, fun and challenging material that goes beyond school maths: mystery and history, activities and oddities, puzzles and problems. (After Christmas, the challenges will take a bit longer.)

- Sign up and each week on Thursday you will receive a Parallelogram, a weekly set of maths challenges.
- It's **FREE** to sign up and all the materials we offer are **FREE**.

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Primary
Secondary, Post 16 and STEP

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The tasks in this feature encourage you to play and explore, then think deeply about the mathematical ideas underneath.

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See all Resources for ages 5-11

Secondary Students

In this feature, explore the problems and then try to explain what's going on!

See all problems Open for Solution
See all Resources for ages 11-18

Events and PD

"It gave me some good ideas to use in the classroom and ... a link that I can get all of the activities

Your Solutions

See if your solutions to our recent problems have been published
Primary

Tweets by @nrichmaths

NRICH maths Retweeted

Liz Woodham
@emw1001

First day of @nrichmaths PD with a new group of primary teachers from Tower Hamlets. Six days focusing on whole class reasoning. And I get to work with @FranMaths too. Woo hoo

Oct 9, 2019


(3) Problem Inventing

Thanks for listening!

philipp@mathigon.org

@MathigonOrg