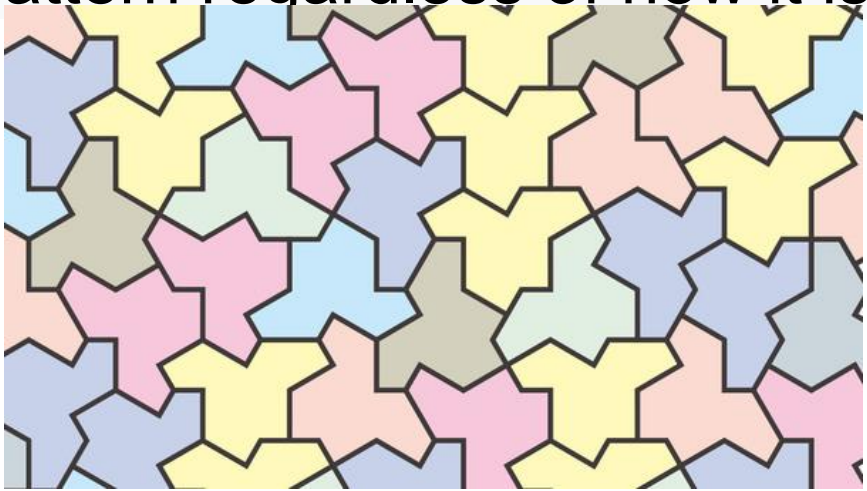
Einstein Puzzle

group 3

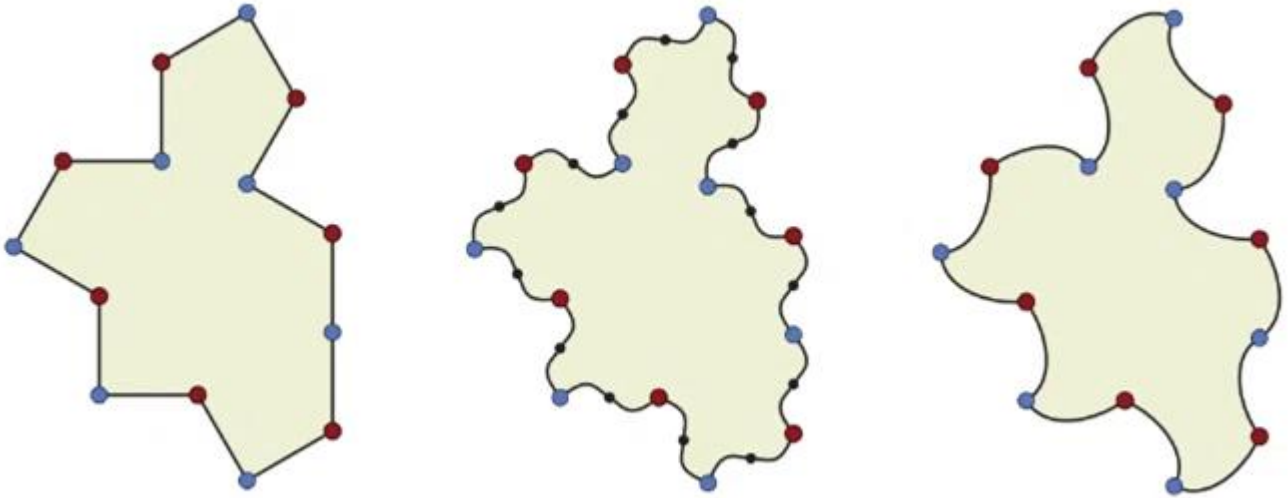
What is Einstein Puzzle?

Can tile a plane without gaps using only a single type of shape

Never repeats the same pattern regardless of how it is arranged.



How to make Einstein Tile

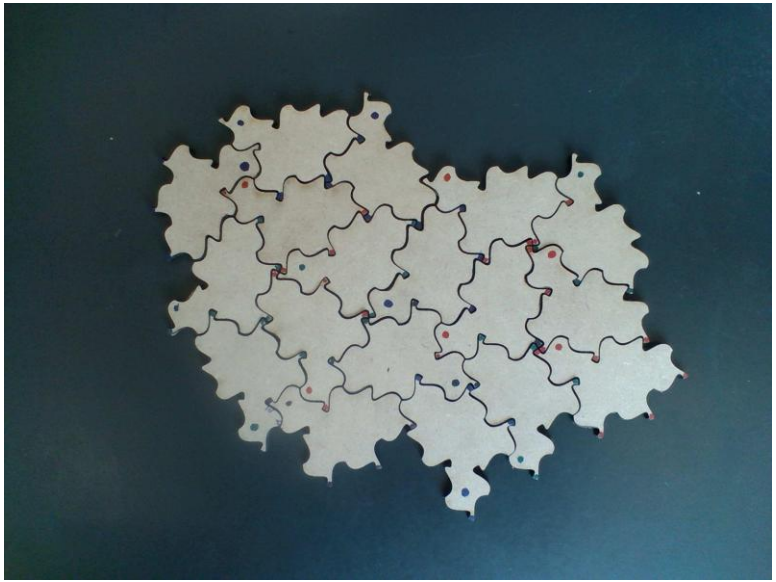


spectres

Shape the Spectres into a curve with alternating convex and concave sections that fit together perfectly.

These are our tiles

Rhinoceros



Dog

Why did we make this shape?

- want to make tiles like animals.
- These were the only two types we were able to make in the short time available.

How many ways can they be arranged? (Rhinoceros)

We found 14 different ways to arrange the tiles.

How many ways can they be arranged? (Dog)

We found 14 different ways

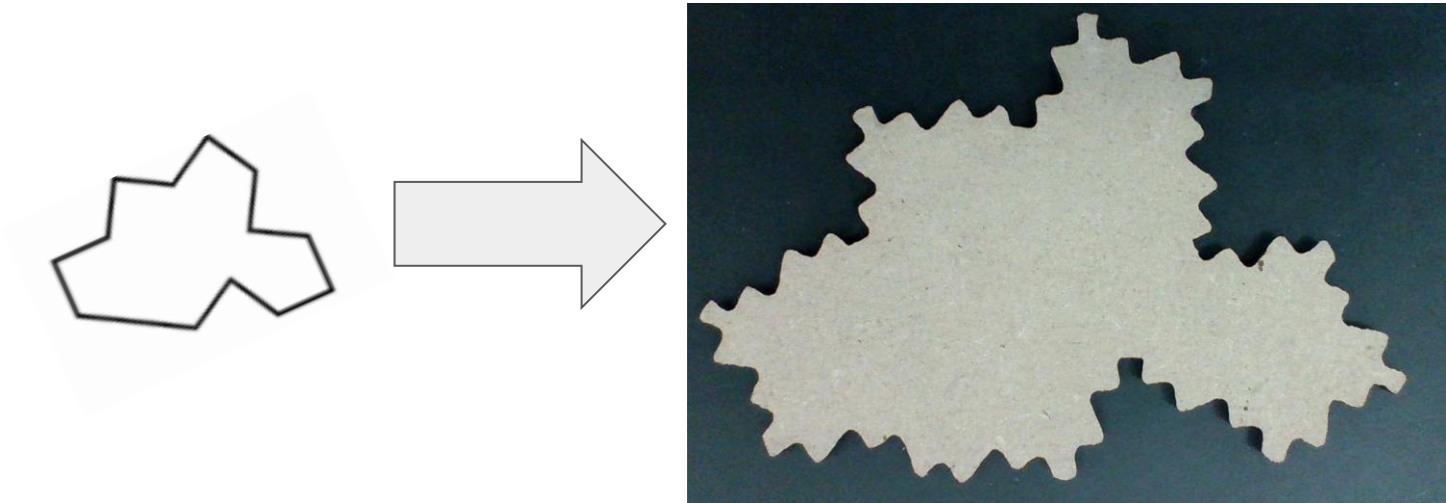
Any questions?

Einstein Puzzle

Group 4

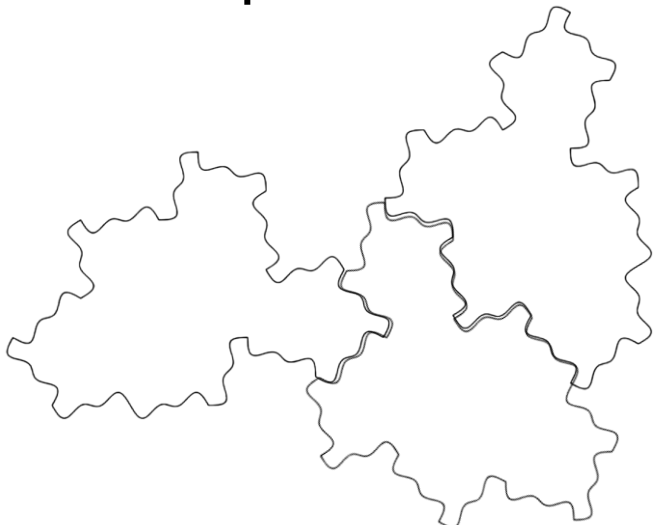
The Feature

From the straight line edge, we changed them into curved line (by sine graph).



The Structure, The Interest

The shape of this tile was developed greatly from Smith-HAT, which was discovered by Shigeki Akiyama. For example, it has a lot of curves.



Coordinates, Angles, Symmetry

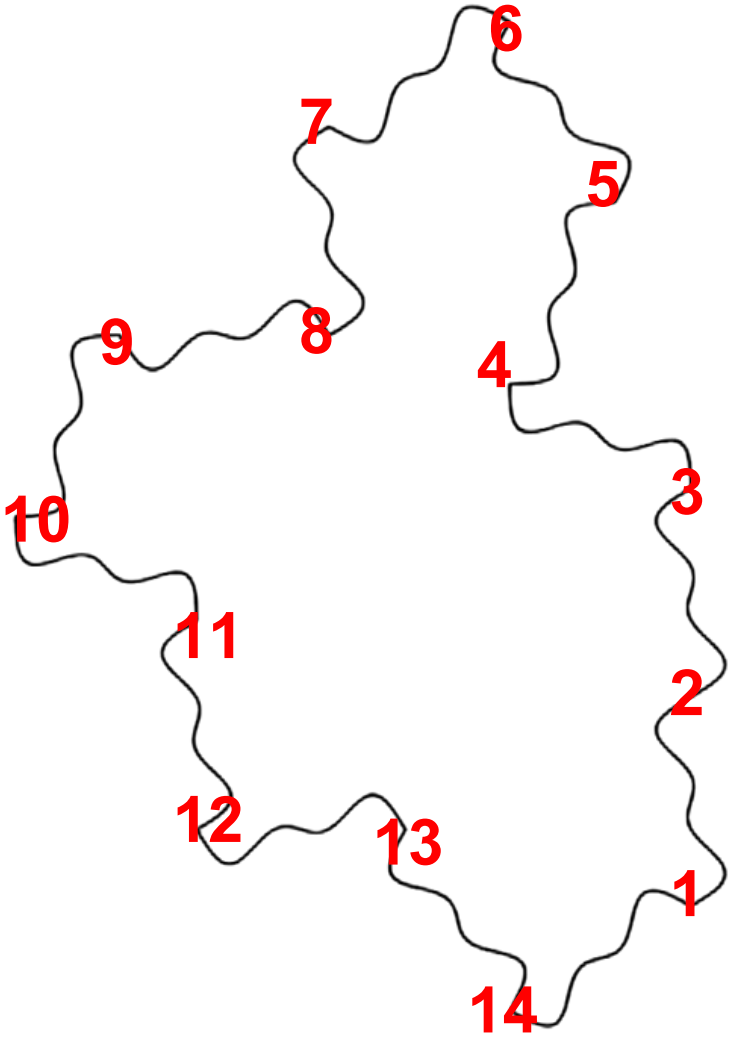
Coordinates: An equilateral 14-sided polygon on a 30° grid, with each edge replaced by a triple-wave curve ($0.09 \sin 2\pi t + 0.075 \sin 6\pi t$) .

Angles: All interior angles are multiples of 30° (90°–270°), with four reflex angles that let neighboring tiles interlock.

Symmetry: The tile itself has no symmetry yet. Its point-symmetric edges tile the plane only aperiodically.

The Ways That Prototile, The Number of Types

Probably, there are 46 types of shapes with 2 tiles. We counted types carefully so as not to count the same pattern. We used numbers to divide each vertex(1 to 14). The numbers were put in places where the convexity of the sin change.

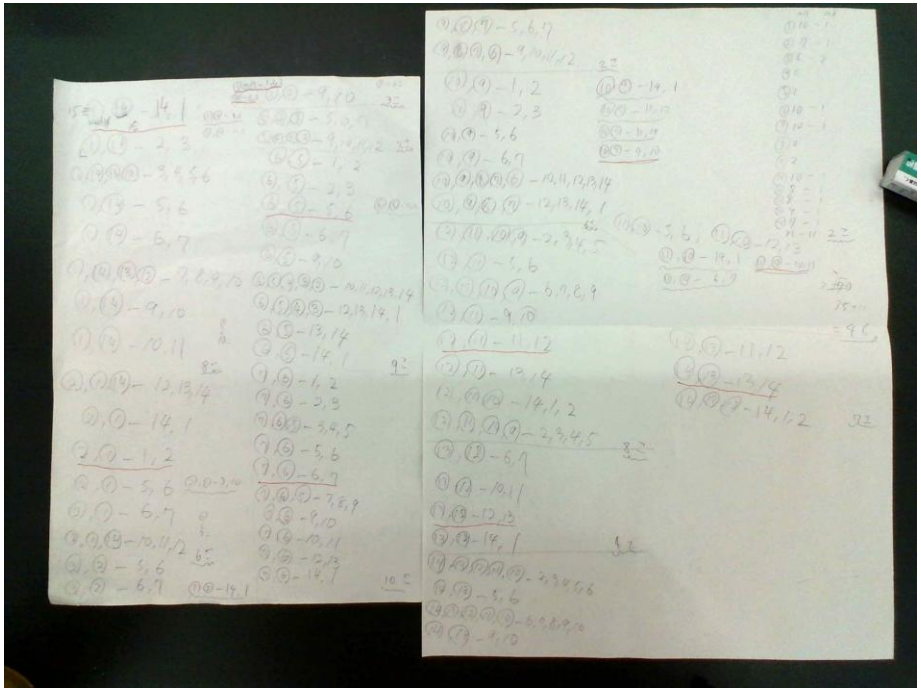


The Possibility of Combinations in two tile Condition

As in the before slide, we made number in every vertex.

We counted the number of combination using the vertex number of each tile.

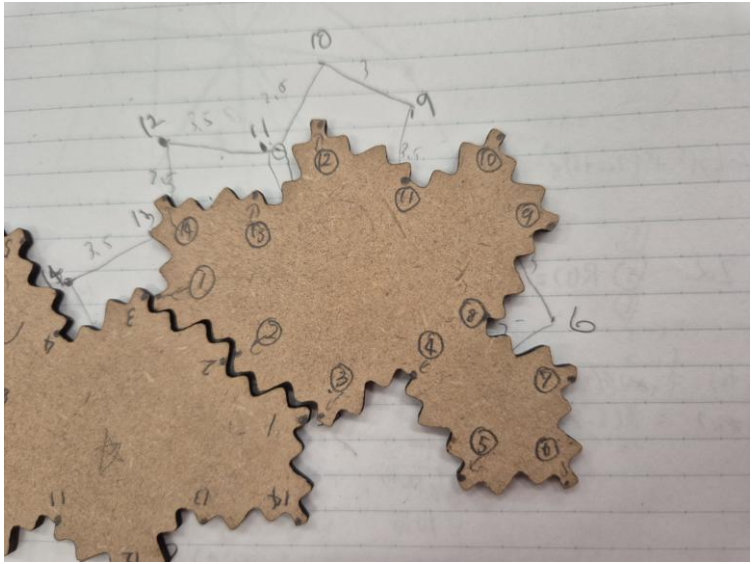
From the vertex number 1 to vertex number 14 we counted.



The Analysis of Counting Possibility

As a result of the counting we found total of 46 different kind of types.

At first we got totally 81 possibilities of combinations for two tiles, but there exists duplication problem. Specifically, if the shape is not point symmetry, the shape is counted in two times, so we must find out the number of point symmetry. After that, we divided the number of not point symmetry by 2(70→ 35) and added symmetry shape(11). Finally we got 46(35+11).



Proving the Only Tiling Method

We can’t prove it concretely,

but we expect it

because Smith-HAT, the origin of it, has the only tiling method.

Group 6

Motivation for the research

After listening to Professor Kamata's lecture and learning that a net of a regular tetrahedron can serve as a prototile to tile a plane without gaps, we became curious about whether this would be possible with any kind of shapes.

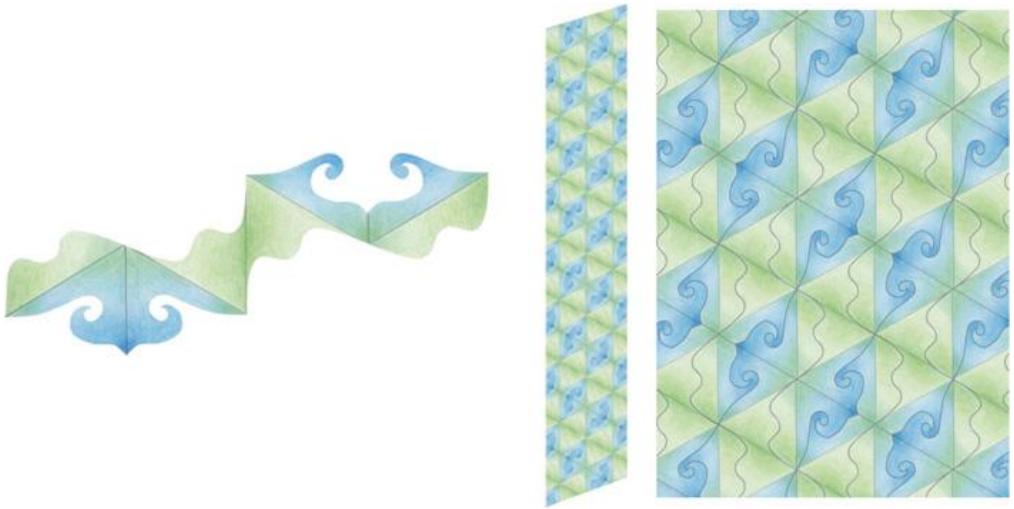


Figure1　Periodic Tiles

https://www.tamagawa.jp/education/report/detail_19080.html

How to make

Using Canva

(https://www.canva.com/)

Make a prototile*2

※Created accurately using line angles and the properties of shapes

Using geogebra

(https://www.geogebra.org/calculator)

Using a laser cutter(Cutting tiles)

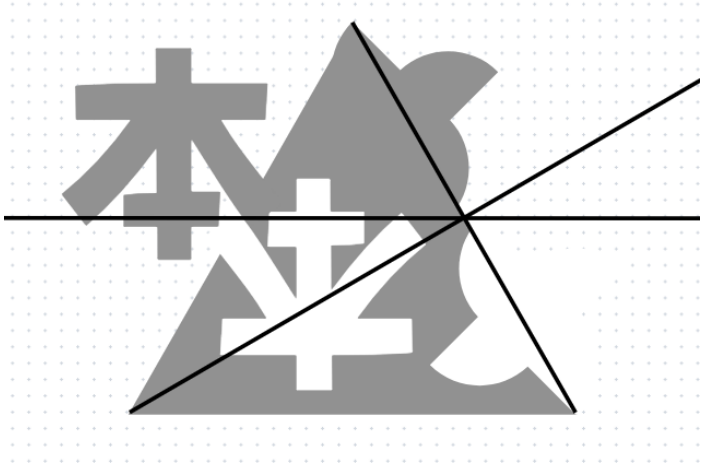


Figure4 [Canva]

Previous research

1. Preparing the envelope.

2.Drawing cut lines freely on both the front and back sides.

⇒Lines extend to all 4 corners, with no closed loops.

3. Cut along the drawn lines to open the envelope into a single, continuous shape, as shown in Figure 3–4. Cut each side individually.

Figure5-1

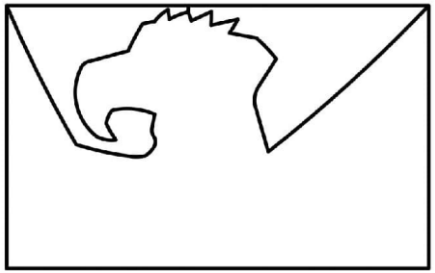


Figure5-2

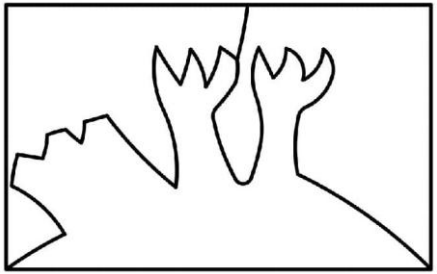


Figure5-3

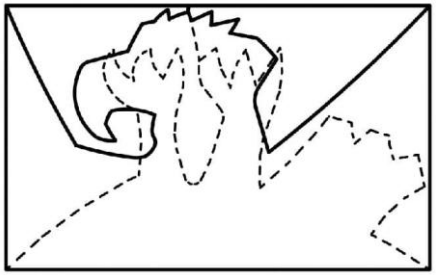
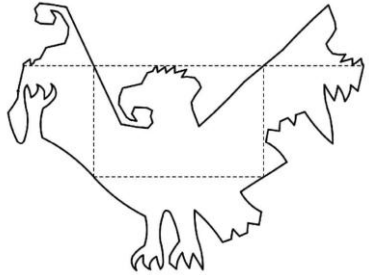


Figure5-4



「今日からあなたは芸術家」https://www.sanyo-chemical.co.jp/magazine/archives/5856

Dr. Jin Akiyama

A famous mathematician

Specializing in geometry

Figure2 Geometry

Based on the tiles he created

Figure3 Dr. Jin Akiyama

Point that we want you to see

An interesting feature of this prototile is that it leverages the property that, no matter how a regular tetrahedron is cut, its net can be used as a prototile to tile the plane.“本” is a kanji character which means “sacred.”

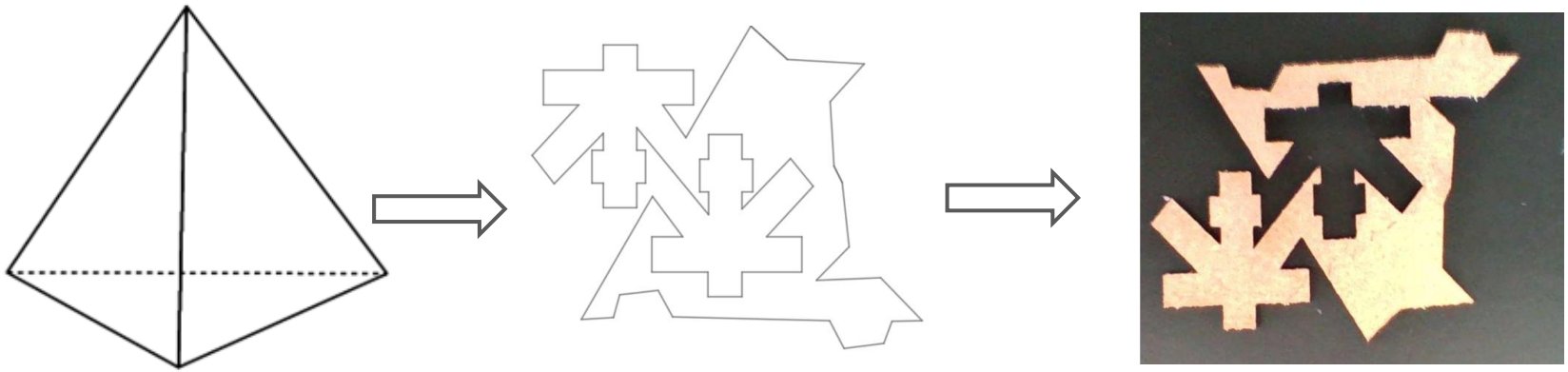


Figure6-1 Figure6-2 Figure6-3

reflection points

The Challenge of Converting Canva Data to Geogebra Data

The Challenges of Creating Prototypes with Mathematical Appeal

The Challenges of Language Barrier

reference

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https://www.sanyo-chemical.co.jp/magazine/archives/5856 7/28 14:56