14th International Congress on Mathematical Education
July 11 to 18, 2021 Shanghai, China

# PUSE (Poly-Universe in School Education) Methodology

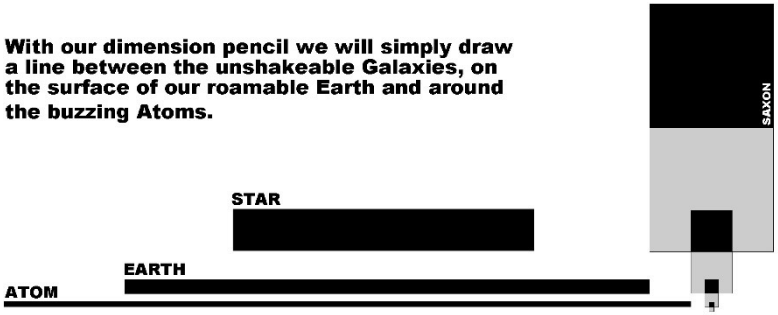
Visual Experience Based Mathematics Education

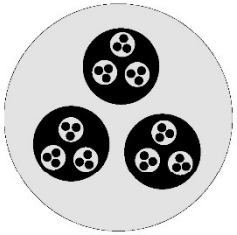
**Presented by János Szász SAXON** & **Zsuzsa Dárdai**
Poly-Universe Ltd Szokolya, Hungary
http://poly-universe.com
https://puse.education

14th International Congress on Mathematical Education
July 11 to 18, 2021 Shanghai, China
ICME-14
SZÉCHENYI · IRODALMI · ÉS · MŰVÉSZETI · AKADÉMIA · 1992 ·
MAGYAR TUDOMÁNYOS AKADÉMIA · 1825 ·
Saxon

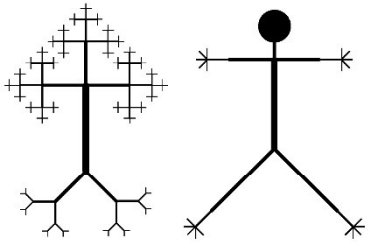
# Dimension-pencil and the Poly-Univers

With our dimension pencil we will simply draw a line between the unshakeable Galaxies, on the surface of our roamable Earth and around the buzzing Atoms.

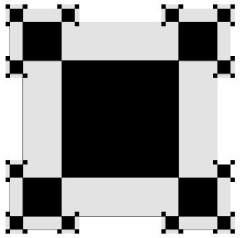


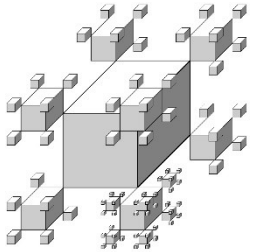
The poly-dimensional point



The poly-dimensional line



The poly-dimensional field

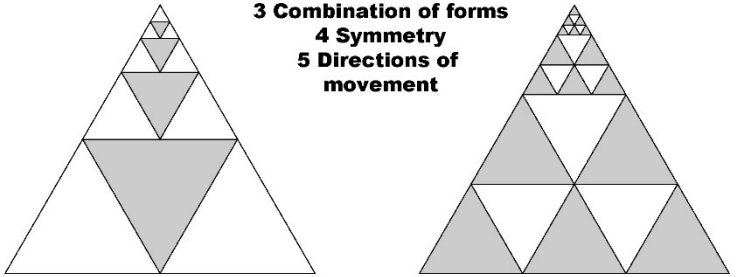


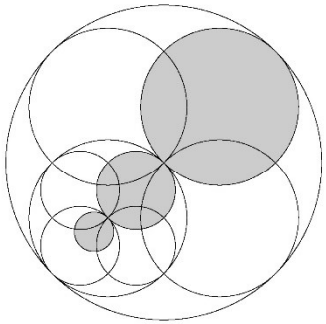
The poly-dimensional space

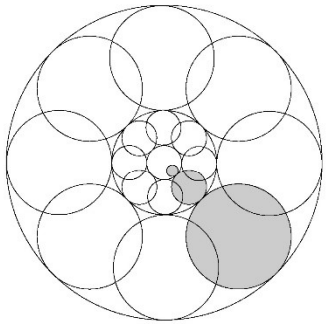
Espace de l'Art Concret, F- 06370 Mouans-Sartoux, Tel.: 33 04 93 75 71 50, Fax: 33 04 93 75 8888

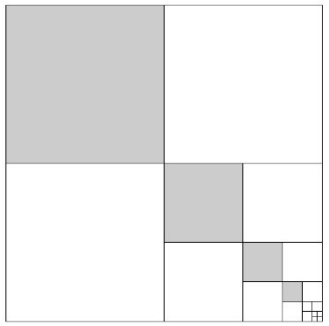
# BASIC GEOMETRICAL FORMS

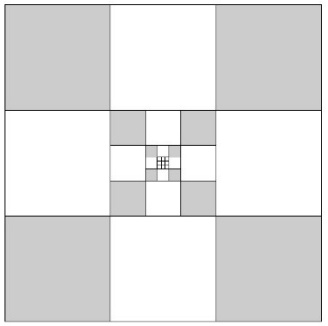
1 Seeking proportions
2 Compositional borders
3 Combination of forms
4 Symmetry
5 Directions of movement











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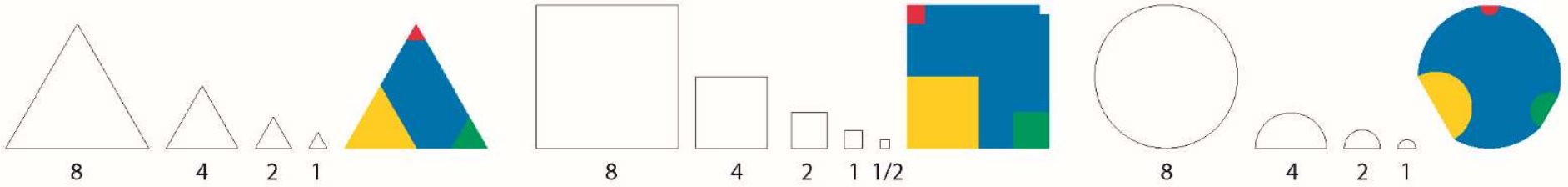
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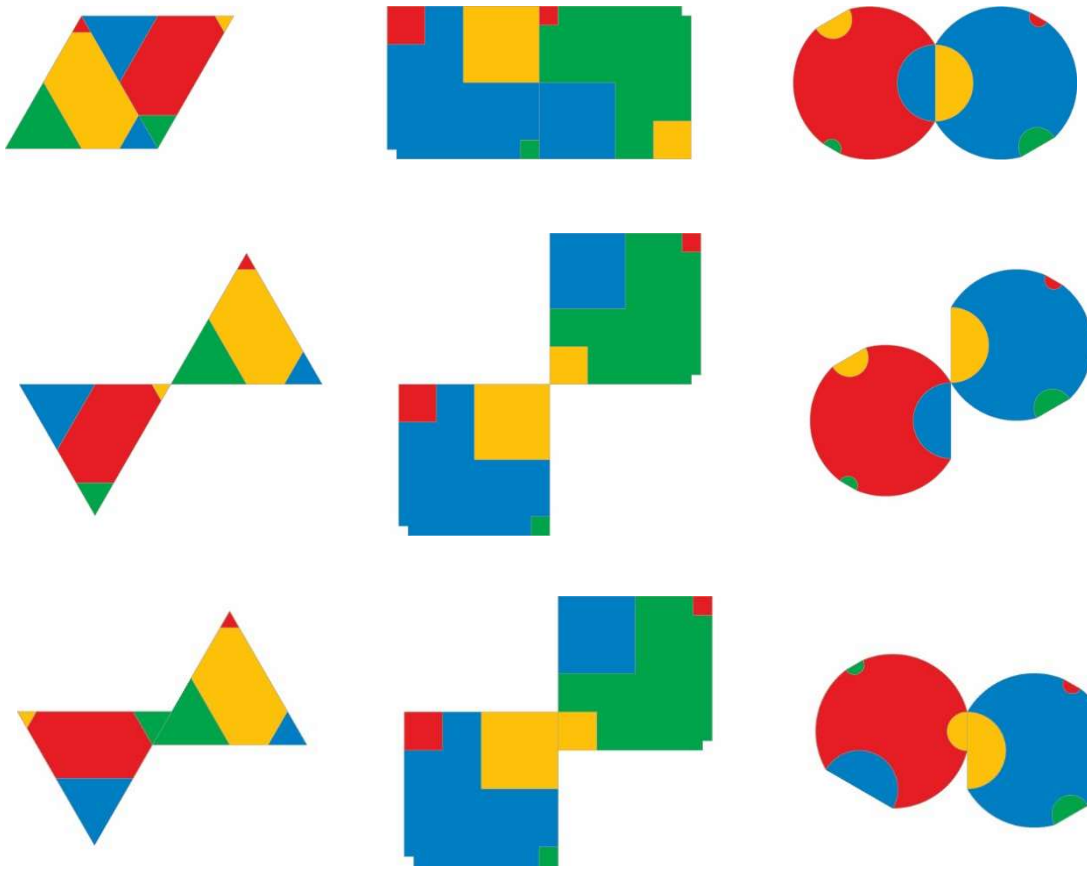

KREATÍV ISKOLANAP
A születés hete
2003. május 19–24.
HÍDAK

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LIFE IS BETTER WITH WIFI

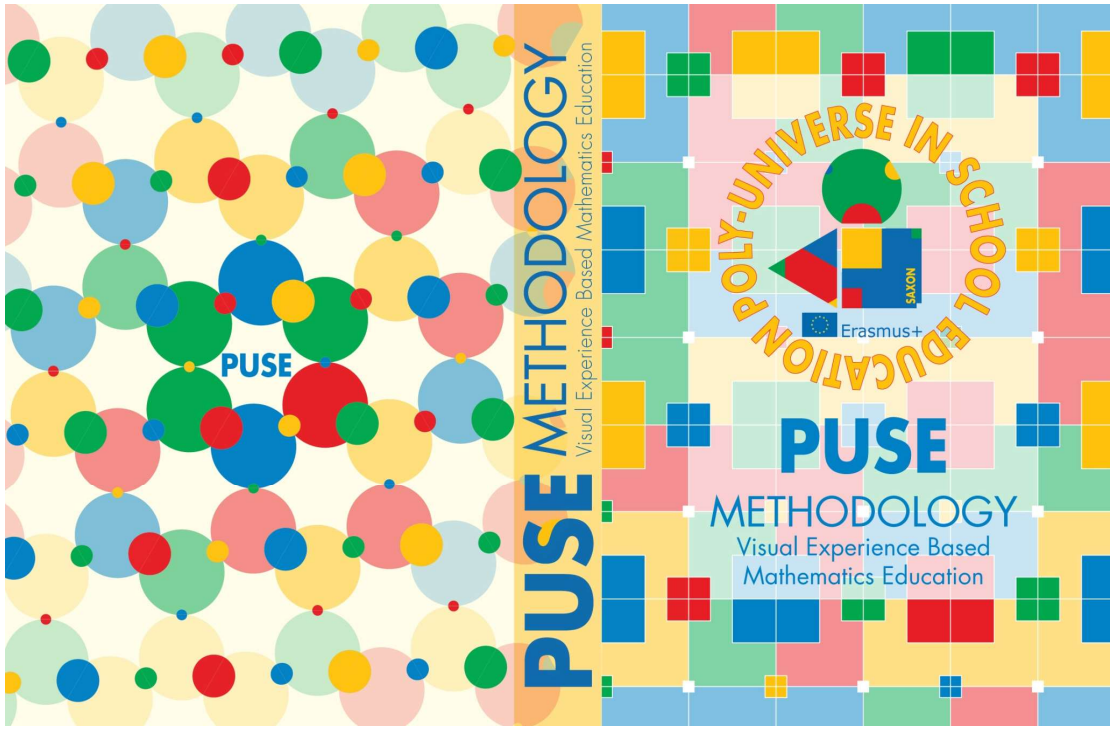
14th International Congress on Mathematical Education
July 11 to 18, 2021 Shanghai, China

# PUSE (Poly-Universe in School Education) Methodology

Visual Experience Based Mathematics Education; ISBN 978-615-81267-1-7

Edited by János Szász SAXON & Dr Eleonóra Stettner PhD

Free downloadable electronic version [PDF]: www.poly-universe.com




The **PUSE Methodology book** consists of five main thematic units:

**1 Geometry & Measurement**
**2 Combinatorics & Probability**
**3 Sets & Logic**
**4 Graphs & Algorithms**
**5 Complex & Visuality**

The **PUSE student workbook** target three different age groups:

**A/lower grades**
**B/upper grades**
**C/high school students**

**Grade B / Age: 10-14**
**Topic:** combinatorics
**Sets:** triangle, one set
**Further tools:** paper, pencil
**Language:** English

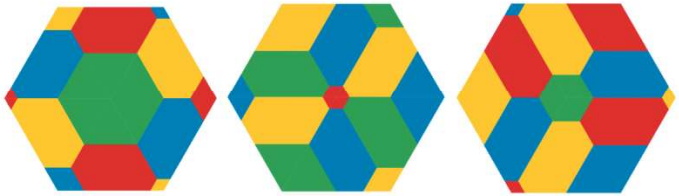
**TEACHER**
PUSE Task Number
**B**
**212**

**Description of the task:**

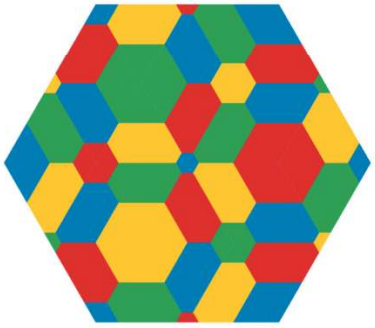
a) Construct the smallest possible regular hexagon with same colour and size connections. How many such hexagons can be built from a triangle set? (They don't have to be set out simultaneously; you can deconstruct them if you don't have enough elements. Two constructions are different if there is at least one element that has different neighbours in the constructions.)
b) Use the entire set to construct a regular hexagon with same colour and size connections. How many different constructions are possible this time?

**Solution(s) of the task:**

a) Due to the same colour connections, we will have a monochrome hexagon in the middle. There is only one way of constructing each of those central hexagons. Thus, for each colour and size, there is one solution, so we have 4 colours × 3 sizes = 12 different constructions. Some examples:



b) As seen in Task a) we can start building hexagons in 12 ways. But after we have our hexagon in Task a), there is only one way of continuing it as there is only one suitable element to be connected to each side of the triangle elements. (Two colours are defined by the connecting triangle elements, and the other two colours can only be changed among each other. The latter two can only be the triangle we are connecting with and the triangle we are connecting to.) By constructing them, we can check the fact that all 12 solutions can be finished. Some examples:

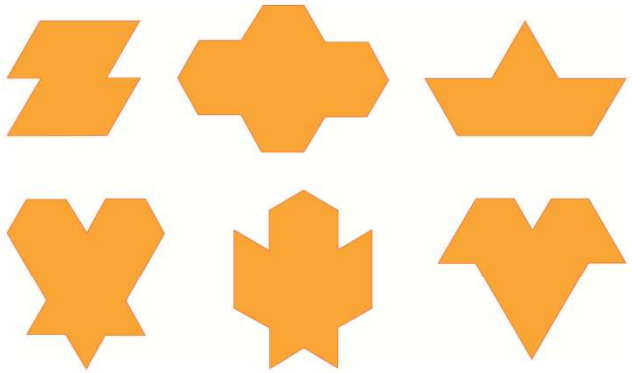


**Grade B / Age: 10-14**
**Topics:** combinatorics, geometry, Tangram
**Sets:** triangle (one set)
**Further tools:**
**Language:** English

**TEACHER**
PUSE Task Number
**B**
**509**

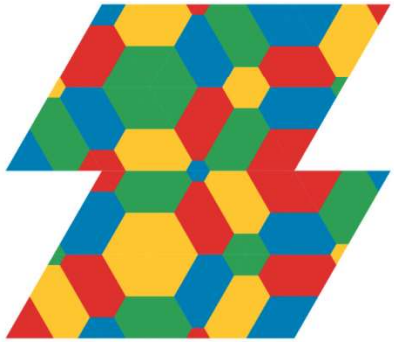
**Description of the task:**

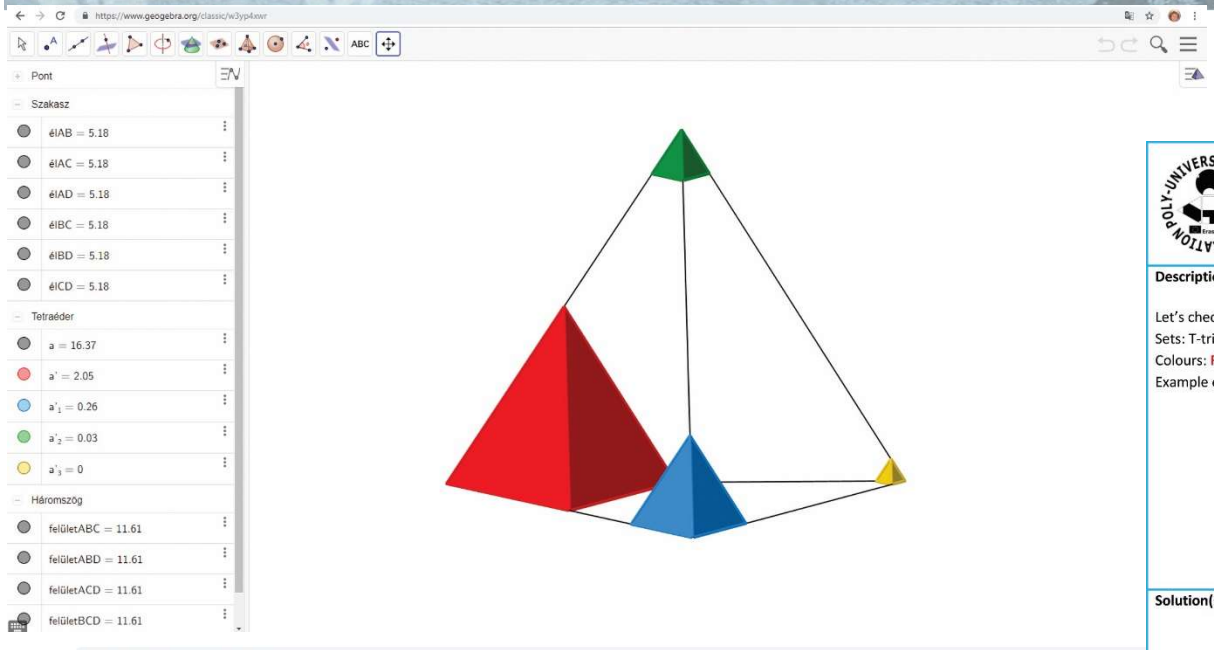
a) Use triangles to construct this shape. Use up the entire set.
b) Construct the shape with connections of the same size.
c) Construct the shape with connections of the same colour.
d) Construct the shape with connections of the same size and colour.

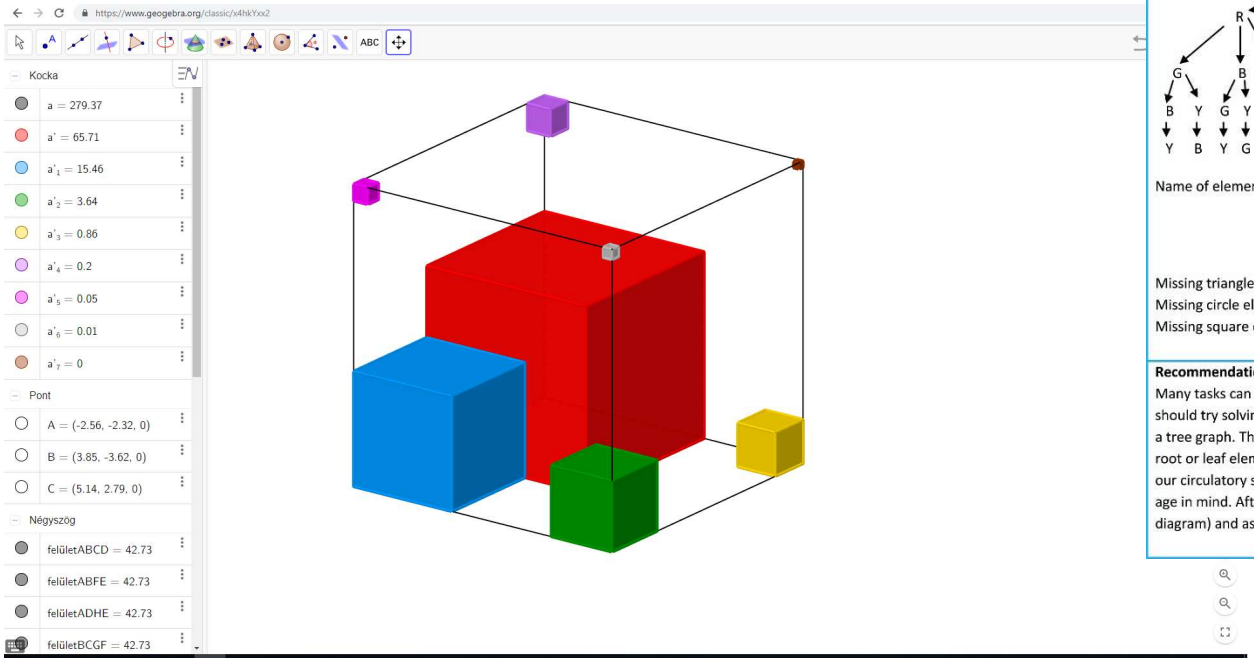


**Solution(s) of the task:**

Tasks a), b) and c) have several possible solutions, but d) might cause difficulties. (This one has several solutions as well, below we show one of each)






**Grade B / Age: 10-14**
**Topics:** classification, graphs
**Sets:** triangle, circle, square
**Further tools:** paper, coloured pencil
**Language:** English

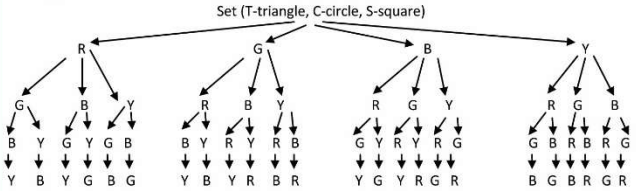
**TEACHER**
PUSE Task Number
**B**
**406**

**Description of the task:**

Let's check how many and what kind of elements are there in each set.
Sets: T-triangle, C-circle, S-square
Colours: **R-RED; G-GREEN; B-BLUE; Y-YELLOW**
Example of labelling elements:

TGYRB CBGRY SRBYG

**Solution(s) of the task:**




Name of element: ... RGBY ☐ ; ...RGYB ☐ ; ...RBGY ☐ ; ...RBYG ☐ ; ...RYGB ☐ ; ...RYBG ☐
... GRBY ☐ ; ...GRYB ☐ ; ...GBRY ☐ ; ...GBYR ☐ ; ...GYRB ☐ ; ...GYBR ☐
... BRGY ☐ ; ...BRYG ☐ ; ...BGRY ☐ ; ...BGYR ☐ ; ...BYRG ☐ ; ...BYGR ☐
... YRGB ☐ ; ...YRBG ☐ ; ...YGRB ☐ ; ...YGBR ☐ ; ...YBRG ☐ ; ...YBGR ☐

Missing triangle elements: Red: TRBYG, TRGBY / Yellow: TYRBG, TYBRG / Blue: TBGRY, TBYRG
Missing circle elements: Red: CRGBY, CRBYG / Yellow: CYRGB, CYGBR / Blue: CBYZR, TBGYR
Missing square elements: Red: SRGBY, SRBGY / Yellow: SYRGB, SYBRG / Blue: SBYGR, SBGYR

**Recommendations for teachers:**

Many tasks can be assigned to children relating to the classification of Poly-Universe elements. First, they should try solving these tasks without laying out the sets. In this case, it is best to motivate students to use a tree graph. The term *tree graph* can be accounted for the similar structure of trees, thus we can refer to root or leaf elements. The tree graph can be associated with other similar patterns in nature, for example our circulatory system, lungs, etc. In connection with the task, we can talk about fractals, keeping students' age in mind. After solving the task, they can come up with new tasks (which can be illustrated with a tree diagram) and assign them to each other.

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# Erasmus+ PUNTE

## (Poly-Universe in Teacher Training Education)

STEAM educational system

2020-1-HU01-KA203-078810 Project, 2020-2023

# PRIZES of Poly-Universe

2021 **ISAS, STEAM** Academic Archievement Award (Korean)
2021 **Top100 Media**, Hungary
2018 **Hungary Emerging** - Magyar Foundation of North America (USA)
2019 **Pollock-Krasner Grant,** New York (USA)
2010 **Prize of ScienTile**, Bridges Pécs 2010
2010 **Special Award of the Innovation** – Pannon Novum, (Hungary)
2009 **Prize of POLIUNIVERSE** - knowledge produc – Innoreg, Gábor Baross, (Hungary)

## PARTNERS of Poly-Universe

Bridges Finland 2016
University of Jyväskylä

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www.experienceworkshop.org

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INTERNATIONAL SYMMETRY ASSOCIATION
ISA

GYURIK Plastic Ltd

European Society for Mathematics and Art
ESMA

MMM
Magyar Matematikai Múzeum
1117 Budapest, Pázmány Péter sétány 1/A,
a főbejárat fölött az 1. emeleten

mobile MADI museum

SAXON art gallery

Erasmus+

ISAS International Society for the Advancement of STEAM
국제융합교육발전학회

ULB UNIVERSITÉ LIBRE DE BRUXELLES

MOMATH
NATIONAL MUSEUM OF MATHEMATICS

NKTH
Nemzeti Kutatási és Technológiai Hivatal

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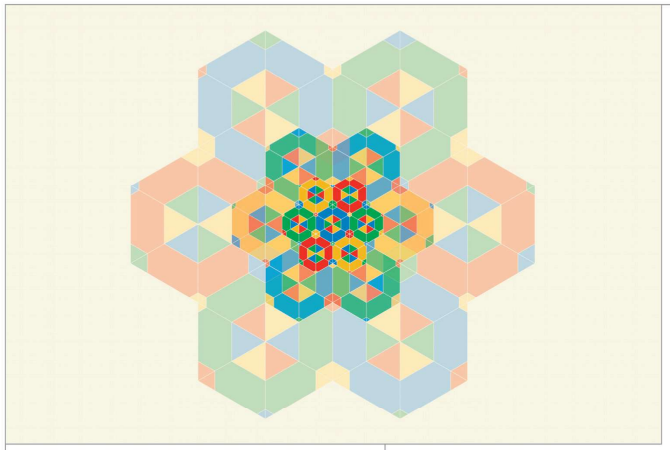

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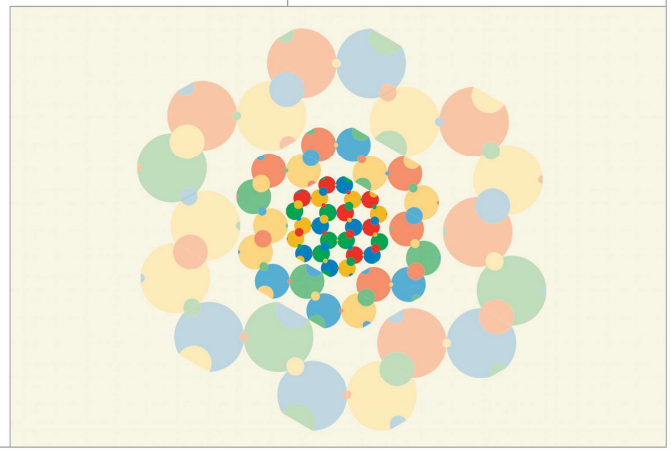

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# Symmetry: Culture and Science

## Poly-Universe in School Education

The journal of the Symmetrion

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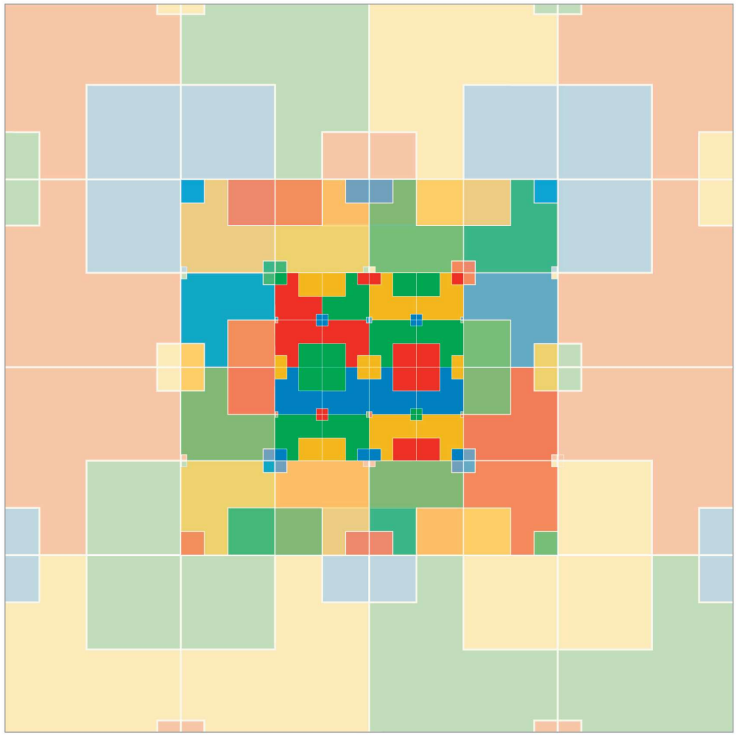

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# PUSE

## E-learning trial version available

## https://puse.education

saxon@poly-universe.com

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SOLUTIONS