

TEMPLATE for the TEACHERS

★ **Name of the project:**

Platonic Solids Made By Origami

★ **Subjects covered from STEAM areas:**

Mathematics, Geometry, Art, Origami

★ **Target group (age range and size of the group)**

14-18, whole class, group work.

★ **Duration of the activity:** 90 minutes

★ **Keywords:**

Origami, Platonic solids, Geometry, Paper folding,

★ **Key sentence describing context of the activity, followed by short description (200 words):**

Students explore Platonic solids' properties and models through hands-on activities and paper folding-origami. Origami gives students various opportunities to explore information about polyhedrons' properties. Through this activity students have a better insight of terms such as edges and vertices of polyhedrons, and the outside and inside of polyhedrons. The concept of convexity and concavity can also be illustrated by making different polyhedrons by origami. Understanding of polyhedron's network allows easier understanding and solving geometrical problems. The student may view it from different angles and obtain certain conclusions.

★ **Description of the activity environment, including the list of materials and tools needed:**

This is a classroom activity, and students need instructions for paper folding. Students explore Platonic solids' mathematical properties after making their 3D models.

★ **Step by step, detailed description of the activity, including teaching and learning strategies.**

In this activity students are introduced with the definition of polyhedrons and to the techniques of paper folding and connection of Origami to mathematics. Students will make Platonic solids using Origami solids. After finishing their work, students exhibit their work and explore mathematical properties of Platonic solids.

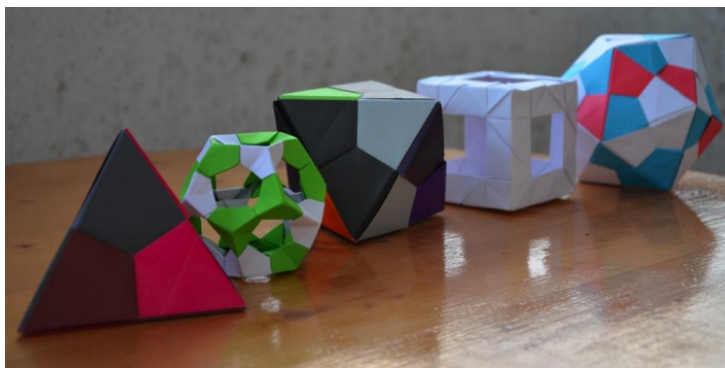
★ **Learning objectives/competencies:**

This activity invokes mathematical thinking, math concept and vocabulary. It develops geometrical and measurements skills. During this lesson students get information and explanations about symmetry, congruence, angles, and polyhedrons' features. Students also have a possibility of investigating 3-dimensional shapes, objects, and spatial relationships. This activity saves resources - only paper is required, and students

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can work with recycled paper.

In the Figure below there are five Platonic solids - results of paper folding.



★ Evaluation/Assessment guidelines

Evaluation in this activity could be done with formal assessment made by the teacher. An example of the task is given below. It is a task where students discover Euler's theorem for convex polyhedrons.

Polyhedron	Tetrahedron	Cube	Octahedron	Dodecahedron	Icosahedron
Vertices (V)					
Edges (E)					
Faces (F)					
V-E+F					

Students can also calculate different polyhedrons' properties using formulae. The task can be related to the polyhedrons students made with origami techniques.

Polyhedron	Tetrahedron	Cube	Octahedron	Dodecahedron	Icosahedron
Dihedral angles	$\arccos\left(\frac{1}{3}\right)$	$\frac{\pi}{2}$	$\pi - \arccos\left(\frac{1}{3}\right)$	$\pi - \arccos(2)$	$\pi - \arccos\left(\frac{\sqrt{5}}{3}\right)$
Area	$\sqrt{3}a^2$	$6a^2$	$2\sqrt{3}a^2$	$3\sqrt{25+10\sqrt{5}}a^2$	$5\sqrt{3}a^2$
Volume	$\frac{a^3}{6\sqrt{2}}$	a^3	$\frac{\sqrt{2}}{3}a^3$	$\frac{15+7\sqrt{5}}{4}a^3$	$\frac{5(3+\sqrt{5})}{12}a^3$
Circumradius	$\frac{\sqrt{6}}{4}a$	$\frac{\sqrt{3}}{2}a$	$\frac{a}{2}\sqrt{2}$	$\frac{a\sqrt{3}}{4}(1+\sqrt{5})$	$\frac{a}{4}\sqrt{10+2\sqrt{5}}$
Inradius	$\frac{a}{\sqrt{24}}$	$\frac{a}{2}$	$\frac{a}{6}\sqrt{6}$	$\frac{a}{2}\sqrt{\frac{15}{2} + \frac{11}{10}\sqrt{5}}$	$\frac{\sqrt{3}(3+\sqrt{5})}{12}a$

★ Lessons learned:

The proposed workshop gives us a chance to explore Platonic solids that have been studied throughout centuries due to their mathematical and aesthetic beauty. Origami

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provides techniques with which models of Platonic solids can be made and gives an opportunity to explore their properties empowered with visual representations.



★ Additional information/Links:

Instructions for Origami folding of Platonic solids:

<https://www.youtube.com/watch?v=789UqXtGyH0>

<https://www.youtube.com/watch?v=eqJTWrrRgaE>

<https://www.youtube.com/watch?v=KQPe0mCuwF8>

<https://www.youtube.com/watch?v=3FlvwCDJkjo>

<https://www.youtube.com/watch?v=OmYY9uUnAO4>

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