

LESSON SCENARIO 10: PLATONIC POLYHEDRA

Topic: Geometry

Level: Age 14 -16

Foreknowledge: Basics of geometry

Correlation: Architecture



LEARNING OUTCOMES

- Student is able to understand the concept behind a platonic solid
- Student is able to identify different types of polyhedron and name them

TEACHING METHODS

- Hands-on activity
- Group work
- Practical exercise and references to life examples

KEY WORDS

- Platonic solid
- Euler's polyhedral formula

RESOURCES

- Exercise sheet
- Colourful sheets of paper
- Sheets of foam
- Glue
- Straws
- Crayons

ACTIVITIES




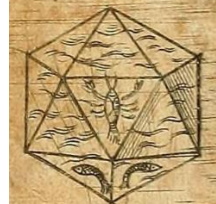

INTRODUCTION (10 minutes)

What are polyhedra?

The word polyhedra comes from Latin:

- poly – many
- edra - faces

Platonic polyhedra, or platonic solids, come from the Greek philosopher and mathematician Plato (c. 428-347 B.C.). He attributed these polyhedra to the elements and to the universe as represented below by Johannes Kepler in 1619. You will see that each polyhedron contains several polygons.

Hexahedron	Tetrahedron	Octahedron	Icosahedron	Dodecahedron
Earth	Fire	Air	Water	Universe
				

Question for students:

Based on the pictures, could you tell what the prefix before -hedron (remember latin: edro - face) means?

- Hexa (answer: 6)
- Tetra (answer: 4)
- Octa (answer: 8)
- Isoca (answer: 20)
- Dodeca (answer: 12)

A polyhedron is a solid figure made of flat surfaces called polygons. These surfaces cannot be rounded nor curved.

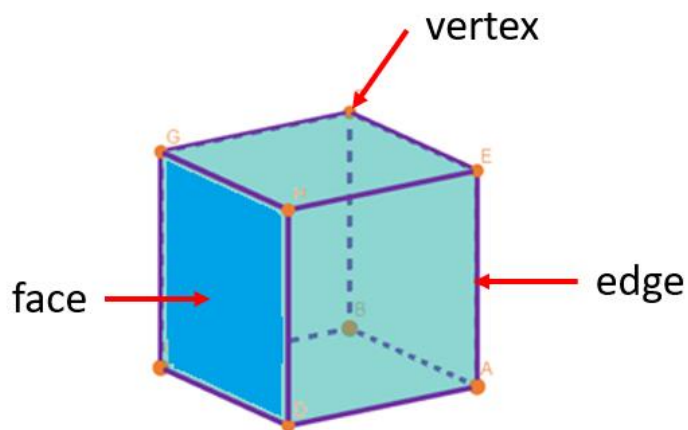
What is special about Platonic polyhedra:

They are convex polyhedra, which means that if you draw a straight line from one point of the polyhedron to another of its points, the line will stay within the solid.

- They are regular polyhedra, which means that their flat surfaces, or faces, are regular polygons with the same number of sides.

How we can recognize a polyhedron?

To better recognize the different parts of regular polyhedra, here is a Hexahedron with a different colour for each part (faces, vertices, and edges):



A German mathematician called Leonard Euler (1707-1783) also studied polyhedra and found a formula that allows us to check if a figure is a polyhedron or not. It was used by mathematicians who tried to find other platonic polyhedra. The conclusion was that there are only five of them!

Here is Euler's polyhedral formula:

$$F + V - E = 2$$

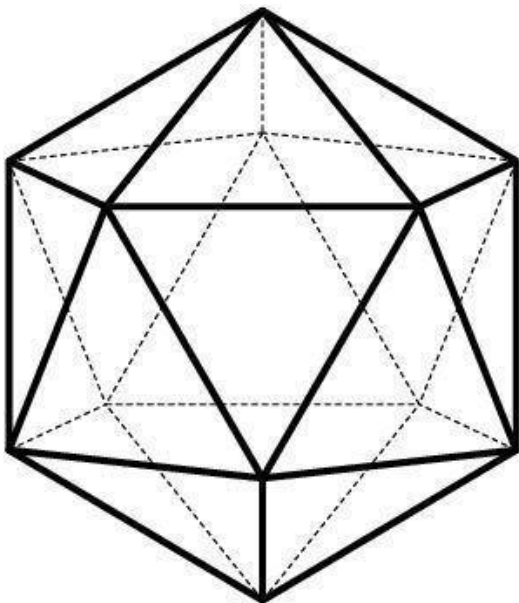
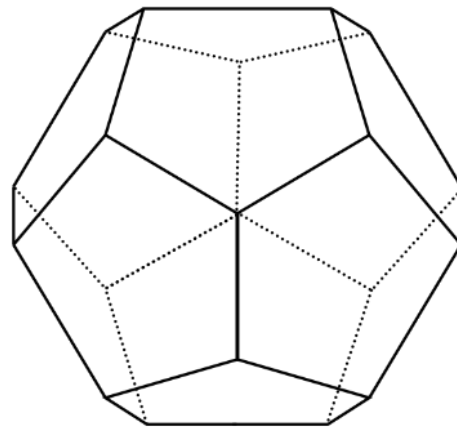
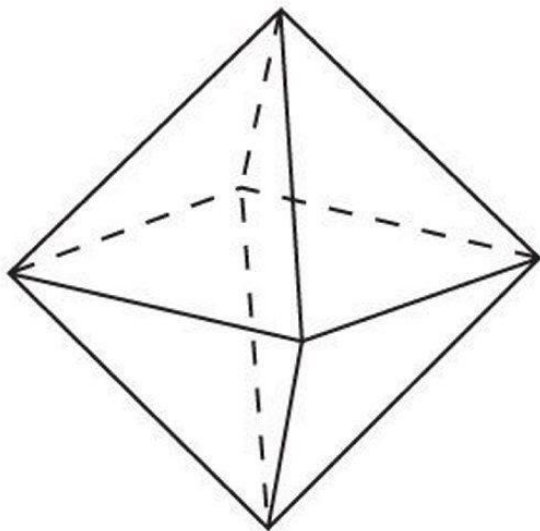
In which F is the number of Faces, V the number of Vertices, and E is the number of Edges.

EXERCISES (25 minutes)

Worksheet for students

Task 1:

Mark and colour the following polyhedra's Faces, Vertices and Edges.



Task 2:

Let's build!

The teacher creates groups and assigns 1 Platonic polyhedron to each team.

The team has straws, coloured sheets and sheets of foam to build the polyhedron.

The teacher explains the steps.

Step 1: Use the straws as the edges of the solid

Step 2: Use the coloured sheets to create the faces and glue them in-between the straws.

Step 3: Cut small circles from the sheet of foam and glue them to the vertices of the polyhedron.

Once all the polyhedra are created, students will have emphasized all the needed elements of Euler's formula.

Task 3:

Given Euler's formula $F + V - E = 2$ (where V = vertices, E = edges and F = faces), fill in the following table:

Platonic solid	Number of faces (F)	Number of vertices (V)	Number of edges (E)	$E + 2$	$F+V$
Hexahedron					
Tetrahedron					
Octahedron					
Dodecahedron					
Icosahedron					

ANSWERS

Platonic solid	Number of faces (F)	Number of vertices (V)	Number of edges (E)	$E + 2$	$F + V$
Hexahedron	6	8	12	14	14
Tetrahedron	4	4	6	8	8
Octahedron	8	6	12	14	14
Dodecahedron	12	20	30	32	32
Icosahedron	20	12	30	32	32

EVALUATION

FINAL PART (5 minutes)

State and describe Euler's formula.

How many vertices, edges and sides does an Octahedron have? Check your answers by using Euler's formula!

Give two examples of every-day objects that look like platonic solids and write down the names of these platonic solids!

1. Name Euler's formula!

$$F + V - E = 2$$

2. How many vertices, edges and sides does an Octahedron have? Check your answers by using Euler's formula!

$$V = 6, E = 12, F = 8$$

$$\rightarrow 8 + 6 - 12 = 2$$

3. Give two examples of every-day objects that look like platonic solids and write down the names of these platonic solids!

e.g. a Rubik's cube = Hexahedron, a pyramid = Tetrahedron, a playing dice = Hexahedron / Icosahedron

INCLUSIVENESS GUIDELINES

Every student is different and their needs for the material might vary. Below you will find several tips that could make mathematics lesson more inclusive for students who struggle with learning disorders.

- When giving assignments to classroom try to break them into small pieces of information. Avoid the double tasks in the instructions. Remember that in case of operations/exercises with multiple steps, it is critical to help learners decompose the steps.
- You can use checklists for your students to make sure they have done all the steps
- Make sure the font, line spacing, and alignment of your document is accessible for students with learning disorders. It is recommended to use a plain, evenly spaced sans serif font such as Arial and Comic Sans. Others: Verdana, Tahoma, Century Gothic and Trebuchet. Spacing should be 1.5 and try to avoid justification in the text.
- At the end of each activity, take some time to ask the students what they have learnt to acknowledge every step in their learning process
- Make sure that the material the students manipulate is easy enough to grasp
- While using different media (paper, computer and visual aids) choose different background than white which can be too bright for students with learning disorders. The best choice would be cream or soft pastel but try to test different colours to learn more about student's preference.
- To stimulate short and long-term memory prepare for all the students in the classroom an outline describing what they are going to learn on this lesson and finish it with a resume of what has been taught. In this way they will strengthen the ability to remember information.

EXAMPLE:

1. Start every lesson with a short "CHECK-IN"

- Today, we will study the topic (name of the topic)
- I will tell you about: (name 3 keywords connected with the topic)
- Then I will present exercises: (name the exercises form the student book)
- Then we will do exercises (explain the way student will be working: ex. together with teacher / in pairs /individually)
- Once the exercises will be done [To continue]

2. Then finish lesson with a short "CHECK-OUT"

- During the lesson we learn about (topic of the lesson)
- The most important things were: (name 3 keywords connected with the topic)
- We were able to do... (tell about the work student done during the lesson)
- We will explore the topic next time when we will learn about (name the following topic)

It is a small adjustment that will take 5 min from the lesson but can make a great difference in the way that the material will be remembered. Try to create this as a routine habit.