LESSON SCENARIO 10: PLATONIC POLYHYDERA

Topic: Polyhydera

Level: Age 14 -15

Foreknowledge: Basics of geometry

Correlation: Architecture, Construction

Time: 45 minutes

LEARNING OUTCOMES

- **Understanding the concept behind a platonic solid**

TEACHING METHODS

- **VR technology**
- **Individual work and pair work**

KEY WORDS

- **Platonic solids**
- **Euler's Polyhedral formula**

RESOURCES

VR headsets
Worksheet for students

INTRODUCTION

5 MIN: RULES OF CONDUCT WHEN USING VR IN THE CLASSROOM

The teacher starts discussion with the students asking them about the use of VR and their expectations in using VR in classroom.

After the discussion the teacher defines the work methods and rules of conduct for students regarding safety precautions for using VR headsets in the classroom and learning in virtual environment:

- **listen to the teacher carefully**

- **remove physical obstacles before using VR**

- **always work in pair - never alone**

- **keep the device clean.**

5 MIN THEORY: CONCEPT OF POLYHYDERA

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 on your worksheet that each polyhedron contains several polygons.
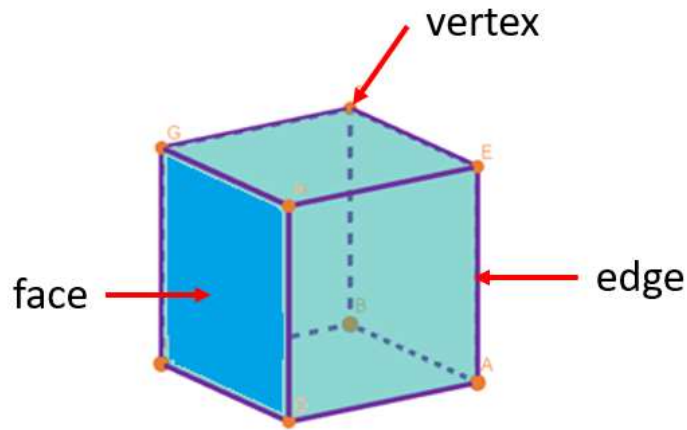
A **polyhedron** is a solid figure made of flat surfaces called polygons. These surfaces cannot be rounded nor curved.

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 polyhedral?

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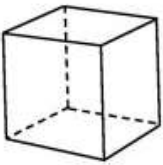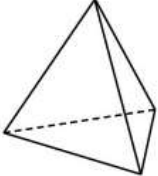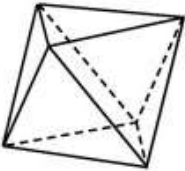

PREPARATION:
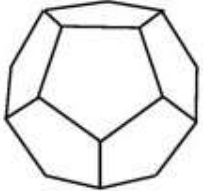
- the teacher divides the students into pairs - in each pair there is a student A and a student B; student A has a VR headset, and student B assists him.
- student A carefully puts on his VR headset and starts the task in the VR application.
- student A finds and selects the Polyhydera exercise on the exercise shelf (second shelf)
- after completing the tasks, students A and B change roles

ACTIVITY

WORKSHEET FOR STUDENTS

5 min: Warm-up exercise before launching the VR APP

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

Hexahedron	Tetrahedron	Octahedron	Icosahedron	Dodecahedron

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

10 min: VR Task 1

Task for student A (with the headset):

By pointing on the polyhedron and holding those buttons student can check all the solid from all sides and count faces + vertex + edges

Student B (who does not have VR headset on) reads the solid details from the following table and writes down the result of student A.

	Faces	Vertex	Edges
Hexahedron			
Tetrahedron			
Octahedron			

After that task, the students switch places.

Student B who now has VR headset solves the task in the following table:

	Faces	Vertex	Edges
Icosahedron			
Dodecahedron			

After the completion of the task by students, students discuss the question:

QUESTION:

What examples of real-world polyhedrons are coming to your mind? Name at least 1 each.

Examples of answers: Crystals, Pyramids, Iglo, soccer balls, dice for role playing games

5 min: Teacher gives a theory about the Euler's formula

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 (teacher writes that on the board):

$$F + V - E = 2$$

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

10 min: VR Task 2

Student A (with the VR headset) checks the following solids in VR **and Student B (who does not have VR headset on)** filles the following table according to the Euler's formula

	Number of faces (F)	Number of vertex (V)	Number of edges (E)	E+2	F+V
Hexahedron					
Tetrahedron					
Octahedron					

After that task, the students switch places.

Student B who now has VR headset solves the task in the following table:

	Number of faces (F)	Number of vertex (V)	Number of edges (E)	E+2	F+V
Icosahedron					
Dodecahedron					

	1	2	3	4	5
1. I like the way of work in this lesson.	1	2	3	4	5
2. This lesson was interesting.	1	2	3	4	5
3. It is clear what I was supposed to learn in this lesson.	1	2	3	4	5
4. The subject matter was clearly explained.	1	2	3	4	5
5. I have learned the subject matter.	1	2	3	4	5
6. I think I actively participated in this lesson.	1	2	3	4	5
7. I was more active in this lesson than usually.	1	2	3	4	5
8. By being active I contributed to the quality of the lesson.	1	2	3	4	5
9. I was motivated for work in this lesson.	1	2	3	4	5
10. I prefer using VR in lessons.	1	2	3	4	5
11. Name two things you liked in this lesson.					
12. Name two things you didn`t like in this lesson.					

INCLUSIVENESS GUIDENESS

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.