Teacher's Handbook for the packet „Class Set"

There are an infinite number of convex polyhedra. Unlike the cube or the pyramid, which are both polyhedra, most of them do not have a name. Together with your students, you can change that. Adopt the polyhedra and give them names.

Convex polyhedra consist of:

- flat side surfaces
- straight edges
- outward pointing corners

The cube, pyramid and an (still) unnamed polyhedron with six corners.

Learning Goals:

The main learning objectives of this project are the relation between space and form and understanding different mathematical representations. The handling of spatial geometric objects is practiced and the representation of the polyhedron as a polyhedral net invites students to consider forms in different dimensions. The two-dimensional net must be brought into its three-dimensional shape by the process of cutting, folding and gluing together.

On the website, students find their personal polyhedra in an interactive, computer-aided, digital representation. Their polyhedron can be changed by color or by switching the corners, edges and side surfaces viewer on and off. The students have the opportunity to give their personal polyhedron a name. The symbolic representation is therefore chosen by the students and is not given, as is usual in mathematics and the natural sciences. In this way, students learn that it is possible to participate in shaping science. This change in the perception of mathematics is one of the main goals of our project.

Polyhedra can be incorporated into many different lesson plans. For example, a series of lessons on surface area and volume calculations of geometric bodies or in the context of analytical geometry. For ages 10 to 14, we recommend accompanying the learning packet “Polly's Journal” to this class set, which can be found on our website.

What do you need for the implementation of the project?

- Roughly two hours

- A class set of polyhedral nets
- Adoption worksheet
- Finding research questions worksheet (optional)

- Scissors
- Tape or glue

- Internet enabled devices: cell phones, tablets, computers…
- Email addresses for registration

Components of the project

Adoption worksheet: The Adoption worksheet gives the definition of convex polyhedra, briefly summarizes the work assignments and contains the website address where the polyhedra can be adopted.

Polyhedral nets: Each student receives an individual polyhedral net with a number. The nets are cut out along the outer line, folded along the black edges and glued together using the gray tabs.

Model building: The models are created from the craft sheets. The class set of polyhedra is generated fresh from our database with each download. Therefore, these are various and randomly gathered polyhedra that are still available for adoption. The polyhedral nets have different complexities and therefore can be distributed to students based on their skill level.

Video tutorial: There is a video with instructions for building the models. You can watch it on our homepage and download it for use in the classroom.

Adoption: On the website www.polytopia.eu, your students can register with their email addresses. From experience, it is helpful to inquire beforehand if the students already have email addresses and if they have access to them. No further data is needed. Using the identification number on the crafting sheet, the respective polyhedron can be found on the website.

Finding Research Questions worksheet: This worksheet turns the usual mathematics lesson on its head. The goal is to find an interesting and not yet answered question about polyhedra. As the project "Adopt a Polyhedron" springs from scientific mathematics, we would like to invite the students to take on a research point of view of polyhedra.

Questions and Feedback: We welcome comments, questions and feedback on your project experience. Write us an email: schule@polytopia.eu

About the project, "Adopt a Polyhedron"

The project “Adopt a Polyhedron” is part of the public relations work of the Collaborative Research Center “Discretization in Dynamics and Geometry”, which is funded by grants from the Deutschen Forschungsgemeinschaft (DFG) and is primarily involved with the structure and applications of discrete mathematics. Mathematicians from the Technische Univerität Berlin, the Technische Universität München, and the Freie Universität Berlin are investigating the discretization of differential geometry and dynamic systems. Discrete in a mathematical context means distinguishable. For example, the four corners of a square are clearly separated while a circle could be understood as a polygon with an infinite number of indefinable corners. Three-dimensional polyhedra, with their well-defined corners, edges and side surfaces belong to the classical research field of discrete geometry.

Goals

The goal of this project is to build models of “all” polyhedra in a collective endeavor. To accomplish this, we have initially released all polyhedra with up to nine vertices for adoption. It is not possible to realize all polyhedra, as there are an infinite number of them, but everyone can help bring as many as possible to life by adopting their own individual polyhedron, giving it a name and then building a model. In particular, we would like to invite students to actively participate in mathematics by focusing on the construction of geometric models. Modeling has long been a central discipline in (university) mathematics and has in recent decades been phased out by visualization with computers. However, the manual assembling of a model allows engagement and a deeper understanding of mathematics beyond abstract ideas.

Citizen Art

Lately, there has been an increasing effort in Citizen Science to actively engage everyday people in scientific research. As mathematicians, we also wish to offer interested people an opportunity to participate. Since the construction of models also has a creative and individual aspect and we want to emphasize the relationship between mathematics and art, we characterize our project under the term *Citizen Art*.