GOSTEAM Hands-on Activity Template *(Classroom-Formal)*

Title:

Experiments with PET-powered rockets

Short Description (Max 500 words):

Design, test, analyze and adapt PET-powered / compressed air rockets and determine flight altitudes.

Keywords (Up to 5):

Information about the Implementation

Age and language of the students:

	9-12	12-15	15-18	18+
Language: Age:	☐	■	☐	☐

Number of Lessons – Duration (per lesson):

Number of Lessons: 6 Duration per Lesson: 50 min

Subjects:

For which subject(s) the activity is usable, is it an interdisciplinary activity?

- Science ■
  - Physics ■ Chemistry ☐ Biology ☐ Geosciences ☐ Environmental ☐ Other ☐
- Technology ■
- Engineering ■
- Arts ☐
- Mathematics ☐

Information about the Scenario

Curriculum and country:

Link of the current activity to the curriculum:

Country: Austria Class: Grade: 7

Topic: Influence of physics on aesthetics, function and design

Objectives (Max 100 words):

Description of the learning objectives

The students should recognize the influence of physical laws on everyday objects and get to know its practical areas of application.

Materials (Max 100 words):

Which resources and materials (software, hardware) are needed?

PET bottles, bicycle tubes, PVC pipes, paper, adhesive tape,

Spatial concepts, skills and abilities:

Which spatial concepts and skills are covered by the activity?

Spatial concepts:

Primitives: Identity/Name ☐ Location ☐ Space/Time ■

Simple: Distance ■ Direction ☐ Connectivity ☐ Movement ■

Boundary ☐ Shape/Area ☐ Adjacency ☐

Difficult: Overlay ☐ Buffer ☐ Topology ☐ Coordinate ☐

Map ☐ Scale ☐ Shortest Path ☐ Navigation ☐

Surface ☐ Slope/Gradient ☐ Aspect ☐ Contour ☐

Complex: Interpolation ☐ Map Projection ☐ Spatial Dependency ☐

Other:

Spatial skills:

- ☐ Map literacy
- ☐ Navigation/orientation
- ■ Estimating distances and directions
- ☐ Recognizing and understanding patterns/Understand and identify models of spatial organization
- ☐ Select an ideal location based on the given spatial features
- ☐ Visualization
- ■ Understand and identify spatial correlations/ dependencies
- ☐ Categorize spatial entities/ geographic features and identify hierarchies
- ☐ Compare spatial entities and draw analogies among them
- ☐ Identify/determine connections/relations
- ☐ Understanding scale in space and time
- ☐ Delineation of spatial regions/ zones based on given features/ properties

Short Description

Navigation/orientation: Finding one's way in unfamiliar environments, interpreting and giving walking and driving directions.
Estimating distances and directions: Measure paths, weighted distances, angles.
Map literacy: Using, interpreting/understanding, learning from, and communicating acquired spatial knowledge from maps, comprehension of geographic features represented as points, lines, or polygons.
Recognizing and understanding patterns/Understand and identify models of spatial organization. Delineation of spatial regions/zones based on given features/properties: Regionalization processes, pattern recognition and clustering identification in the 2d and/or the 3d world.
Select an ideal location based on the given spatial features: Single or multi-criteria siting and optimal areas identification.
Visualization: Visualizing spatial entities from written/oral verbal descriptions, from their 2d or graphical representations or through mental transformations; such as axis rotation or perspective taking.
Understand and identify spatial correlations/ dependencies: The ability to realize, identify and explain patterns, clusters and relevant spatial dependencies.
Categorize spatial entities/geographic features and identify hierarchies: Identify the hierarchical form of data and gradients between spatial entities.
Compare spatial entities and draw analogies among them: Calculate and compare different geometric objects' shapes, area and, boundaries.
Identify/determine connections/relations: The ability to identify links and common characteristics among spatial entities and between humans and spatial entities.
Understanding scale in space and time: The understanding of changes/transitions through space and time for different spatio-temporal scales.

Geospatial concepts and spatial abilities documentation (see Section 3.2):
http://www.gosteam.eu/wp-content/uploads/2021/05/GOSTEAM_IO1_A1_final.pdf

Description of the activity in detail

Classroom activities

The students should recognize the influence of physical laws on everyday objects and get to know its practical areas of application. The aim is to overcome subject boundaries in order to recognize connections. The influence of physics on design should be conveyed through the dream of flying. Aerodynamics, time and speed, movement-inhibiting and movement-promoting processes are thematized and implemented practically, experimentally. The principles learned are tested, reflected on and improved using PET bottle-powered rockets which are created in crafts and technology lessons.

Experiments with PET-powered rockets

Step 1:

Build launch pad:

To do this, a stable wooden board is used as a base and a second one is fixed at right angles to it with wooden skrews. The vertical board should be in the middle of the base. Now you can mount two PVC electrical installation pipes (16mm) on both sides of the vertical board in such a way that they protrude slightly above. The rockets will later be placed on these tubes. The easiest way to do this is to screw on the clamps provided for this purpose.

At the lower end of the pipe you need an elbow or a piece of hose to extend the vertical pipe horizontally with a second pipe on the floor board. This tube should be long enough so that the pupils are not in the "danger zone" when they rockets are fired, i.e. their heads above the rocket. (approx. 1- 1.5m)

In order to be able to quickly change the PET bottles brought by the students, it is advisable to build a nozzle with a bottle cap. To do this, you drill a hole through a closure with a suitable knothole drill (16mm), insert a pipe and glue everything with epoxy glue or hot glue. So you can simply screw the bottles onto the launch pad without having to work with adhesive tape.

As an alternative to the PET powered system, a bicycle tube can also be cut apart. One end (at the valve) is knotted and thus closed. The other end is taped directly to the vertical tube of the launch pad. A bicycle pump can be used to build up pressure in the hose. To achieve this, the hose must be squeezed shut and suddenly released when there is enough pressure.

When launching the rocket, always make sure that no student is standing over the launch station in order to prevent injuries.

Step 2:

Build missiles:

For the construction you need about 30cm long pieces of the same pipes as for the launching station (16mm). A4 paper is tightly rolled around this and fixed with adhesive tape. The plastic tube is removed again.

Effect of design on flight characteristics.

A rocket head is designed to close the case at the top. This head can be shaped differently (cone, drop, blunt, ...) and will thus have an effect on the flight characteristics.

The paper tips are attached to the fuselage of the rocket with adhesive tape.

The weight can also be varied to observe the effects. The easiest way to do this is with corks, which are already wrapped in the fuselage.

Finally, fins are designed and attached with adhesive tape. Here, too, the design has a decisive influence on the flight characteristics. Draw the design on a piece of folded paper and cut it out with the scissors so all Finns are in the same shape.

Step 3:

Launch and adaptation:

For the launch, a PET bottle is screwed to the launch station and the rocket is placed on the vertical tube. It shouldn't be too tight or too loose. Then jump on the PET bottle.

After completing the first test flights, the rockets are evaluated and adapted depending on the individual problems.

Step 4:

Height measurement:

To carry out the measurement by means of triangulation, a measuring device is built according to the construction manual.

Two people follow the flight with the measuring device and determine the highest point by eye.

1. Determine the length of the adjacent cathetus.
2. The flight of the rocket is followed with the "protractor". At the turning point (highest Rise, apogee) the angle is fixed by holding the thread on the protractor,read and noted. Several people during the measurement improve the result. When determining the height, take the eye level into account.
3. Via the trigonometric definition of the tangent, the height of rise (opposite cathetus in a right triangle) of the missile.

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References (if any):

Assessment (if any):