Title

Volume of Japanese rice box

Author

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Table of activities

School subject	*Mathematics*
Topic	*Volume*
Age	*18 years*
Required time fo the acitivity	*90 minutes*
Required materials	*Paper, computer, scissors, the Internet*
Cultural concept	*Japanese technique of paper folding*

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Teaching concept

In this activity, students will engage in both hands-on activities and computer-based visualizations to learn advanced concepts in geometry. They will use Japanese traditional paper folding to observe the geometry of a three-dimensional mathematical solid, which will help them solve real-world problems related to determining maximum volume. In addition to the hands-on activities, students will also use educational software called GeoGebra (www.geogebra.com) to explore different possibilities for solving real-world problems.

Cultural concept

Origami is a traditional Japanese paper folding activity that is not only aesthetically beautiful but also practical for everyday use. One example of an origami object that can be used in daily life is the Massu box, which is specifically designed for storing rice.

Mathematical concept

In this activity, students will analyze the problem of maximizing the volume of a box. This problem is an excellent example of practical applications of advanced mathematical concepts and calculus, making it a valuable tool for teaching these concepts to students.

Aim of activity

The purpose of this activity is to explore the applications of calculus to real-world problems, specifically those related to calculating the volume of a box. This will be achieved through a combination of paper folding techniques and computer-algebra applications.

Activities

This activity is comprised of two tasks. The first task involves folding a paper masu box using origami techniques. Masu boxes were traditionally used for measuring rice in feudal Japan and can be easily folded from a square sheet of paper using instructions found online.

The second task involves determining the height that maximizes the volume of the masu box. To solve this problem, students will analyze the crease pattern of the masu box and utilize GeoGebra software to assist with their calculations. By examining the crease pattern, students will be able to connect the fact that the volume of a box folded from a square sheet of paper with side length "a" can be described with the mathematical function $V(h)=4h^3-4ah^2+a^2h$*, where "h" is the height of the box. To arrive at this formula, students will apply their prior knowledge of calculating the volume of a prism and multiplying the height and the area of the box's base,*

which in this case is a square with side length "a-2h". Students will then calculate the first derivative of the function, which is $V'(h)=12h^2 -8ah+a^2$, and use GeoGebra to identify the local extremes. As the first derivative is a quadratic equation, there will be two solutions, with one representing the maximum height value of the box.

Additional material

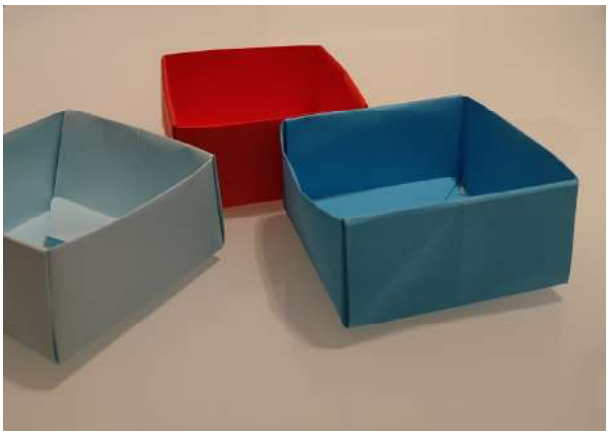

Figure 1 Folded masu boxes

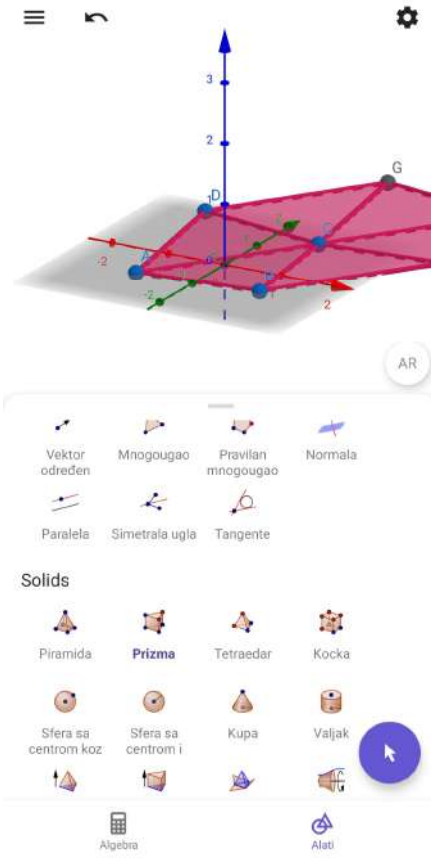

Figure 2 Exploring problem using GeoGebra

Figure 2 Folded masu boxes are used for keeping rice