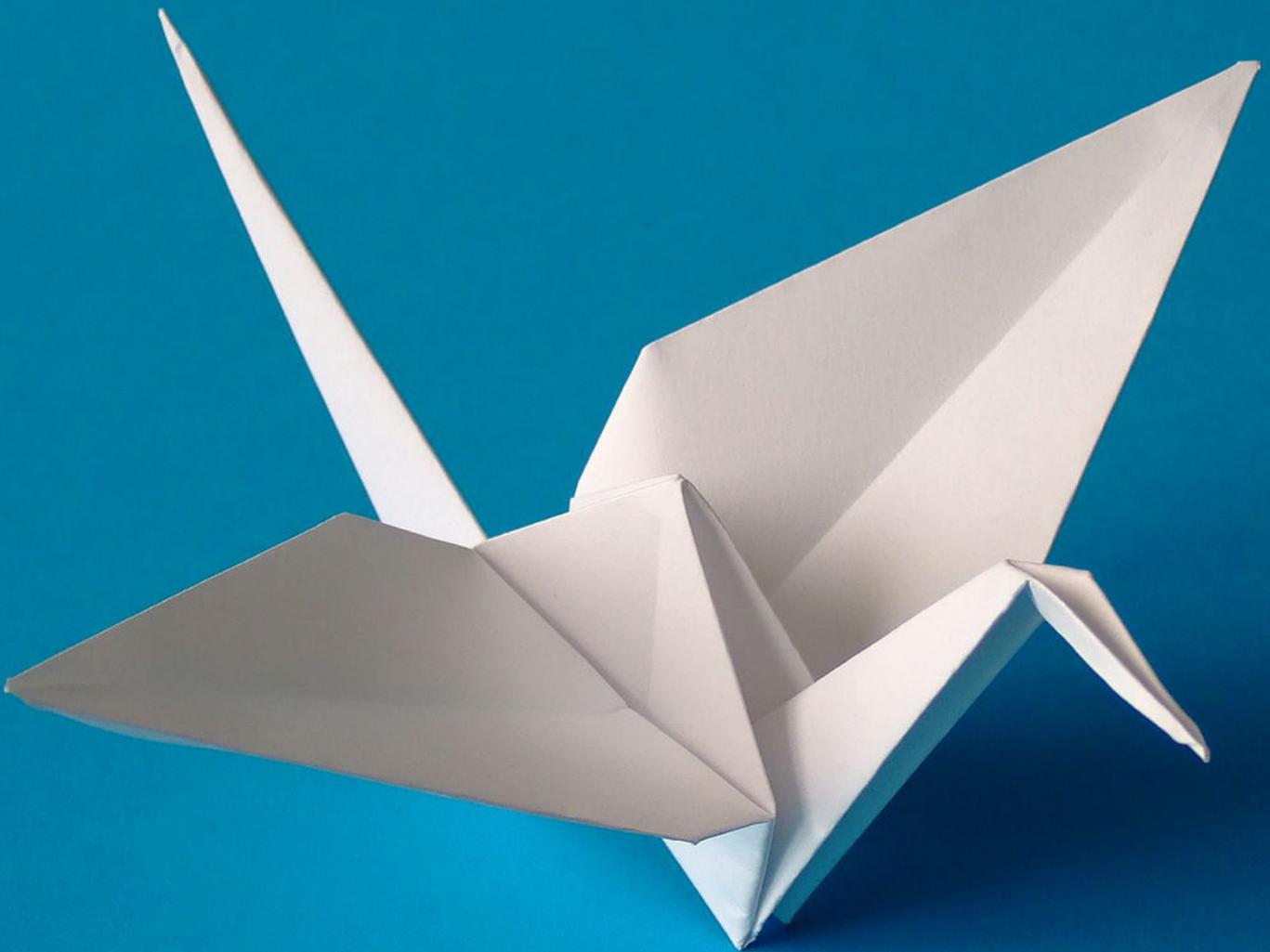


# ORIGAMI BOXES

Using Paper Folding to Teach Geometry

James Swart, Extension Graduate Assistant, 4-H Youth Development



# Tennessee 4-H Youth Development

## ***Origami Boxes***

*Using Paper Folding to Teach Geometry*

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### **Skill Level**

Intermediate

### **Learner Outcomes**

*The learner will be able to:*

- Understand the relationship between two-dimensional and three-dimensional shapes.
- Measure a three-dimensional shape and compute the surface area.

### **Educational Standard(s) Supported**

6<sup>th</sup> Grade

Math-Geometry #4

7<sup>th</sup> Grade

Math-Geometry #3, #6

\*See supplemental information for text of standards.

### **Success Indicator**

Learners will be successful if they:

- Construct an origami box.
- Compute the surface area of the origami box.

### **Time Needed**

30-40 Minutes

### **Materials List**

Paper, cut into a square

Rulers

Scissors

Student Handout

*Optional*

Colored pencils, markers, crayons

### **Introduction to Content**

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This lesson uses the Japanese art of paper folding to introduce students to concepts in math and geometry. In this lesson, students will create an origami box and then calculate the surface area of their box. Students will be able to see the connection between two-dimensional shapes and three-dimensional shapes.

### **Introduction to Methodology**

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This lesson uses a hands-on approach to teaching math. Students will begin by calculating the area of different squares and then will have the opportunity to construct their own origami boxes. After completing their boxes, students will measure and calculate the surface area of their boxes. The lesson has a K-W-L activity incorporated throughout to use as an assessment for the students.

### **Author**

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## Terms and Concepts Introduction

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Origami — The Japanese art of folding paper into decorative shapes and figures.

Surface Area — The area of an outer part or uppermost layer of an object. The surface area of a cube is calculated using  $6a^2$ , where “a” is the length of an edge.

## Setting the Stage and Opening Questions

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Begin the lesson by passing out the student handout. Say the following:  
*“Today, we are going to do a fun origami activity. Before we get started with the paper folding, on the page I just passed out fill out the K and W sections. This is what you know, under K, and what you want to know, under W, about geometry. Take about four to five minutes to complete this.”*

While students are completing this portion, pass out two squares of paper to each student.

Ask students to share a few items that they wrote under K and W on their handout, and then move into the experience.

## Experience

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To begin, you will guide students through two simple origami foldings that will show students the importance of being accurate with folds. Completing steps 1 and 2 of the box activity (see Supplemental Information on page 4) using two different pieces of paper and then taping the folded pieces together can accomplish the first activity. Instructions for the second activity are included on the student handout.

Instruct the students that it will be important that they pay close attention to the instructions as you move through how to fold their origami boxes. It will also be important to remind the students that this may come easily to some and may be difficult for others. Instructions for how to fold the box are included in the supplemental information.

After students have completed their box folding, say the following: *“Now, we are going to look at the area that our cubes take up and then calculate their surface area. Who can tell me the formula for the area of a square? (length times width, or side squared) Who knows the formula for surface area? (see above; if no one knows, share the formula with the students) We’re going to do a little experiment. I want this half of the room to calculate the surface area of their cube using the surface area formula, and this half will calculate it by finding the area of each of the sides and adding them together. When you have your area calculated, come up and write it on the board.”*

Allow students time to calculate the area; both groups should arrive at the same number.

Say: *“Now that you know a formula for surface area, you can easily calculate that instead of summing the areas of each square. We can also see that a three-dimensional cube is just made up of six different squares. You can now fill out the L portion of your handout, which is what you learned today.”*

## Tips for Engagement

Work slowly enough through the paper folding for all students to follow along.

Encourage students who follow the process easily to help the students who are struggling.

## **Share**

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Ask students the following questions:

*“What was one interesting thing you learned from today’s lesson?”*

## **Process**

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*“What are some other 3D shapes that are just made up of other 2D shapes that you can think of?”*

Instruct the students to write a short haiku about what they learned about surface area. A haiku is a Japanese style of poetry that has five syllables in the first line, seven in the next, and five in the last.

## **Generalize**

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*“Thinking about some of the shapes that you just mentioned, what are some easy ways that we could calculate the surface area of each of those?”*

## **Apply**

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*“What are some uses for some of the 3D shapes we named of?”*

*“Will certain shapes work better than others?”*

### **Life Skill(s)**

#### **Sixth Grade**

**Use the senses to gain new information or find new ways to use information (Head, Thinking).**

#### **Seventh Grade**

**Use the learned information in new situations, to solve problems, or to change one's behavior (Head, Thinking).**

## ***Supplemental Information***

### ***State Content Standards Met***

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#### **Sixth Grade**

- Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures.
- Apply these techniques in the context of solving real-world and mathematical problems.

#### **Seventh Grade**

- Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.
- Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms.

## Origami Box Folding Instructions

1. Fold a sheet of square paper in half vertically and then horizontally. Unfold and flip the paper over.
2. Fold the paper along each diagonal, unfolding between the folds.
3. Fold in the two side pieces along the nondiagonal fold until you have a pyramid shape (Image 1).
4. Fold the triangles up in half so they meet in the middle at the top; repeat for the back side.
5. Fold the right and left corners to the center of the diamond shape. Repeat for the opposite side (Image 2).
6. Fold the small triangles in half so they meet in the center, and repeat for the backside.
7. Unfold the larger triangles on the sides and fold down the smaller triangles one more fold (Image 3).
8. Tuck the smaller triangles gently into the openings on the larger side triangles (Image 4).

Blow in the small hole to inflate the cube.

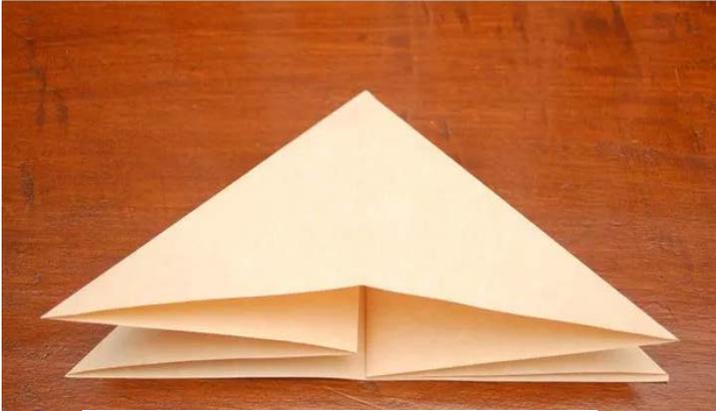


Image 1

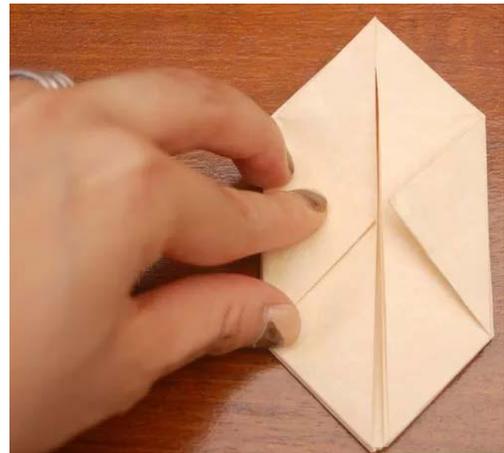


Image 2

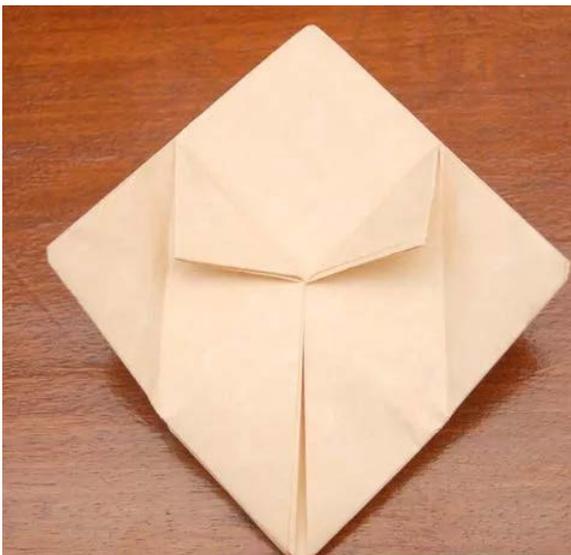


Image 3



Image 4

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**K**

**W**

**L**

## Exploding Triangle Folding Instructions

Fold a square piece of paper along each diagonal and make sharp creases.

Fold in half along each edge, so the paper is divided into eight triangles.

Fold in along one of the horizontal lines, so your paper looks like the image below.

Fold the whole shape in half and decorate each page!

