

MODULAR ORIGAMI

BY TRISHA KODAMA

How does the appearance and form of three-dimensional shapes relate to math?
How do shipping companies use volume to transport cargo in the most cost efficient way?

ELEMENTARY FIFTH GRADE

TIMEFRAME FIVE CLASS PERIODS (45 MIN.)

STANDARD BENCHMARKS AND VALUES

MATHEMATICAL PRACTICE

CCSS.MATH.CONTENT.5.MD.C.3

- Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

CCSS.MATH.CONTENT.5.MD.C.4

- Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.

CCSS.MATH.CONTENT.5.MD.C.5

- Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.

General Learner Outcome #2 – Community Contributor

General Learner Outcome #5 – Complex Thinker

General Learner Outcome #6-Effective and Ethical User of Technology

NA HONU MAULI OLA PATHWAYS

- 'Ike Pilina-Relationship Pathway: Students share in the responsibility of sharing what they learn about origami with others.

- 'Ike Piko'u-Personal Connection Pathway: Students will develop a sense of pride and self-worth while contributing to the learning of our class and the other 5th grade class.

- 'Ike Na'auao-Intellectual Pathway: Students nurture their curiosity of origami by learning how to fold other objects.

NA HOPENA A'O

- Strengthened Sense of Responsibility: Students will demonstrate commitment and concern for others when working with their partner. They will give each other helpful feedback in order to complete tasks.
- Strengthened Sense of Excellence: Students will learn that precise paper folding will lead to producing quality work, a perfect Sonobe cube.
- Strengthened Sense of Aloha: Students will show Aloha to students in the other 5th grade class when presenting their slideshow and teaching them how to fold a Sonobe unit and put together a Sonobe cube.

ENDURING UNDERSTANDINGS

- There are many connections between mathematics and the art of origami.
- Having an understanding of three-dimensional shapes and having spatial reasoning will help students determine volumes to solve real world and mathematical problems.
- Hawai'i's geographical location makes shipping goods to the islands difficult and costly.

CRITICAL SKILLS AND CONCEPTS:

- Students will learn to fold a basic modular origami unit to construct a Sonobe cube, a three-dimensional shape.
- Students will use the formula to calculate the volume of individual Sonobe cubes.
- Students will make predictions on the number of cubic units needed to fill a specific box and make enough Sonobe cubes to fill the box.
- Students will create a Google Slide presentation of the steps in making a Sonobe cube.

AUTHENTIC PERFORMANCE TASK:

- Students will work with a partner to construct Sonobe cubes out of origami paper.
- Students will use the formula to accurately calculate the volume of their Sonobe cube.
- Students will use one of their Sonobe cubes to help them make an accurate prediction on the volume of a specific box.
- Students will be assessed on a Google Slide presentation of the construction of a Sonobe cube and calculation of the volume of a three-dimensional shape made out of Sonobe cubes.
- Rubric

AUTHENTIC AUDIENCE:

- Students will give presentations to peers in the other 5th grade class
- Students will teach the students in the other 5th grade class how to make a Sonobe cube.

OTHER EVIDENCE:

- Observation of students working individually and with partners.
- Presentation of Google Slide
- Teacher created rubrics; one for the constructing of the Sonobe cube and volume calculation and one for the Google Slide Presentation.



LEARNING PLAN

Lesson One: Introduction to Origami (45 minutes)

Materials Needed:

Library books: (See References/Resources)

- Yoko's Paper Cranes
- Urashima Taro and other Japanese Children's Favorite Stories

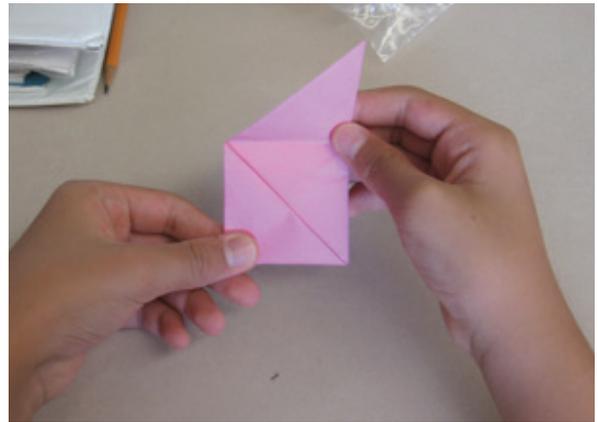
Origami paper, 6"x6" in various solid colors, 6 sheets per student

Video on how to fold a Sonobe unit:

<https://www.youtube.com/watch?v=TKGW2W168H0>

Ziploc gallon size bag; 1 per student to hold folded paper

- Read the book, Yoko's Paper Cranes; Wells, Rosemary and the story "The Fairy Crane" from Urashima Taro.
- Begin discussion on cultural importance of origami using KWL chart.
- Show students the video and teach students how to fold the Sonobe unit.
- Students will fold 6 Sonobe units, with a partner if necessary. Keep all the units in the Ziploc bag for the next lesson.



One Sonobe unit

Lesson Two: Construct Sonobe Cube (45 minutes)

Materials Needed:

- Folded units (6) of Sonobe cube
- Video on how to construct a Sonobe cube: <https://www.youtube.com/watch?v=WasvUFxmACK>
- Ruler with standard and metric units of measurement
- Teacher created worksheet to record data (see References/Resources)
- School iPads or digital camera (1 for each pair of students) to take pictures to document the process

- Students will work with a partner to take pictures/video of each other constructing their cube.
- Students will use their ruler to measure the length, width, and height of their cube and record their data on the worksheet. Then use their data and the formula to calculate the volume of their cube.
- Students will use their Sonobe cube to predict the number of cubic units needed to fill a specific box (I used a box that held 5 reams of copy paper).



Constructed Sonobe Unit

- Students will write a paragraph using math vocabulary words to describe their Sonobe cube (quadrilateral, equilateral triangle, etc)
- Students will construct enough Sonobe cubes to fill the box.
- Conduct class discussion on how many cubes are actually needed to fill the box.
 - ▶ How many cubes are in each layer? How many cubes can the box hold?
 - ▶ Was your prediction close?
 - ▶ Do the cubes fill the box exactly?
 - ▶ What about the empty space in the box?
 - ▶ What are some other similar situations that you would have to use this skill of “packing” things, using volume, and estimating?
 - ▶ Go back to fill in KWL Chart



Example of Filled Box

Lesson Three: Creating a Google Slide show (Three 45 min blocks)

Materials Needed:

- Students' completed worksheet
- Student Chromebooks and school iPads or digital cameras

- Students will be given a teacher created Google Slide lesson, including a rubric. (see References/Resources)
- Students will compile their pictures (Students may need to be taught how to import pictures into their slideshow if they did not learn this skill yet) and data collected (measurements and calculations of volume from earlier lesson) into a Google Slide and present to their peers.

References/Resources

Article: Meaning of the Origami Crane, JCCC Origami Crane Project Materials for Teachers and Students, www.jccc.on.ca/origami-cranes/pdf/meaning_of_the_origami_crane.pdf

Article: The History of Origami, Origami Resource Center; <http://www.origami-resource-center.com/history-of-origami.html>

Books:

- Yoko's Paper Cranes; Well, Rosemary; Hyperion, ISBN: 978-0-7868-0737-6
- Urashima Taro and Other Japanese Children's Favorite Stories; Sakade, Florence; Tuttle Publishing, ISBN: 9784805309971
- Beginner's Book of Modular Origami Polyhedra; The Platonic Solids; Gurkewitz, Rona & Arnstein, Bennett, Dover Publications, Inc., New York, 2008; ISBN: 0486461726/ISBN 13: 9780486461724

Students' Chromebooks, iPads, and/or digital cameras

NAME _____

DATE _____

SONOBE CUBE ACTIVITY

1. Measurements of your Sonobe cube:

LENGTH	WIDTH	HEIGHT

2. What is the volume of your Sonobe cube? Show your work. _____

3. Estimate the number of cubic units needed to fill the box: _____

4. What is the actual number of cubic units? _____

5. Describe your Sonobe cube using the appropriate math vocabulary (quadrilateral, triangle, sides, vertices, etc.)

SONOBE CUBE

GOOGLE PRESENTATION EXAMPLE

Sonobe Cube Presentation

2015-2016

Task:

- ❖ You will be putting together a presentation to teach someone the steps to folding and putting together a Sonobe cube.
- ❖ You will also be explaining how to measure the dimensions and find the volume of your Sonobe cube.

Criteria:

- ❖ You need a title slide with your name and date.
- ❖ Explain every step to fold and add a picture of the step.
- ❖ Show the final product.
- ❖ Measurement can be in either standard or metric units.
- ❖ Show how you calculated the volume of your cube.

Rubric:

	ME	MP	DP	WB
Volume	Volume is calculated accurately.	Volume is calculated with minor errors.	Volume is calculated inaccurately.	Volume is not calculated.
Presentation	<ul style="list-style-type: none"> Includes a creative title slide Detailed steps include pictures Includes picture of final product 	<ul style="list-style-type: none"> Includes a title slide Appropriate steps include pictures Includes picture of final product 	<ul style="list-style-type: none"> Steps include pictures, but some steps may be missing or not clear Includes picture of final product 	<ul style="list-style-type: none"> Steps include pictures, but may be unclear or hard to follow Includes picture of final product