BIFOLD BOXES
Lesson 1: Bifold Boxes

Australian Curriculum: Mathematics (Year 5)

ACMMG111: Connect three-dimensional objects with their nets and other two-dimensional representations.
ACMMG115: Apply the enlargement transformation to familiar two-dimensional shapes and explore the properties of the resulting image compared with the original.

Lesson abstract

Students fold origami boxes from proportional paper squares and compare the dimensions of the boxes.

Mathematical purpose (for students)

How does changing the size of a paper square change the dimensions of origami folded from that square?

Mathematical purpose (for teachers)

Students use multiplicative reasoning to justify why changing the size of an origami square by a factor of 4 results in changing the size of a box folded from that square by a factor of 8.

Suggested presentation: One lesson of one hour

Vocabulary encountered:
- proportional
- dimensions

Lesson materials:
- Large and small paper squares (see Preparation below)
- *1a Folding a Box* PowerPoint (for display) or video directions for folding an origami box, such as this video.

Preparation: The small paper squares must be **one-quarter** of the size of the large squares. We recommend cutting A3 paper into squares to create large squares, and then cutting large squares into quarters to make the small squares. This creates squares that are a convenient size for folding.

Alternatively, you may choose to use squares with integer measurements for more convenient calculations, for example 10x10 and 20x20 cm squares or 16x16 and 32x32cm squares.

Each student will need at least 1 large square and 1 small square.

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Introduction

Explain to students that in this lesson you will be folding origami boxes using differently sized paper squares and investigating how changing the size of the square affects the size of the box.

Give out Student Sheet – Folding Boxes and small paper squares. Students measure and record the dimensions of the square on their sheet.

Using *1a Bifold Boxes* PowerPoint or video directions such as this video on YouTube, have students fold their square into an origami box.

Teacher notes

- Some of the steps are complex and it would be helpful to practice in advance.
- Some steps in the PowerPoint and in the video are given in a slightly different order, but the final box is identical.
- The PowerPoint requires some degree of familiarity with origami diagrams. If students are unfamiliar with origami diagrams the video will be more useful.

Exploration

Discuss: *what do you notice about your original square and the box you have made? What do you wonder?*

Ask students: *How might we change the dimensions of the box? If we wanted a box that was twice this size, what could we do? What if we wanted a box four times the size?*

Give each student a large paper square and ask: *how does this square compare to your first paper square?* Focus students' attention on the fact that this square has side lengths *twice* that of the original square, and therefore its area is *four times* that of the original square. Explore why this is.

Ask: *Can you predict how a box folded from this square will compare to the box you have already folded?* Students record the dimensions of the square and their predictions on their student sheet, then fold the large square into a box as before.

Discuss: *what do you notice? What do you wonder?*

Class discussion

Discuss:

- *How do the side lengths of the two squares compare?*
- *How do the areas of the two squares compare?*
- *How do the sizes of the two boxes compare?*
- *How many **times bigger** is the large box than the small box?*
    - **Enabling Prompt**: *How many of the small boxes could you fit inside the large box?*

Ask:

- *If we followed different directions to make a different origami box using the same squares, will the smaller square **always** make a box with one-eighth the size of the larger box?*

Folding Boxes

Name: _____

Small square

Side length:

Area:

Small box

Side length:

Depth:

Area of base:

Observations:

Large square

Side length:

Area:

Large box

Side length:

Depth:

Area of base:

Predictions:

Observations:

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