

Dimensions of Design

This lesson guides students toward a deeper understanding of the concept of area and its application to real-world problems through an investigation of Japanese screens. The folding screen was a creative, infinitely adaptable solution to the problem of delineating private and public space in elite Japanese homes, palaces, and temples built along open interior plans. Traditionally made in coordinating pairs, screens present unique design challenges as both functional and decorative objects. That design challenge is the starting point for a hands-on investigation at the intersection of art and math.

Grade Level

Grades 4–8

Common Core Academic State Standards

- [CCSS.MATH.PRACTICE.MP4](#)
- [CCSS.MATH.CONTENT.3.MD.C.7](#)
- [CCSS.MATH.CONTENT.7.G.B.6](#)
- [CCSS.ELA-LITERACY.CCRA.R.7](#)

National Visual Arts Standards

- Presenting: interpreting and sharing artistic work
- Connecting: relating artistic ideas and work with personal meaning and external context

Art Images Required

Click on the titles below to view high-resolution photographs on the Philadelphia Museum of Art website. Images that are also available in the Artstor Digital Library are indicated by an ID number or search phrase.

- [Kotodama](#), 2008 (Heisei Period, 1989–present), by Motoko Maio

Supplementary Images

- ["Red-Seal" Ship](#) and [companion screen](#), early 17th century, Japan
Artstor ID number: PMA_.1938-31-1 and PMA_.1953-32-1
- [Eight Daoist Immortals Crossing the Sea](#) and [companion screen](#), 1915, by Senei Hata
Artstor search: 2000-56-1a--f



Kotodama, 2008

Motoko Maio (Japanese)

Silk and paper, mounted as a screen

a: 60 1/16 inches, 8 feet 9 1/8 inches (152.5 × 267 cm)

b: 48 1/16 inches × 12 feet 1/8 inches (122 × 366 cm)

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Lesson Objectives

Students will be able to:

1. Apply their understanding of the concept of area to modeling and solving a real-world problem.
2. Manipulate a given number of square units to create rectilinear, non-rectilinear, congruent, and non-congruent forms.
3. Justify design choices based on form and function.

Essential Question

How do creative people work within practical constraints to design objects that are both beautiful and functional?

Materials Needed

- Screen for projecting images
- Pencils and grid paper
- Square wooden or plastic tiles of a uniform size, or uniform squares cut from heavy paper stock, 48 per pair of students

Lesson Process

1. Show students the Supplementary Images above as an example of traditional screens. Allow a few minutes for thoughtful looking.
2. Ask students to describe what they see. What shapes stand out to you? What numbers stand out to you? What do you notice about the decoration? What do you think these objects are? What is their purpose? What do the pairs of screens have in common? How are they different? Can you imagine using an object like this in your home? How does the size and design of the screens reflect how they were used? What questions do you have? Background information for the teacher can be found [here](#).
3. Now, show students the images of Motoko Maio's *Kotodama*. Ask them to describe what they see. Focus again on shape, form, numbers, colors, repetition, and congruence. Working as a whole class, compare and contrast the contemporary pair of screens with the more traditional examples.
4. Ask students if they think that the *Kotodama* screens are the same size or different sizes. What makes you say they are the same or different? What information would you need in order to answer that question?
5. Share the dimensions of the two screens with your students. You may choose to simplify by rounding to whole numbers, or convert inches to feet, depending on the needs of your students. Can you compare the sizes of the two screens based on their dimensions, or would you need to know something else? Guide students to go beyond describing and comparing length and height to calculating area. Area will tell us exactly how much space each screen covers in square units.
6. Students should now work in pairs to calculate the area of each screen in square units. They may work in inches and feet or in centimeters and meters. Provide students with grid paper for drawing and modeling in order to scaffold their calculations. Answers should be around 45 square feet for screen A, and around 48 square feet for screen B. Suggestions for Differentiation can be found below.

7. When students have completed their calculations, ask them if their impressions were confirmed or if they were surprised by the results. Which one of these screens would you find more useful in your home? Why? Which screen is more pleasing or attractive to you?
8. Distribute square tiles to pairs of students. Tell them to imagine that they have been given 48 square units of material to design the perfect screen for a client's home. How many different rectangular screens covering an area of 48 square units can you come up with? How many can be divided into an even number of congruent panels? How many of those possibilities would also be practical? What information would you need in order to decide on the best dimensions for your client?
9. Give students time to play with the tiles and consider the guiding questions. Circulate, assist, and answer questions as needed.
10. Bring the class back together to discuss results. Does completing this exercise change the way you think about the artist's work? How could you use this exercise as a way to explain the concept of area to someone else?

Differentiation

1. The simplest way for less proficient students to calculate area will be to multiply height by length of the whole screen, given measurements rounded to the nearest whole foot. Taking screen A as an example: 60 $\frac{1}{16}$ inches can round to 60 inches, or 5 feet, and 8 feet 9 $\frac{1}{8}$ inches can round to 9 feet. Multiply 5 feet by 9 feet to find an area of 45 square feet.
2. More confident students can be encouraged to convert inches to feet and round to the nearest whole unit themselves.
3. Students with an advanced understanding of area might be provided with the dimensions of one panel of each screen and then asked to find the area of the whole. For example, challenge students to describe multiple strategies for finding the area of screen a given the dimensions 60 inches by 1 $\frac{1}{2}$ feet for each panel.

Assessment

Given 48 square units, have individual students design a screen that is both functional and a creative expression. Remove the requirement that the screen be rectangular, or composed of rectangles, and challenge them to find a unique shape or arrangement that would still serve the practical purpose of a screen. Students must consider the dimensions of the whole screen and where panels would fold in order to justify the practicality of their designs.

Supplemental Activity

Kotodama means "soul of language" in Japanese. Learn more about how Motoko Maio imbued her creation with language through her choice of materials. Change out plain square tiles for Scrabble tiles, or make your own letter tiles, and ask students to experiment with adding an element of language to their designs. What can the design of a screen say about the artist who created it or about its purpose?