Philadelphia Museum of Art

Thinking Space: The Grid in Art and Math

Both artists and mathematicians use grids to help them understand and manipulate space. Spatial ability, which is the ability "to generate, retain, retrieve, and transform well-structured visual images"[1] in two and three dimensions is fundamental to both domains, and has been found to be a key indicator in the long-term academic and professional success of students.[2] Experiences of looking at and creating works of art may help develop this skill, and can significantly enhance student math achievement, as documented by the *Framing Student Success: Connecting Rigorous Visual Arts, Math and Literacy Learning*[3] program that integrated and studied the effects of high-quality standards-based instruction in the visual arts, math, and literacy in three New York City public schools. This lesson asks students to use grids to think and create in two and three dimensions by looking, drawing, and making.

Curricular Areas

Art, Math

Grade Level

Best for middle or high school, but adaptable for younger learners

Common Core Academic Standards

- CCSS.MATH.CONTENT.4.G.A.1
- CCSS.MATH.CONTENT.5.G.A.2
- CCSS.MATH.CONTENT.7.G.A.1
- CCSS.MATH.CONTENT.HSG.MG.A.3
- CCSS.MATH.CONTENT.HSG.MG.A.1

National Visual Arts Standards

- Anchor Standard: Organize artistic ideas and work+
- Anchor Standard: Perceive and analyze artistic work

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.

- *Giant Three-Way Plug (Cube Tap),* 1970 by Claes Oldenburg
  Artstor search: Three-way plug

[1] Lohman, D. F. "Spatial ability" In R.J. Sternberg (Ed.), *Encyclopedia of Intelligence* (Vol. 2, p. 1000). New York: Macmillan.
[2] Wai, Jonathan, David Lubinski, and Camilla P. Benbow. "Spatial Ability for STEM Domains: Aligning Over 50 Years of Cumulative Psychological Knowledge Solidifies Its Importance." In Journal of Educational Psychology (Vol. 101, No. 4, p. 817–35).
[3] An Arts in Education Model Development and Dissemination (AEMDD) project funded by the Federal Department of Education and implemented through a partnership between the Studio in a School Organization and the New York City Department of Education.

- *The Bucintoro at the Molo on Ascension Day*, c. 1745, by Canaletto
  Artstor search: E1924-3-48
- *Admonishing with the Drum/Censuring on Wood*, 17th–18th century (Edo Period, 1615–1868), by School of the Kano family artist
  Not available on Artstor

Materials Needed

- Drawing paper, pencils
- Card stock printed with 1.5 inch grid
- Scissors
- Tape (small tape circles used to mail brochures work best)

Lesson Process

1. **Observe:** Spend several minutes looking closely at a sculpture with a basic geometric form (either one on view inside the Museum, outside in the Anne d'Harnoncourt Sculpture Garden, such as Oldenburg's *Giant Three-Way Plug (Cube Tap)*, or a public artwork in the city).
2. **Draw:** Have students draw a two-dimensional representation of the three-dimensional object. Stress that there is not one "right" way to draw it, and that everyone will come up with a different outcome depending on their approach and point of view.
3. **Analyze and Discuss:** As a large group, share the drawings. Organize the drawings into groups based on similarity. At one extreme, there will be maps or diagrams; at the other, perceptual drawings which attempt to capture what was seen as accurately as possible. Most of the drawings will probably fall in between these two poles. Discuss the variety of approaches to solving the problem of drawing a three-dimensional object on a flat surface, how some people want to show what they know, or understand about the sculpture, while others focus on only what they can see.
4. **Build:** Explore creating in three dimensions by using a dot-grid, scissors, and tape. Have students build a three-dimensional model inspired by the drawings of the sculpture they viewed (thus reversing the process).
5. **Analyze and Discuss:** As a large group, share the models. How have we turned a flat piece of paper into a three-dimensional object? What is different about creating in three dimensions vs. two dimensions? Discuss the variety of approaches.
6. **Compare:** View other works of art that represent space in a variety of ways, such as the Canaletto painting and Kano school painted screen mentioned above. Spend time looking, analyzing, and discussing the similarities and differences. How do the artists represent three-dimensional space? How does each use a grid system?

Vocabulary

- Two-dimensional space
- Three-dimensional space
- Coordinate grid
- Form
- Sculpture
- Abstract

- *X*, *Y*, and *Z* coordinate axes
- Geometric solids
- Minimalist

Assessment

Evaluate the students on their ability to:

- discuss the differences between two and three dimensions
- describe the characteristics of Minimalist sculpture
- convey 3-D structure in their drawings
- create abstract sculpture, making precise, regular geometric forms by cutting, folding, and attaching paper

Enrichment

1. Visit or look at photos of abstract geometric sculpture (ie, Anthony Caro, David Smith). Make a new drawing of the sculpture you completed in the lesson. Imagine how big it could be and where it might be located. In your drawing, place it in an imaginary setting, which could be indoor or outdoor, in the city or in the countryside.
2. View a work of art that encompasses a fourth dimension (time) such as the 1973 Minimalist dance *Calico Mingling* by Lucinda Childs (available here). Take notes about the movement of the dancers through the grid as you watch the video. Compare notes and discuss as a group. As an extension, create your own dance through a gridded space (you can create a grid with masking tape on the floor), using everyday movements.