# ARTS IMPACT LESSON PLAN

Visual Arts and Math Infused Lesson

Lesson Two: Scaling Up Shapes for Sculpture

Author: Meredith Essex Grade Level: Eighth

Enduring Understanding

Ratio and proportional relationships guide design of scale models and fabrication of full-sized sculpture.

Lesson Description (Use for family communication and displaying student art)

Students analyze proportional relationships of elements in art. Students graph a small-scale right triangle for a

design model on the coordinate plane then enlarge it to graph a similar right triangle which becomes a pattern for

the final sculpture. The design model and pattern are then cut out, and the larger pattern is traced on heavy

colorful paper. The model triangle is transformed from 2-D to 3-D through cutting and folding. Last, the final

sculpture is created through replicating the same 2-D to 3-D process on a larger scale.

Learning Targets and Assessment Criteria

Target: Identifies similar figures in art.

Criteria: Describes proportional relationships of geometric shapes/forms seen in art.

Target: Shows a proportional relationship.

Criteria: Graphs similar right triangles on the coordinate plane.

Target: Uses proportional reasoning to plan a sculpture.

Criteria: Uses coordinates and scale factor to graph a small right triangle as a sculpture design

model and a larger similar right triangle paper sculpture pattern.

Target: Uses craftsmanship in making paper shapes.

Criteria: Smoothly and accurately cuts: enlarged triangle pattern drawn on coordinate plane,

enlarged triangle shape on cardstock (after tracing pattern), and small triangle design model on

coordinate plane.

Target: Creates design model and enlarged paper sculpture.

Criteria: Measures, cuts (without cutting apart) and folds 2-D design model triangle shape into a

3-D form. Uses measurement and scale factor to proportionally cut and fold enlarged triangle shape

into a 3-D form based on design model.

ARTS IMPACT VISUAL ARTS AND MATH INFUSION – Eighth Grade Lesson Two: Scaling Up Shapes for Sculpture

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Vocabulary

Arts Infused:

2-Dimensional

3-Dimensional

Geometric Shape

Grid

Model

Plane

Proportion

Ratio

Scale

Math:

Coordinate Plane

Coordinates

Origin

Right Triangle

Scale Factor

Similar Figures

Slope

Vertex

Vertices

X-axis

Y-axis

Arts:

Craftsmanship

Design

Sculpture

Materials

Museum Artworks or Performance

Seattle, WA

Seattle Art Museum

Tacoma, WA

Tacoma Art Museum

Materials

Drawing pencil: 4H; Vinyl eraser; Arts

Impact sketchbook; White copy paper:

8.5x11”; copy Coordinate Plane

worksheet from lesson: two per student;

Cardstock: 8.5x11”, two-colored (front

and back different color), one per

student; Scissors; Protractors; Rulers;

Class Assessment Worksheet

Seattle Art Museum images:

The Middle West, 1929, Mark Tobey,

42.20

Gray Point, 1981, Robert Maki, 82.68

Learning Standards

WA Arts State Grade Level Expectations

For the full description of each WA State Arts Grade

Level Expectation, see:

http://www.k12.wa.us/Arts/Standards

1.1.2 Elements: Shape

1.1.7 Principles of Design: Proportion

1.2.1 Skills and Techniques: Drawing, Paper

Sculpture

2.1.1 Creative Process

2.2.1 Presentation Process

2.3.1 Responding Process

4.2.1 Connection between Visual Arts and Math

Common Core State Standards (CCSS) in

Math For a full description of CCSS Standards by

grade level see:

http://www.k12.wa.us/CoreStandards/Mathematics/

Standards/default.aspx

8.EE. Understand the connections between

proportional relationships, lines and linear

equations.

8.EE.6. Use similar triangles to explain why the

slope m is the same between any distinct points on

a non-vertical line in the coordinate plane; derive

the equation y=mx+b for a line intercepting the

vertical axis at b.

CCSS Mathematical Practices

MP.4. Model with mathematics.

MP.5. Use appropriate tools strategically.

MP.6. Attend to precision.

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Pre-Teach

Ask students to search for and share examples of objects or images that

represent a scale or ratio relationship: toy models, images on electronic devices.

Discuss the practical need for designing small for building large and how using

ratio and scale factor plays into calculating needs for fabricating a large threedimensional

work of art or other kinds of large constructions.

Lesson Steps Outline

1. Introduce and guide art analysis of The Middle West by Mark Tobey from the

Seattle Art Museum collection. Focus on scale relationships, similar

figures/shapes, and the process of planning and creating sculpture.

Criteria-based peer assessment and teacher checklist: Describes proportional

relationships of geometric shapes/forms seen in art.

2. Guide practice exercise graphing a right triangle on the coordinate plane.

Guide graphing a similar larger triangle and noting conclusions about slope and

proportional relationships.

Criteria-based peer assessment and teacher checklist: Graphs similar right

triangles on the coordinate plane.

3. Facilitate discussion of scale models and how important they are in design and

fabrication of large-scale sculpture.

4. Guide students in graphing similar right triangles on the coordinate plane

using craftsmanship, then cutting the entire larger triangle out. The smaller will

become a small-scale design model, and the larger will become a pattern traced

on cardstock, cut out, and used for the final enlarged sculpture.

Criteria-based teacher checklist: Uses coordinates and scale factor to graph a

small right triangle as a sculpture design model, and a larger similar right triangle

paper sculpture pattern. Smoothly and accurately cuts enlarged triangle pattern

drawn on coordinate plane.

5. Introduce and guide art analysis of the sculpture Gray Point by Robert Maki

from the Seattle Art Museum collection. Note that the sculpture is composed of

basically 2-dimensional flat planes, yet appears to definitely be 3-dimensional.

ICON KEY:

3 = Indicates note or reminder for teacher

= Embedded assessment points in the lesson

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6. Demonstrate and guide tracing pattern for larger triangle on cardstock of

choice. After tracing the large triangle, directs student to cut out the small

triangle that is “inside” the pattern.

Demonstrate strategically using measurement to mark, cut and fold (without

cutting shape apart) small-scale triangle (model) into a 3-dimensional form. The

scale design model is then used as a guide to mark, cut, and fold the final

enlarged sculpture proportionally.

Criteria-based teacher checklist: Smoothly and accurately cuts: enlarged

triangle shape on cardstock (after tracing pattern), and small triangle design

model on coordinate plane. Measures, cuts (without cutting apart) and folds 2-D

design model triangle shape into a 3-D form. Uses measurement and scale factor

to proportionally cut and fold enlarged triangle shape into a 3-D form based on

design model.

7. Facilitate criteria-based peer and group math and art reflection.

Criteria-based peer assessment and group reflection: Compares scale models

with finished sculptures, reflects on artistic and mathematical challenges, and

explores interaction of sculptures in space.

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LESSON STEPS\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Introduce and guide art analysis of The Middle West by Mark Tobey from the Seattle Art

Museum collection. Guide math and art analysis with focus on scale relationships, similar

figures/shapes, and the process of planning and creating sculpture.

3 The Seattle Art Museum’s collection is available on-line at:

http://www.seattleartmuseum.org/emuseum/code/collection.asp. To find the images in this lesson,

enter the accession number for the work of art in the search box on the collections page of SAM’s

website. Accession numbers for these works of art are listed in the materials box at the beginning of

the lesson.

• Notice the small and large buildings in Mark Tobey’s painting. Are they of the same proportion?

Are there similar shapes?

• In looking at a 3-dimensional work, Beverly Pepper’s sculpture, where do you see

similar figures?

• Talk about these two works of art with a partner. Use your knowledge of math, estimation and

geometry to identify whether they are composed of similar figures/shapes. What could be a

math strategy for figuring that out?

• What do you notice? Share you and your partner’s conclusions and the thinking/discussion that

led to that conclusion.

Criteria-based peer assessment and teacher checklist: Describes proportional relationships of

geometric shapes/forms seen in art.

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B

C

2. Guide practice exercise graphing a right triangle on the coordinate plane.

Guide graphing a similar larger triangle and noting conclusions about slope and

proportional relationships.

3 This step can be differentiated and simplified by assigning specific coordinates for B and

C vertices, then asking students as a group to use the same factor to identify coordinates

for and graph a similar triangle.

• Using the coordinate plane, graph a small right triangle with one vertex (A)

at the origin, a second vertex (B) on the x-axis, and the third vertex (C)

placed on a line parallel with the y-axis.

• Using a scale factor, calculate the length of sides of a similar, larger triangle (ADE), and graph it

in the same quadrant (also using the origin/A as a vertex.)

• What do you notice about the relationship of the two triangles? (rate of slope is the same)

Criteria-based peer assessment and teacher checklist: Graphs similar right triangles on the

coordinate plane.

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3. Facilitate discussion of scale models and how important they are in design and

fabrication of large-scale sculpture.

• Why would an artist or designer build something small before constructing it on a larger scale?

• What math concepts might be important in the process of designing and fabricating a work of

art? (measuring, proportion, ratio…)

• We are going to work with the process of using proportional reasoning to create a small-scale

design model for a sculpture and a slightly larger finished sculpture. Both model and sculpture

will be constructed from similar right triangles.

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4. Guide students in graphing similar right triangles on the coordinate plane using

craftsmanship, then cutting the entire larger triangle out. The smaller will become a smallscale

design model, and the larger will become a pattern traced on cardstock, cut out, and

used for the final enlarged sculpture.

• Using the same process we practiced earlier, graph a right triangle (ABC).

• Now graph a larger similar right triangle (ADE).

• The small triangle on grid paper (ABC) will be your scale design model for a paper sculpture.

The large triangle (ADE) on grid paper becomes a pattern for cutting out your sculpture shape

out of cardstock: Cut the larger triangle out. Use craftsmanship: care and attention to

mathematical precision in measuring and cutting. Criteria-based teacher checklist: Uses coordinates and scale factor to graph a small right triangle as

a sculpture design model, and a larger similar right triangle paper sculpture pattern. Smoothly and

accurately cuts enlarged triangle pattern drawn on coordinate plane.

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5. Introduce and guide art analysis of the sculpture Gray Point by Robert Maki from the

Seattle Art Museum collection. Note that the sculpture is composed of basically 2-

dimensional flat planes, yet appears to definitely be 3-dimensional.

• Sometimes sculptures are created out of flat, seemingly 2-dimensional materials. Often they are

metal sheets that have been altered to become 3-dimensional sculptural forms.

• Our paper sculpture scale design model and final work are similar because they are flat to start

with and will be altered by cutting and folding to become 3-dimensional forms.

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6. Demonstrate and guide tracing pattern for larger triangle on cardstock of choice. After

tracing the large triangle, directs student to cut out the small triangle that is “inside”

the pattern.

• Select a color and size of cardstock that works with your pattern size.

• Trace around your larger similar triangle pattern on cardstock. Line up the corner of the triangle

with a corner of the paper for minimal waste.

• Now, cut out your little small-scale triangle that is part of the larger triangle pattern on the

coordinate plane.

Demonstrate strategically using measurement to mark, cut and fold (without cutting

shape apart) small-scale triangle (model) into a 3-dimensional form. The scale

design model is then used as a guide to mark, cut, and fold the final enlarged

sculpture proportionally.

• We want to be strategic. We will transform the design model into a 3-dimensional form by

cutting and folding (but not cutting the shape completely apart) and then use it as a guide for

our final sculpture.

• Measure and mark where you will cut and where you will fold on the small design model

triangle. Know that you will be creating the same alterations to the large triangle, but on a

larger proportional scale.

• You can use your grid paper pattern (for cutting out the large triangle) to help figure out how

to proportionally measure, mark, cut and fold your larger sculpture shape.

• Fold and cut precisely!

Criteria-based teacher checklist: Smoothly and accurately cuts: enlarged triangle shape on cardstock

(after tracing pattern), and small triangle design model on coordinate plane. Measures, cuts (without

cutting apart) and folds 2-D design model triangle shape into a 3-D form. Uses measurement and scale

factor to proportionally cut and fold enlarged triangle shape into a 3-D form based on design model.

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7. Facilitate criteria-based peer and group math and art reflection.

3 Cover a large table with black paper to enhance presentation and have students arrange their

models with their finished sculptures into a kind of miniature sculpture park (like SAM’s Olympic

Sculpture Park).

• Place your scale model next to your final paper sculpture within a miniature class

“sculpture park”.

• Compare models and finished sculptures. How accurately did the artist reproduce design model

shapes and relationships in the larger scale final sculpture?

• Describe the challenges of creating your sculpture proportionally based on your design model.

• How does your perception of the sculpture change when sculptures are placed in relation to

one another?

Criteria-based peer assessment and group reflection: Compares scale models with finished

sculptures, reflects on artistic and mathematical challenges, and explores interaction of sculptures in

space.

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Scaling Up Shapes for Sculpture Coordinate Plane Worksheet

Name: Date:

Math-Aids.Com

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ARTS IMPACT LESSON PLAN Visual Arts and Math Infusion

Eighth Grade Lesson Two: Scaling Up Shapes for Sculpture

3 Teachers may choose to use or adapt the following self-assessment tool.

STUDENT SELF-ASSESSMENT WORKSHEET

Disciplines VISUAL ARTS AND MATH Total

Concept Ratio and Proportion Craftsmanship/Ratio/Proportion 6

Criteria

Student Name

Describes

proportional

relationships

of geometric

shapes seen

in art.

Graphs

similar

right

triangles

on the

coordinate

plane.

Uses

coordinates

and scale

factor to

graph a small

right triangle

and a larger

similar right

triangle (for

model and

pattern).

Smoothly and

accurately cuts:

enlarged triangle

pattern on

coordinate plane,

enlarged triangle

shape on cardstock

(after tracing

pattern), and small

triangle design

model on

coordinate plane.

Measures,

cuts and

folds 2-D

design

model

triangle

shape into

a 3-D

form.

Uses

measurement

and scale

factor to

proportionally

cut and fold

enlarged

triangle shape

into a 3-D form

based on

design model.

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ARTS IMPACT LESSON PLAN Visual Arts and Math Infusion

Eighth Grade Lesson Two: Scaling Up Shapes for Sculpture

CLASS ASSESSMENT WORKSHEET

Disciplines VISUAL ARTS AND MATH Total

Concept Ratio and Proportion Craftsmanship/Ratio/Proportion 6

Criteria

Student Name

Describes

proportional

relationships

of geometric

shapes seen

in art.

Graphs

similar right

triangles on

the

coordinate

plane.

Uses

coordinates

and scale

factor to graph

a small right

triangle and a

larger similar

right triangle

(for model and

pattern).

Smoothly and

accurately cuts:

enlarged triangle

pattern on coordinate

plane, enlarged

triangle shape on

cardstock (after tracing

pattern), and small

triangle design model

on coordinate plane.

Measures,

cuts and

folds 2-D

design

model

triangle

shape into

a 3-D

form.

Uses

measurement

and scale factor

to proportionally

cut and fold

enlarged

triangle shape

into a 3-D form

based on design

model.

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Total

Percentage

What was effective in the lesson? Why?

What do I want to consider for the next time I teach this lesson?

What were the strongest connections between visual arts and math?

Teacher: Date:

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