

Visual Arts and Math Infused Lesson

Lesson Three: *Polygons in Architectural Design*

Author: Meredith Essex Grade Level: Fifth



Enduring Understanding

Polygons are classified according to properties and can be combined in architectural designs.

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

Students practice drawing a variety of geometric figures using math/architectural drawing tools. Students then observe, name, and classify polygons seen in urban photos and architectural plans. Students design a bridge, tower, or building combining three different kinds of triangles and three different kinds of quadrilaterals. Pencil drawings are traced in pen, and architectural details/patterns are added. Last, students reflect on and classify 2-dimensional figures seen in their architectural designs.

Learning Targets and Assessment Criteria

Target: Classifies 2-dimensional figures.

Criteria: Identifies and describes polygon figures, and properties of their sides, and angles seen in art.

Target: Combines polygons in an architectural design.

Criteria: Designs a structure made of straight sided shapes that include three kinds of triangles and three kinds of quadrilaterals.

Target: Refines design.

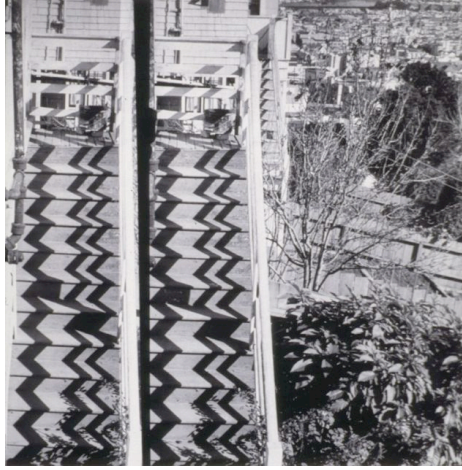
Criteria: Traces over drawing in pen, adds architectural details and patterns.

Target: Uses craftsmanship.

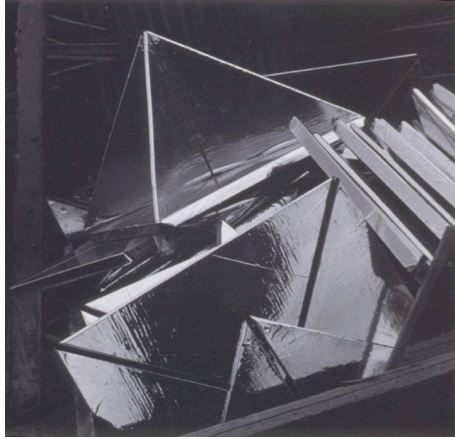
Criteria: Uses grid, rulers, and templates in drawing design.

Vocabulary	Materials	Learning Standards
<p><u>Arts Infused:</u> Geometric shape Parallel Pattern Perpendicular Rectangle Square Symmetry</p> <p><u>Math:</u> Congruent Equilateral Isosceles Parallelogram Polygon Quadrilateral Rhombus Scalene Trapezoid</p> <p><u>Arts:</u> Architecture Detail Refine Template</p>	<p><u>Museum Artworks or Performance:</u></p> <p>Seattle, WA Seattle Art Museum</p> <p>Tacoma, WA Tacoma Art Museum</p> <p>Materials 1/2" graph paper: 8.5x11", 2 per student; Tracing paper/vellum: 8.5x11"; Drawing pencils: 2H; Vinyl erasers; Blue painter's tape; Protractors; Rulers; Geometry/ architectural shape templates; Recycled jar lids or caps: optional; Black markers: fine, extra fine, and ultra fine tips; Arts Impact sketchbooks; Class Assessment Checklist; Photos of Structures; photos or diagrams of bridges from end of lesson</p> <p>Connections <i>Everyday Mathematics</i> 3.6, 3.7, 3.9</p> <p><i>continued</i></p>	<p>WA Arts State Grade Level Expectations <i>For the full description of each WA State Arts Grade Level Expectation, see: http://www.k12.wa.us/Arts/Standards</i></p> <p>1.1.2 Elements: Geometric Shape 1.1.7 Principles of Design: Symmetry, balance, repetition 1.2.1 Skills and Techniques: Architectural Drawing 2.1.1 Creative Process 2.3.1 Responding Process 4.2.1 Connection between Visual Arts and Math</p> <p>Early Learning Guidelines (Pre-K – Grade 3) <i>For a full description of Washington State Early Learning and Child Development Guidelines see: http://www.del.wa.gov/development/guidelines/ (Age 4-5) 6. Learning about my world: Math: Match and sort simple shapes; follow simple directions for position. Arts: Use a variety of materials to create representations of people and things.</i></p> <p><i>continued</i></p>

Seattle Art Museum images:
Stairs and Stairs at Merrie's, 1959, Imogen
Cunningham, 89.50



Rubbish as Design, 1965, Imogen
Cunningham, 89.65





Common Core State Standards (CCSS) in Math

For a full description of CCSS Standards by grade level see: <http://www.k12.wa.us/CoreStandards/Mathstandards/>
5.G.3. Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category.
5.G.4. Classify two-dimensional figures in a hierarchy based on properties.

CCSS Mathematical Practices

- MP 2. Reason abstractly and quantitatively.
- MP 3. Construct viable arguments and critique the reasoning of others.
- MP 4. Model with mathematics.
- MP 5. Use appropriate tools strategically.
- MP 6. Attend to precision.
- MP 7. Look for and make use of structure.

ICON KEY:

-  = Indicates note or reminder for teacher
-  = Embedded assessment points in the lesson

Pre-Teach

Sketchbook Activity: Observe and draw school and neighborhood buildings. Name, draw, and classify polygons seen. Notice how different styles and ages of buildings have different combinations of shapes.


Lesson Steps Outline

Day One

1. Warm-Up: Guide students in practicing craftsmanship in drawing polygons using rulers, grid paper, protractors, and architectural templates. Demonstrate using grid squares/corners to draw accurate polygons.

2. Review classification of polygons into categories based on properties of sides and angles.


3. Introduce and guide identifying, drawing, and classifying geometric figures seen in photographs *Stairs and Stairs at Merrie's* and *Rubbish as Design* by Imogen Cunningham from the Seattle Art Museum collection.

 Criteria-based teacher checklist and peer assessment: Identifies and describes polygon figures, and properties of their sides, and angles seen in art.

4. Show images of buildings (architectural plans or photos) and images of bridges and towers. Guide sketching ideas for structures.

 Criteria-based teacher process assessment: Sketches ideas for structures.

5. Demonstrate and guide drawing basic polygon shapes for structure in pencil on grid paper. Emphasize craftsmanship and precision.

 Criteria-based teacher checklist: Uses grid, rulers, and templates in drawing design.

Day Two

1. Facilitate peer assessment before refining architectural design by tracing it on white paper. Demonstrate setting up paper and carefully drawing/tracing over polygons (drawn in pencil on the grid paper) using a fine-tipped black marker and ruler/templates.

Criteria-based teacher checklist and peer assessment: Designs a structure made of straight sided shapes that include three kinds of triangles and three kinds of quadrilaterals.

2. Demonstrate and guide using a template and ruler to add details like windows, doors, lights, and railings. Share and encourage ideas for adding decorative elements to structures such as patterns or textures.

Criteria-based teacher checklist: Traces over drawing in pen, adds architectural details and patterns. Uses grid, rulers, and templates in design.

3. Display architectural designs together, guide criteria-based self and group reflection.

Criteria-based student self and group assessment: Checks for craftsmanship, identifies quadrilaterals and triangles in art. Reflects on classification of polygons.

LESSON STEPS

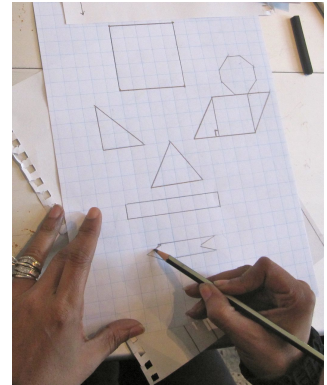
Day One

1. Warm-Up: Guide students in practicing craftsmanship in drawing polygons using rulers, grid paper, protractors, and architectural templates. Demonstrate using grid squares/corners to draw accurate polygons.



Drawing with Templates

- *Practice creating very precise mathematical lines and polygon shapes. Let the lines and corners of the grid paper help you. Dot the corners of grid paper to mark the corners of your shapes first. I am dotting four corners for a square and a rectangle.*
- *Spread your non-drawing hand out to anchor your ruler so it does not slide. Practice making lines connecting dots you made for the corner of shapes. A protractor is small, so sometimes it is easier to draw with than a ruler.*
- *Let's figure out how to make a triangle using the same technique. How about a right, scalene, or isosceles triangle?*
- *Think about the properties of trapezoids, kites, or parallelograms. Where would we dot grid paper to create the corners of those shapes? How can a shape's symmetry help us draw it?*
- *These are architectural/math drawing templates. What are the polygons that you see? These also need to be anchored down so they do not slip. Adding some pressure against the inside edges of a shape as you draw with your pencil can help with accuracy.*



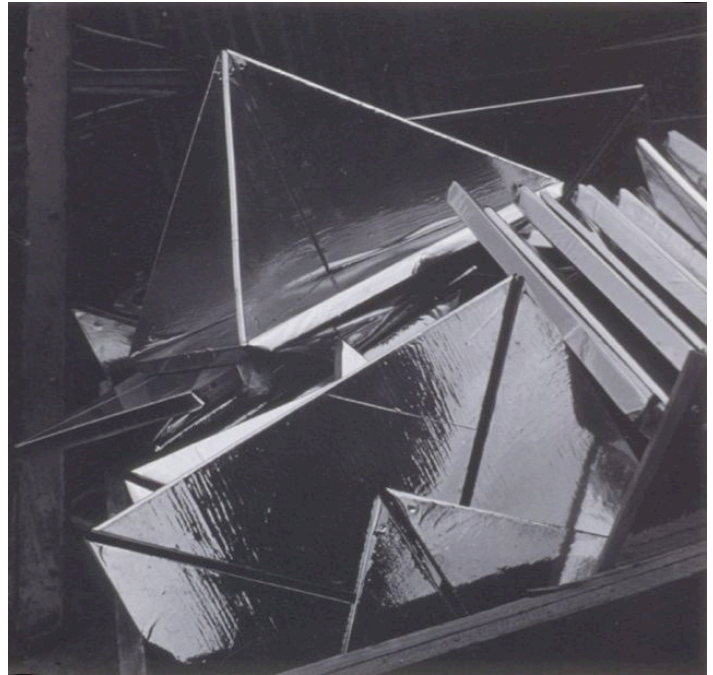
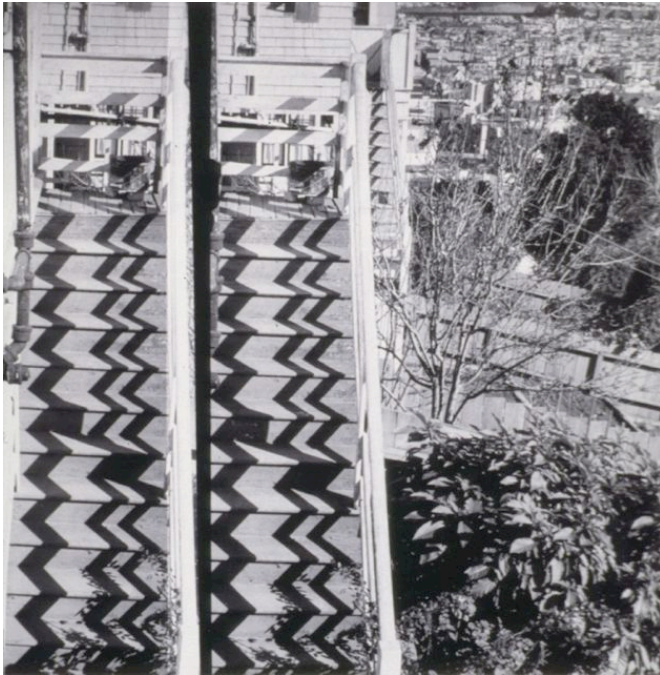
2. Review classification of polygons into categories based on properties of sides and angles.

- *What are the properties of our largest category--polygons? (A straight sided, closed figure) There are two major groups of shapes that are classified as polygons. Their number of sides determines which group they are in...(quadrilaterals and triangles).*
- *What are the other properties besides number of sides that we look for in shapes to help us classify them? Parallel, perpendicular, congruent sides? What does each of these words mean?*
- *What are other properties that shapes are classified according to? (Angles)*
- *What are the properties of different quadrilaterals: parallelogram, trapezoid, kite, rectangle, square, or rhombus?*
- *What are the properties of sides in different triangles: scalene (no sides of triangle are same length), isosceles (two sides are congruent/same length), and equilateral (all sides are congruent/same length)?*
- *What are the properties of angles in different triangles: right (one angle that measures 90°), obtuse (one angle greater than 90°), and acute (all angles less than 90°).*

3. Introduce and guide identifying, drawing, and classifying geometric figures seen in photographs *Stairs and Stairs at Merrie's* and *Rubbish as Design* by Imogen Cunningham from the Seattle Art Museum collection.



Responding to Art in
the Classroom



▣ 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.

- *In your sketchbook using a ruler or a template, draw and label a quadrilateral or triangle that you see in each picture. Also notice and show the direction it is oriented in.*
- *Share your findings with a partner and notice what different quadrilaterals or triangles (and their properties) that they discovered.*
- *Share your findings with the whole class.*

☑ Criteria-based teacher checklist and peer assessment: Identifies and describes polygon figures, and properties of their sides, and angles seen in art.

4. Show images of buildings (architectural plans or photos) and images of bridges and towers. Guide sketching ideas for structures.

▣ Buildings or bridges can be drawn using strictly polygons or can include circles or arches in addition to three types of triangles and three types of quadrilaterals.

- *Using ruler, grid paper, templates, and very creative imaginations, we are designing structures. They can be a bridge, a tower, or some other type of building.*
- *In these examples (photos or architectural drawings of structures), notice the triangles and quadrilaterals. Your job is to use very specific quadrilaterals and triangles in your design, and be able to name them and their properties.*
- *Sketch some ideas in your sketchbook: towers are interesting because they can be mythical and suggest observation or separation. Bridges connect things so they can suggest access, discovery, movement, and bringing people together.*
- *You may choose to make your design symmetrical. Remember that structures often have a larger base or foundation than upper parts: think about how bridges allow water or roads or canyons to flow between their supports.*
- *You must also include three types of quadrilaterals and three types of triangles.*



Prompting for Creativity

Criteria-based teacher process assessment: Sketches ideas for structures.

5. Demonstrate and guide drawing basic polygon shapes for structure in pencil on grid paper. Emphasize craftsmanship and precision.

- *You can also line up the sides of your template shapes with your grid lines. Every line should be drawn with a ruler or a template.*
- *Draw your shapes including three types of triangles and three types of quadrilaterals. Don't worry about details such as windows, doors, lights, or railings yet. They will be added next time.*



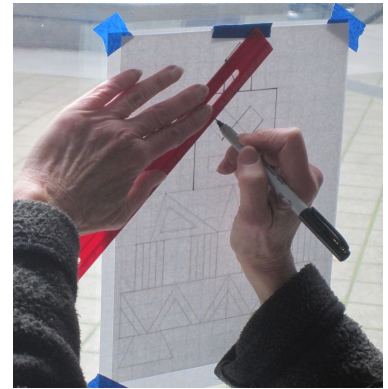
Drawing with Rulers on Grids

Criteria-based teacher checklist: Student uses grid lines, rulers, and templates in drawing design.

Day Two

1. Facilitate peer assessment before refining architectural design by tracing it on white paper. Demonstrate setting up paper and carefully drawing/tracing over polygons (drawn in pencil on the grid paper) using a fine-tipped black marker and ruler/templates.

- *Switch papers with a partner and identify the polygons that you see in their design. Do they have three different types of triangles? How about three different types of quadrilaterals?*
- *Before we add any details, add any additional structure shapes that you might have missed that you identified through conversation with a partner.*
- *Align your white paper with the edges of the grid paper underneath. Tape each of all four sides with a small piece of tape.*
- *Trace over your polygons using math tools and medium, fine, and ultra fine-tipped markers. Using different widths of pen can add interest to your drawing so think about ways to use different thicknesses of line. Be careful and precise!*

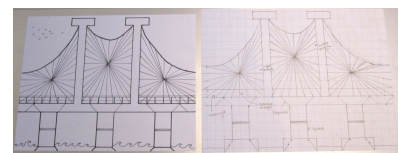


▣ White paper (vellum or other semi-opaque paper) taped onto grid paper drawings can be placed against windows to better see and trace over architectural designs.

☑ Criteria-based teacher checklist and peer assessment: Designs a structure made of straight sided shapes that include three kinds of triangles and three kinds of quadrilaterals.

2. Demonstrate and guide using a template and ruler to add details: windows, doors, lights, and railings. Share and encourage ideas for adding decorative elements to structures such as patterns or textures.

- *Step back and think about your structure. Can you add doors, windows, lights, railings, or any other details that help to communicate something about your structure?*
- *Check for areas that you might draw polygons within polygons or add interesting patterns.*
- *In your sketchbook, list the three types of quadrilaterals and three types of triangles you used.*
- *Gently remove the grid paper and tape, and sign in the lower right corner so that your drawing is ready to display.*



☑ Criteria-based teacher checklist: Traces over drawing in pen, adds architectural details and patterns. Uses grid, rulers, and templates in drawing design.

3. Display architectural designs together and guide criteria-based self and group reflection.

- *Check your craftsmanship: have you used grid paper, rulers, and templates effectively? Are your shapes and lines precise and clear?*
- *Respond to another artist's work by naming the quadrilaterals and triangles that you see. Check for consistency with that artist's self-generated list of polygons.*
- *Review classification of polygons as a group: What is the largest category? What are the next categories based on of number of sides? Describe the properties of triangles and quadrilaterals in each category.*

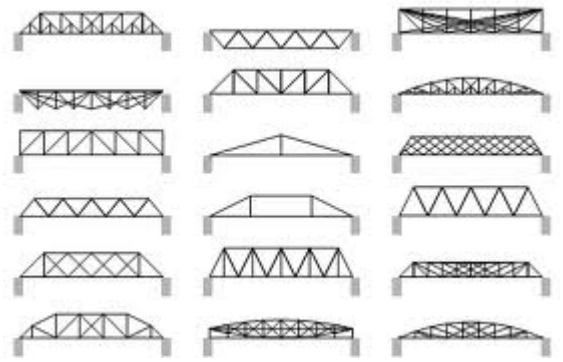


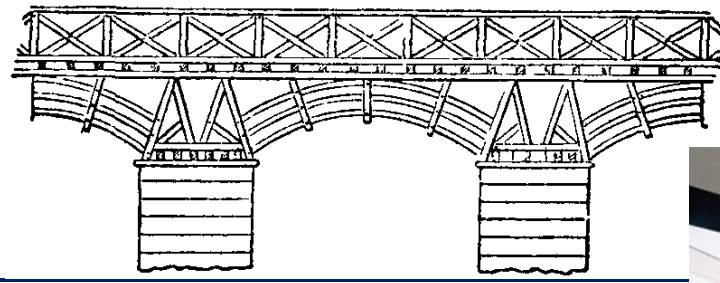
Guiding Reflecting on Student Art

Criteria-based student self and group assessment: Checks for craftsmanship, identifies quadrilaterals and triangles in art. Reflects on classification of polygons.

Everyday Mathematics Extensions:

3.8, 3.10





Owachomo Bridge in Natural Bridges National Monument





ARTS IMPACT LESSON PLAN Visual Arts and Math Infusion

Fifth Grade Lesson Two: *Polygons in Architectural Design*

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

STUDENT SELF-ASSESSMENT WORKSHEET

Disciplines	VISUAL ARTS AND MATH					Total
Concept	Geometric Shapes				Craftsmanship	5
Criteria	Identifies and describes polygon figures and properties of their sides and angles seen in art	Designs a structure made of straight sided shapes that include three kinds of triangles	Designs a structure made of straight sided shapes that include three kinds of quadrilaterals	Traces over drawing in pen, adds architectural details and patterns	Uses grid, rulers and templates in drawing design	
Student Name						

ARTS IMPACT LESSON PLAN Visual Arts and Math Infusion

Fifth Grade Lesson Two: *Polygons in Architectural Design*

CLASS ASSESSMENT WORKSHEET

Disciplines	VISUAL ARTS AND MATH					Total 5
Concept	Geometric Shapes				Craftsmanship	
Criteria	Identifies and describes polygon figures and properties of their sides and angles seen in art	Designs a structure made of straight sided shapes that include three kinds of triangles	Designs a structure made of straight sided shapes that include three kinds of quadrilaterals	Traces over drawing in pen, adds architectural details and patterns	Uses grid, rulers and templates in drawing design	
Student Name						
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						
21.						
22.						
23.						
24.						
25.						
26.						
27.						
28.						
29.						
30.						
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: _____

VISUAL ARTS AND MATH LESSON: *Polygons in Architectural Design*

Dear Family:

Today your child participated in an **Arts and Math lesson**. We looked at examples of polygons—straight-sided closed shapes seen in art photography and architectural design. We talked about how there are many kinds of these geometric shapes and reviewed their classification and properties. We created our own architectural design for a structure using polygons.

- We practiced drawing a variety of geometric shapes using math/architectural drawing templates and grid paper.
- We observed, named, and classified polygons seen in urban photos and architectural plans.
- We talked about how polygon shapes are grouped according to properties of sides. The two main groups of polygons are triangles and quadrilaterals: three and four sided shapes.
- We also talked about how triangles and quadrilaterals are grouped according to length and relationship of their sides and size and relationship of their angles.
- We designed bridges, towers, or buildings combining at least three different kinds of triangles and three different kinds of quadrilaterals using grid paper as a guide.
- We traced over our pencil drawings using different widths of black pen to refine them and make them more complete.
- We added architectural details like windows, doors, railings, and lights. We also added decorative patterns.
- We reflected by finding and talking about all of the different polygons we saw in each other's work.

At home, you could design a fort, tree house, or pet house. You could experiment with collecting and combining small boxes to create 3-dimensional models of towers, bridges, or buildings. You could make 2-dimensional drawings of your constructions using polygons.

Enduring Understanding

Polygons are classified according to properties and can be combined in architectural designs.