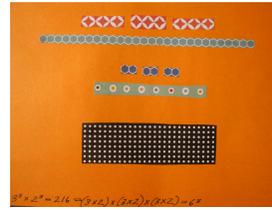


ARTS IMPACT LESSON PLAN

Visual Arts and Math Infused Lesson

Lesson One: *Expressing Exponential Relationships*

Author: Meredith Essex Grade Level: Eighth



Enduring Understanding

Exponential relationships can be expressed visually in art and numerically in equations.

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

Students analyze, interpret and propose equations representing exponential relationships seen in works of art. Students create a balanced collage composition composed of dot/grid paper cut into shapes representing an exponential equation. Students then generate another equivalent expression to describe their composition using properties of exponents.

Learning Targets and Assessment Criteria

Target: Identifies numerical relationships in art.

Criteria: Writes an equation using exponents to describe a work of art.

Target: Creates a balanced composition representing an equation.

Criteria: Counts, cuts and organizes grid/dot papers in symmetry to show an exponential expression and its numerical equivalent.

Target: Uses craftsmanship in collage.

Criteria: Cuts and attaches shapes smoothly and securely.

Target: Writes an equivalent expression representing composition.

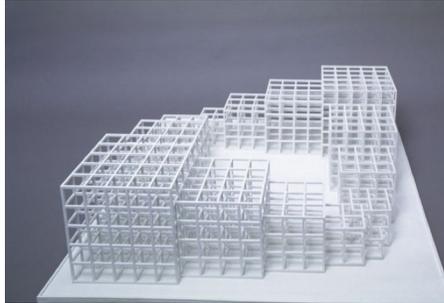
Criteria: Applies properties of exponents (product of powers or commutative/associative property of multiplication) to generate an equivalent numerical expression.

Vocabulary	Materials	Learning Standards
<p><u>Arts Infused:</u> Symmetry Repetition</p> <p><u>Math:</u> Equation Expression Exponents Integer</p> <p><u>Arts:</u> Balance Collage Composition Craftsmanship</p>	<p>Museum Artworks or Performance</p> <p><u>Seattle, WA</u> Seattle Art Museum</p> <p><u>Tacoma, WA</u> Tacoma Art Museum</p> <p>Materials Drawing pencil: 4H; Vinyl eraser; Arts Impact sketchbook; Paper: colorful repeating shapes, dots, or grid paper to cut up and collage; Cardstock: 8.5x11", variety of colors; Scissors; Glue sticks; Recycled magazines: to use as glue mats; Rulers; Classroom Assessment Worksheet</p> <p style="text-align: center;"><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:</i> http://www.k12.wa.us/Arts/Standards</p> <p>1.1.2 Elements: Shape 1.1.7 Principles of Design: Balance 1.2.1 Skills and Techniques: Collage 2.1.1 Creative Process 2.3.1 Responding Process 4.2.1 Connection between Visual Arts and Math</p> <p>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/</p> <p>8.EE. Work with radicals and integer exponents. 8.EE.1. Know and apply the properties of integer exponents to generate equivalent numerical expressions. <i>For example, $3^2 \cdot 3^5 = 3^3 = 1/3^3 = 1/27$.</i></p> <p>CCSS Mathematical Practices MP.2. Reason abstractly and quantitatively. MP.4. Model with mathematics. MP.5. Use appropriate tools strategically. MP.6. Attend to precision.</p>

Seattle Art Museum images:
Some/One, 2001, Do Ho Suh, 2002.43



1,2,3,4,5, 1980-83, Sol LeWitt, 83.42



Blanket Stories: Three Sisters, Four Pelts, Sky Woman, Cousin Rose, and All My Relations, 2007, Marie Watt, 2007.41



ICON KEY:

 = Indicates note or reminder for teacher

 = Embedded assessment points in the lesson

Pre-Teach

Guide brainstorming about contexts where using exponents might be used to express very large or very small quantities or numbers is most efficient. Review generating equivalent exponential expressions. Guide practice identifying equivalent expressions using exponents in sketchbook.

Lesson Steps Outline

1. Introduce and guide art analysis of *Blanket Stories: Three Sisters, Four Pelts, Sky Woman, Cousin Rose, and All My Relations* by Marie Watt and/or *1,2,3,4,5* by Sol LeWitt from the Seattle Art Museum collection. Lead discussion about artistic concept of formal balance and equivalent expressions and exponents.

 Criteria-based teacher process assessment: Participates in math and art visual analysis.

2. Continue class discussion about exponential relationships of elements. Share *Some/One* by Do Ho Suh from the Seattle Art Museum collection and discuss some of the background of this artwork. Guide students in creating a mathematical interpretation by generating equivalent expressions describing the art.

Guide student pairs in creating an equation using the properties of integer exponents that can represent the artwork. Facilitate sharing equivalent equations with the whole class.

 Criteria-based teacher checklist: Writes an equation using exponents to describe a work of art.

3. Introduce and demonstrate the creative process of planning a collage composition using repeated elements to represent an equation using exponents.

4. Distribute/assign exponential expressions (featuring multiplication) and guide students in turning those expressions into equations. Guide representing equations visually in sketchbook. Guide students in choosing dot/grid papers as well as a color cardstock background paper for collage.

 Criteria-based teacher process assessment: Solves and maps out equation in Arts Impact sketchbook.

5. Guide cutting and arranging shapes to show equation and checking math with a partner before gluing.

Criteria-based peer assessment and teacher checklist: Counts, cuts, and organizes grid/dot papers in symmetry to show an exponential expression and its numerical equivalent.

6. Demonstrate and guide craftsmanship in gluing collage shapes.

Criteria-based teacher checklist: Attaches shapes smoothly and securely.

7. Guide students in developing an equivalent exponential expression representing their composition.

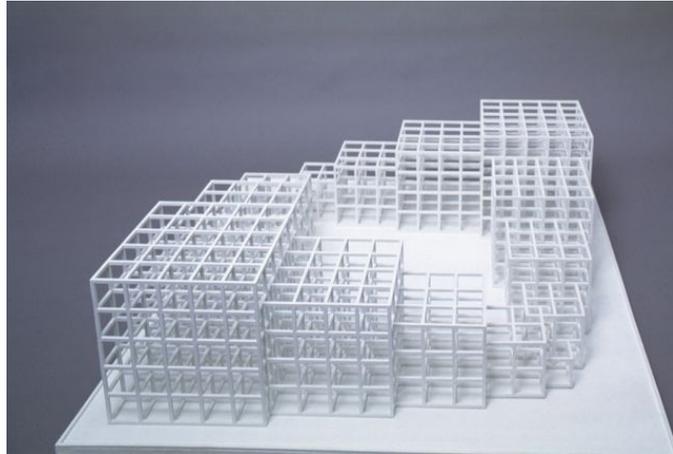
Criteria-based teacher checklist assessment: Applies properties of exponents to generate an equivalent numerical expression.

8. Facilitate peer assessment and reflection on the math and art of the learning process.

Criteria-based peer assessment and reflection: Interprets a peer's collage by identifying the equation it represents and checks for accuracy. Identifies and reflects on craftsmanship and artistic choices that create balance.

LESSON STEPS

1. Introduce and guide art analysis of *Blanket Stories: Three Sisters, Four Pelts, Sky Woman, Cousin Rose, and All My Relations* by Marie Watt and/or *1,2,3,4,5* by Sol LeWitt from the Seattle Art Museum collection. Lead discussion about artistic concept of formal balance and equivalent expressions and exponents.



▣ 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.

- *What art elements stand out most in these compositions? (repetition)*
- *Where do you see multiples of the same objects, shape, or form?*
- *Do you think the art is balanced visually and/or physically? What do you see that suggests that? Symmetry?*
- *If you were an artist creating an inventory or list for constructing one of these artworks, how might you use a numerical expression to efficiently express large numbers? (using exponents)*
- *Could an equation represent a work of art? Share your ideas.*

Criteria-based teacher process assessment: Participates in math and art visual analysis.

2. Continue class discussion about exponential relationships of elements. Share *Some/One* by Do Ho Suh from the Seattle Art Museum collection and discuss some of the background of this artwork. Guide students in creating a mathematical interpretation by generating equivalent expressions describing the art.



- *Some/One is a sculpture (a three dimensional work of art) created out of 100 thousand stainless steel military issue dog tags. Tell us what you know about military dog tags. What sort of form does the dog tags cover/create? Does it appear balanced?*
- *Each tag has random letters and numbers on it. Why so many dog tags, and why the form they take? Share ideas about your interpretation of this art.*
- *How is the huge exponentially large number of dog tags an important part of the impact of the work? What is the message they communicate?*
- *In looking at the artwork, and knowing that it is composed of 100,000 dog tags, how could we describe this art using exponents?*

Guide student pairs in creating an equation using the properties of integer exponents that can represent the artwork. Facilitate sharing equivalent equations with the whole class.

- *What are some equivalent expressions using exponents that we could write to describe the art? (for example: $10^2 \times 10^3 = 10^{2+3}$) Work with a partner to develop an equation that represents the dog tags in *Some/One*.*
- *Share your equation with the class, and note equivalent expressions.*

Criteria-based teacher checklist: Writes an equation using exponents to describe a work of art.

3. Introduce and demonstrate the creative process of planning a collage composition using repeated elements to represent an equation using exponents.

- *How can I creatively organize shapes with small dots or grids (to represent numbers) on a piece of paper to represent an exponential expression and the very large number that it equals?*
- *How can I map out notes in my sketchbook to show my ideas?*

- *I am selecting a dots/grid papers to cut apart (and a color cardstock background paper) to represent my equation. I am using craftsmanship: care and attention to mathematical precision in counting dots or grids and cutting shapes to represent each number.*
- *Using the concept of balance, and my notes/sketches in sketchbook, I am organizing my composition so that I use all parts of the paper, and my shapes representing numbers are balanced in symmetry.*

4. Distribute/assign exponential expressions (featuring multiplication) and guide students in turning those expressions into equations. Guide representing equations visually in sketchbook. Guide students in choosing dot/grid papers as well as a color cardstock background paper for collage.

▣ Teachers can differentiate by providing expressions matched with student ability or choose to have students all work with one equation.

- *Identify the number that each part of the expression represents. Turn it into an equation by solving the problem.*
- *Map the equation out visually in your sketchbook.*
- *Select a color background paper for your collage and grid/dot papers to show the numbers in your expression.*

☑ Criteria-based teacher process assessment: Solves and maps out equation in sketchbook.

5. Guide cutting and arranging shapes to show equation and checking math with a partner before gluing.

- *Count dots/grid representing each number. Lightly mark where you will cut and use craftsmanship: care and attention to mathematical precision in measuring/counting and cutting.*
- *Arrange your shapes in symmetrical balance in a way that clearly shows the numbers in your equation.*
- *Before you glue, have a partner check your equation collage. Have you counted and cut accurately? Can your partner "read the equation"? Does it express or illustrate the equation effectively?*

☑ Criteria-based peer assessment and teacher checklist: Counts, cuts, and organizes grid/dot papers in symmetry to show an exponential expression and its numerical equivalent.

6. Demonstrate and guide craftsmanship in gluing collage shapes.

- *Now that your collage shapes are arranged artistically and mathematically, glue them down using craftsmanship.*
- *Without disturbing the careful arrangement of your shapes illustrating your equation, turn each shape over on a glue mat or scrap paper and apply glue stick around the edges of the shape.*
- *Glue down with care to make sure that the shape is flat and secure with no corners*

or edges sticking up.

- *Record your equation at the bottom left of your paper.*

Criteria-based teacher checklist: Attaches shapes smoothly and securely.

7. Guide students in developing an equivalent exponential expression representing their composition.

- *Now, using your exponential expression, equation, and composition as a guide, develop an equivalent expression for your composition.*
- *Notice the visual relationships between numbers that your collage suggests as you think about an equivalent expression. Which shapes represent numbers added or multiplied? Which shapes or number of shapes represent the base number and the exponent?*
- *Consider what you know about the properties of exponents. If you are multiplying the same base numbers with different exponents, how can you generate an equivalent expression?*
 $(2^3 \times 2^4 = 2^7)$
- *When base numbers are different and the exponents the same, how do the associative and commutative properties of multiplication help us to write an equivalent exponential expression?*
 $2^2 \times 3^2 = (2 \times 3) \times (2 \times 3) = 6^2$
- *Add your equivalent expression to the equation noted at the bottom left of your collage.*

Criteria-based teacher checklist assessment: Applies properties of exponents to generate an equivalent numerical expression.

8. Facilitate peer assessment and reflection on the math and art of the learning process.

- *"Read" the equation seen in a classmate's collage. Check interpretations against equations noted at the bottom of collages for accuracy.*
- *Describe a collage that captures your attention and describe what artistic choices or use of craftsmanship makes that artwork especially effective.*
- *Describe the visual effects of combining different papers and creating symmetrical balance in compositions.*

Criteria-based peer assessment and reflection: Interprets a peer's collage by identifying the equation it represents and checks for accuracy. Identifies and reflects on craftsmanship and artistic choices that create balance.

Expressing Exponential Relationships

Sample Exponential Expressions

Can be copied and cut into cards or assigned to students

$$3^3 \times 2^3 =$$

$$2^5 \times 2^2 =$$

$$4^2 \times 2^2 =$$

$$2^3 \times 2^2 =$$

$$2^3 \times 5^3 =$$

$$3^4 \times 3^2 =$$

$$4^3 \times 4^2 =$$

$$2^3 \times 2^4 =$$

ARTS IMPACT LESSON PLAN Visual Arts and Math Infusion

Eighth Grade Lesson One: *Expressing Exponential Relationships*

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

STUDENT SELF-ASSESSMENT WORKSHEET

Disciplines	VISUAL ARTS AND MATH		VISUAL ARTS	MATH	Total
Concept	Exponential Equations		Craftsmanship	Equivalent Expressions	5
Criteria	Writes an equation using exponents to describe a work of art.	Counts, cuts and organizes grid/dot papers in to show an exponential expression and its numerical equivalent.	Counts, cuts and organizes grid/dot papers in symmetry	Cuts and attaches shapes smoothly and securely.	Applies properties of exponents to generate an equivalent numerical expression.
Student Name					

ARTS IMPACT LESSON PLAN Visual Arts and Math Infusion

Eighth Grade Lesson One: *Expressing Exponential Relationships*

CLASS ASSESSMENT WORKSHEET

Disciplines	VISUAL ARTS AND MATH			VISUAL ARTS	MATH	Total 5
Concept	Exponential Equations		Symmetry	Craftsmanship	Equivalent Expressions	
Criteria	Writes an equation using exponents to describe a work of art.	Counts, cuts and organizes grid/dot papers in to show an exponential expression and its numerical equivalent.	Counts, cuts and organizes grid/dot papers in symmetry.	Cuts and attaches shapes smoothly and securely.	Applies properties of exponents to generate an equivalent numerical expression.	
Student Name						
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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: *Expressing Exponential Relationships*

Dear Family:

Today your child participated in an **Arts and Math** lesson. We looked at art composed of many repeating elements and talked about how those multiple parts could be represented numerically using exponents. Then we created our own artistic collage that represents an equation with exponents.

- We learned about and interpreted a sculpture called *Some/One*. The artist, Do Ho Suh, used 100,000 military issue dog tags to cover the surface of that work of art. We talked about the how the huge number of dog tags in the art communicates an idea. We identified ways that we could express that number of dog tags using exponents.
- We solved an equation featuring exponents, and worked with ways that we could visually represent that equation in our sketchbook using dots or shapes.
- We cut up colorful dot and/or grid papers to represent the numbers in our equation.
- We organized our shapes to represent our equation and create a balanced artistic composition in symmetry.
- We carefully glued our shapes down to colorful background paper using craftsmanship.
- We generated and noted another equivalent numerical expression representing our collage by applying the properties of exponents.

At home, you could use your knowledge of exponential relationships to plan and create artworks composed of small ordinary household objects: paper clips, bread closers, or small caps for instance. You could develop artistic exponential representations that relate to your time or your money.

Enduring Understanding

Exponential relationships can be expressed visually in art and numerically in equations.