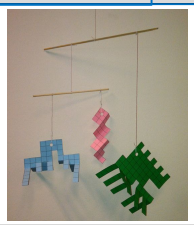
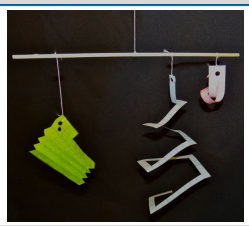
ARTS IMPACT LESSON PLAN

Visual Arts and Math Infused Lesson

Lesson One: *Mobiles: Balancing Equations*

Author: Meredith Essex Grade Level: Fifth

Enduring Understanding

Equal numbers, shapes, or area suspended on either side of a center point can create balance.

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

Students focus on the concept of numerical equivalency and how that idea relates to art and the physical world: balance in sculpture and mobiles. An equation is translated into shapes cut out of colorful grid papers. Math is checked and a mobile in balance is constructed by suspending shapes representing numbers of the equation on either side of an equal/balance point. Lesson can be extended to practice solving and representing missing variable equations and in mobiles.

Learning Targets and Assessment Criteria

Target: Makes shapes expressing numbers.
Criteria: Cuts out three shapes with number of grid squares/area corresponding with three numbers in equation.

Target: Makes a mobile expressing equation.
Criteria: Balances equivalent weight/area of shapes representing numbers on either side of a center equal point.

Target: Uses craftsmanship in construction.
Criteria: Cuts shapes smoothly, and securely attaches with string.

Extension: Target: Solves a missing variable equation.
Criteria: Uses grouping and operations to find an unknown number.

Vocabulary

Arts Infused:
2-dimensional
3-dimensional
Asymmetry
Balance
Physics
Symmetry

Math:
Area
Equal
Grid
Polygon
Variable

Arts:
Balance point
Edge
Form
Formal balance
Informal balance
Level
Mobile
Suspend

Materials

Museum Artworks or Performance:

Seattle, WA
Seattle Art Museum

Tacoma, WA
Tacoma Art Museum

Materials
Bamboo skewers: 10-12" in length, pointed tip cut off; Drawing pencils: 2H; Vinyl erasers; Scissors; Rulers; Multiple bright colors copy paper: 8.5x11", several copies in each color of 10x10 cm grid from lesson, cut in half, 3 grids per student; Glue sticks; Lightweight string: pre-cut to 12" and 18" pieces, two pieces of 12" and one piece of 18" per student; Hole punches; Recycled magazines: glue mats; Arts Impact sketchbooks; Class Assessment Worksheet

Connections
Everyday Mathematics
10.1, 10.2, 10.3, 7.7.4, 7.5

continued

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: 2-D shape and 3-D form
1.1.7 Principles of Design: Balance
1.2.1 Skills and Techniques: Paper construction+
2.1.1 Creative Process
2.3.1 Responding Process
4.2.1 Connection between Visual Arts and Math

Early Learning Guidelines (Pre-K – Grade 3)
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: Count out 10 items; count and group things by number; compare groups of up to 10 objects. Arts: Show Creativity and Imagination.

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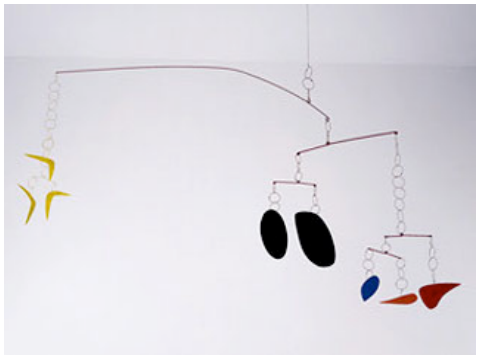
Seattle Art Museum images:
Bunyon's Chess, 1965, Mark di Suvero
T2004.104

Calder Foundation
Boomerangs, 1941, Alexander Calder,
A16031



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/*
4.OA.3. Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity.
5.OA.1. Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

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.
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: Search for and draw objects that are balanced. They could be balanced on the ground or suspended in the air…think about furniture, machines, lights, or wind chimes…

Lesson Steps

1. Warm-Up: Guide students in associating physical balance with numerical equivalency.

2. Introduce and guide discussion of formal and informal balance seen in *Bunyon's Chess* by Mark di Suvero and *Boomerangs* by Alexander Calder from the Seattle Art Museum collection.

3. Show strategies for translating the quantities of the addends in an addition equation into three polygon shapes (with straight sides following grid lines) whose area matches the value of addends. The polygons will be suspended in informal balance in a mobile. Demonstrate and guide creating an equation of paper shapes.

☑ Criteria-based process assessment: Participates in discussion about equivalency.

4. Demonstrate and guide representing numbers (area) in an equation through counting, marking, and cutting out three gridded shapes using craftsmanship.

☑ Criteria-based teacher checklist and peer assessment: Cuts out three shapes with number of grid squares/area corresponding with three numbers in equation. Cuts shapes smoothly. (Optional: Manipulates shapes to create 3-dimensional forms.)

5. Demonstrate the physics and math of creating a balance point using a bamboo stick and string. Guide students in attaching string, balancing, and measuring location of balance point.

6. Guide student partners in attaching mobile forms in balance.

☑ Criteria-based teacher checklist: Balances equivalent weight/area of shapes representing numbers on either side of a center equal point. Securely

attaches with string.

7. Guide criteria-based self and group reflection. Hang mobiles on line attached to ceiling using paper clips. Group and compare mobiles that express the same equation.

☑ Criteria-based student self and group assessment: Reflects on challenges in creating balance and craftsmanship. Connects physical balance with equivalency.

Extension of steps 3 and 4: Missing Variables and Equivalency
Facilitate solving missing variable equations using number grouping strategies. Link equations with area /number of grid squares. Guide selecting papers, marking, and cutting shapes.

☑ Criteria-based teacher checklist: Uses grouping and operations to find an unknown number.

LESSON STEPS

1. Warm-Up: Guide students in associating physical balance with numerical equivalency.

- *What does the equal sign mean? What are some other words that have similar meaning? Balance, symmetry? In art and math, balance is often conceptual: an idea represented by numbers, symbols, or 2-dimensional shapes.*

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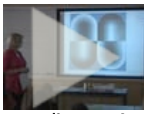
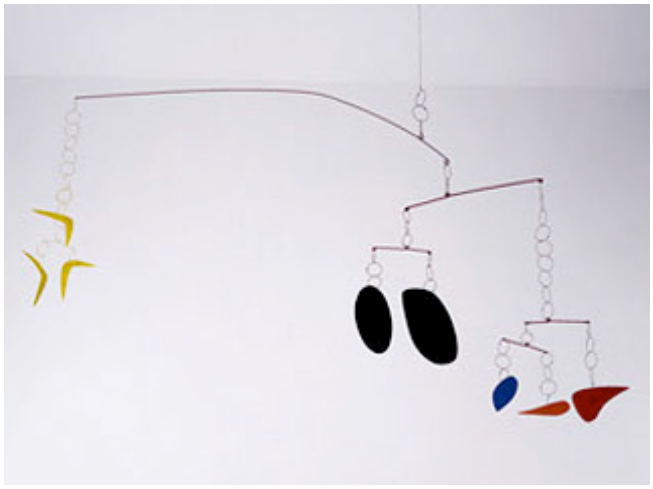
2. Introduce and guide discussion of formal and informal balance seen in *Bunyon's Chess* by Mark di Suvero and *Boomerangs* by Alexander Calder from the Seattle Art Museum collection.



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.

Additional mobiles by Alexander Calder can be found at http://calder.org/work/category/hangingmobile.html.

- *When the word balance is used in 2-dimensional art, sometimes it is strictly about what our eyes and brains perceive.*
- *In art, formal balance refers to symmetry: same placement of shapes, colors, and/or lines in mirror reflection on either side of a line of symmetry. An equation that looks like this is: 2+4 = 4+2.*
- *When a 3-dimensional form, object with height, width, and length are balanced, it becomes physical and visual. Do sculptures—3-dimensional works of art—need to be in balance? Why?*
- *If sculpture—made of sheets of steel or chunks of wood or glass—is balanced, then what does that mean? Equal weight? What about sheets of steel? Equal area? If you divided a sculpture in half, would it stand up if it was unbalanced?*
- *Can a sculpture be balanced and be asymmetrical? How? This is called informal balance.*
- *The idea of mobiles was invented by artist, Alexander Calder. Notice how suspended shapes balance in space.*

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3. Show strategies for translating the quantities of the addends in an addition equation into three polygon shapes (with straight sides following grid lines) whose area matches the value of the addends. The polygons will be suspended in informal balance in a mobile. Demonstrate and guide creating an equation of paper shapes.

Students can generate their own equations or they can be assigned to students depending on student ability.

- *Write an equation where two numbers add up to a number between 50 and 100.*
- *I have two 100s grids to work with. If my equation is 31 + 53 = 84, then how can I show those numbers using grid paper? How can I be precise and accurate about area or weight?*
- *Help me count the squares. Does my shape have to be a square or rectangle to represent that number, or will number of grid squares be the most important consideration? Will weight and area be the same?*

☑ Criteria-based process assessment: Participates in discussion about equivalency.

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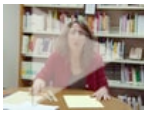
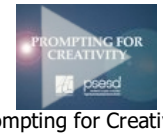
4. Demonstrate and guide representing numbers (area) in an equation through counting, marking and cutting out three gridded shapes using craftsmanship.

- *In demonstrating my mobile equation 31 + 53 = 84, I count and mark squares for a shape composed of 31, a shape composed of 53, and a shape composed of 84 grid squares.*


Cutting out Grid Shapes

- *Mark the edges of your shapes using your ruler aligned with grid lines and pencil. Carefully cut out exactly on the grid lines thumb up, and cutting slowly…accurate cutting means accurate weight for equal balance. In pencil, write the area/number expressed neatly in the center of the grid side of each shape.*

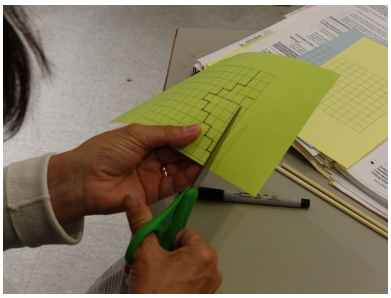


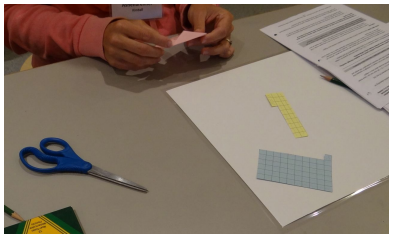
Prompting for Creativity

STOP AND LOOK: Have a partner check to make sure your equation matches your shapes.

Optional:

- *Practice transforming 2-dimensional shapes into 3-dimensional forms using paper scraps: Fold, curl, or pleat without cutting (so their weight or area remains the same). Look closely at your mobile shapes and carefully use those techniques to give them a form.*





☑ Criteria-based teacher checklist and peer assessment: Cuts out three shapes with number of grid squares/area corresponding with three numbers in equation. Cuts shapes smoothly. (Optional: Manipulates shapes to create 3-dimensional forms.)

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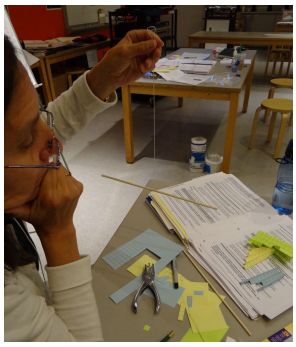
5. Demonstrate the physics and math of creating a balance point using a bamboo stick and string. Guide students in attaching string, balancing, and measuring location of balance point.

- *Using the longer length of string, tie a tight knot around the bamboo stick close to the middle. Suspend the bamboo from the string. Move the string until the bamboo balances so that it is level (parallel with the floor).*



- *Once it balances, measure the length of your bamboo, and the point of your string attachment. Is it half? What does this say about physical balance and equal numbers?*
- *Add a little dab of glue stick glue to string/bamboo connection to hold in place.*
- *Punch a hole near an edge of each shape (approximately 1/8 of an inch) but not too close, so the paper cannot be torn by the string. Using the shorter strings, tie string to paper shapes using secure knots.*

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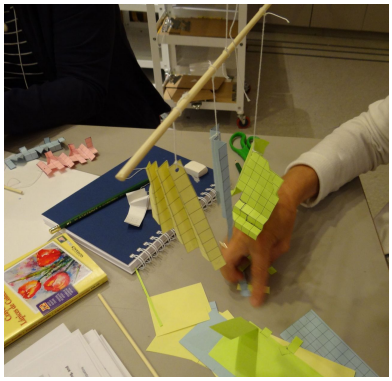
6. Guide student partners in attaching mobile forms in balance.

- *Two shapes on one side and one on the other will be balanced to show the equation.*
- *Think about weight and area on either side of the balance point. How will length of string or holes punched on each side impact the balance?*
- *Think about the single shape on one side having the longest string. How can string length be equivalent also? That equation might look like this: 6 inches of string = a + b: a and b are the lengths of the strings for your two shapes…*



- *Once string is equivalent, tie your shapes to the bamboo securely. Partners need to suspend mobiles while artists adjust (move attachment points of string/shapes) until the bamboo stick/beam is level and shapes are balanced.*
- *Complete by adding a bit of glue stick to string/bamboo attachment points to stabilize, tying a paper clip to the string suspending the whole mobile, and trimming excess string at all tie points to about 1/4 of an inch.*

☑ Criteria-based teacher checklist: Balances equivalent weight/area of shapes representing numbers on either side of a center equal point. Securely attaches with string.

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7. Guide criteria-based self and group reflection. Hang mobiles on line attached to ceiling using paper clips. Group and compare mobiles that express the same equation.


Guiding Reflecting on Student Art

- *Notice the balance seen in mobiles. Share your experiences adjusting to create balance. Was it tricky? Why or why not?*
- *Is your mobile balanced? Where do you feel you used good craftsmanship in cutting and construction?*
- *Compare the mobiles expressing the same equation: can you tell at a glance?*
- *What was one part of achieving balance that we did not talk about, but was part of your process? (adjusting location of attachments on bamboo beam). Is there a missing variable equation there as well? (calculating lengths of attachment from center point).*
- *Have your ideas about equations or balance changed because of this process?*

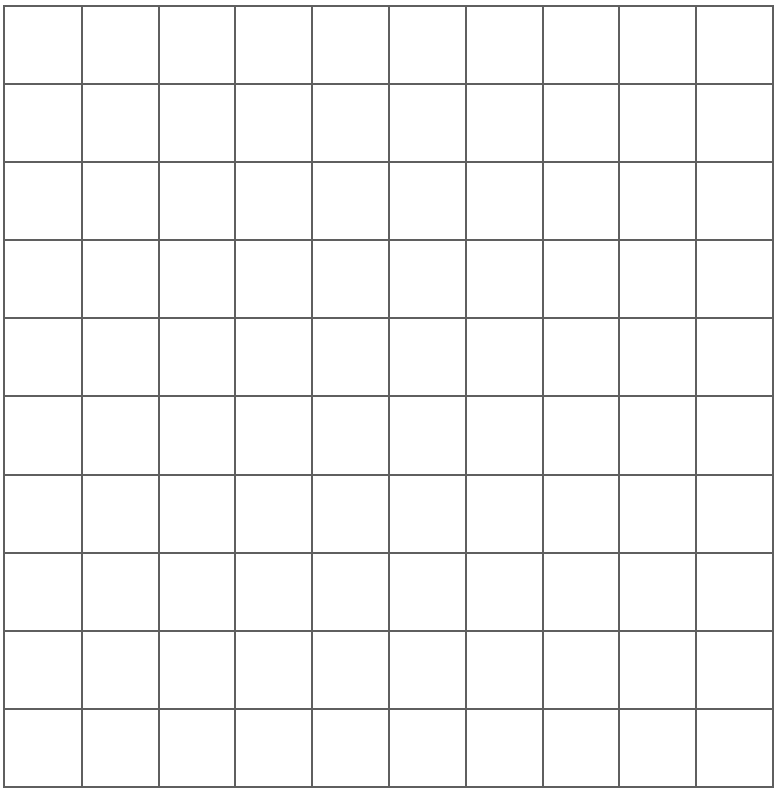
☑ Criteria-based student self and group assessment: Reflects on challenges in creating balance and craftsmanship. Connects physical balance with equivalency.

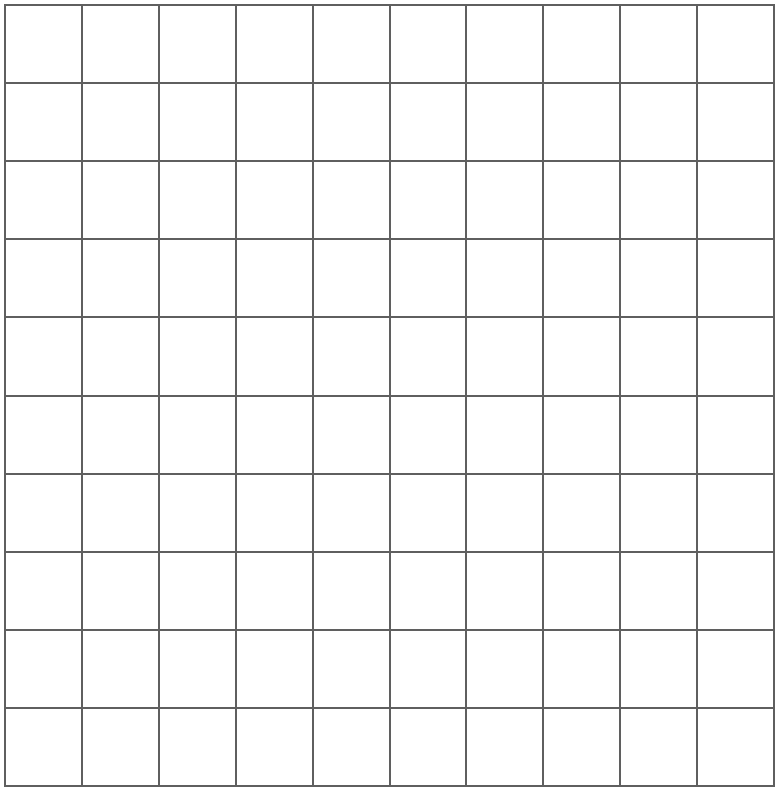
Extension of steps 3 and 4: Missing Variables and Equivalency
Facilitate solving missing variable equations using number grouping strategies.
Link equations with area /number of grid squares. Guide selecting papers, marking, and cutting shapes.

- *In solving a missing variable equation, how does equivalency help us figure out what that letter means? Try some missing variable equations: Calculations in brackets are done first. (23 – 11) + (3 x 4) = a, or (12) + (12) = 24; (a) + (2 x 4) = 32, or (a) + (8) = 32. How does equivalency help us figure out what number (a) is in this equation? Can we subtract 8 from 32 to find out what (a) is?*
- *Using another missing variable equation, let's translate each calculation within a bracket (and the missing variable number) into shapes that will become a mobile: a + (3 x 5) = 22. What number is (a)? So we can write this as: (7) + (15) = 22. So, our three shapes will need to be (in weight and area) 7 and 15 squares on one side of the balance point, and 22 squares on the other.*
- *If we have the same total number, weight, or area on either side of an equal sign, or balance point, in the case of my mobile, will my mobile be balanced?*
- *Solve your equation (equation on board or distributed to students) by finding the missing variable and calculating numbers in the brackets.*
- *Create three shapes on grid paper that represent each of the three numbers grouped in the equation. The number in the equation needs to match the exact number of squares (area) in each shape.*

☑ Criteria-based teacher checklist: Uses grouping and operations to find an unknown number.

***Everyday Mathematics* Extensions:**
10.4, 10.5, 10.6





ARTS IMPACT FAMILY LETTER

Fifth Grade Lesson One: *Mobiles: Balancing Equations*

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 3 (or 4)
Concept	**Equivalency/Balance**		**Craftsmanship**	**Variables**	
Criteria Student Name	Cuts out three shapes with number of grid squares/area corresponding with three numbers in equation	Balances equivalent weight/area of shapes representing numbers on either side of a center equal point	Cuts shapes smoothly, manipulates to create 3-D forms (optional), and securely attaches with string	**Extension** Uses grouping and operations to find an unknown number	

ARTS IMPACT FAMILY LETTER

Fifth Grade Lesson One: *Mobiles: Balancing Equations*

CLASS ASSESSMENT WORKSHEET

Disciplines	**VISUAL ARTS AND MATH**		**VISUAL ARTS**	**MATH**	Total 3 (or 4)
Concept	**Equivalency/Balance**		**Craftsmanship**	**Variables**	
Criteria Student Name	Cuts out three shapes with number of grid squares/area corresponding with three numbers in equation	Balances equivalent weight/area of shapes representing numbers on either side of a center equal point	Cuts shapes smoothly, manipulates to create 3-D forms (optional), and securely attaches with string	**Extension** Uses grouping and operations to find an unknown number	
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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: _____

ARTS IMPACT FAMILY LETTER

VISUAL ARTS AND MATH LESSON: ***Mobiles: Balancing Equations***

Dear Family:

Today your child participated in an **Arts and Math lesson**. We looked at examples of sculpture and mobiles that show the math, science, and art concept of balance or equivalency. We talked about how in 2-dimensional art, balance is something we perceive visually, but when art becomes 3-dimensional—especially in large scale sculpture—balance becomes even more important. We made mobiles that expressed the balance or equality of numbers in an equation.

- We focused on the concept of equal numbers or amounts and how that idea relates to art and the physical world.
- We cut out shapes from colorful grid papers to represent three different numbers in an addition equation.
- We attached a bamboo stick to a string and suspended it to find a central balance point. This balance point is similar to the equal sign in an equation.
- We constructed a mobile in balance by suspending shapes representing the equation on either side of the balance point on our mobile.
- We reflected as a group on all of the artistic ways that one equation could be expressed. We also talked about the challenges of finding balance, and how there were additional variables at play when we made adjustments to our mobiles to balance them.

At home, you could notice balance and equivalency in your everyday world. You could create balanced mobiles out of all kinds of different objects and materials, string, and sticks. You could experiment with adding more than one weighted beam/stick to make an even more complex system of weights and balance.

Enduring Understanding

Equal numbers, shapes, or area suspended on either side of a center point can create balance.