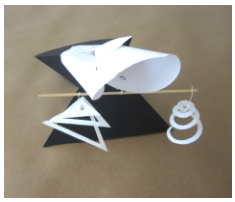
ARTS IMPACT LESSON PLAN

Visual Arts, Science, and Engineering Infused Lesson



Sculpture in Balance

Authors: Meredith Essex

Enduring Understanding

Counterweighting forms can create a balanced sculpture. Building a balanced sculpture can solve an engineering design problem by creating strength and stability.

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

Students analyze sculpture and role of sculptor as engineer. Next, students explore paper construction techniques and design, construct, test, and optimize a standing mobile sculpture. Design criteria include strength, balance, and use of three or more construction techniques. Students test and revise engineering through use of a wind, drop, and earthquake test and document engineering process on an Artist Engineer Worksheet. Last, students reflect on sculptures in a class sculpture park, and write about how their artistic engineering process reflects a growth mindset.

Learning Targets and Assessment Criteria

Target: Employs a range of paper sculpture techniques.
Criteria: Uses at least three methods: cuts, crumples, folds, knots, rolls, and/or weaves (etc.) and then attaches paper to make a 3-D form.

Target: Solves artistic and engineering design problem.
Criteria: Conceptualizes, tests, optimizes, and documents the construction of a sculpture.

Target: Creates a balanced standing mobile sculpture.
Criteria: Suspends forms from a balance point securely attached to a stable 3-D form.

Target: Creates a strong standing mobile sculpture.
Criteria: Constructs a sturdy three-dimensional form which can withstand a wind, drop, and earthquake test.

Target: Demonstrates a growth mindset.
Criteria: Takes risks, embraces alternative possibilities, and develops work over time.

Vocabulary

Arts Infused:
2-D
3-D
Asymmetry
Symmetry

Science:
Balance
Balance Point
Base
Beam
Counterweight
Engineer
Mobile
Process

continued

Materials

Museum Artworks or Performance

Seattle, WA
Seattle Art Museum

Tacoma, WA
Children's Museum of Tacoma
Tacoma Art Museum

Additional Resources
Alexander Calder Foundation:
www.calder.org
Margie McDonald:
www.margiemcdonald.com
www.ptartscape.com: *Mobiles, Stabiles and Circus Creatures*

continued

Learning Standards

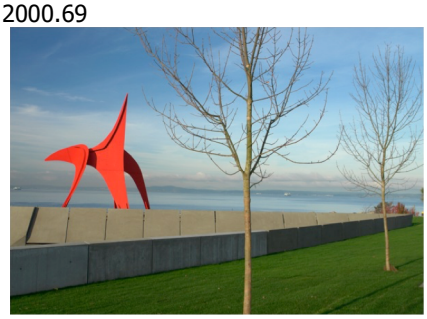
WA Arts Learning Standards in Visual Arts
For the full description of each standard, see:
http://www.k12.wa.us/Arts/Standards
Creating (Concepts: Shape/Form, Balance. Technique: Paper Construction)
1. Generate and conceptualize artistic ideas and work.
2. Organize and develop artistic ideas and work.
3. Refine and complete artistic work.
Performing/Presenting/Producing
4. Select, analyze, and interpret artistic work for presentation.
5. Develop and refine artistic techniques and work for presentation.
Responding
7. Perceive and analyze artistic work.
8. Interpret intent and meaning in artistic work.
9. Apply criteria to evaluate artistic work.

continued

Arts:
Balance Point
Form
Mobile
Point of View
Sculpture
Stabile

Materials
Arts Impact sketchbook; Drawing pencils: 2B and HB; Vinyl erasers; Card stock, black or white: 5.5x8.5" (two pieces per student for practice) and 8.5x11" (two-three pieces per student for final composition); Copy paper: 8.5x11", copy Artist Engineer Worksheet from lesson, 1 per student; Scissors; Hole punches; Light (kite weight) string; Bamboo sticks: (different lengths and diameters of skewers with point cut off); Glue sticks; Tacky glue; Stapler (one per two students); Hot glue gun; Pruning shears; Class Assessment Worksheet

Seattle Art Museum images:
The Eagle, 1971, Alexander Calder, 2000.69



Bunyon's Chess, 1965, Mark di Suvero, T2004-104

continued

Connecting
11. Relate artistic ideas and works with societal, cultural, and historical context to deepen understanding.

Early Learning Guidelines (Pre-K – Grade 3)
For a full description of Washington State Early Learning and Child Development Guidelines see:
https://www.del.wa.gov/sites/default/files/imported/publications/development/docs/guidelines.pdf
(Age 4-5) 6. Learning about my world: Science: Ask questions and identify ways to find answers. Try out these activities and think about what to do next to learn more. Arts: Show an increasing ability to use art materials safely and with purpose.

Next Generation Science Standards
http://www.nextgenscience.org/next-generation-science-standards
Topic:
Forces and Interactions
Engineering Design

Disciplinary Core Ideas:
PS2.A. Forces and Motion
PS2.B. Types of Interactions
PS3.C. Relationship between Energy and Forces
ETS1.A. Defining Engineering Problems
ETS1.B. Designing Solutions to Engineering Problems
ETS1.C. Optimizing the Design Solution

Science Kits Addressed:
PreK: Building Structures
2: Balancing and Weighing
5: Models and Designs

Performance Expectations:
K-PS2-1. Plan & conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
3-PS2-1: Plan & conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each perform.
3-5-ETS-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Crosscutting Concepts:
Cause and Effect
Scale, Proportion and Quantity
Systems and System Models

Science and Engineering Practices:
1. Asking Questions and Defining Problems
2. Developing and Using Models
3. Planning and Carrying out Investigations
6. Constructing Explanations and Designing Solutions

continued

Bala Krishna, dancing, ca. 15th century, India, 51.117

Tacoma Art Museum images:
Leroy the Big Pup, Scott Fife, 2004

Hanging Healing, Nancy Mee, 1990

ICON KEY:

📄 = Indicates note or reminder for teacher

☑ = Embedded assessment points in the lesson

Pre-Teach

Notice and talk about how functional and decorative three-dimensional forms such as furniture, machines, or other objects are engineered for strength and balance.

Lesson Steps Outline

Day One

1. Ask students to identify sculptures seen in museums, community buildings, and other locations. Introduce and guide art analysis of *Eagle* by Alexander Calder, *Bunyon's Chess* by Mark Suvero, and *Bala Krishna, Dancing*, India, from the Seattle Art Museum collection and *Leroy the Big Pup* by Scott Fife and *Hanging Healing* by Nancy Mee from the Tacoma Art Museum collection.

☑ Criteria-based process assessment: Analyzes sculpture.

2. Introduce and guide discussion about engineering as a systematic problem-solving process. Facilitate discussion about the engineering and artistic challenges of designing and constructing a sculpture. Define growth mindset.

☑ Criteria-based process assessment: Reflects on artists as engineers and how both have a growth mindset.

3. Ask students to creatively experiment with manipulating paper in order to transform it from being flat to having dimension using a variety of techniques.

☑ Criteria-based process assessment: Cuts, crumples, folds, knots, rolls, and/or weaves (etc.) paper to make a 3-D form.

4. Demonstrate and guide experimenting with techniques for attaching two papers. Assist students in informally testing strength and balance, and reflecting with a peer on findings.

☑ Criteria-based peer process assessment: Attaches paper to make a 3-D form; Constructs a sturdy three-dimensional form that can withstand a wind, drop, and earthquake test.

Day Two

1. Share information about *Eagle* artist, Alexander Calder. Share photos of mobiles, stabiles, and standing mobiles from the Calder Foundation website www.calder.org.

2. Define creative engineering problem to solve. Guide gathering information from own and peer experiences and sketching to conceptualize standing mobile sculpture.

☑ Criteria-based teacher checklist: Gathers ideas, conceptualizes construction of a standing mobile sculpture.

3. Demonstrate and guide balancing/counterweighting forms to build a balanced base.

☑ Criteria-based peer assessment: Tests, optimizes, and documents the construction of a sculpture. Uses at least three methods: cuts, crumples, folds, knots, rolls, and/or weaves (etc.), and then attaches paper to make sturdy three-dimensional form which can withstand a wind, drop, and earthquake test.

4. Discuss the possible engineering impacts of adding a mobile to the base. Demonstrate and guide creating a strong mobile attachment point on the base sculpture and attaching a mobile component. Emphasize trying multiple solutions.

☑ Criteria-based teacher checklist: Suspends forms from a balance point securely attached to a stable 3-D base.

5. After glue is dry, guide engineering tests, evaluation, and optimization of standing mobile sculptures.

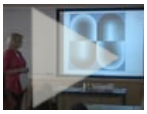
☑ Criteria-based peer and teacher checklist: Tests, optimizes, and documents the construction of a sculpture. Uses at least three methods: cuts, crumples, folds, knots, rolls, and/or weaves (etc.), and then attaches paper to make a sturdy three-dimensional form which can withstand a wind, drop, and earthquake test.

6. Facilitate presentation and criteria-based critique reflection of all standing mobiles as a group in a classroom sculpture park. Guide student checklist assessment and final reflection on growth mindset.

☑ Criteria-based group reflection, student self-assessment: Reflects on interaction of forms in classroom sculpture park, construction techniques, engineering problems and solutions. Completes written reflection on growth mindset and completes self-assessment checklist. Takes risks, embraces alternative possibilities and develops work over time.

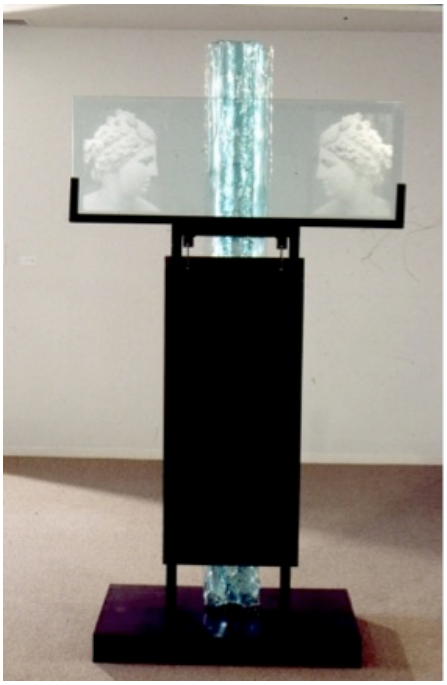
LESSON STEPS

Day One


Responding to Art in the Classroom

1. Ask students to identify sculptures seen in museums, community buildings, and other locations. Introduce and guide art analysis of *Eagle* by Alexander Calder, *Bunyon's Chess* by Mark Suvero, and *Bala Krishna, Dancing*, India, from the Seattle Art Museum collection and *Leroy the Big Pup* by Scott Fife and *Hanging Healing* by Nancy Mee from the Tacoma Art Museum collection.

The Seattle Art Museum's collection is available on-line at: http://www1.seattleartmuseum.org/eMuseum/code/emuseum.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.



The Tacoma Art Museum's collection is available on-line at: http://www.tacomaartmuseum.org/explore/collections

This lesson can be adapted according to age and ability by having students complete the steps for Day One only or both Day One and Day Two.

- *What is a sculpture? Describe the types of sculptures you have seen in museums, buildings, or parks. Do all sculptures sit on the floor or the ground?*
- *These are sculptures from two of our regional museums:* Seattle and Tacoma Art Museums.
- *What do you notice: How are they similar? How are they different?*
- *What does 3-D mean?* (height, width, and depth) *What are the concerns of the sculptor in creating a work of sculpture? (*viewed from multiple points of view*) What challenges does a sculptor face that a painter does not?*

☑ Criteria-based process assessment: Analyzes sculpture.

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2. Introduce and guide discussion about engineering as a systematic problem-solving process. Facilitate discussion about the engineering and artistic challenges of designing and constructing a sculpture. Define growth mindset.

- *In the Next Generation Science Standards, I found this quote about what we will be doing today:* The goal of engineering is to solve problems. Designing solutions to problems is a systematic process that involves defining the problem, then generating, testing, and improving solutions. (Next Generation Science Standards: Scientific Practice: Constructing Explanations and Designing solutions)
- *What do you think this means? What sorts of problems might a sculptor face in making a sculpture?*
- *Do sculptors need to be engineers? Why?*
- *Part of being an effective artist or scientist or engineer is having a growth mindset: Taking risks, embracing alternative possibilities, and allowing work to develop over time.*

☑ Criteria-based process assessment: Reflects on artists as engineers and how both have a growth mindset.

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3. Ask students to creatively experiment with manipulating paper in order to transform it from being flat to having dimension using a variety of techniques.


Shape to Form

Distribute paper sculpture construction practice papers: Two 5.5 x 8.5" pieces of card stock per student.

- *I am demonstrating some of the ways that I can change my two papers from being flat (2-D) to having form or dimension (3-D).*
- *Without cutting your papers into smaller pieces, experiment with cutting, crumpling, folding, knotting, rolling, weaving, and/or other techniques you discover.*
- *When you are thinking creatively, you consider and try many different ways to make what you want, and make artistic choices. We're doing that when we are experimenting with paper today!*

☑ Criteria-based process assessment: Cuts, crumples, folds, knots, rolls, and/or weaves (etc.-) paper to make a 3-D form.

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4. Demonstrate and guide experimenting with techniques for attaching two papers. Assist students in informally testing strength and balance, and reflecting with a peer on findings.

Teachers may choose to just offer one technique for attaching papers or encourage experimentation with and comparison of multiple techniques.

- *If I notch one paper with a cut about an inch long, and then notch the other paper, I can push together and connect the two pieces.*
- *What are some ways I can use additional tools and materials to connect 3-D paper forms without using glue? Staplers? Hole punches and string for tying?*
- *Why might I "double up" paper. What are ways that I can do this to make areas stronger*

- *Experiment with attaching your pieces using notching, stapling, and/or hole punching.*
- *Test the strength and sturdiness of your attachment by blowing on your sculpture (as if blowing out birthday candles), shaking, and dropping your paper construction. Does it tip over? Fall apart?*
- *Talk to a peer: Compare your paper constructions. Did they fall over or come apart when you tested? Together, figure out how you could improve (optimize) or fix and test again.*

☑ Criteria-based peer process assessment: Attaches paper to make a 3-D form; Constructs a sturdy three-dimensional form that can withstand a wind, drop, and earthquake test.

LESSON STEPS

Day Two

1. Share information about *Eagle* artist, Alexander Calder. Share photos of mobiles, stabiles, and standing mobiles from the Calder Foundation website www.calder.org.

- *Alexander Calder created large-scale mobiles (suspended balanced artworks), and stabiles (sculptures which are still), and standing mobiles (essentially a combination of both) throughout his career.*
- *Calder's work was revolutionary in its exploration of balance and movement. He was a prolific artist who visited many places, had many experiences and made many different kinds of artworks. He also created delightful kinetic (moving) circus creatures and performers out of wire and found materials.*
- *What do you observe in the photographs of Calder's work? What do you notice that might indicate that Calder had a growth mindset?*

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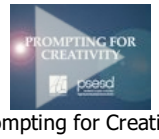
2. Define creative engineering problem to solve. Guide gathering information from own and peer experiences and sketching to conceptualize standing mobile sculpture.

- *Our artistic and engineering problem to solve is to construct standing mobile sculptures. We will need to think creatively!*
- *Our artistic engineering design criteria are: use a range of construction techniques plus build and test for balance and strength.*



Prompting for Creativity

- *We also are limited in the amount and type of materials we have for construction.*

Having specific limitations on materials ensures equity and consistency of engineering problem to solve for each student.

- *Make some rough sketches of a standing mobile that you might choose to construct (inspired by Calder's art) to get your creative juices flowing.*
- *Know that throughout this process, your ideas will change as you work through problems and discover alternate possibilities.*



☑ Criteria-based teacher checklist: Gathers ideas, conceptualizes construction of a standing mobile sculpture.

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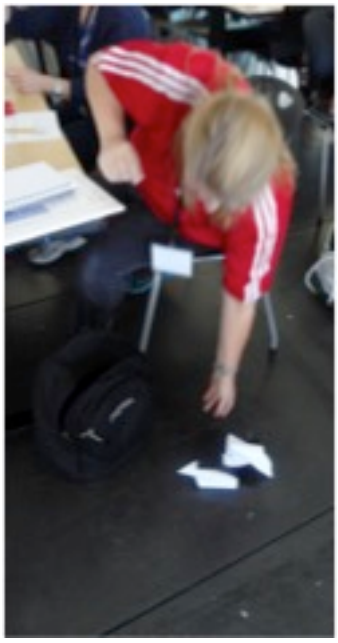
3. Demonstrate and guide balancing/counterweighting forms to build a balanced base.
Distribute Artist Engineer Worksheet and two-three 8.5 x 11" pieces of card stock per student and tools to share: scissors, hole punches, and staplers.

- *As your design idea comes to life and you solve engineering problems as they arise, note changes you make on your* Artist Engineer Worksheet.

- *What have we learned so far about attaching paper and making 3-D paper forms sturdy enough to withstand our testing?*



- *Note where you might attach the balancing mobile component. Use a range of paper construction techniques (at least three) and think about all points of view that your sculpture will be viewed from.*

- *Test the strength and sturdiness of your base sculpture by blowing on your sculpture (as if blowing out birthday candles), shaking, and dropping your paper construction. Does it tip over? Fall apart? Note findings on your* Artist Engineer Worksheet.

- *Talk to a peer: Compare your paper constructions. Did they fall over or come apart when you tested? Together, figure out how you could improve or fix and test again. Note on your* Artist Engineer Worksheet.

☑ Criteria-based peer assessment: Tests, optimizes, and documents the construction of a sculpture. Uses at least three methods: cuts, crumples, folds, knots, rolls, and/or weaves (etc.), and then attaches paper to make sturdy three-dimensional form which can withstand a wind, drop, and earthquake test.

4. Discuss the possible engineering impacts of adding a mobile to the base. Demonstrate and guide creating a strong mobile attachment point on the base sculpture and attaching a mobile component. Emphasize trying multiple solutions.


Base and Mobile

Teachers can have students balance objects supported by one bamboo "beam" suspended from the base sculpture or can have students explore more complex balancing with multiple bamboo beams. Some students may need instruction and practice in tying simple knots.

- *What might happen when we attach the mobile component? Will it change the balance of the whole sculpture? How can we make the attachment point strong enough to support it?*

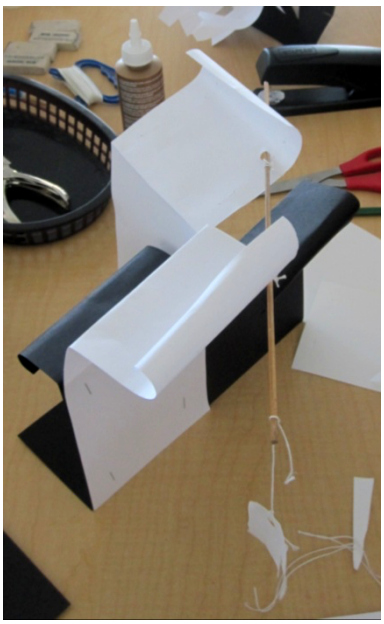
- *Reinforce the mobile attachment point on the sculpture base by doubling up paper, stapling and punching, then construct (up to three) 3-D paper forms to suspend in a mobile (punch holes to suspend them by).*

- *I have suspended a main "beam" of my mobile by creating an attachment point: Now I can attach forms and counter-weight them so they are suspended in balance.*

Provide different lengths of bamboo and light (kite weight) string.

- *As you work, remember that it may require extensive problem solving and exploration of alternate possibilities to achieve balance, stability, and strength in your sculpture. Making changes is expected. Don't give up! Know that it takes time to build something well, and it's through taking the time that we learn what works best.*

- *Once mobile balance is achieved, complete by adding a bit of glue stick or tacky glue to string/bamboo attachment points to stabilize. Trim excess string at all tie points to about ¼ of an inch.*



☑ Criteria-based teacher checklist: Suspends forms from a balance point securely attached to a stable 3-D base.

5. After glue is dry, guide engineering tests, evaluation, and optimization of standing mobile sculptures.

- *Test the strength and sturdiness of your standing mobile sculpture by blowing on your sculpture (as if blowing out birthday candles), shaking, and dropping. Does it tip over? Fall apart? Note findings on your* Artist Engineer Worksheet.

- *Talk to a peer: Compare your paper constructions. Did they fall over or come apart when you tested? Together, figure out how you could improve (optimize) or fix and test again. Note on your* Artist Engineer Worksheet.

☑ Criteria-based peer and teacher checklist: Tests, optimizes, and documents the construction of a sculpture. Uses at least three methods: cuts, crumples, folds, knots, rolls, and/or weaves (etc.), and then attaches paper to make a sturdy three-dimensional form which can withstand a wind, drop, and earthquake test.

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6. Facilitate presentation and criteria-based critique reflection of all standing mobiles as a group in a classroom sculpture park. Guide student checklist assessment and final reflection on growth mindset.


Guiding Reflecting on Student Art

🗎 Have students purposefully place sculptures on black paper or tablecloth or sheltered outdoor area.

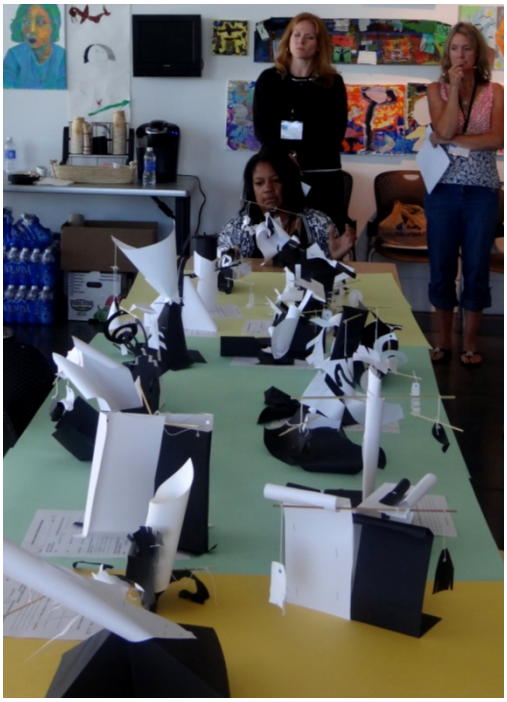
- *Place your sculpture thoughtfully in relation to other sculptures to help create our class sculpture park. What do you notice about how 3-dimensional works of art interact with the space around them?*

- *Identify three different paper construction techniques that are interesting artistically and/or solve an engineering problem and describe for the class—ask each artist how they did it.*

- *Refer to your* Artist Engineer *W*orksheet *and share examples of changes you made along the way to solve balance or strength engineering problems as you built your sculpture.*

- *Think about your artistic engineering process from start to finish.*

- *On your self-assessment worksheet, reflect on ways that you showed growth mindset. Then complete the checklist.*



☑ Criteria-based group reflection, student self-assessment: Reflects on interaction of forms in classroom sculpture park, construction techniques, engineering problems and solutions. Completes written reflection on growth mindset and completes self-assessment checklist. Criteria-based teacher checklist: Takes risks, embraces alternative possibilities, and develops work over time.

Sculpture in Balance Artist Engineer Worksheet

Name: _____ Date: _____

SCULPTURE BASE

Strength and Balance Test | Revision/Optimization Ideas: What/How to change?

WIND Pass ☐ Fail ☐ → _____

DROP Pass ☐ Fail ☐ → _____

EARTHQUAKE Pass ☐ Fail ☐ → _____

If there was failure and revision/optimization, retest and indicate findings below: Did you correct the problem? If so how?

_____

_____

_____

_____

SCULPTURE WITH MOBILE ATTACHED (after glue has dried)

Strength and Balance Test | Revision/Optimization Ideas: What/How to change?

WIND Pass ☐ Fail ☐ → _____

DROP Pass ☐ Fail ☐ → _____

EARTHQUAKE Pass ☐ Fail ☐ → _____

If there was failure and revision/optimization, retest and indicate findings below: Did you correct the problem? If so how?

_____

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_____

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

STUDENT SELF-ASSESSMENT WORKSHEET

Disciplines	**VISUAL ARTS**		**VISUAL ARTS/ENGINEERING/SCIENCE**					Total 7
Concept	**Paper Sculpture**		**Artistic Design/Engineering: Balance and Strength**				**Growth Mindset**	
Criteria Student Name	Uses at least three methods: cuts, crumples, folds, knots, rolls, and/or weaves (etc.)	Attaches paper to make a 3-D form.	Conceptualizes (sketches)	Tests, optimizes documents construction of sculpture on worksheet.	Suspends forms from a balance point securely attached to a stable 3-D form.	Constructs a sturdy 3-D form which can withstand a wind, drop, and earthquake test.	Takes risks, embraces alternative possibilities, and develops work over time.	

Self-Assessment Questions:

Growth Mindset:

Look at your standing mobile sketch and read the notes you took on you Artist Engineer Worksheet to help you answer the following questions:

Did your plans or ideas turn out like you thought they would? What changed? Why?

When did you take a risk, try something and fail? What did you learn from your idea not working?

How did your sculpture change over time? Were there parts of your sculpture you had to keep returning to and changing again and again? What was valuable about that process?

How do you feel that you showed a growth mindset?

ARTS IMPACT LESSON PLAN Arts Infusion

Sculpture in Balance

CLASS ASSESSMENT WORKSHEET

Disciplines	**VISUAL ARTS**		**VISUAL ARTS/ENGINEERING/SCIENCE**					Total 7
Concept	**Paper Sculpture**		**Artistic Design/Engineering: Balance and Strength**				**Growth Mindset**	
Criteria Student Name	Uses at least three methods: cuts, crumples, folds, knots, rolls, and/or weaves (etc.)	Attaches paper to make a 3-D form.	Conceptualizes (sketches)	Tests, optimizes documents construction of sculpture on worksheet.	Suspends forms from a balance point securely attached to a stable 3-D form.	Constructs a sturdy 3-D form which can withstand a wind, drop, and earthquake test.	Takes risks, embraces alternative possibilities, and develops work over time.	
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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 other subjects?

Teacher: _____ Date: _____

VISUAL ARTS, SCIENCE, AND ENGINEERING LESSON: ***Sculpture in Balance***

Dear Family:

Your child participated in an **Arts, Science, and Engineering** lesson. We learned about the role of engineering in creating sculpture and engineered our own sculptures.

- We analyzed different types and characteristics of sculpture from our community and local museums. We talked about the role of the sculptor as engineer.
- We talked about how artists, scientists, and engineers approach their work with a growth mindset: a willingness to take risks, embrace alternate possibilities and develop work over time.
- We creatively explored paper construction techniques through cutting, crumpling, folding, knotting, rolling, and/or weaving. We transformed paper from being 2-Dimensional to 3-Dimensional.
- We looked at standing mobiles by the artist Alexander Calder. He was revolutionary in his work engineering balancing forms in sculpture. Our artistic and engineering problem to solve was to also construct a balanced and sturdy standing mobile sculpture.
- We gathered ideas and conceptualized by sketching our sculpture ideas.
- We counterweighted and reinforced forms for the standing mobile base, created an attachment point, and suspended and balanced mobile elements.
- We considered and tried multiple creative solutions. We tested, revised, and optimized our engineering through use of a wind, drop, and earthquake test. We documented our engineering process on an Artist Engineer Worksheet.
- We thoughtfully placed our sculptures in a class sculpture park and reflected on our artistic engineering process. Last, we reflected on how we demonstrated a growth mindset throughout our own creative process.

At home, you could use an engineering and visual arts process to build an indoor or outdoor standing mobile, which creates sound or transforms light.

Enduring Understanding

Counterweighting forms can create a balanced sculpture. Building a balanced sculpture can solve an engineering design problem by creating strength and stability.