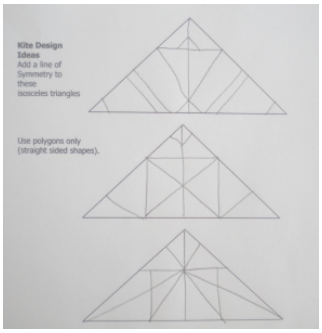
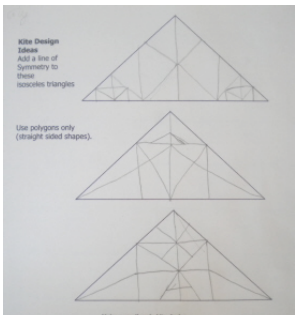
ARTS IMPACT—ARTS-INFUSED INSTITUTE LESSON PLAN (YR2-MAP)

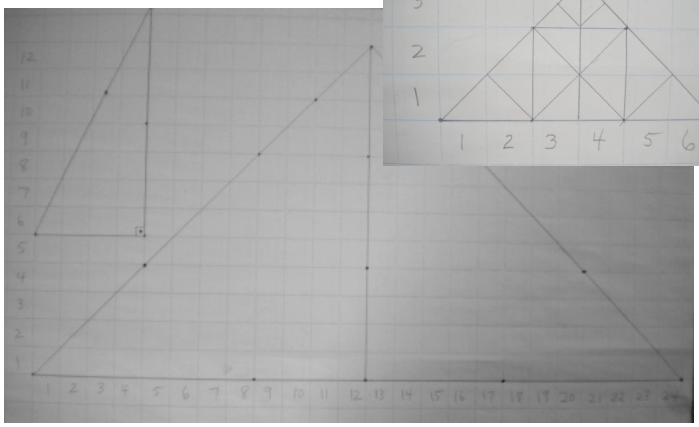
SEVENTH GRADE—LESSON ONE: Kites: Calculations and Designs: Enlarging Scale Part I

Artist-Mentor – Meredith Essex Grade Level: 7th

Examples:







Enduring Understanding

Application of knowledge of ratio, scale factor and proportion can be used to accurately enlarge the scale of shapes used in design and construction.

Art

Target: Plans a symmetrical design for surface decoration (of kite sail).

Criteria: Organizes and draws geometric shapes in reflection on a proportional isosceles triangle on one-inch grid paper—formula: b:h=2:1.

Art and Math

Target: Accurately applies calculations to make a larger scale pattern.

Criteria: Measures using grid, ruler and protractor (optional) and draws full-size proportional pattern of isosceles (sail) and scalene (keel) on 1-inch grid paper. (Delta-style kite)

Session I

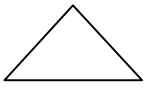
Materials
1-inch grid paper 9x12", small rulers, pencils, erasers, My Kite Journal (MKJ), 2-gallon zipper bags (ex: Ziploc)

Resources
TAM Image: *Leroy the Big Pup* by Scott Fife
Kite images, SAM Cultural geometric designs

Learning Targets
- Plans a symmetrical design for surface decoration (of kite sail).

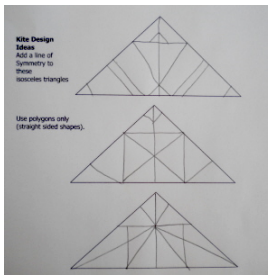
Do Now
Draw 3 symmetrical polygons (straight-sided, closed shapes) that include lines of symmetry.

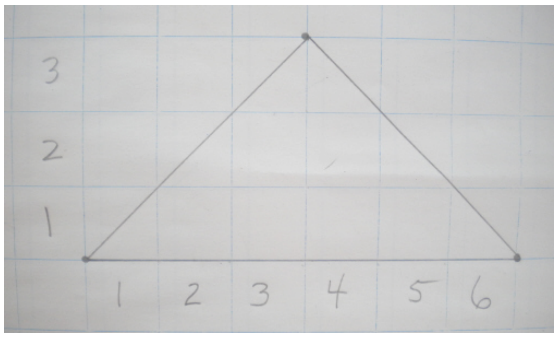
Activities/Prompts
- Meet *Leroy the Big Pup* (MKJ 8-2). How did the sculptor (artist who works in 3-D) use math to make this giant dog in proportion?
- Kites have been made for over 2000 years and have scientific, cultural and religious roles in many countries. What do all of these kites have in common? Symmetry. Why? For aerodynamic balance in flight. See www.drachen.org.
- The kites (Delta style designed by Tony Cyphert) we will build are composed of an isosceles triangle (sail) and a scalene triangle (keel). We use a proportional formula for aerodynamic design that is the same whether building a huge or tiny kite.
- Sketch three simple symmetrical designs using polygons only. MKJ 8-3

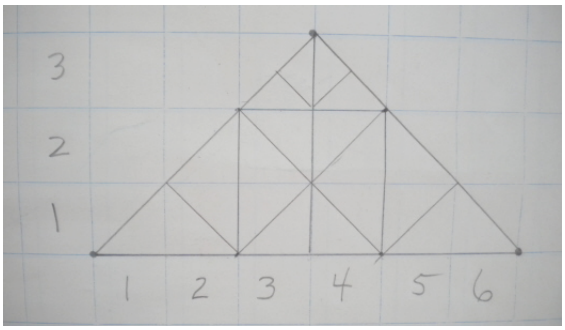


- Create a small scale sail shape for your kite sail (isosceles triangle) using a 2:1 b:h ratio on 1-inch grid paper. Count and number (in the middle of the square) six squares for sail/triangle base and up three for the height or spine of the sail. MKJ 8-3
- Choose your best design and draw it on your small scale sail.

Big Math and Art Ideas
Ratio/proportion, symmetry, polygons/similar figures isosceles triangle, scalene triangle, balance







Self Assessment/Reflection
Students peer check for symmetry + correct number and proportion of grid squares for sail.

Closure Students put MKJ and grid paper (and any other tools as directed by teacher) in zipper bag with name on it. Binder clip student desk/table group bags together for ease of distribution; store.

Assessment Criteria
☐ Organizes and draws geometric shapes in reflection on a proportional isosceles triangle on 1-inch grid paper—formula: b:h=2:1.

Next Steps/Follow up Needs Cut 1-inch grid paper to 15x30 inches, if needed.

Session II

Materials
1-inch grid paper 15x30", small and large rulers, pencils, erasers
Resources Color wheels, TAM or SAM resources showing complementary color geometric designs

Learning Targets
- Accurately applies calculations to make a larger scale pattern.

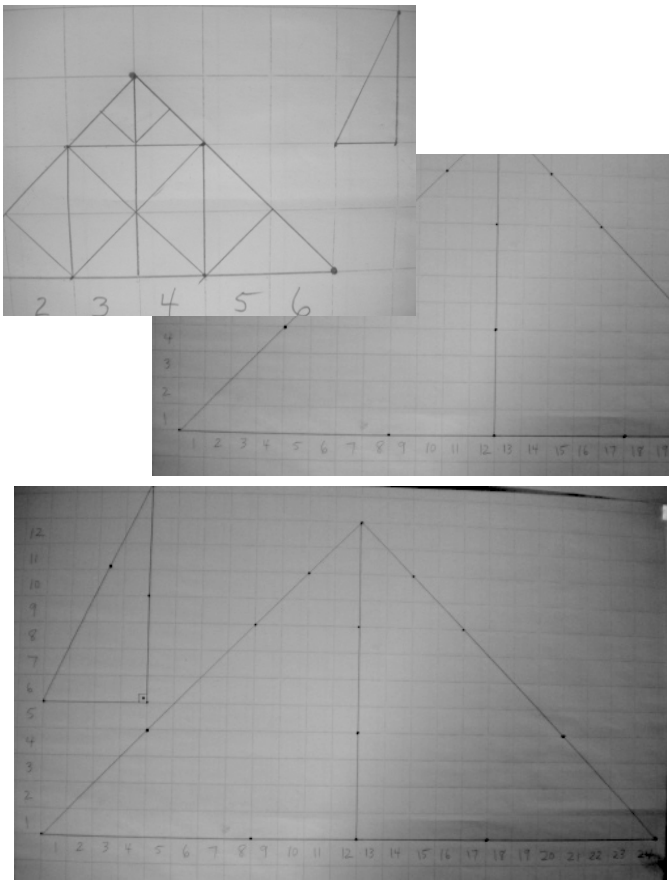
Do Now
Calculate the dimensions for other delta kites using the 2:1 base to height formula.
Practice Measuring: Find and mark 1½, 2 ¼, and 3 ¾ on the ruler shown.

Activities/Prompts
- Color preview: We are using complementary color combinations (across from another on the color wheel) for contrast. Which pair will you use?
- Using our Delta Kite formula, multiply h (3 inches) of small scale sail design by the following percentages for keel dimensions:

Keel Formula MKJ 8-4
shortest side: 33% x h
medium side: 69% x h
hypotenuse/long side: 79% x h (round off)

- Draw 30/60/90 degree keel scalene triangle on 1-inch grid paper. Start with aligning the 90 degree angle with a grid paper square, measure and draw. Label the 90 degree angle; add geometric design to keel.
- **Make it bigger!**
  Calculate kite sail full size (b:h = 24:12 inches) and draw pattern on 1-inch grid paper.
  What is the scale factor? Use your ruler: line up with grid squares to be accurate! MKJ 8-5
- Count and number (in the middle of the square) 24 squares for sail/triangle base and up 12 for the height/ spine of the sail.
- Use formula to calculate full size keel, measure and draw on 1-inch grid paper.

Big Math and Art Ideas
scalene right triangle, isosceles triangle, scalene triangle, scale factor, ratio/ proportion, symmetry, polygons, similar figures, balance, contrast/complementary colors

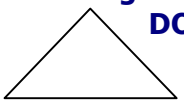


Self Assessment
Peer check. Students complete self-checklist and reflect: *Why is it important that the formula stays the same no matter the size of the kite?* MKJ 8-5
Closure Students place MKJ and all drawings in zipper bag and store as directed.

Assessment Criteria
☐ Measures using grid, ruler and protractor (optional) and draws full-size proportional pattern of isosceles (sail) and scalene (keel) on 1-inch grid paper.

Next Steps/Follow up Needs Guide completion of full size sail and keel pattern in preparation for drawing enlarged design on full size pattern.

Session I
Teaching and Learning Strategies



DO NOW WARM-UP

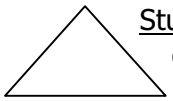
Draw 3 symmetrical polygons (straight-sided closed shapes) that include lines of symmetry.

1. Warm-up: Introduces *LeRoy the Big Pup* by Scott Fife from the Tacoma Art Museum Collection. (MKJ 8-2) Prompts: *When you look at this sculpture, what do you notice—does it look like a real dog? Share what mathematical operations or processes you think the artist would have needed to create his dog in* ***proportion****—with all parts of the animal having the same* ***ratio*** *or relationship to one another—on a much larger scale? Why is it important to know how to proportionally increase or decrease the scale of an object or design?*
Student: Participates in discussion.

2. Introduces scope of kite-making art lessons and shares a brief history with images of kites and focus on their significance culturally and scientifically. Shares images of kites from all different cultures and countries on www.drachen.org. Prompts: *You will use Math and Visual Arts to create kites that are unique and beautiful works of art that fly! Kites have been in existence for over 2000 years and probably originated in China. They have been a part of religious celebrations, also used for competitions and recreation. They have been put to work in the service of construction, military, transportation and scientific purposes. Kites have been used to solve many problems: to lift meteorological instruments to high altitudes, study weather, take photographs, and to transport cables over bodies of water in early construction projects. Why do you think all of the kites are symmetrical in shape? Think about science and the concept of* ***balance****. We will be using* ***symmetry*** *to make sure that our kites are balanced aerodynamically, artistically and mathematically. Symmetry will also simplify our process of measuring and enlarging our kite pattern and kite designs. We will be starting a scale design today that we will be enlarged for a full sized kite.*
Student: Participates in discussion.

Guides students in identifying shapes for kite pattern. Prompts: *We are going to create a kite using an aerodynamic formula designed for flight created by a kite designer named Tony Cyphert. Our basic kite shapes include a sail and keel—both triangles. The sail is an* ***isosceles triangle*** *and the keel is a* ***scalene triangle****. The sail catches the wind and provides a tow attachment point that sets the kite into the wind at an angle that makes flight possible. No matter how big or small the kite is, if the same formula and ratio of all of the parts is used, it will be aerodynamic.*
Student: Notes shapes.

3. **Guides students in looking at TAM and SAM collection art and visualizing a geometric design for the surface of the kite that is composed of polygons in reflection.** Prompts: *Describe how many lines of symmetry you see in this work of art? We will all be working with very simple* ***geometric shapes—polygons*** *(circles/half-circles can be used—at discretion of math teacher) Here are some ideas: think simple lines and shapes. When we enlarge the kites we can add more detail.*
No Letters and no numbers; just purely geometric shapes.



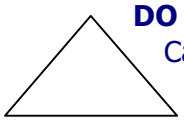
Student: Participates in discussion. Sketches three different ideas for a symmetrical geometric kite design. MKJ 8-3

4. **Demonstrates drawing proportional triangle as a small design/pattern on 1-inch grid paper using b:h=2:1 ratio.** Prompts: *The ratio of base to height in the Delta kite formula is b:h=2:1. All critical measurements for the kite are related to the height of the sail (isosceles triangle). We are starting with a small scale drawing that is 6 (one inch) squares for the* ***base*** *and 3 squares for the height. The* ***height*** *of our kite/triangle is 3 inches. Number your grid squares right in the middle of each square and count 6 for the base and 3 for the height. Dot vertices and connect dots by drawing with a ruler.*

Pick your most interesting symmetrical sketch in My Kite Journal and draw it on your grid paper sail shape by precisely lining up a ruler with grid lines and counting squares for symmetry. Use dots on the grid to mark the vertices of all figures. MKJ 8-3
Student: Draws small scale design for sail.
Embedded Assessment: Criteria-based teacher checklist

Session II
Teaching and Learning Strategies

DO NOW WARM-UP



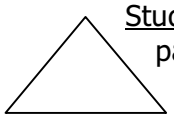
Calculate the sail size for other delta kites listed using the 2:1 base to height formula.
Practice Measuring: Find and mark 1½, 2 ¼, and 3 ¾ on the ruler shown.

1. Previews focus on complementary color for kite design. *Prompts: We are using complementary color combinations for **contrast** to make our kites visually POP! Complements are directly across from each other on the color wheel. Start thinking about which **complementary pair** you will use in your design.*
Student: Starts to visualize kite color combinations.

2. Demonstrates calculating and drawing a small scale keel in proportion. *Using our Delta formula, we multiply the height (3 inches) of our small scale sail design by the following percentages to get the keel dimensions.*

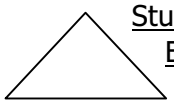
Keel Dimensions: 30/60/90 degree scalene triangle
shortest side = 33%xh (3 inches)
medium side = 69%xh (3 inches)
hypotenuse/long side = 79%xh (3 inches)

*It is a **right scalene triangle with 30-60-90 degree angles**. Prompts: This type of triangle is used in many real world applications—especially construction. The ratios of the sides are special, and you will learn more about these in geometry. Draw 30/60/90 degree keel scalene triangle on 1-inch grid paper. Start with aligning the 90 degree angle with a grid paper square, measure and mark shortest and medium length sides of the triangle, then draw the hypotenuse (longest side) from vertex to vertex. On the keel shape, create a simple geometric design using grid lines and vertices—it does not have to be symmetrical since it is on a triangle that does not have any lines of symmetry, but, you might want to align the design with your sail design.*



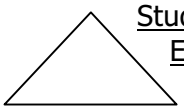
Student: Calculates small scale keel dimension, rounds off and converts to inches and draws on same paper as small scale sail design, then adds simple geometric design. MKJ 8-4

3. Demonstrates enlarging the sail for the full sized kite pattern. *Prompts: **Now, let's make it bigger.** I am drawing a full size isosceles triangle for my kite sail using a 2:1 b:h ratio on 1-inch grid paper (24:12). What is the **scale factor** (4)? Count and number (in the middle of the square) 24 squares for sail/triangle base and up 12 for the height/ spine of the sail. It is really important to be mathematically accurate in counting squares and confirming symmetry—otherwise errors will compound and you will have put a lot of time into a design that has to be re-done.*



Student: Confirms correct ratio and dimensions and draws full size pattern for sail. MKJ 8-5
Embedded Assessment: Peer check for correct number of squares/proportional triangle

4. Demonstrates enlarging the keel for the full-sized kite pattern. *Prompts: I am calculating full-size keel dimensions using the formula above. Multiply the height (12 inches) by each percentage. Notice I draw the full size 30/60/90 degree keel scalene triangle on 1-inch grid paper. Start with aligning the 90 degree angle with a grid paper square as with the small keel, measure and mark shortest and medium length sides of the triangle, then draw the hypotenuse (longest side) from vertex to vertex. Label the 90 degree angle with a square to show which angle is 90 degrees.*



Student: Confirms correct ratio and dimensions and draws full size pattern for keel. MKJ 8-5

Embedded Assessment: Peer check for correct keel measurements

Vocabulary	Materials and Community Resources	WA Essential Learnings & Frameworks
Arts Infused: Enlarge Geometric shape Pattern Proportion Scale Symmetry Math: Angle Base Isosceles triangle Ratio Reflection Scale factor Scalene triangle Side Triangle Vertex Vertices Art Abstract Balance Complementary Colors Contrast Kite Base Keel Sail	**Museum Artworks** Color wheel poster Tacoma Art Museum Collections: Scott Fife, *LeRoy the Big Pup*, 2004 Picturing America: *Anasazi Cylinder Jars,* c. 1100, Pueblo Bonito, Chaco Canyon *Beacon Lights*, 1904-05, Louisa Keyser *Gullah rice fanner basket,* 1872-1960, Attributed to Caesar Johnson *Diamond in the Square – Sunshine and Shadow Variation Pattern Quilt*, c. 1935, Gift of "The Great Women of Lancaster" *Bars – Wild Goose Chase Pattern Quilt,* c. 1920, Gift of Irene N. Walsh *Lone Star Pattern Quilt,* c. 1920, Gift of Irene N. Walsh **Additional Resources:** *The Making of Japanese Kites: Tradition, Beauty and Creation* by Masaaki Modegi, Japan Publications Trading Co., 2007 www.drachen.org *Kites for Everyone: How to Make and Fly Them* by Margaret Gregor, Dover Books, 2000 Delta Kite Design Formula by Tony Cyphert **Art Materials:** My Kite Journal Pencils Vinyl erasers 1-inch grid paper, 9x12 1-inch grid paper, 15x30 Small and large rulers **Optional:** Protractor Compass Calculator	**Arts State Grade Level Expectations** AEL 1.1 concepts *Geometric shape* *Scale* AEL 1.1.2 composition *Proportion* *Symmetry/balance* *AEL 1.2 skills and techniques: Measuring, drawing, enlarging* AEL 4.2 connections between the arts and other content areas *Explains relationships between the arts and other content areas* **Math State Grade Level Expectations** 7.2.B proportionality and similarity *Solves single- and multi-step problems involving proportional relationships and verifies the solutions* 7.2.C proportionality and similarity *Describes proportional relationships in similar figures and solves problems involving similar figures* 7.2.D proportionality and similarity *Makes scale drawings and solves problems related to scale* 7.2.H proportionality and similarity *Determines whether or not a relationship is proportional and explains reasoning* 7.2.I proportionality and similarity *Solves single- and multi-step problems involving conversions within or between measurement systems and verifies the solutions*

ARTS IMPACT—ARTS-INFUSED INSTITUTE LESSON PLAN (YR2-MAP)

SEVENTH GRADE—LESSON ONE: Kites: Calculations and Designs: Enlarging Scale Part I

ASSESSMENT WORKSHEET

Disciplines	**ART**		**ART AND MATH**		**Total 4 Points**
Concept	**Balance**		**Ratio: Proportion**		
Students	Draws proportional isosceles triangle with line of symmetry	Draws geometric shapes in reflection	Measures using grid, ruler and protractor	Draws full size proportional pattern	
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2.					
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23.					
24.					
25.					
26.					
Total					
Percentage					

Criteria-based Reflection Questions: (Note examples of student reflections.)

Why is it important that the formula stays the same no matter the size of the kite?

Thoughts about Learning: *Which prompts best communicated concepts? Which lesson dynamics helped or hindered learning?*

Lesson Logistics:

Which classroom management techniques supported learning?

Teacher: _____ Date: _____