Celebrating Appalachian Culture

K-12 Mathematics Lessons Set in Context

http://college.wfu.edu/education/wp-content/uploads/ncctm2016.pdf

Mathematics Education
Department of Teacher Education
Wake Forest University

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Appalachian Culture - Patchwork Quilts

Leah McCoy

Quilts are valued throughout Appalachian culture. Culturally and historically, quilts were made by early American women, including Native Americans, slaves escaping through the Underground Railroad, and immigrants from Europe and Asia. Patchwork quilt-making is based on geometric shapes, and a variety of mathematical topics can be experienced in this context.

Grandmother's Flower Garden

K-3 Level - Creating a Bulletin Board Quilt

Introduction – Students will be learn about quilts from a story read by the teacher, and then each student will construct a quilt square which will be combined to create a class quilt on a bulletin board or wall.

NCSCOS (Common Core Standards):

- K.G. Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).
- K.G.6 Compose simple shapes to form larger shapes. For example, “Can you join these two triangles with full sides touching to make a rectangle?”

Objectives:

- SWBAT use a pattern to cut shapes and use them to compose a quilt square.

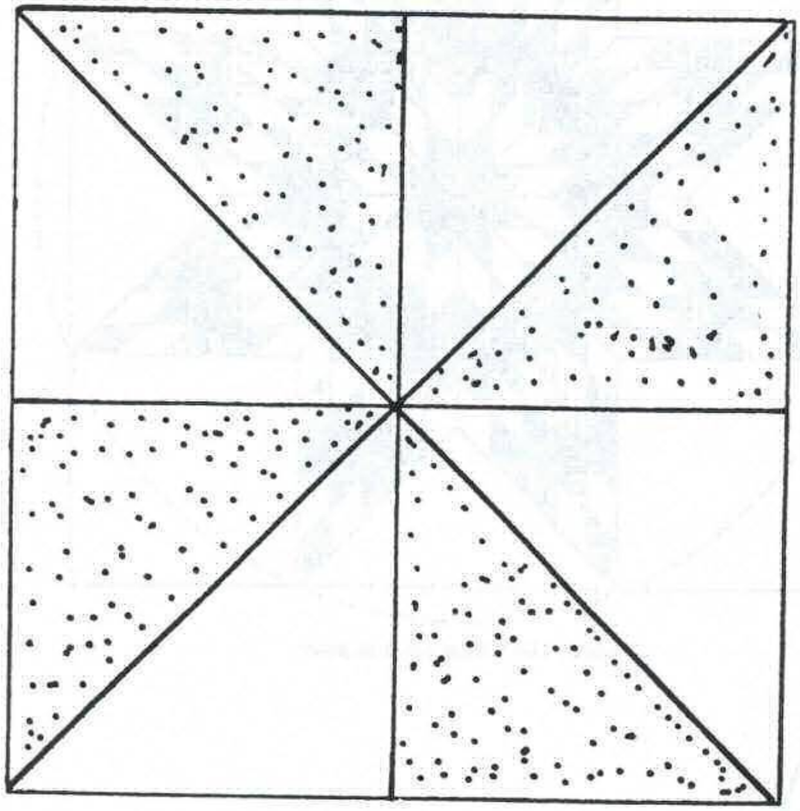
Materials

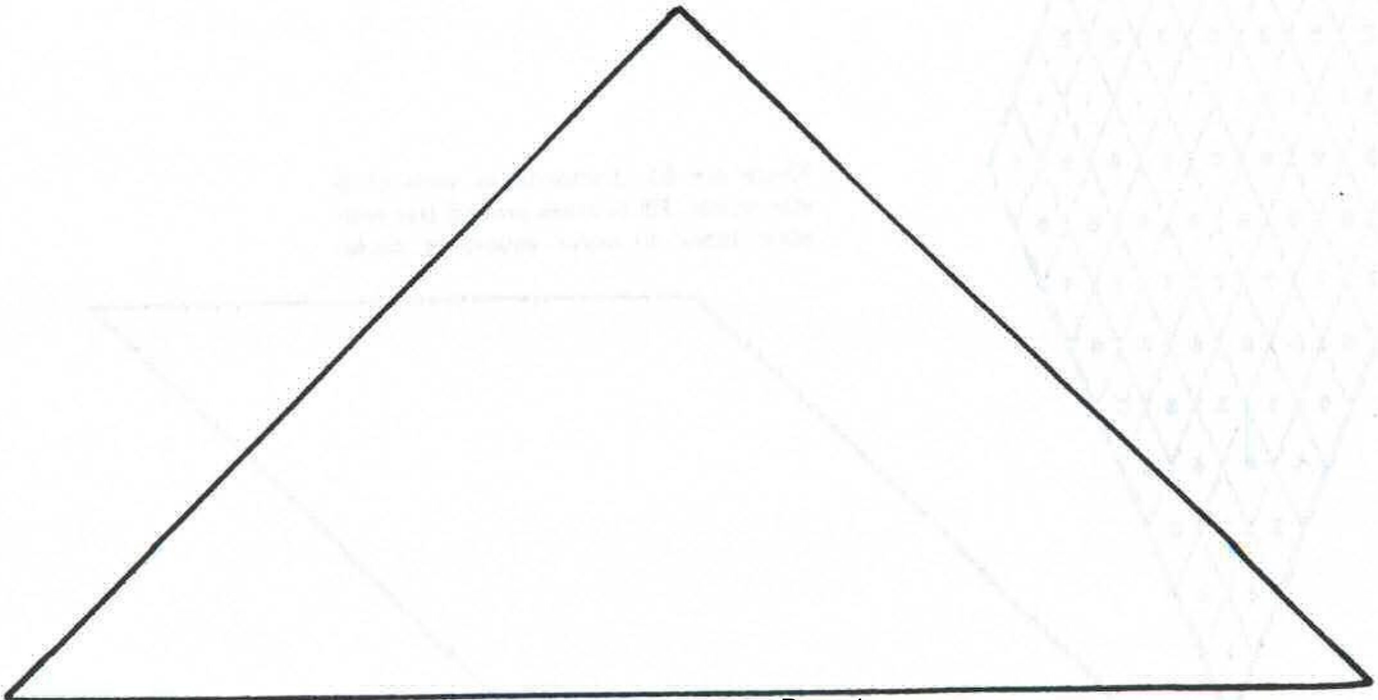
- Pinwheel Quilt Pattern
- Cardboard pattern (see handout) for each student
- Various paper materials, construction paper, wrapping paper, wallpaper samples
- Glue sticks

Learning Activities

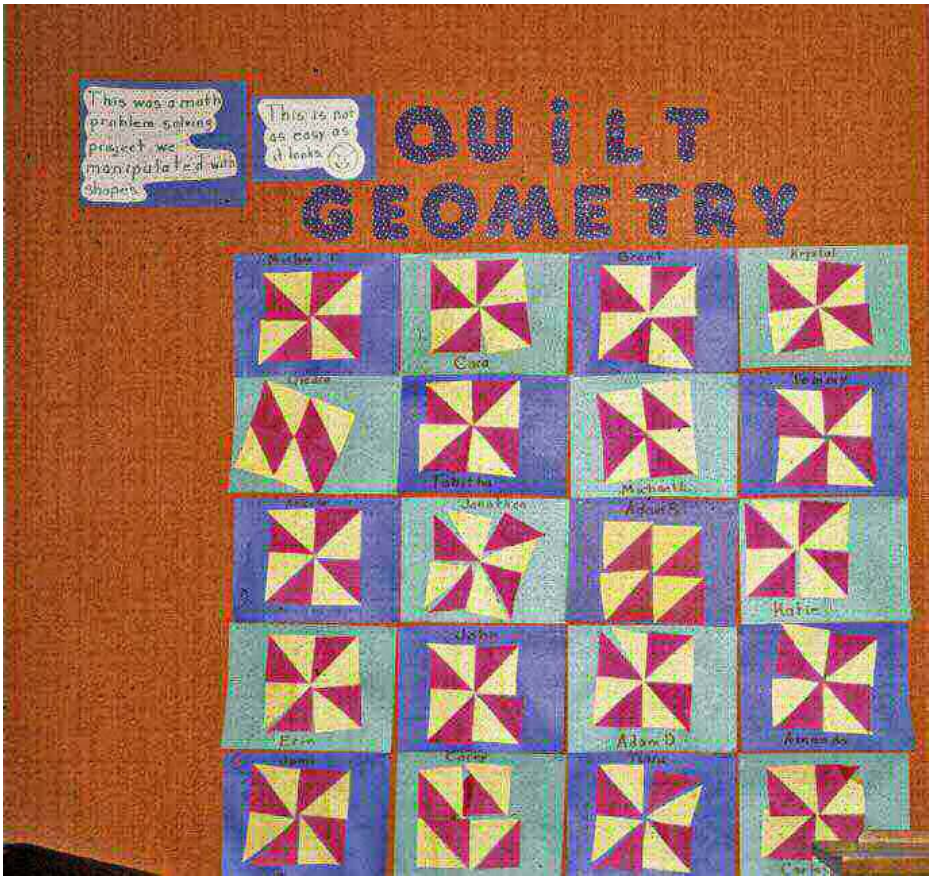
- Quilts will be introduced with the teacher reading *The Patchwork Quilt* or one of the other quilt-related children’s books listed below to the class.
- Triangle shape will be defined and discussed.
- Students will then be given cardboard patterns of large triangles and will trace and cut four triangles in each of two colors or patterns.
- They will then glue their pieces together to form a Pinwheel Quilt Square.
- The teacher will combine the individual squares to make a “class quilt” on a bulletin board or wall.

Pinwheel





Class Project Example



Quilt Related Children's Books

Avery, Kristin. (1994). *The Crazy Quilt*. Glenview, IL: Good Year Books.
Bolton, Jane. (1994). *My Grandmother's Patchwork Quilt*. New York: Delacorte.
Coerr, Eleanor. (1989). *The Josephina Story Quilt*. New York: HarperCollins.
Flournoy, Valerie. (1985). *The Patchwork Quilt.* New York: Scholastic.
Hill, Margaret Bateson. (2001). *Shota and the Star Quilt.* Zero to Ten Books.
Hopkinson, Deborah. (1995). *Sweet Clara and the Freedom Quilt*. New York: Reading Rainbow.
Johnston, Tony. (1985). *The Quilt Story.* New York: Putnam Sons.
Parton, Dolly. (1994). *Coat of Many Colors.* New York: HarperCollins.
Polacco, Patricia. (1988). *The Keeping Quilt*. New York: Simon & Schuster.
Stroud, Bettye. (2007). *The PatchWork Path: A Quilt Map to Freedom.* Somerville, MA: Candlewick.
Vaughan, Marcia. (2002). *The Secret to Freedom.* New York: Lee & Low Books.

Tobin, Jacqueline L. and Raymond G. Dobard. (1999). *Hidden in Plain View: A Secret Story of Quilts and the Underground Railroad*. New York: Doubleday.

4-8 Level - Ratio and Percent of Shapes and Colors on a Quilt Square

Introduction – Students will represent parts of quilt squares as ratio, decimal and percent. This will give them mathematical experience in a geometric real-world context

NCSCOS (Common Core Standards)

- **6.RP.3.c**. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.

Objectives

- SWBAT express the area of parts of a quilt square as fractions, decimals, and percent.

Materials

- Quilt Patterns. Note: The attached patterns are from an old quilt book. The grid is useful and could be added if the chosen pattern does not include it.
- Handout. Analysis Guide.
- Colored markers

Learning Activities

- Student groups will randomly select a quilt pattern.
- They will analyze the pattern to report the fraction, decimal, and percent of different shapes in the pattern.
- Then they will color the pattern and give the same report for different colors in the pattern.
- The group will represent the pattern and the two sets of analysis on a poster or using computer graphics.

Quilt Patterns Online

- Quilt Patterns. http://www.quiltindex.org/lessonplans.php
- History in Quilts. http://edsitement.neh.gov/lesson-plan/history-quilts
- NCTM Unit. Paper Quilts. http://illuminations.nctm.org/Unit.aspx?id=6100
- Lesson Plans from Crayola. http://www.crayola.com/lesson-plans/patchwork-quilt-lesson-plan/
- Block Patterns. http://www.mccallsquilting.com/Block_Reference.html
- Nine-patch patterns. http://quilting.about.com/od/blockofthemonth/tp/Free-Nine-Patch-Quilt-Block-Patterns.htm
- Card Trick Pattern. http://www.mccallsquilting.com/patterns/details.html?idx=7969
- Many patterns. http://quilt.com/

Quilt Square Analysis

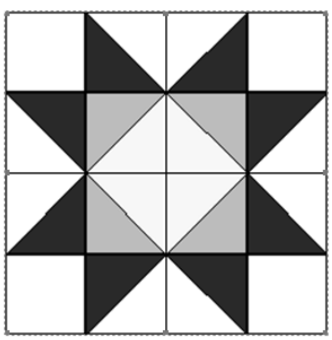
Select a quilt pattern. If your pattern does not have a grid, use a ruler and pencil and draw horizontal and vertical lines to divide the square evenly. Each small square will be a “unit square.”

To analyze by color: If your square does not have color, then use markers to color as you choose. Count total number of unit squares in the block, and then the number of squares of each color. These "counts" are placed in a table, and then written as fraction, decimal and percent of the total square for each color. Your square might have diagonal lines that will create instances where there is ½ square.

To analyze by shape. Identify the different shapes in your square. Count the number of unit squares or fractions of unit squares in each shape. Report in a table.

Your group will report your results in a poster or PowerPoint.

One possible solution:



Wishing Star

COLOR	NUMBER	FRACTION	DECIMAL	PERCENT
Red (dark)	8 x ½ = 4	4/16 = 1/4	.25	25%
Yellow Light)	4 + (12 x ½) = 10	10/16 = 5/8	.625	62.5%
Green (medium)	4 x ½ = 2	2/16 = 1/8	.125	12.5%

SHAPE	NUMBER	FRACTION	DECIMAL	PERCENT
Triangle	12 squares	12/16 = 3/4	.75	75%
Square	4 squares	4/16 = 1/4	.25	25%

The Wishing Star square has sixteen unit squares. The most common color is yellow with 62.5%. Red is 25%, and green is 12.5%. The pattern has 75% triangles and 25% squares.

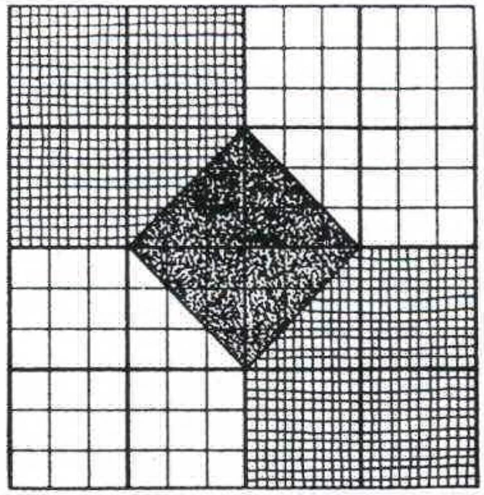
BOW TIE 1

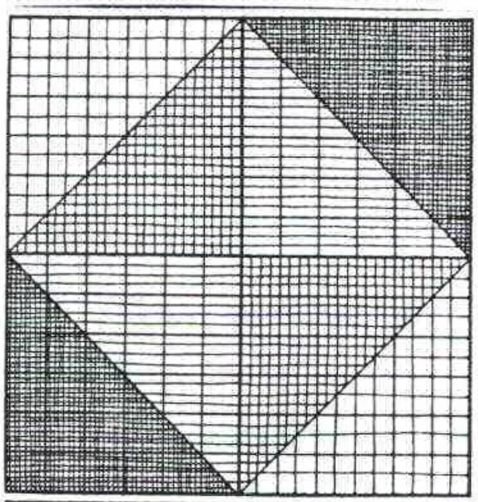
4-patch

dark print or solid (color A)

medium print or solid (color B)

light solid or white





BROKEN DISHES 2

4-patch

dark print (color A)

light print (color A)

medium print (color B)

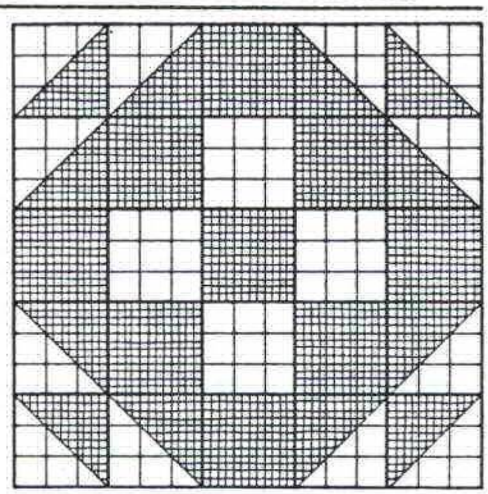
light print (color C)

DUCK AND DUCKLINGS

5-patch

medium print (color A)

light solid or white



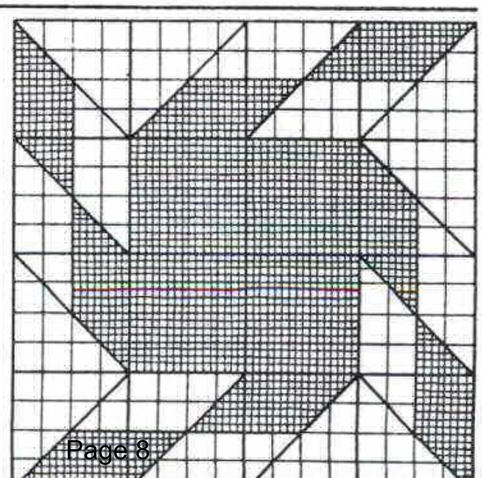
FLYING BATS

the flying bats, bat block

4-patch

dark print (color A)

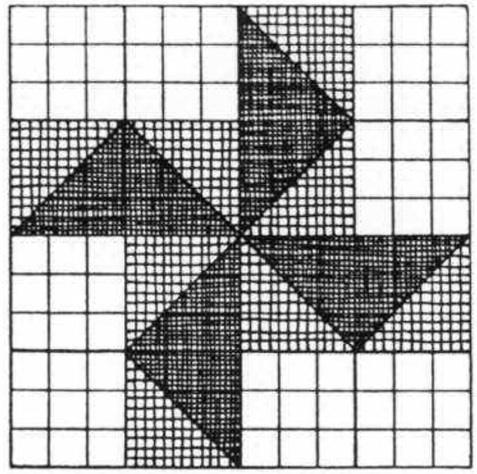
light solid or white



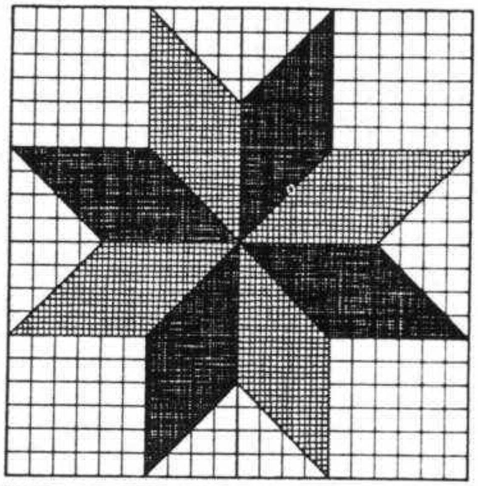
LOUISIANA
Louisiana block, Louisiana patch

4-patch

- dark print (color A)
- medium print (color B)
- light solid or white



EIGHT-POINT STAR 1
8-pointed star



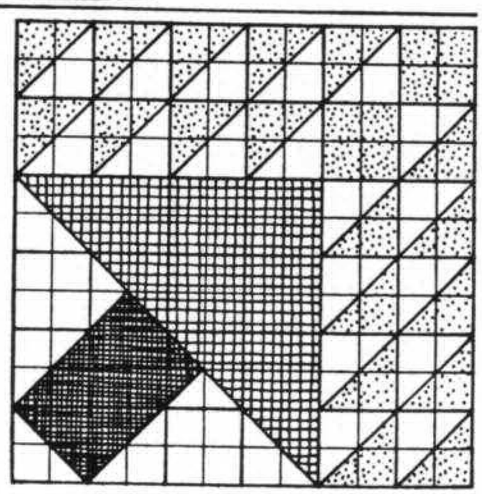
4-patch

- dark print (color A)
- light print (color A)
- light solid or white

PINE TREE 1
pine tree II

9-patch

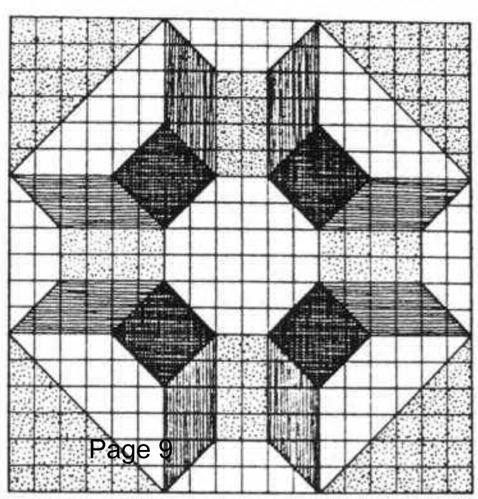
- dark print (color A)
- medium print (color B)
- light print (color B)
- light solid or white

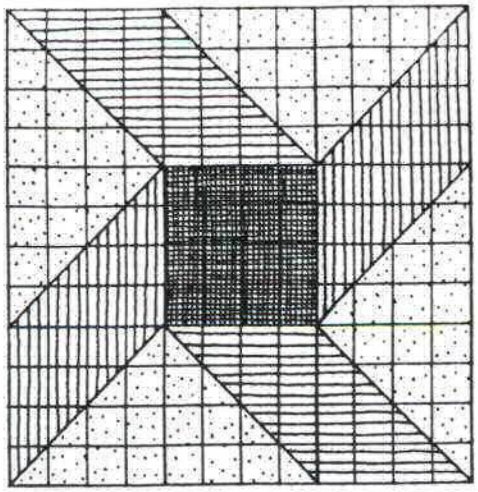


PROSPERITY
empty spools, prosperity block

9-patch

- dark print (color A)
- medium print (color A)
- medium print (color B)
- light solid or white





BOX PATTERN 2
box quilt, formal garden

9-patch

dark print (color A)

medium print (color A or B)

light solid or white

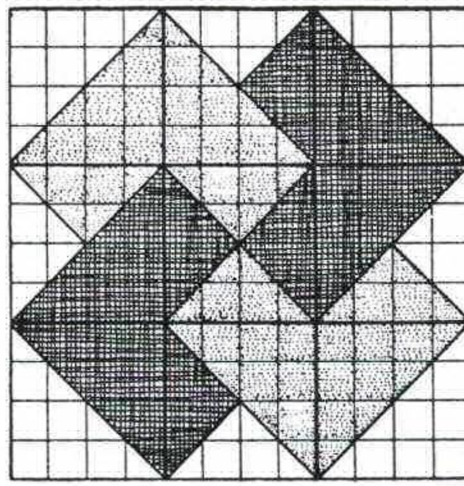
CARD TRICKS
interlaced squares

9-patch

dark print (color A)

medium print (color B)

light solid or white



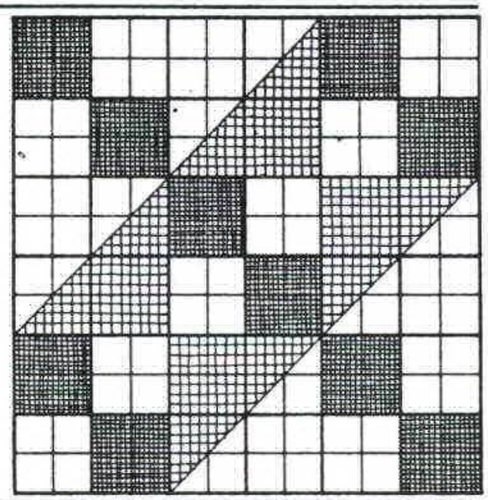
JACOB'S LADDER 1

9-patch

medium print (color A)

dark print (color B)

light solid (color B)



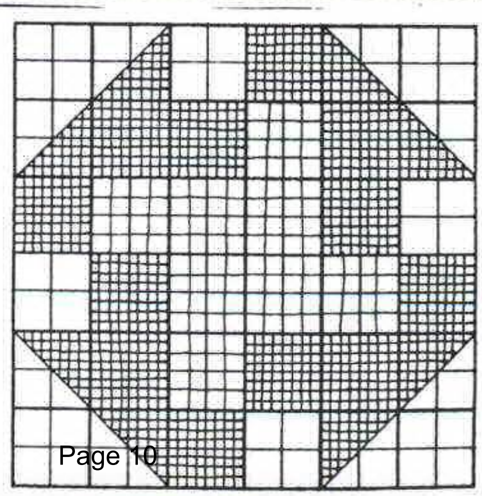
PRAIRIE QUEEN 1
prairie queen

9-patch

dark print (color A)

light print (color A)

light solid or white



9-12 Level – Constructing a Pythagorean Triples Quilt Square

Introduction – Students review the Pythagorean Theorem and Pythagorean Triples. They then construct a paper quilt square from four sets of right triangles.

NCSCOS (Common Core Standards)

- **8.G.7** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
- **NC.M2.G-SRT.8.** Define trigonometric ratios and solve problems involving right triangles. Use trigonometric ratios and the Pythagorean Theorem to solve problems involving right triangles in terms of a context.

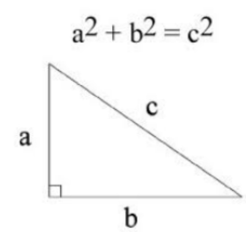
Objectives

- SWBAT use sets of Pythagorean triples (8 each) to tessellate a square in a quilt pattern.

Materials

- Construction paper (various colors, plus white), scissors, glue sticks

Learning Activities



- Review the Pythagorean Theorem. In any right triangle, the sum of the squares of the legs is equal to the square of the hypotenuse: $a^2 + b^2 = c^2$
- A Pythagorean Triple is a set of three nonzero whole numbers, a, b, and c, that are the lengths of the sides of the right triangle.
- Complete the table of four sets of Pythagorean Triples.

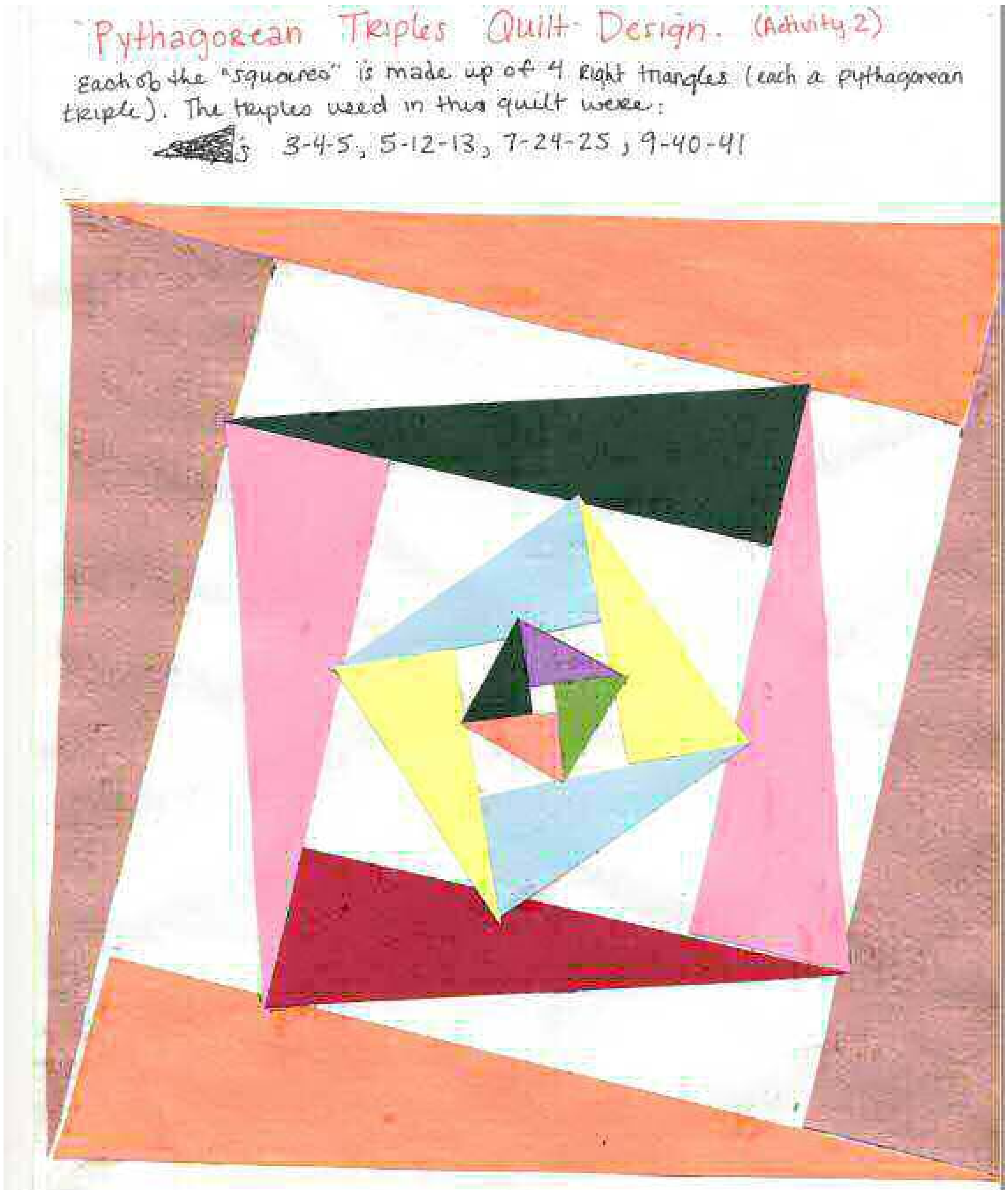
a	b	c
3	4	5
5	12	13
7	24	25
9	40	41

- Using graph paper, construct patterns for each triple. Then cut four colored and four white triangles for each triple.

- Use a large sheet of construction paper for the background. Begin with a 1-in square in the middle of the large square. Arrange the four 3, 4, 5 colored triangles around the center square to form a square (see pattern). Then arrange the four white 3, 4, 5 triangles, matching hypotenuses, to form another square. Repeat with the next set of triples. Each time you add a set of triangles, you should get another square. Continue through the four sets of triples in the table above, with a colored then a white layer.

- Note: A similar pattern is called Spiraling Pythagorean Triples. The spiral is created if when you add the next larger size, you match the right angles of the smaller triangles and the right angles of the larger triangles so that they share a common vertex.

Student Project Example



Appalachian Culture – NASCAR

Chloe Holt

The National Association for Stock Car Auto Racing (NASCAR) is an American franchise that is family-owned and operated. The company was founded in 1948 by Bill France, Sr. NASCAR sanctions over 1,500 races at over 100 tracks in 39 of 50 of the United States as well as in Canada. The Sprint Cup Series, the Xfinity Series, and the Camping World Truck Series are the three largest racing series sanctioned by the company. The official headquarters of NASCAR is in Daytona Beach, Florida, but there are offices in Concord, Conover, and Charlotte, North Carolina as well. NASCAR is second only to the NFL among professional sports in terms of fans and television viewers in the United States. *Fortune 500* companies sponsor NASCAR more than any other motor sport, and as of 2004, seventeen of the Top 20 regularly attended single-day sporting events in the world belonged to NASCAR races.

K-3 Level: Racing on a Number Line

Introduction: In this lesson, we will explore names of numbers and their position on the number line by racing toy cars down a number line and identifying where they stop. Students will explore number names by talking and writing about them.

NCSOS: K.CC Know the number names and the count sequence.

Objectives: Students will be able to identify numbers from a number line.

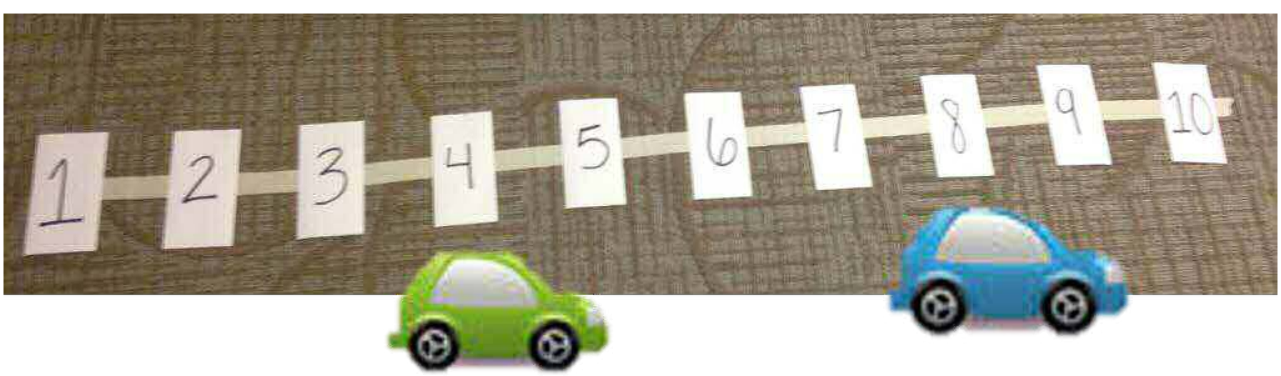
Materials

- Toy car for each child
    - It may be helpful to ask students to bring in toy cars from home if they have them.
- 2 yard sticks per group
- Masking tape
- Numbered index cards

Learning Activities:

1. Students will be divided into small groups with 3 or 4 students per group. Each group will be given multiple toy cars (one for each student), each a different color or type.
2. Create a number line on the floor using masking tape and place yard sticks on each side of the number line to keep the cars from straying off path.
3. One at a time within the groups, students will push a car down the number line starting at one.
4. Students will then identify the number their car reached and write a descriptive sentence (ex: "The blue car stopped at 4.").

Example Number Line



4-8 Level: Measurement Conversion with Racecars

Introduction: In this lesson, students will learn to convert measurements within a given system by measuring the distance different groups can push toy cars in different units and then converting the units to determine which group achieved the farthest distance.

NCSCOS: 5.MD.1. Convert like measurement units within a given measurement system.

1. Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

Objectives: Students will be able to convert units within a given measurement system.

Materials:

- Rulers with centimeter measures
- Decimeter stick (can make using the plain side of a ruler)
- Meter sticks
- Toy car for each group

Learning Activities:

1. Students will be divided into small groups with 3 or 4 students per group.
2. Each group will be given a toy car and a tool for measurement. Some groups should be instructed to measure by meters, some by decimeters, and some by centimeters.
3. Have students conduct a set number of trials to see how far they can get the car to go and report the farthest distance to the class.
4. Once all measurements are displayed for the whole class, have students choose a measurement and convert all data to that measurement in order to see which group's car went the farthest distance.

Measurement Conversion with Racecars

Your group was assigned to use _____________ as units of measure.

Step 1: Push the racecar from a marked starting point.

Step 2: Measure the distance from the starting point to the front of the car where the car stops.

Step 3: Record the distance (including units) on the table below.

Step 4: Repeat Steps 1,2, and 3 four more times.

Trial	**Distance**
1	
2	
3	
4	
5	

Example Tables & Conversions

Group 1	
Trial	**Distance**
1	48 cm
2	52 cm
3	39 cm
4	51 cm
5	46 cm

Group 2	
Trial	**Distance**
1	.6 m
2	.55 m
3	.72 m
4	.45 m
5	.59 m

Group 3	
Trial	**Distance**
1	6.5 dm
2	4.7 dm
3	5.4 dm
4	3.2 dm
5	4.9 dm

Group	Original Distance	Converted Distance
1	52 cm	52 cm
2	.72 m	72 cm
3	6.5 dm	65 cm

9-12 Level: Finding Arc Measures of Race Tracks

Introduction: In this lesson, students will apply the knowledge of finding the arc length of a circle to calculating a portion of famous motor speedways.

NCSOS: NC.M3.G-C.5 Using similarity, demonstrate that that the length of an arc, *s,* for a given central angle is proportional to the radius, *r*, of the circle. Define radian measure of the central angle as the ratio of the length of the arc to the radius of the circle, *s/r*. Find arc lengths and areas of sectors of circles.

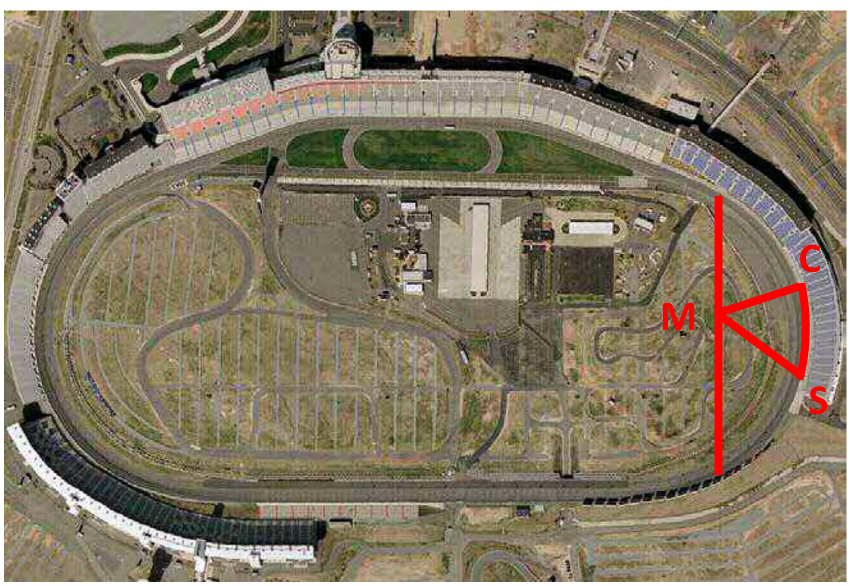
Objectives: Students will be able to find the arc length of a circle when given a radius or diameter and a central angle.

Materials:

- Cards of each race track with pertinent information
- Laptop/computer/iPad for each group

Learning Activities:

1. Students will be divided into small groups, and each group will randomly select a racetrack from a stack of cards.
2. Each group will be given the diameter or radius for a portion of the track as well as the arc length. Their task will be to find the angle.
3. Once the angle is found, each group will make a presentation on why their track would be the most thrilling to race on. Each presentation must cite at least two sources.



Find angle CMS.

Diameter: $\frac{4400}{\pi}$ feet

Arc Length: 550 feet

Charlotte Motor Speedway

Find angle BMS.

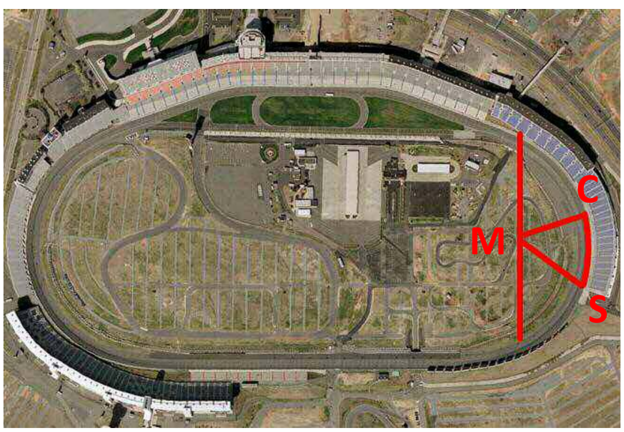
Diameter: $\frac{514}{\pi}$ feet
Arc Length: $\frac{257}{4}$ feet

Bristol Motor Speedway

Find angle TPS.

Diameter: $\frac{2150}{\pi}$ feet
Arc Length: 1075 feet

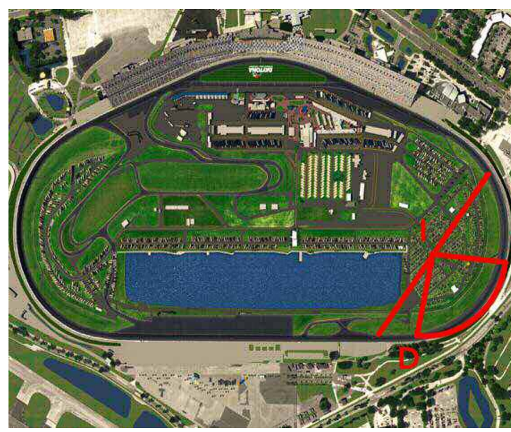
Talladega Super Speedway



Find angle CMS.

Diameter: $\frac{4400}{\pi}$ feet
Arc Length: 550 feet

Charlotte Motor Speedway



Find angle DIS.

Diameter: $\frac{1800}{\pi}$ feet
Arc Length: 600 feet

Daytona International Speedway

Appalachian Culture: Christmas Trees Farms

Meredith Hall

Christmas tree farms are a major part of Appalachian culture, particularly in North Carolina. North Carolina is the state that produces the second-highest amount of Christmas trees each year, next to Oregon (National Christmas Tree Association… 2012). The first record of a Christmas tree on display came from the year 1830, in Pennsylvania where German settlers were dwelling (History of Christmas trees 2016).

K-3 Level: Coloring Sheet on Comparison of Christmas Trees

Introduction: Students will complete a worksheet on Christmas trees where they will use colors to correspond to certain characteristics of Christmas trees such as height, width, and number of branches.

NCSCOS (Common Core Standards): K.MD.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.

K.MD.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference.

1.MD.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object.

Objectives: SWBAT order Christmas trees on a number line according to width, height, and number of branches and use colors to denote attributes of trees.

Materials: student handout, crayons, construction paper, scissors, glue sticks

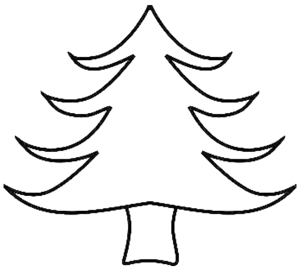
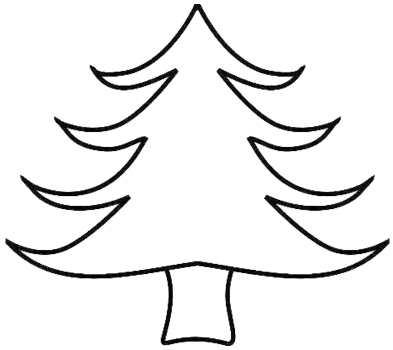
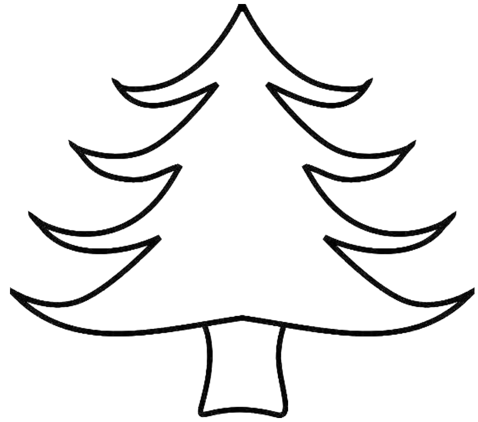
Learning Activities:

Students will complete handout by coloring the Christmas trees the appropriate color.

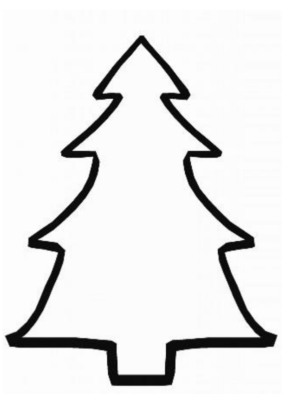
Students will cut out trees and glue them in order on number lines, according to an attribute such as width or height.

Name: ____________________

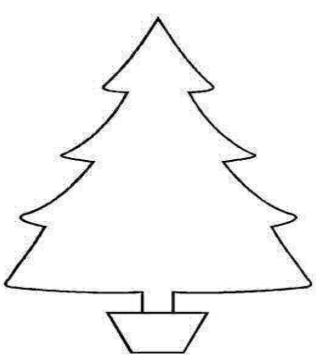
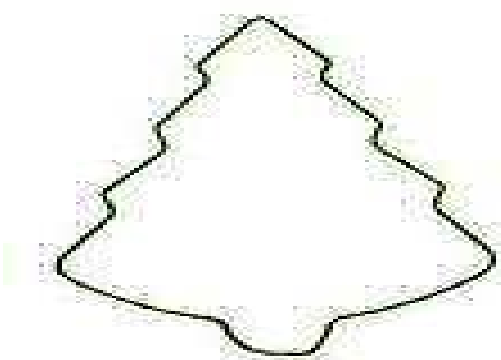
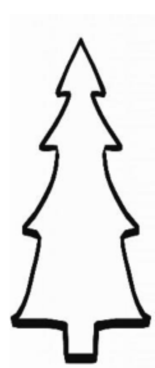
Use BLUE to color the tree that is **tallest**. Use ORANGE to color the tree that is **shortest**.

Use RED to color the tree with the **most branches**. Use PURPLE to color the tree with the **fewest branches**.



Use GREEN to color the tree that is **widest**. Use YELLOW to color the tree that is the **narrowest**.

Color all other trees BROWN.

4-8 Level: Using Linear Relationships to make predictions about Christmas trees

Introduction: In this activity, students will take data relating age of a tree to its height, the height of a tree to its price, and the number of trees sold to the profit made by the farm and plot it on linear models. They will learn to make predictions based on a linear model of the data.

NCSCOS (Common Core Standards):

5.OA.3 Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.

5.G.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.
6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
a. Make tables of equivalent ratios relating quantities with whole- number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
6.EE.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

Objectives: SWBAT graph data points on a coordinate plane, determine the relationship between data, explore linear models and interpret them.

Materials: graph paper (optional), pencil, student handout, computer (or printout of sources for research purposes), colored pencils

Learning Activities:

Students will work in pairs to complete the exploration activity on linear relationships.

They can use computers to research facts about Christmas tree farms to help them decide what kind of tree farm they would have and why.

Optional: Students can prepare a presentation about their chosen species of tree, including pictures and can present in front of the class.

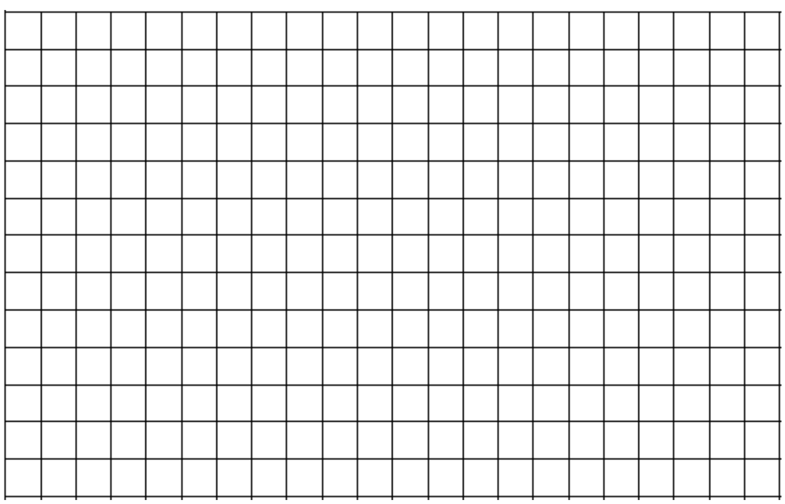
Name: ____________________

Graphing Christmas Tree Data

Several species of evergreen trees are possible Christmas trees. White pines, Basalm firs, and Frasier firs are some of the more common examples. Often, Christmas tree prices vary according to the height. For example, an 8-foot Frasier fir sells for $99, and a 6-foot Frasier fir sells for $59.

1. If this relationship between height and price is constant, how much do you predict a 7-foot Frasier fir will cost? Make a graph of the linear relationship between height of tree and price.

Price of tree ($)



Height of tree (ft)

2. If the Christmas tree farm is actually selling 7-foot Frasier firs for $74, does the buyer get a better deal for buying an 8-foot Frasier fir, or a 7-foot Frasier fir?

Name: ______________________

3. Each type of tree has its own growth rate. Some trees take 11 years to reach mature Christmas tree height, but other types of trees can be harvested earlier than 11 years. Research the growth rate of evergreen trees, and choose three species of trees to graph on the same graph (in 3 different colors). Your x-axis should be age of tree in years, and your y-axis should be height of tree in feet, converting units as needed. Possible sources include http://www.atreetoyourdoor.com/christmas-trees/buy-christmas-tree/index.html or static.**colo**state.edu/client-files/csfs/pdfs/FINAL_**Tree_Growth_Rate**_Study.pdf.

4. The table below gives the price of the tree based on the age of the tree. What is the rule? Can you determine the price of a tree that has aged 12 years, if this pattern continues?

Age of tree	Selling Price
5 years	$34
7 years	$46
9 years	$58
11 years	$70

Rule: ________________________

5. List the pros and cons of growing particular species of trees. Discuss with a partner which type of tree you would put on your own Christmas tree farm if you could and why.

6. If the amount a tree farm makes on each tree sold is $46, and the start-up costs to run a Christmas tree farm total $920, how many trees must the farm sell in order to break even? How much money would the farm make if they planted 600 trees and sold them all?

9-12 Level: Maximizing the Area in a Christmas Tree Farm

Introduction: Students will investigate how to find the maximum area that can be contained within a given perimeter. This can be an exploration activity for students, and in a calculus setting, derivatives can be used to solve the problems more efficiently.

NCSCOS (Common Core Standards):

NC.M3.G-MG.1 Apply geometric concepts in modeling situations Use geometric and algebraic concepts to solve problems in modeling situations: Use geometric shapes, their measures, and their properties, to model real-life objects. Use geometric formulas and algebraic functions to model relationships. Apply concepts of density based on area and volume. Apply geometric concepts to solve design and optimization problems.

Objectives: SWBAT investigate how to maximize area within a given perimeter. If in Calculus, SWBAT use derivatives to solve optimization problems regarding area.

Materials: student handout, pencils

Learning Activities: Students will complete handout with a real-life application. They can work in pairs if necessary.

National Christmas Tree Association News & Media ... (n.d.). Retrieved October 24, 2016, from http://www.realchristmastrees.org/dnn/News-Media/Industry-Statistics

History of Christmas Trees - Christmas - HISTORY.com. (n.d.). Retrieved October 24, 2016, from http://www.history.com/topics/christmas/history-of-christmas-trees

Name: ______________________

Finding the Maximum Amount of Trees Contained within a Fixed Perimeter

1. A Christmas tree farmer has exactly 6,000 feet of fencing to enclose a rectangular plot of land. He plans to plant each tree in a 5 by 5 feet plot to allow for adequate growing conditions. Use the guess and check method to experiment with different dimensions to determine what the largest number of trees he can plant within his 6,000 feet of fencing. (**Hint: Draw pictures if needed**.)

2. Next year, the Christmas tree farmer produces another 6,000 feet of fencing, and he plans to enclose the area directly adjacent to his other plot of land. How many new trees can he plant this year? (**Hint: How many sides of the rectangle does he need?)**

Appalachian Culture – Fall Foliage

An Exploration of Leaves Within the K-12 Mathematics Curriculum

Kyli White

The mountains of Appalachia give rise to magnificent colors of leaves throughout the season of Fall. These leaves are celebrated annually by those who live in and around the Appalachian Mountains. The peak of fall foliage in Appalachia brings families and friends close together. Leaves are plentiful in the fall, and therefore easily obtained for use as manipulatives in the classroom. Fall foliage can function as a versatile theme in the mathematics classroom.

K-3 Level – Leaf Collection Pictograph

Introduction – Students will review the concept of pictographs and construct their own through collected class data about leaves.

NCSCOS (Common Core Standards):

- K-3 Standards:
  - K.MD.B.3: Classify objects into given categories; count the numbers of objects in each category and sort the categories by count.
  - 1.MD.C.4: Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.
  - 2.MD.D.10: Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.
  - 3.MD.B.3: Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.

Objectives:

- SWBAT sort leaves into various categories based on color traits.
- SWBAT organize leaves on a pictograph based on color traits.
- SWBAT draw conclusions from a pictograph about how many leaves they have of each color. Ex: Which color has the most, the least, etc.

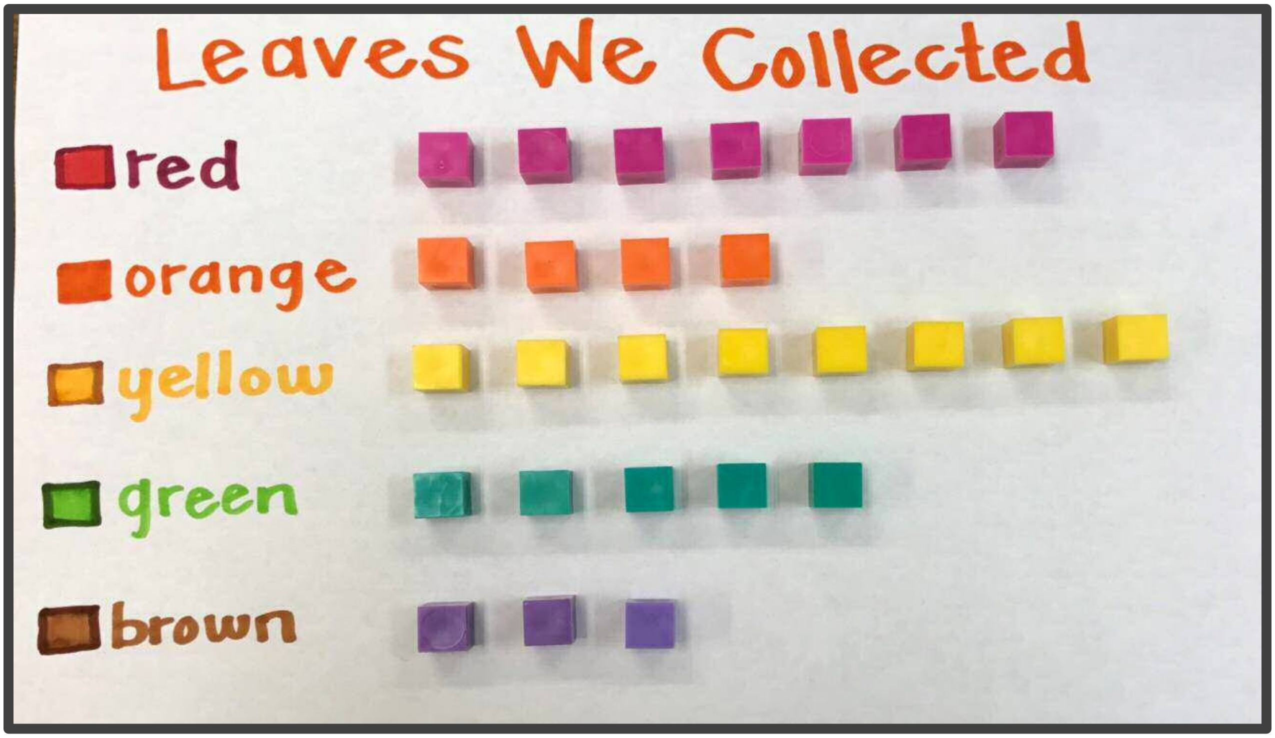
Materials:

- Large piece of paper to create pictograph
- Leaves, collected from outside
- Glue/Tape
- Markers

Learning Activities:

- Allow students to each collect one leaf of their choice from outside.
- Sort leaves into various categories based on color traits.
- Organize leaves on a pictograph based on specified color traits.
- Have students draw conclusions from the pictograph about how many leaves they have of each color. Students should discuss which color has the most, the least, etc.
- Finally, students should talk about which color leaves are their favorite. Collect this information on the board.

- Students should then work individually to create their own pictograph using this new information.


Leaves We Collected
red
orange
yellow
green
brown

4-8 Level – Leaf Transformations and Tessellations

Introduction – Students will review the concept of transformations and identify all three types as they construct their own tessellation.

NCSCOS (Common Core Standards):

- Standards:
  - 7.G.A.1: Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
  - 8.G.A.1: Verify experimentally the properties of rotations, reflections, and translations
  - 8.G.A.2: Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.
  - 8.G.A.3: Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
  - 8.G.A.4: Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.
- If lesson were modified to mainly concern symmetry:
  - 4.G.A.3: Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

Objectives:

- SWBAT describe the effects of translations, reflections, and rotations on two-dimensional figures using coordinates.
- SWBAT create a tessellation and label translations, reflections, and rotations within the pattern.

Materials:

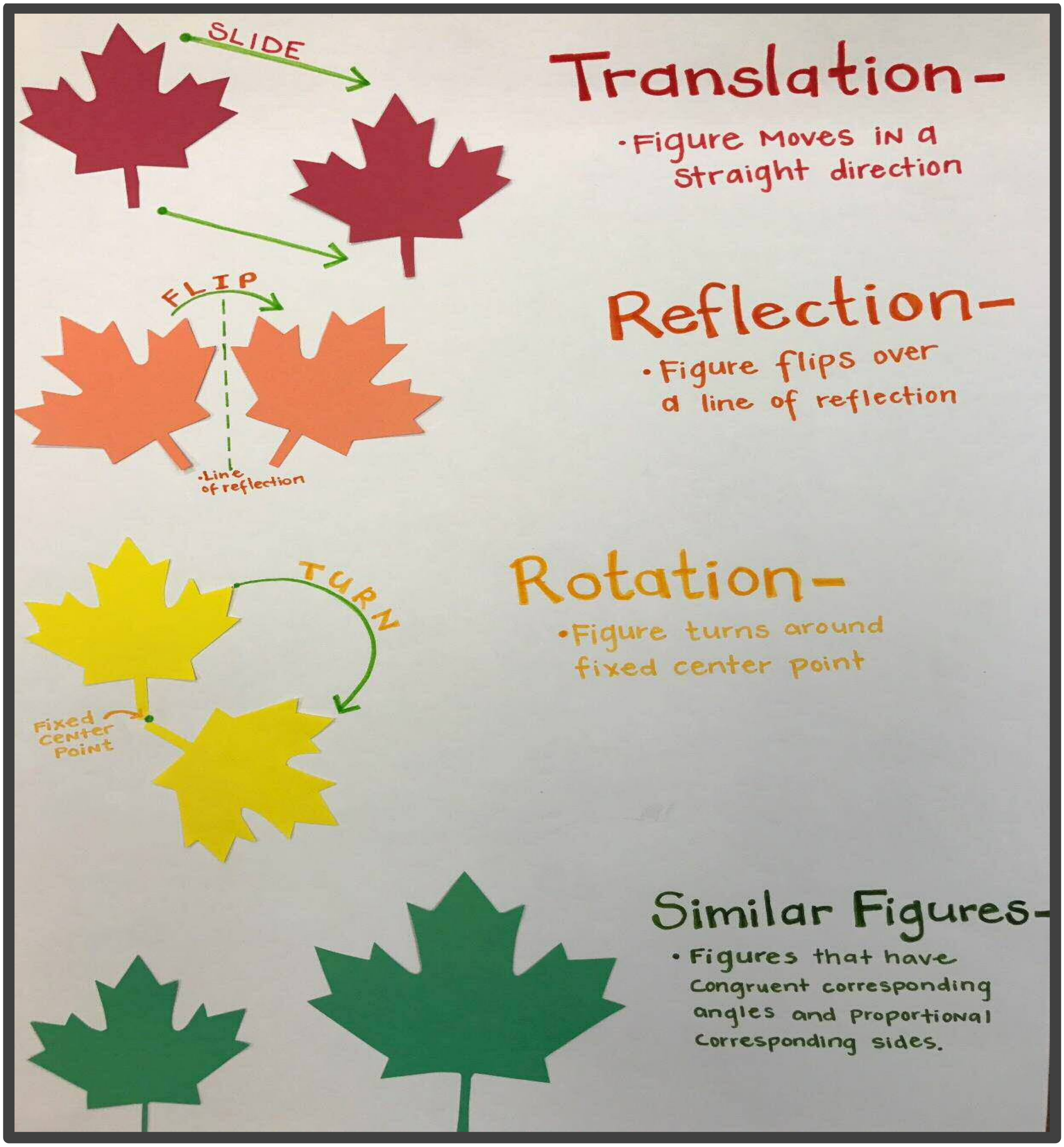
- *Toads and Tessellations* by Sharon Morrisette
- Blank sheet of paper for each student
- Square index card for each student
- Scissors
- Tape
- Markers

Learning Activities:

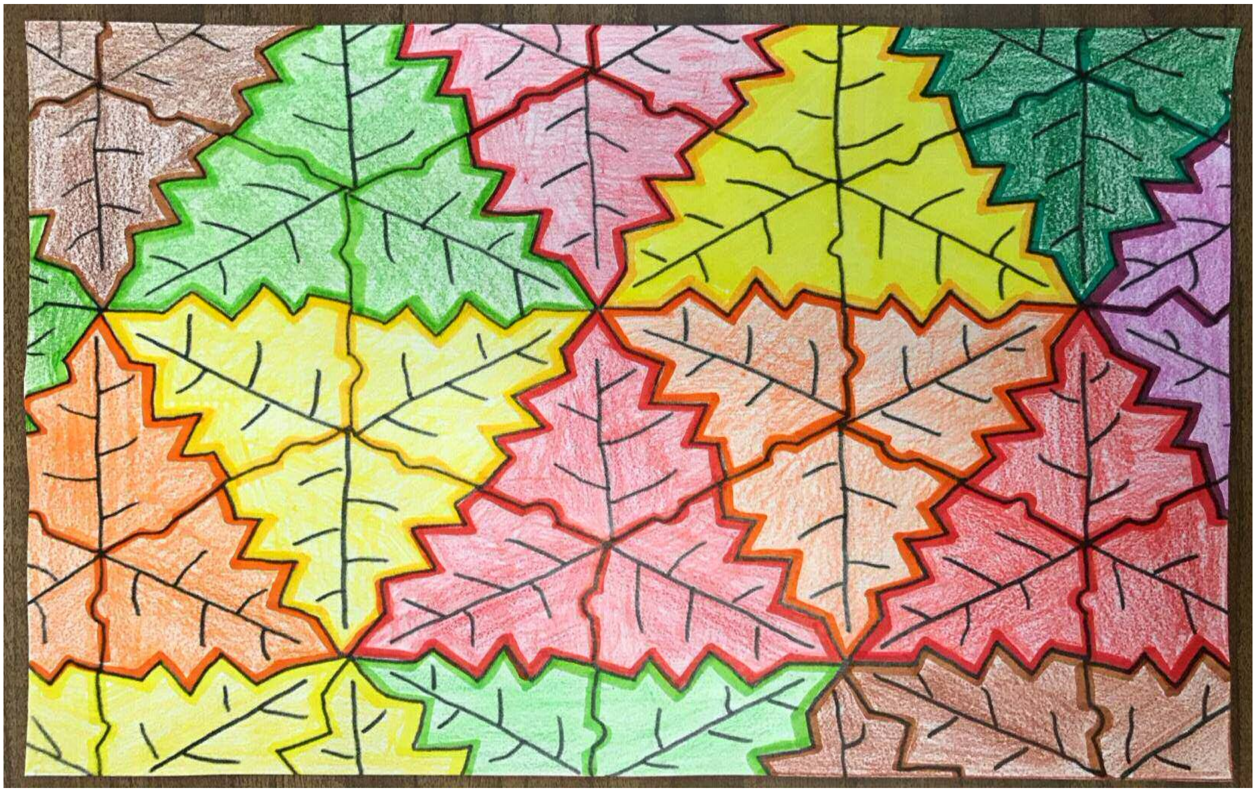
- Read *Toads and Tessellations* by Sharon Morrisette with the class. Discuss ideas.
- Review each of the three transformations of shapes in the coordinate plane.
- Have students create a tessellation from each of the index cards. Find directions for this step from: http://www.exploratorium.edu/geometryplayground/activities.
- On their tessellations, have students color one “base shape” red, one translation blue, one rotation green, and one reflection orange. (They can change up the colors as long as they label which is which).
- Have them find a pattern among their colored shapes in the middle of the tessellation, and color the rest of the paper according to their pattern.

Above Left: Examples of imperfect symmetry in leaves.

Above Right: Fourth-grade work sample from- https://www.pinterest.com/pin/289356344782825310/



Above: Leaves make perfect anchors for the ideas of translations, reflections, and rotations because they have a clear structure that looks identifiably different from every angle. This structure allows the students to see each transformation with clarity.



Above: Possible student-work tessellation retrieved from-
http://almostunschoolers.blogspot.ca/2011/10/fall-leaf-tessellation-coloring-sheet.html

9-12 Level – Leaf Statistics: Fall Foliage Correlations

Introduction – Students will use archival data to create scatter plots and draw conclusions about correlations from the data.

NCSCOS (Common Core Standards):

- 9-12 Standards:
    - HSS.ID.A.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).
    - HSS.ID.B.5: Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
    - HSS.ID.B.6: Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
    - HSS.ID.C.8: Compute (using technology) and interpret the correlation coefficient of a linear fit.
    - HSS.ID.C.9: Compute (using technology) and interpret the correlation coefficient of a linear fit.

Objectives:

- SWBAT use archival data to determine average temperatures, peak foliage, and seasonal rainfall for years 2008-present.
- SWBAT create scatter plots showing the correlations between peak foliage and average temperatures, as well as peak foliage and seasonal rainfall.
- SWBAT draw the line of best fit and calculate the Pearson correlations for each of the scatter plots.
- SWBAT draw conclusions about which factor seems to be a better predictor of foliage peak: temperature or rainfall.

Materials:

- Archival Data from weather-warehouse.com and foliagenetwork.com showing average temperatures, seasonal rainfall, and peak foliage for years 2008-present.
- Graph paper
- Calculator (if desired)

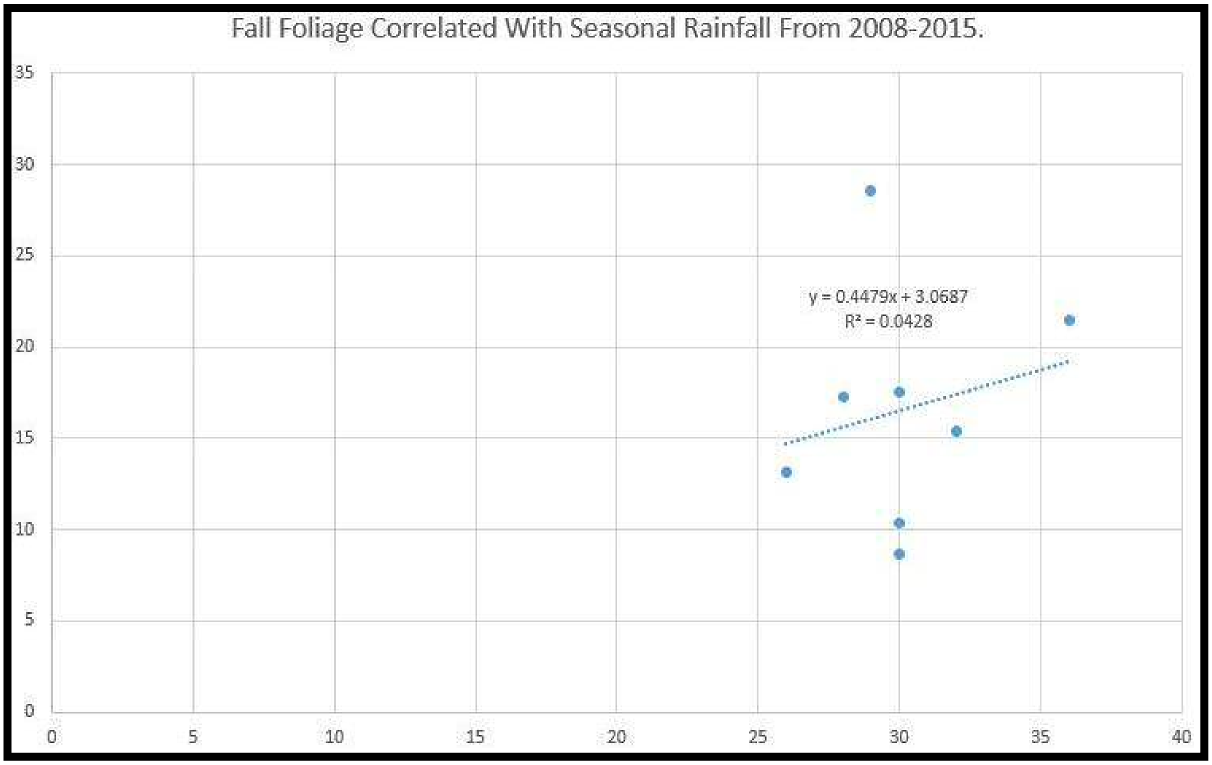
Learning Activities:

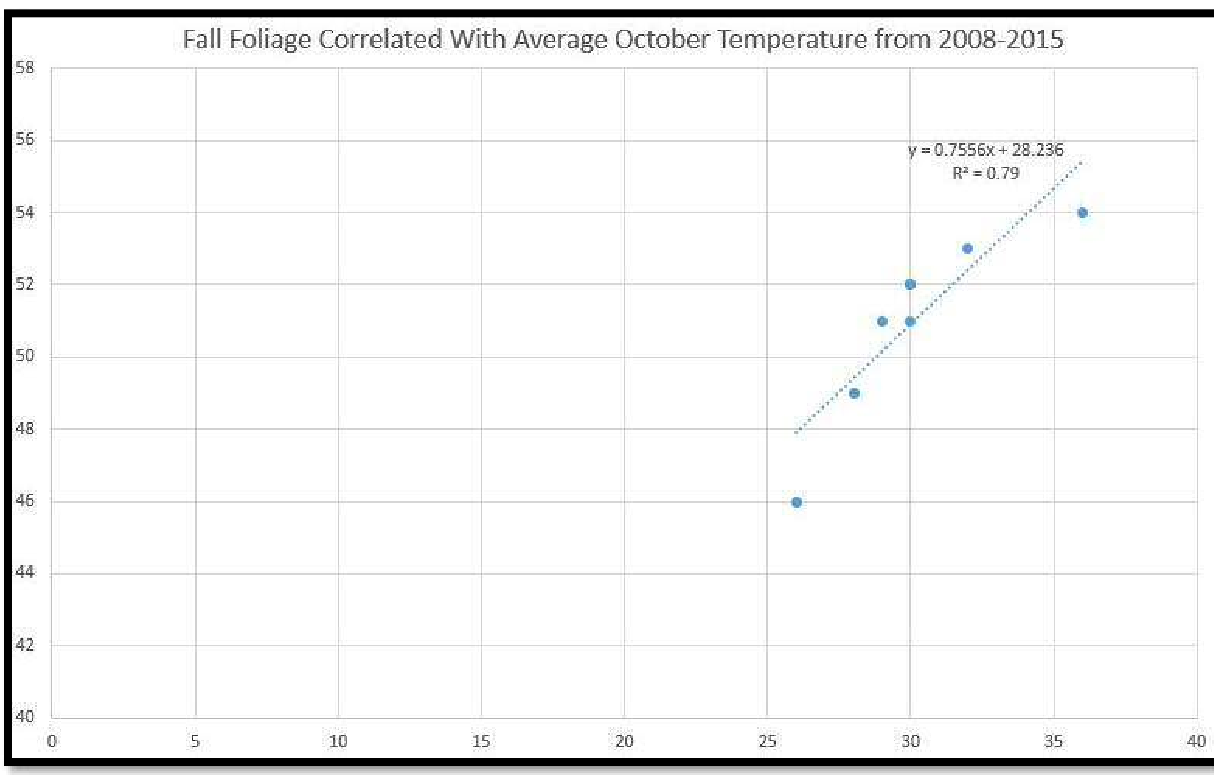
- Allow students to sort through charts of archival data to determine average temperatures, peak foliage, and seasonal rainfall for years 2008-present.
- Partner students together to create two scatter plots showing the correlations between peak foliage and average temperatures, as well as peak foliage and seasonal rainfall.

- Students should then draw the line of best fit and calculate the Pearson correlations for each of the scatter plots. This can be done either manually or digitally.
- Have partners draw conclusions about which factor seems to be a better predictor of foliage peak: temperature or rainfall, and argue their reasoning to the class.
- Discuss with the whole class when they think that the leaves will peak this year and why.

Year	How Many Days After September 30th Until Peak Foliage? (1= Oct. 1, 36= Nov.4)	Average October Temperature in Degrees Fahrenheit	Ave. Seasonal Rainfall in Inches (from Aug. 1st - Oct. 31st)
2008	32	53	15.40
2009	36	54	21.49
2010	30	52	10.33
2011	28	49	17.29
2012	26	46	13.18
2013	30	51	8.640
2014	30	52	17.56
2015	29	51	28.61

Above: Archival data collected from weather-warehouse.com and foliagenetwork.com showing average temperatures, seasonal rainfall, and peak foliage for years 2008-present. Students should compile a similar chart from data archives.


Fall Foliage Correlated With Seasonal Rainfall From 2008-2015.
y = 0.4479x + 3.0687
R² = 0.0428
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
35
40


Fall Foliage Correlated With Average October Temperature from 2008-2015
y = 0.7556x + 28.236
R² = 0.79
58
56
54
52
50
48
46
44
42
40
0
5
10
15
20
25
30
35
40