Access to HS Analytic Geometry Math Module

IDEAS Conference

June 4, 2014

Kayse Harshaw

Special Education Services and Supports

Georgia Department of Education

- **The definitions referenced are for teacher reference only and are not to be memorized by the students.** Students should explore these concepts using models and real life examples. Students should understand the concepts involved and be able to recognize and/or demonstrate them with words, models, pictures, or numbers.

What's the Big Idea in Gen Ed

- Understand congruence in terms of rigid motions.
- Understand similarity in terms of similarity transformations.
- Prove theorems involving similarity.
- Prove geometric theorems.
- Make geometric constructions.

MCC9-12.G.CO.6

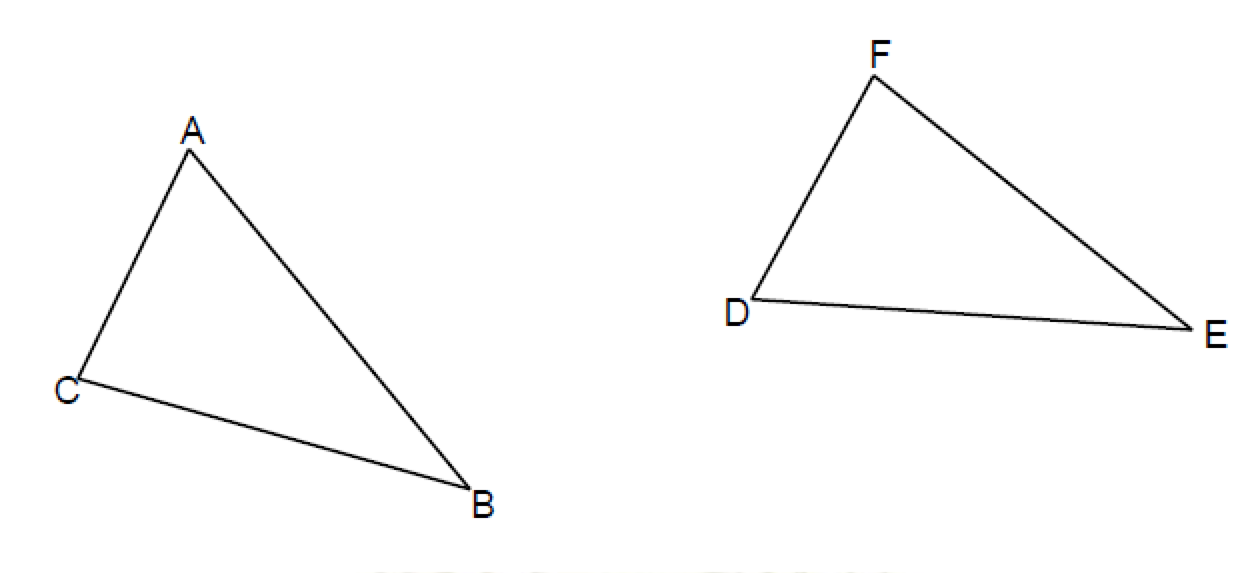
- **Understand congruence in terms of rigid motions**
- **MCC9-12.G.CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.**

What's the Big Idea?

- **Given two figures, how can you move them to determine if they are the same?**
- **Congruent** figures have the same size, shape, and measure.
  - Figures are congruent if all their measures are the same—e.g. angles, sides, etc.
- **Rigid motion** is the action of taking a figure and moving it to a different location without altering its shape or size.
  - Reflection "Flip"
  - Rotation "Turn"
  - Translation "Slide" or "Shift"

Grade Level Example

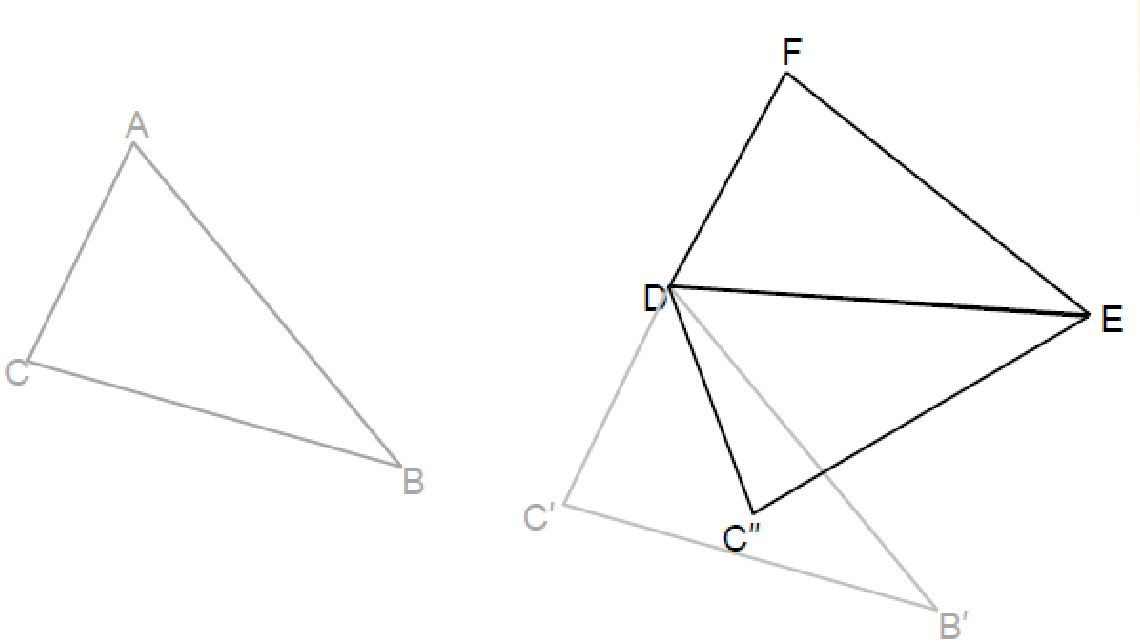
$\overline{AB} \cong \overline{DE}, \overline{AC} \cong \overline{DF}, \overline{BC} \cong \overline{EF}$. Show △ABC ≅ △DEF



Adapted from *Illustrative Mathematics* G.CO.8 Why does SSS Work?

Grade Level Example

$\overline{AB} \cong \overline{DE}, \overline{AC} \cong \overline{DF}, \overline{BC} \cong \overline{EF}$. Show $\triangle$ABC $\cong$ $\triangle$DEF



Shows a translation, rotation, and reflection, to demonstrate congruence of $\triangle$ABC to $\triangle$DEF

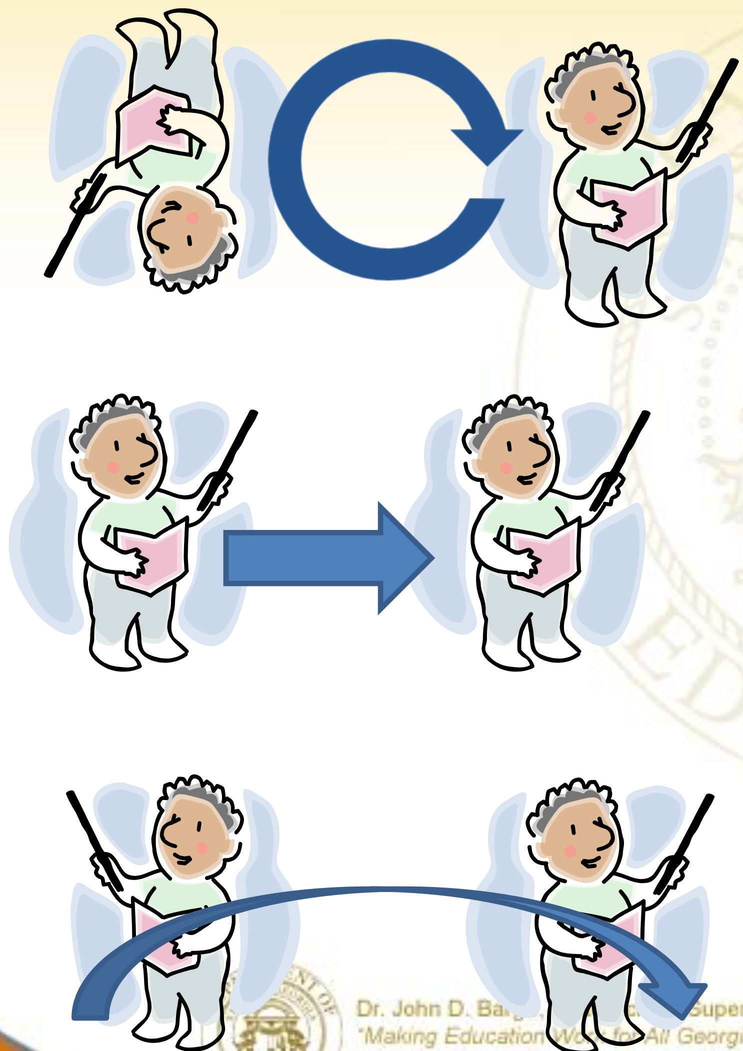
Adapted from *Illustrative Mathematics* G.CO.8 Why does SSS Work?

MCC9-12.G.CO.6
Unpacking the Standards

- Use geometric descriptions of rigid motions to transform figures
- Use geometric descriptions of rigid motions to predict the effect of a given rigid motion on a given figure
- Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent

Access examples

Use geometric descriptions of rigid motions to transform figures



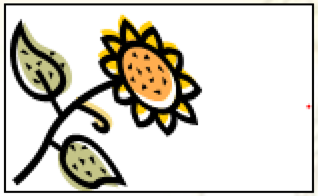
Look at the picture. What do we need to do to the first man to match the second man?

Student can communicate and/or demonstrate the needed rigid motion to match one figure on top of the other (make the shape congruent to the other) by doing a

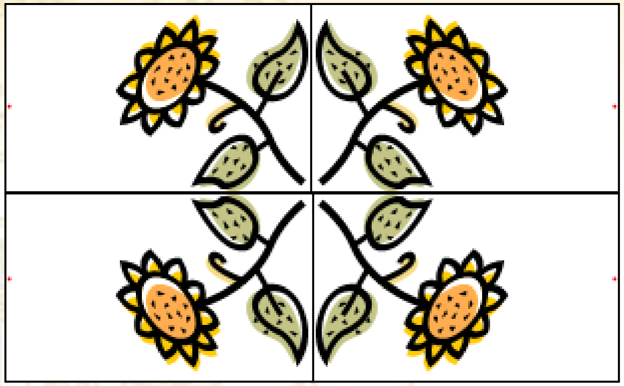
1. “Turn”(rotation)
2. “Slide” (translation),
3. “Flip” (reflection) (with the reverse printed on the back)

(Note that the figure rotated is a two dimensional figure, not a 3-D object.) 3-D objects do not align to the standard.

Access Example



1 2



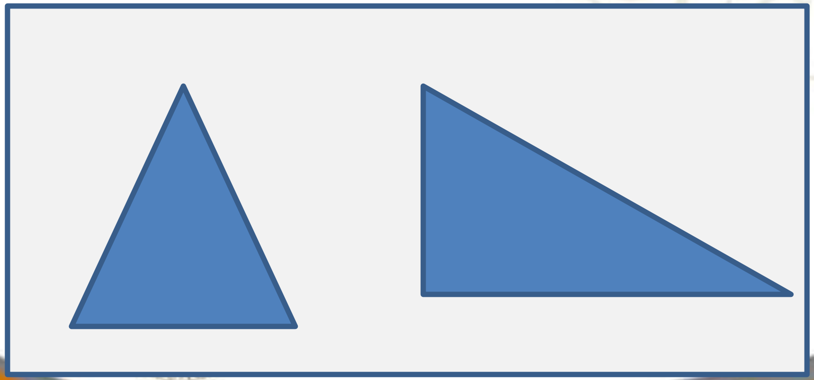
3 4

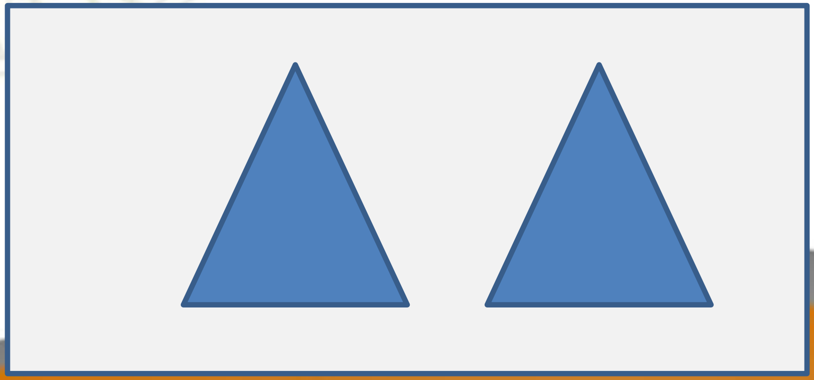
What transformations are needed to use the shape above to create the design of four flowers?

1:Flip, 2:Slide, 3:Rotate, 4: Flip

Access Example

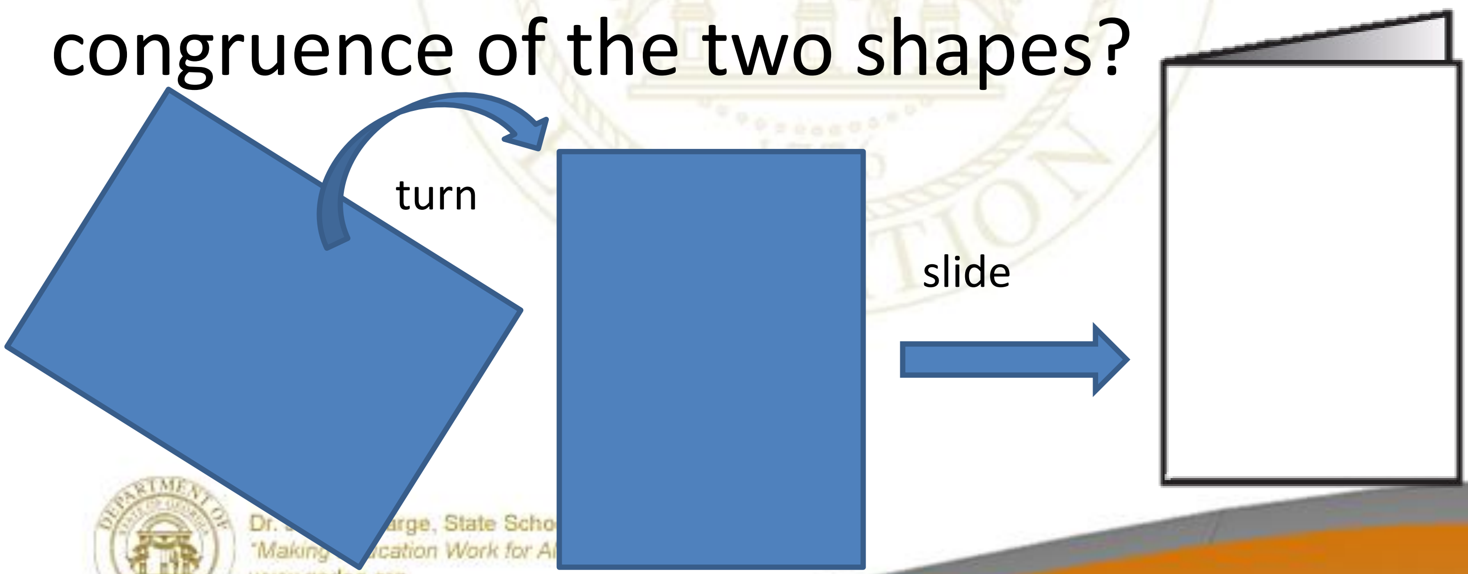
- Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
  - Give student figures to match using the rigid motions.
  - Are they the same? Student communicates “Yes” or “No”





Access Instructional Activity

- Creating greeting cards—placing shapes onto front of card of matching shape and size: Turn, then slide.
- What transformations to you do to show congruence of the two shapes?



Access Example

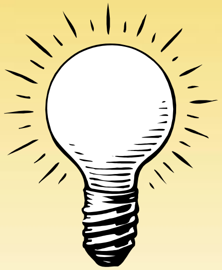
- What do I do to make the shape fit?
  - Rotate, Flip, and/or Slide?

Rotate,
then slide

MCC9-12.G.CO.7

- **MCC9-12.G.CO.7** Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

What's the Big Idea?



- Two triangles are said to be congruent if one can be exactly superimposed on the other by a rigid motion.
- In a pair of congruent triangles, corresponding sides are congruent and corresponding angles are congruent
- *In other words matching angles and sides.*

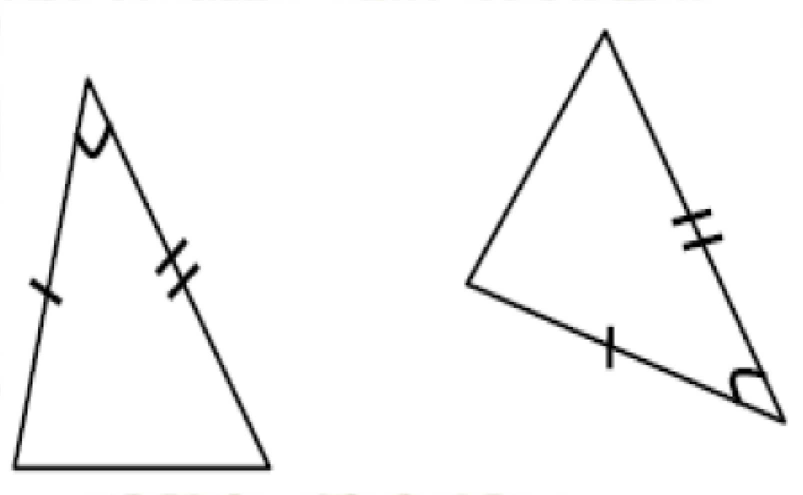
Grade Level Example

- Students identify corresponding sides and corresponding angles of congruent triangles.
- Explain that in a pair of congruent triangles, corresponding sides are congruent and corresponding angles are congruent.
- Demonstrate that when distance is preserved (corresponding sides are congruent) and angle measure is preserved (corresponding angles are congruent) the triangles must also be congruent.

Adapted from *Illustrative Mathematics* G.CO.8 Why does SSS Work?

Grade Level Example

- Are the following triangles congruent? Explain how you know.



MCC9-12.G.CO.7
Unpacking the Standards

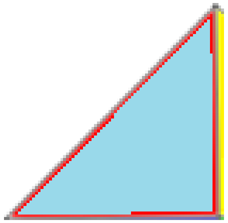
- Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

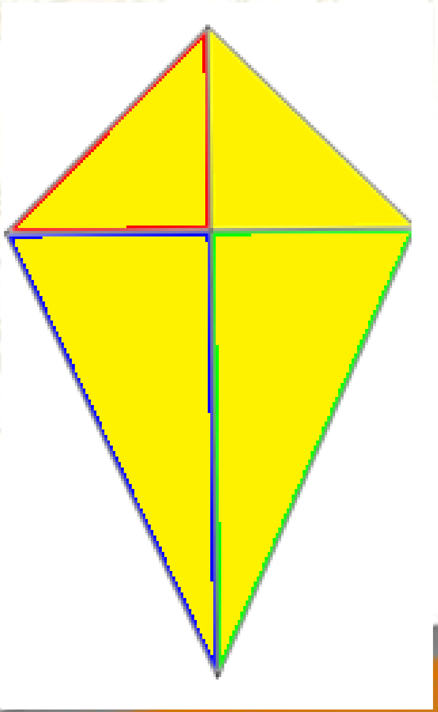
Access Examples

- Identify corresponding congruent parts of two triangles.
- Match triangles by matching congruent sides and angles.
- Choose matching triangle from a choice of two or more, and only one has corresponding sides and angles.

Access Example

- In making a kite, which triangles on the kite will match this triangle? Student must match the correct sides and angles.





MCC9-12.G.CO.12

- **MCC9-12.G.CO.12** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
- Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

What is the Big Idea?

- This is geometric construction through copying or folding—this is not a measurement activity!
- Use a straight edge and compass or string

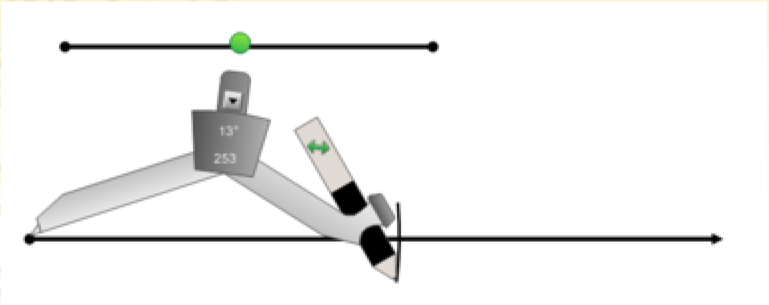
Geometry in Ancient Greece

- Everyone who learned geometry was challenged to construct geometric objects using two simple tools, known as Euclidean tools:

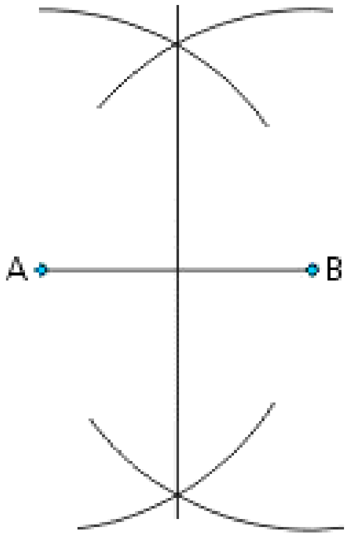
- A straight edge without any markings
- A compass
  - The straight edge could be used to construct lines, the compass to construct circles. As geometry grew in popularity, math students and mathematicians would challenge each other to create constructions using only these two tools.

Grade Level Examples

- Copy a line segment using a compass and straight edge

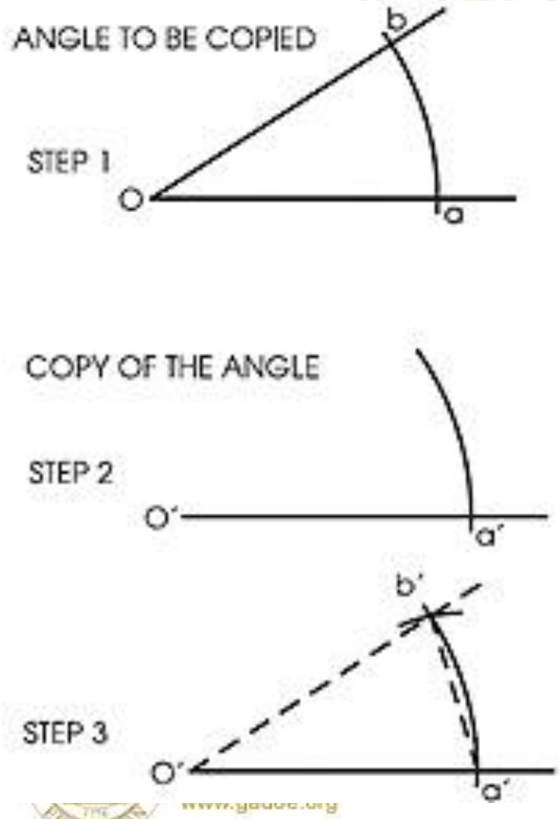


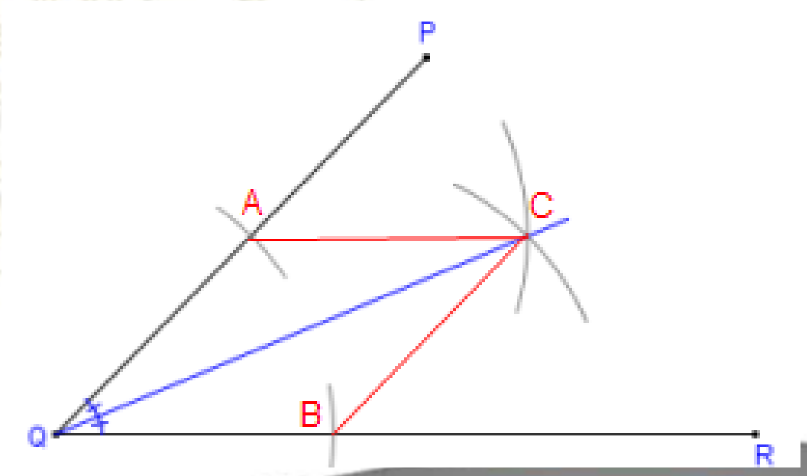
- Bisect a segment and draw line
- perpendicular to a segment



Grade Level Examples

- Copying an angle using compass to draw arcs
- Bisecting an angle using compass and straight edge to connect points





Grade Level Examples

- Construct a line parallel to a given line through a point not on the line—
  - How could you do it?

MCC9-12.G.CO.12
Unpacking the Standards

- Make formal geometric construction *with a variety of tools and methods* (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
- Copy a segment with a variety of tools and methods.
- Copy an angle with a variety of tools and methods.
- Bisect a segment with a variety of tools and methods.
- Bisect an angle with a variety of tools and methods.
- Construct perpendicular lines with a variety of tools and methods.
- Construct the perpendicular bisector of a line segment with a variety of tools and methods.
- Construct a line parallel to a given line through a point not on the line

Activities at an Access Level

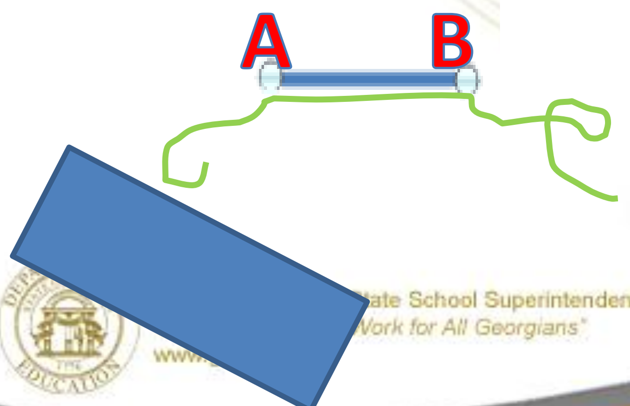
- Copy a segment with a variety of tools and methods.

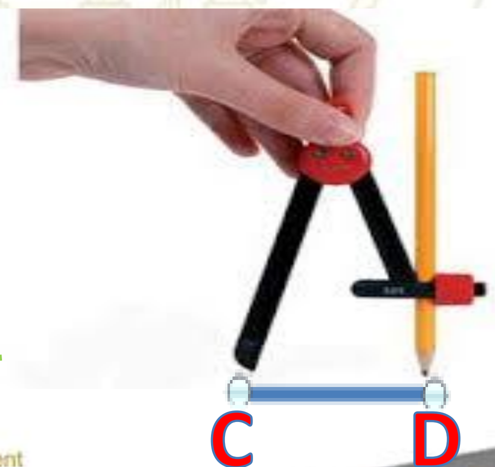
  A line can be copied by with a straight edge, but we would need to determine the length of the points of the segment with a string or compass.
- Bisect a segment with a variety of tools and methods.
  - Fold the paper in half, fold the string in half to find the center point
- Bisect an angle with a variety of tools and methods.
  - Fold the paper constructing perpendicular lines,
- Construct the perpendicular bisector of a line segment with a variety of tools and methods.
  - Fold a piece of paper, keeping the edges and corners straight. The fold is the perpendicular line.
  - Use a right angle template to draw the perpendicular line after the center of the line is located (by folding)

Activities at an Access Level

- Copy a segment with a variety of tools and methods.

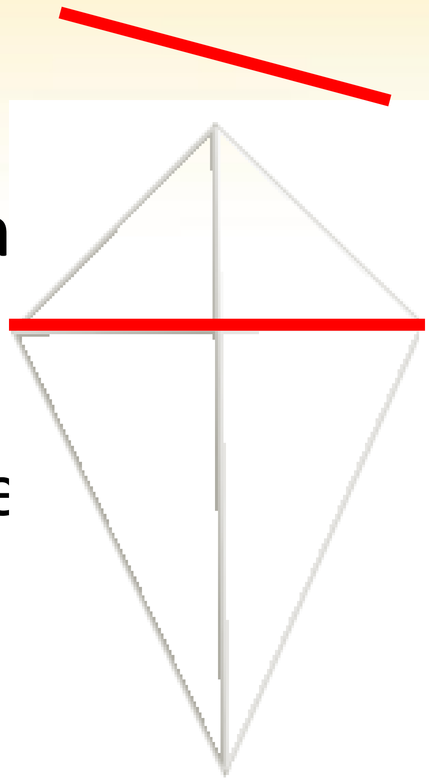
  A line can be copied by with a straight edge, but we would need to determine the length of the points of the segment with a string or compass.





Activities at an Access Level

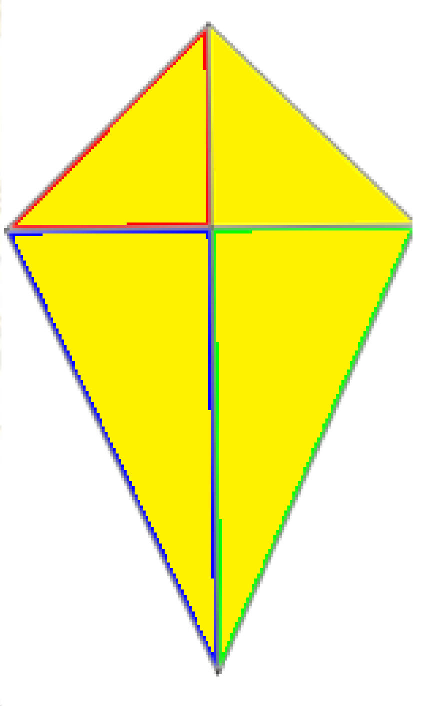
- Let's Make a kite!
- Start with the cross piece of the kite: Give the students a segment the length of the cross piece. Have the students copy the length with the straight edge and a string or compass to measure the length.
- Prerequisite level: Students match lengths to sample to determine matching length.



Access Example

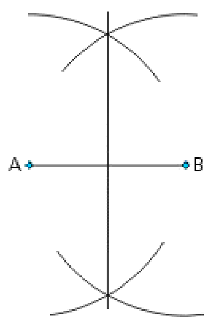
- In making a kite, How can we “bisect” the line we drew earlier to make a perpencular line?
- Or, how can we bisect the angles on the kite to construct the two

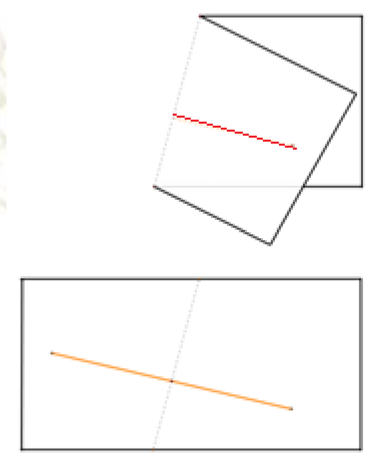
  equal angles?



Activities at an Access Level

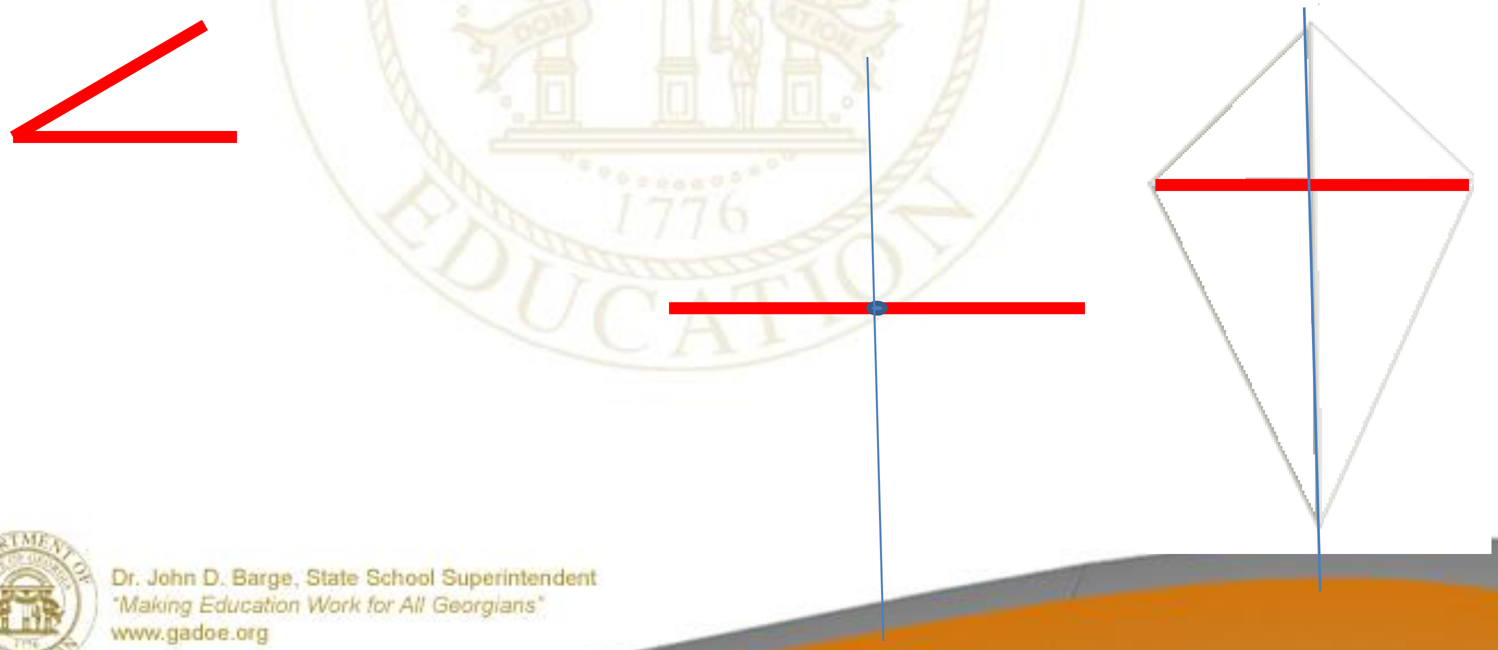
- Bisect a segment with a variety of tools and methods.
  - Grade level students use compass & straight edge
  - Access level: Fold the paper in half, or fold the string in half to find the center point





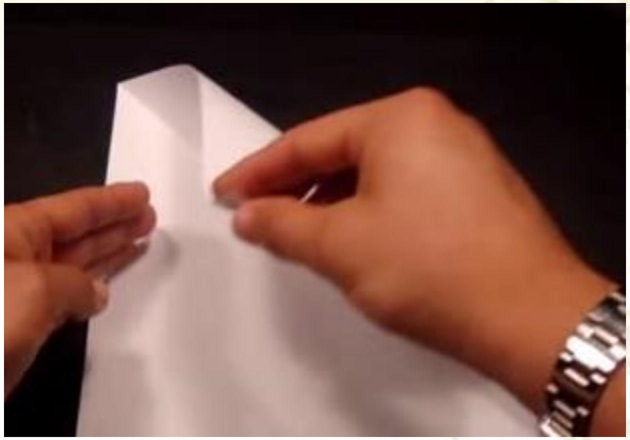
Access Activity

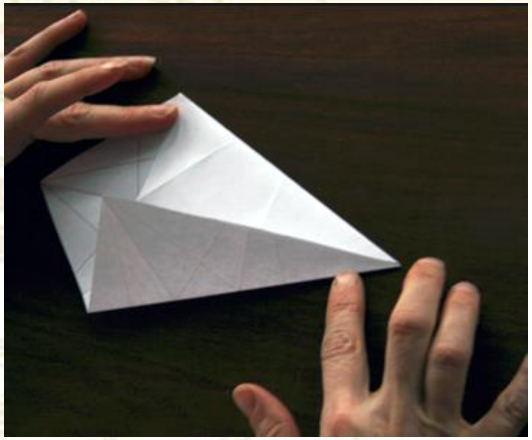
- Bisect the segment
  - Student folds paper or string in half and designate the center of the segment by a crease or a point



Tasks at an Access Level

- Bisect an angle with a variety of tools and methods.



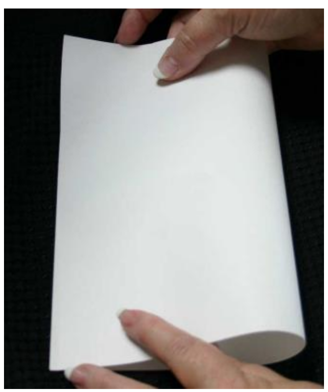


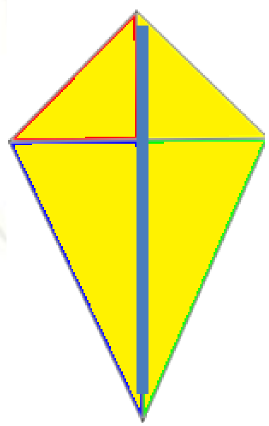
  - Real life activities: Origami, greeting cards, kites

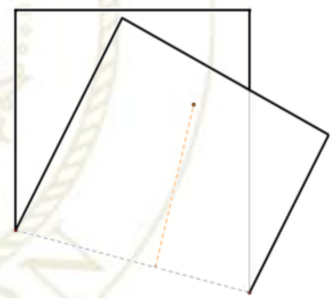
Tasks at an Access Level

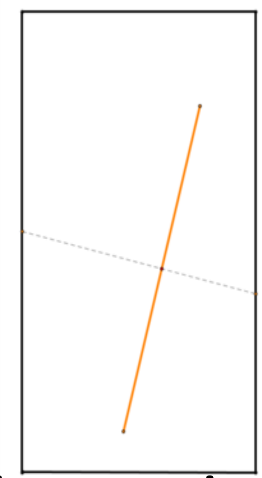
- Bisect an angle with a variety of tools and methods.

Constructing perpendicular lines, including the perpendicular bisector of a line segment









- Application in real life activities: Origami, greeting cards, kites

MCC9-12.G.SRT.1

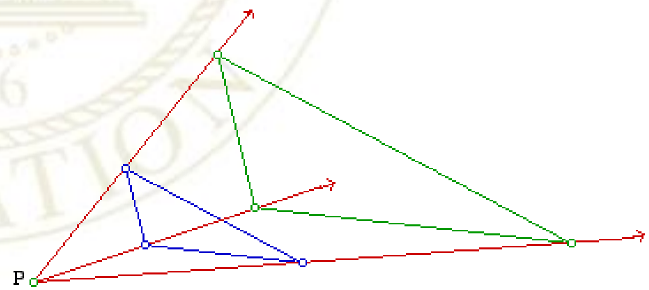
- **Understand similarity in terms of similarity transformations**
- **MCC9-12.G.SRT.1** Verify experimentally the properties of dilations given by a center and a scale factor:
- a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.

What's the Big Idea?

- Students should understand that a dilation (enlargement) is a transformation that moves each point along the ray through the point starting from a fixed center.
  - When a side of the figure passes through the center point of dilation, the side and its dilated(enlarged) image stay on the same line. The corresponding sides of the original image and dilated images are parallel.

Grade Level Example

- Perform a dilation with a given center and scale factor on a figure in the coordinate plane. Verify that when a side passes through the center of dilation, the side and its image lie on the same line. Verify that corresponding sides of the preimage and images are parallel.
  - Draw a dilated figure using a center of dilation and scale factor.



  - P is the center and the
  - green triangle is 2 times the size of the blue triangle.

MCC9-12.G.SRT.1
Unpacking the Standards

MCC9-12.G.SRT.1 a.

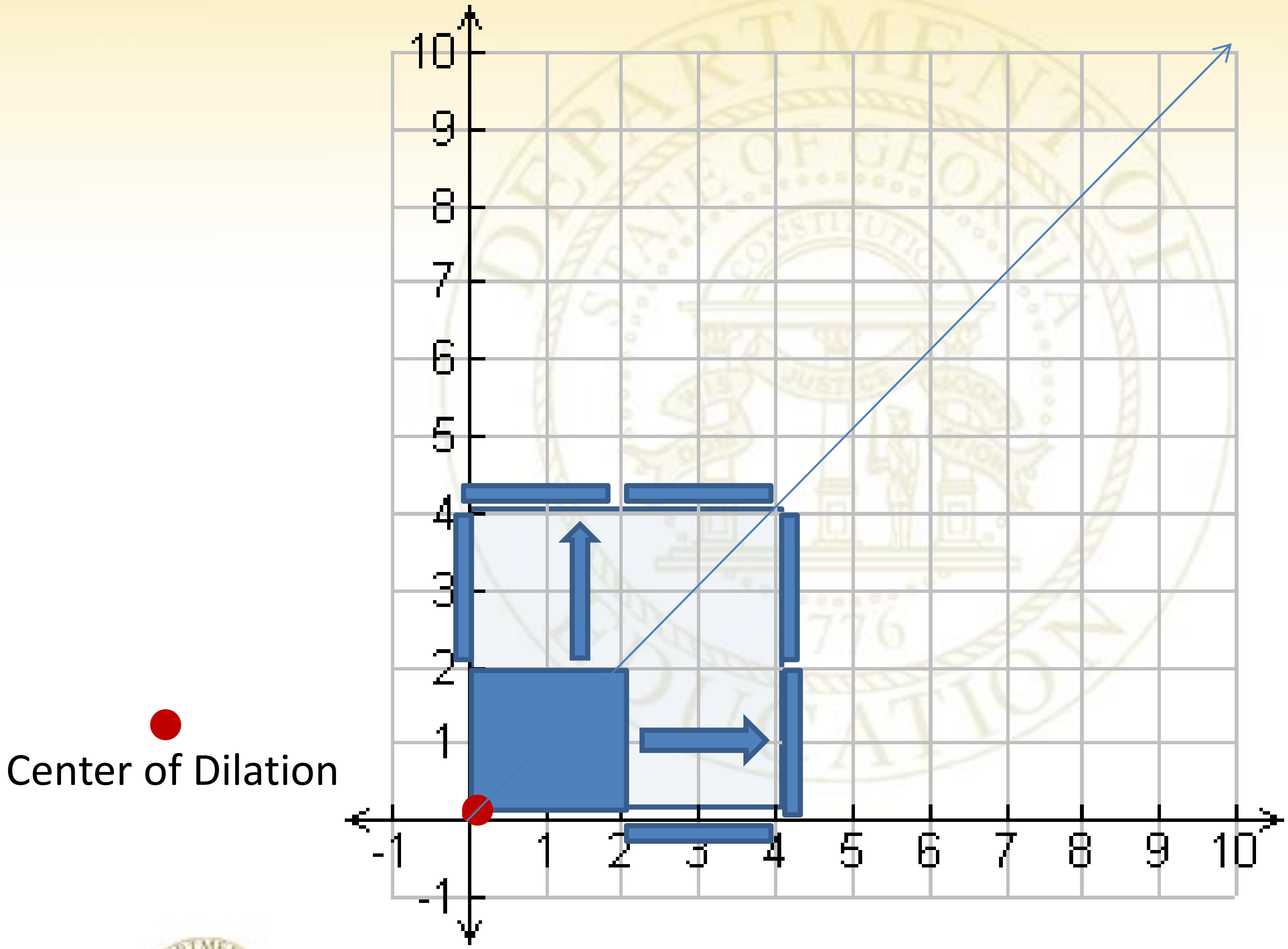
- A dilation takes a line not passing through the center of the dilation to a parallel line
- A dilation leaves a line passing through the center unchanged.

Access Activities

- E.g. can you make it 2x the size, or ½ the size (ratios)
- Use wiki sticks of 2x the size—show student the “center” of dilation, have students place the sticks through the line of dilation, and then parallel to the original lines to dilate

MCC9-12.G.SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor:

a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.

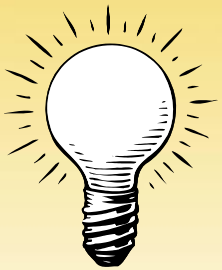


MCC9-12.G.SRT.1 b.

- **MCC9-12.G.SRT.1** Verify experimentally the properties of dilations given by a center and a scale factor:

- b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

What is the Big Idea?



- Students should understand that a dilation is a transformation that moves each point along the ray through the point emanating from a fixed center, and multiplies distances from the center by a common scale factor.
  - A dilation is enlarging a figure from a central point, and all lines of the figure are enlarged at the same scale.

Grade Level Example

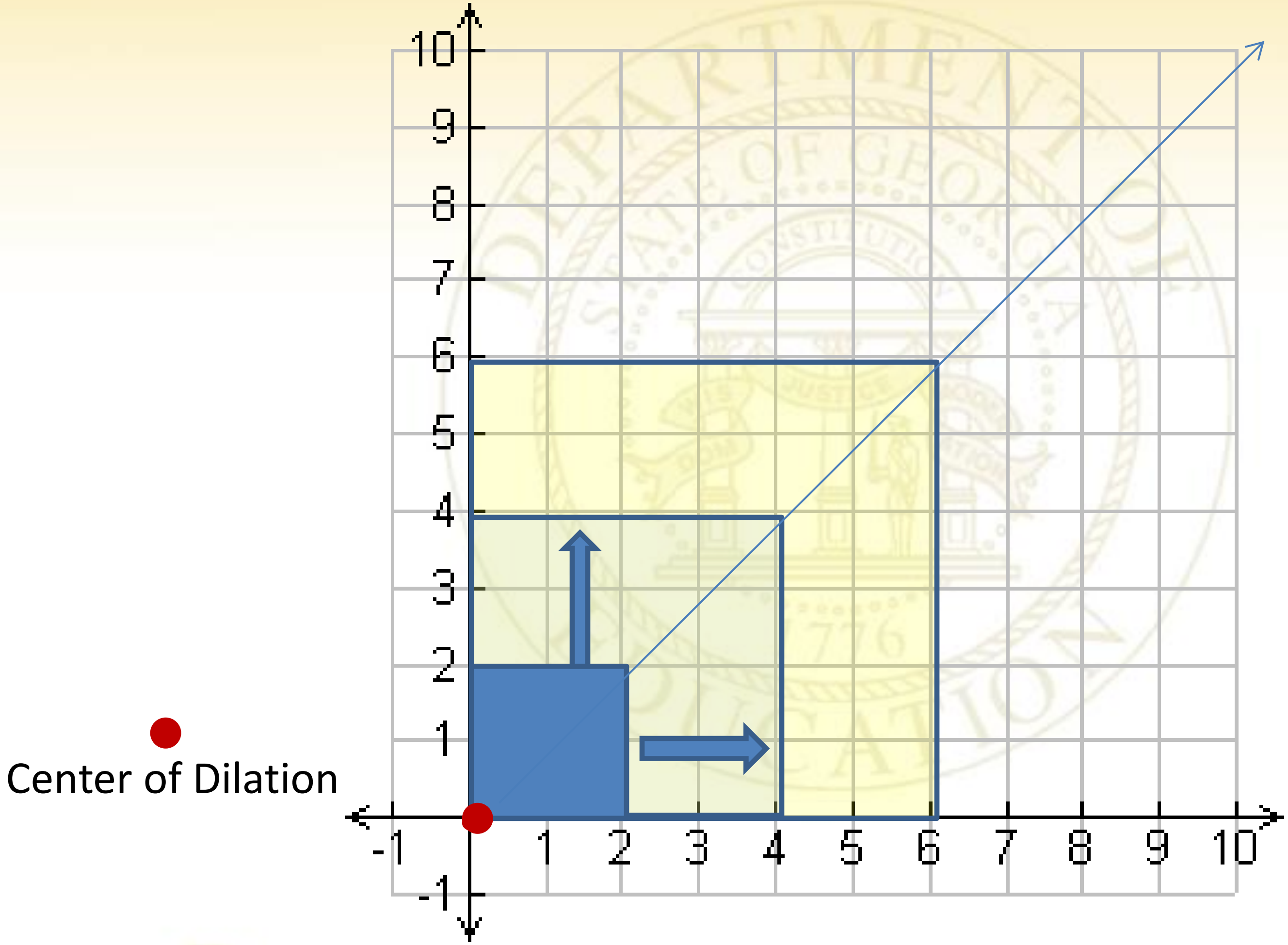
- Perform a dilation with a given center and scale factor on a figure in the coordinate plane. Verify that Verify that a side length of the image is equal to the scale factor multiplied by the corresponding side length of the preimage.
-
- Students may use geometric simulation software to model transformations. Students may observe patterns and verify experimentally the properties of dilations.
-
- **Example:**
-
- Draw a polygon. Pick a point and construct a dilation of the polygon with that point as the center. Identify the scale factor that you used.

Unpacking the Standard

- Verify experimentally the properties of dilations given by a center and a scale factor:
  - The dilation of a line segment is longer in the ratio given by the scale factor.
  - The dilation of a line segment is shorter in the ratio given by the scale factor.

MCC9-12.G.SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor:

b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.



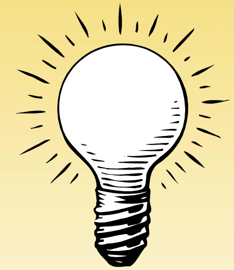
Access Level Examples

- Use manipulatives to demonstrate the graph in the previous slide….

MCC9-12.G.SRT.2

- **MCC9-12.G.SRT.2** Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

What is the Big Idea?



- Use the idea of dilation transformations to develop the definition of **similarity**. Understand that a similarity transformation is a rigid motion followed by a dilation.

- Dilation transformation changes the size of a figure, but not the shape. IE, the angles stay the same, but the sides get longer in the same proportion, e.g. if one side is 2x larger, all are 2x larger.

What is the Big Idea? Cont.

- If you make a triangle larger and keep it similar, all the angles should remain the same.
- If you make a triangle larger and keep it similar, the sides will get larger but in the same proportion, e.g. If the triangle is twice as big, all sides would be two times as long, if the triangle is three times bigger, all the sides would be three times as long
  - Remember, if still a similar triangle, the angles would still be the same.

Grade Level Example

- Demonstrate that in a pair of similar triangles, corresponding angles are congruent (angle measure is preserved) and corresponding sides are proportional.
- Determine that two figures are similar by verifying that angle measure is preserved and corresponding sides are proportional.
-
- Students may use geometric simulation software to model transformations and demonstrate a sequence of transformations to show congruence or similarity of figures.

MCC9-12.G.SRT.2
Unpacking the Standards

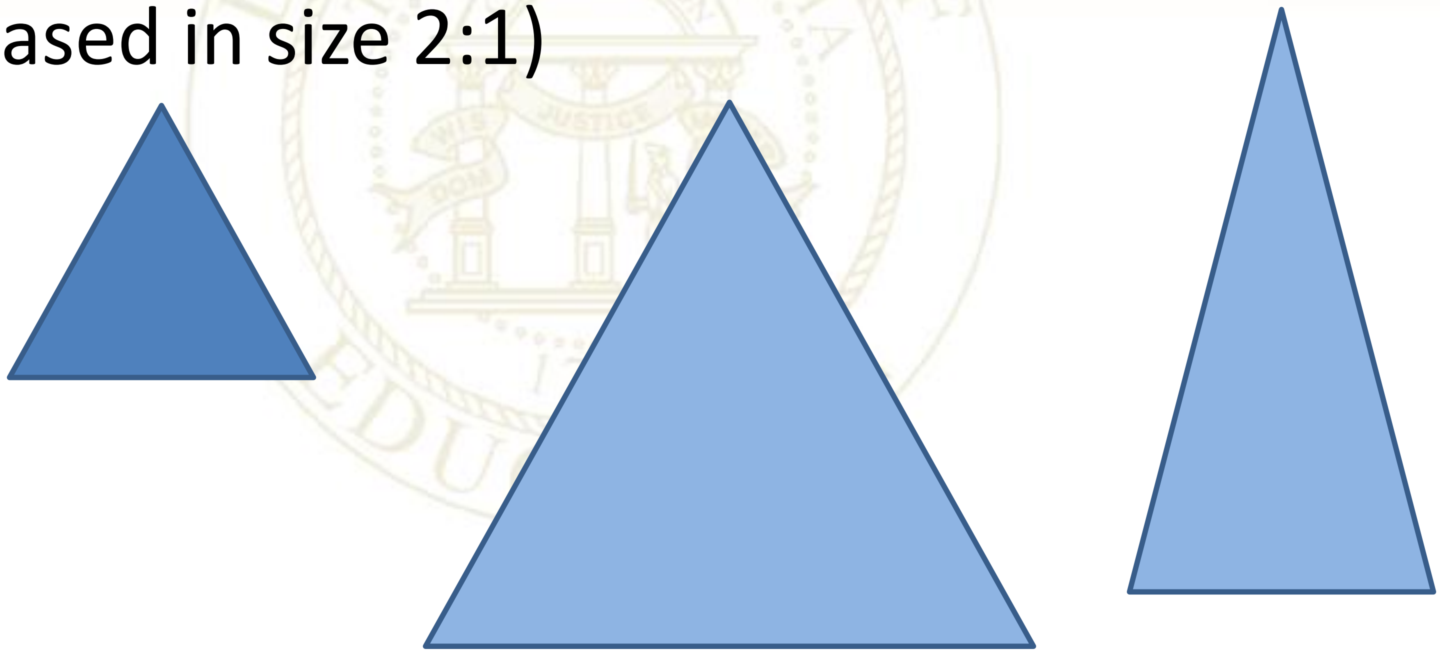
- Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar
- Explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

Access Level Examples

- Given a figure draw a similar figure that is either an enlargement of the original or a reduction.
- Given a shape and a choice of a similar shape and one that is obviously not similar, Identify which shape is similar on a coordinate plane or through using manipulative shapes.

Access to the Standard

- How can you check to which triangle is similar? (The similar triangle should be increased in size 2:1)



Access to the Standard

- Check the corresponding angles: Have a paper triangle identical to the smaller one.
  - Tear off the corners. Place them on the larger triangles to see if the angles all match. Student should note that the angles of the thinner triangle are not the same through matching, using “yes/no” response.
  - Compare the length ratios of the sides. The larger triangle has sides twice the length of the first triangle. Have student compare the length of the base of the triangles to select the triangle that has all sides in a ratio of 2:1.
  - After comparison, have student select the triangle that is similar.

MCC9-12.G.SRT.3

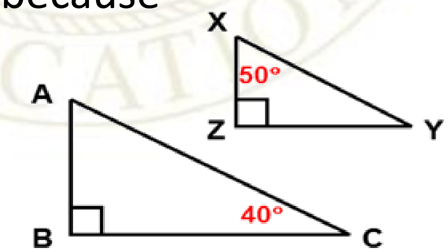
- **MCC9-12.G.SRT.3** Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
- **AA criterion**: Angle/Angle. All you have to do is show that two angles of one triangle are congruent to two angles of the second triangle. Don't have to show proportionality of sides if two of the angles are congruent.

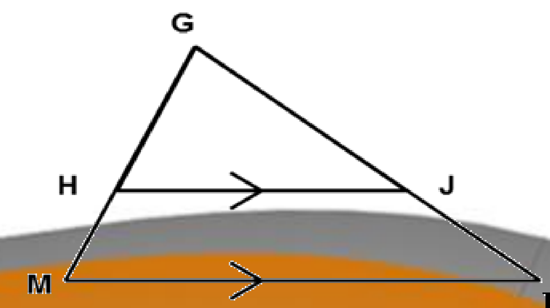
What is the Big Idea?

- **AA criterion**: Angle/Angle. All you have to do is show that two angles of one triangle are congruent to two angles of the second triangle. Don't have to show proportionality of sides if two of the angles are congruent.

Grade Level Example

- Use the properties of similarity transformations to develop the criteria for proving similar triangles: AA.
- Angle-Angle Similarity Postulate (AA~) If two angles of one triangle are congruent to two angles of another triangle then the triangles are similar.
-
- Examples of AA~
- The $\Delta ABC \sim \Delta XZY$ are similar by AA~ because
- They are both right triangles; therefore they both have a 90 degree angle.
- All triangles add up to 180 degrees, since angle C is 40 degrees in ΔABC angle A will be 50 degrees. Therefore, $\angle A$ and $\angle X$ are congruent.
-
- The $\Delta GHJ \sim \Delta GMK$ are similar by AA~ because
  - $\angle H$ and $\angle M$ are congruent by Corresponding Angles Postulate.
  - $\angle HGJ$ and $\angle MGK$ are congruent since they are the same angle.





MCC9-12.G.SRT.3
Unpacking the Standards

- Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

MCC9-12.G.C.2

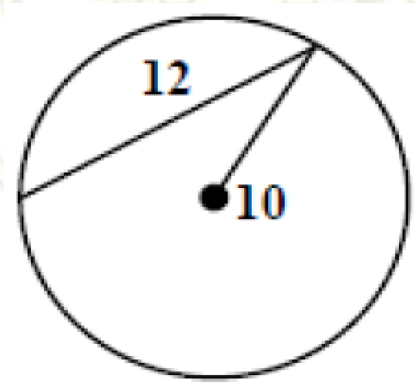
- MCC9-12.G.C.2 Identify and describe relationships among inscribed angles, radii, and chords.
- Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

What is the Big Idea?

- This is not about labeling parts of the circle, it is about identifying relationships and describing relationships.
- Identify central angles, inscribed angles, circumscribed angles, diameters, radii, chords, and tangents.
-
- Describe the relationship between a central angle and the arc it intercepts.
-
- Describe the relationship between an inscribed angle and the arc it intercepts.
-
- Describe the relationship between a circumscribed angle and the arcs it intercepts.
-
- Recognize that an inscribed angle whose sides intersect the endpoints of the diameter of a circle is a right angle.
- Recognize that the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

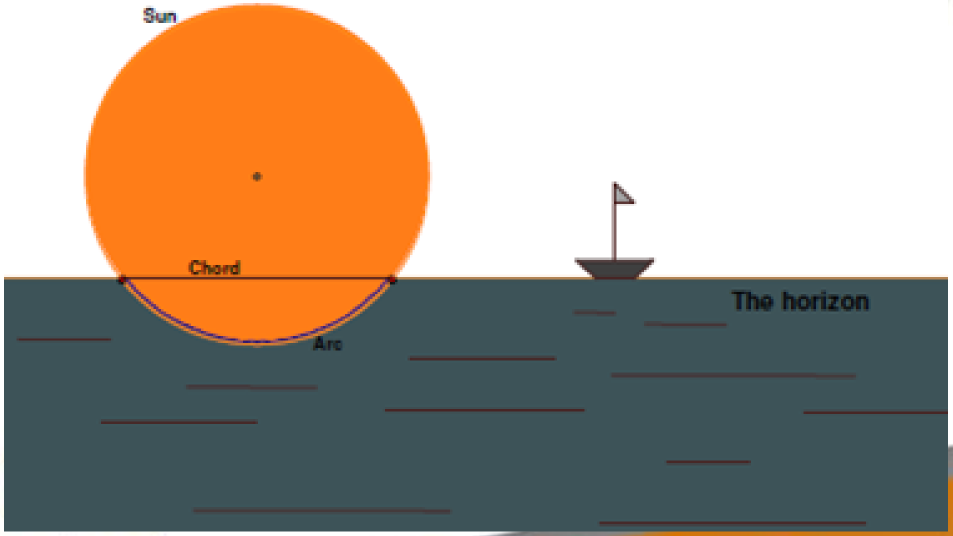
Grade Level Example

- Given the circle below with radius of 10 and chord length of 12, find the distance from the chord to the center of the circle.



Grade Level Example

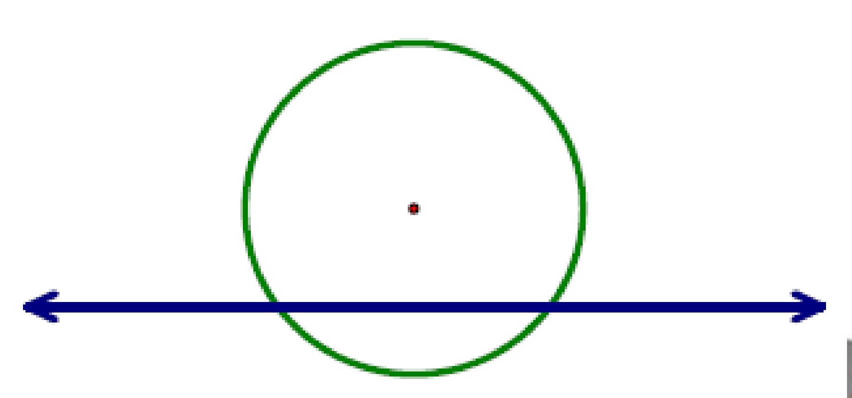
- **Part 1: Sunrise on the First Day of the New Year**
-
- It is customary for people in Asia to visit the seashores on the eastern sides of their countries on the first day of the year. While watching the sun rise over the ocean, visitors wish for good luck in the New Year.
-



Grade Level Example

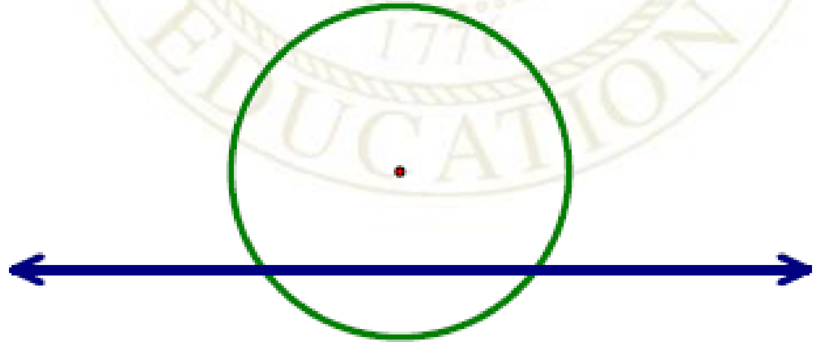
- **Part 1: Sunrise on the First Day of the New Year**

- As the sun rises, the horizon cuts the sun at different positions. Although a circle is not a perfect representation of the sun, we can simplify this scene by using a circle to represent the sun and a line to represent the horizon.
- 1. Using the simplified diagram above, sketch and describe the different types of intersections the sun and the horizon may have.
- A **tangent line** is a line that intersects a circle in exactly one point.
- A **secant line** intersects a circle in two points.
- Do any of your sketches contain tangent or secant lines?
- If so, label them.
- Is it possible for a line to intersect a circle in 3 points? 4 points?
- Explain why or why not.



Grade Level Example

- Draw and describe the relationship between *d* and *r* when *l* is a secant line
- b. Draw and describe the relationship between *d* and *r* when *l* is a tangent line



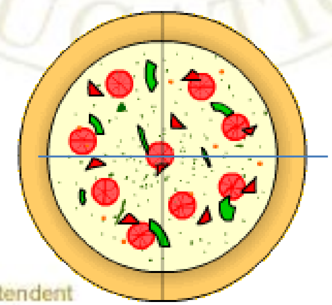
MCC9-12.G.C.2
Unpacking the Standards

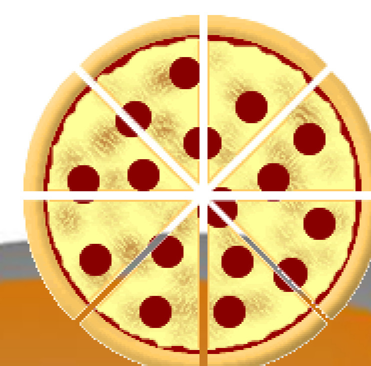
- Identify <u>relationships</u> among inscribed angles, radii, and chords.
- describe <u>relationships</u> among inscribed angles, radii, and chords.
  - the relationship between central, inscribed, and circumscribed angles;
  - inscribed angles on a diameter are right angles
  - the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

Access Level Examples

Describe relationships among inscribed angles:

- A piece of pizza contains central angles.
  - Focus is on the relationship of the central angles.
- How many pieces of pizza with a 90 degree angle will fit in the pizza?
- How many pieces with a 120 degree angle?
- How many pieces with a 45 degree angle?





MCC9-12.G.GMD.3

- **MCC9-12.G.GMD.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.★

What is the Big Idea?

- Find the volume of cylinders, pyramids, cones and spheres in contextual problems.
- Volume must be calculated via a formula or in context of a formula.
- Cylinder: $V = Area\ of\ the\ Base \bullet height$

  $V = B \bullet h$

  $V = \pi r^2 h$

  Cone: $V = \frac{1}{3} volume\ of\ cylinder$

  $= \frac{1}{3}\pi r^2 h$
- Pyramid: $V = \frac{1}{3} volume\ of\ prism$

  $= \frac{1}{3} lwh$

  Sphere: $V_{sphere} = \frac{4}{3}\pi r^3$

Grade Level Example

- Find the volume of a cylindrical oatmeal box.

- Given a three-dimensional object, compute the effect on volume of doubling or tripling one or more dimension(s). For example, how is the volume of a cone affected by doubling the height?

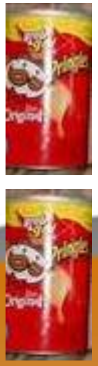
MCC9-12.G.GMD.3
Unpacking the Standards

- Use volume formulas for cylinders to solve problems.
- Use volume formulas for pyramids to solve problems.
- Use volume formulas for cones to solve problems.
- Use volume formulas for spheres to solve problems.

Access Level Examples

Show the student one cylinder. Which container will hold twice as much?   Match the bases to show that the cans have the same size base. Next stack two cans to demonstrate that the large can is 2x as big as the small can. Match the stacked cans to one of the remaining cans to determine which one has twice the volume.

2x height x area of base=



Access Level Examples

Serving Snow Cones!

The formula to determine the volume of a cone is

Volume of cone= 1/3 volume of cylinder of same diameter and height. Which container filled with ice would fill 3 cones to the top?

Access Level Examples

- Check your work!
- Students can check to see if they picked the correct cylinder by filling the small cylinder, transferring the quantity to the larger cylinder twice, ask "Does it fill the cylinder? Is it enough, is it too much?"
- ***Caution:: Do not use discussion of "measurement" of liquids using measuring cups—this is not about how many "cups", etc.
- Must show you are doubling the height and using the formula

Access Level Examples

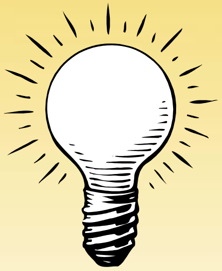
- Check your work--Must show that you are doubling the height.

Domain of Expressions, Equations, and Functions

MCC9-12.A.REI.4

- MCC9-12.A.REI.4 Solve quadratic equations in one variable.
  - MCC9-12.A.REI.4b Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation.

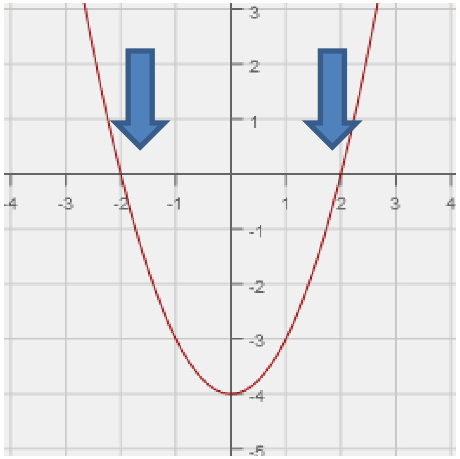
What is the Big Idea?



- Solve quadratic equations in one variable by simple inspection, taking the square root, factoring, and completing the square.
- Understand why taking the square root of both sides of an equation yields two solutions.
- **Example:**
- Solve $x^2 = 25$
- $x = \pm\sqrt{25}$
- $x = \pm 5$
- The two solutions are + 5 and -5.

Grade Level Example

- Solve quadratic equations in one variable by simple inspection: Graph the equation and find where the graph crosses "x"
- Completing the square
  - Taking the square root of both sides



Grade Level Example

- In simplest form:
- Solve $x^2 = 25$
- $x = \pm\sqrt{25}$
- $x = \pm 5$
- The two solutions are + 5 and -5.

MCC9-12.A.REI.4
Unpacking the Standards

- MCC9-12.A.REI.4b
  - Solve quadratic equations by inspection (e.g., for x2 = 49) as appropriate to the initial form of the equation.
  - Solve quadratic equations by taking square roots as appropriate to the initial form of the equation.
  - Solve quadratic equations by completing the square as appropriate to the initial form of the equation.
  - Solve quadratic equations by the quadratic formula and factoring as appropriate to the initial form of the equation.

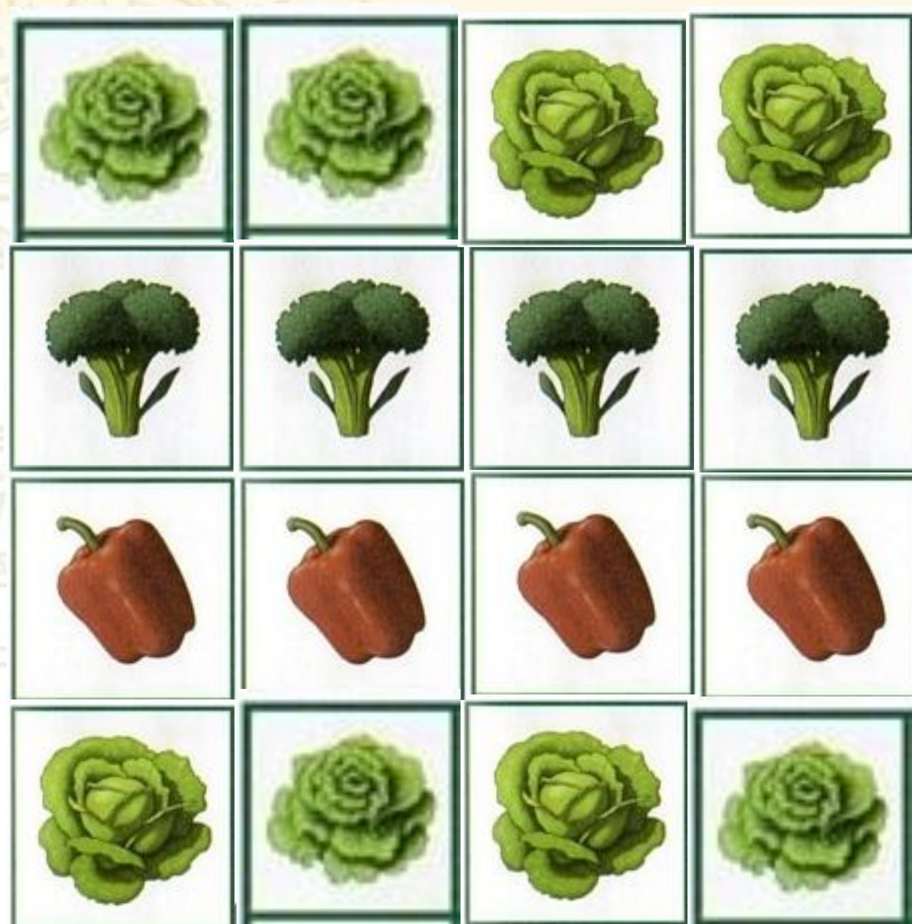
Access Level Examples

- $x^2 = 16$
- We have 16 plants. If we put them in a square, how many plants will be on each row (the square root)?

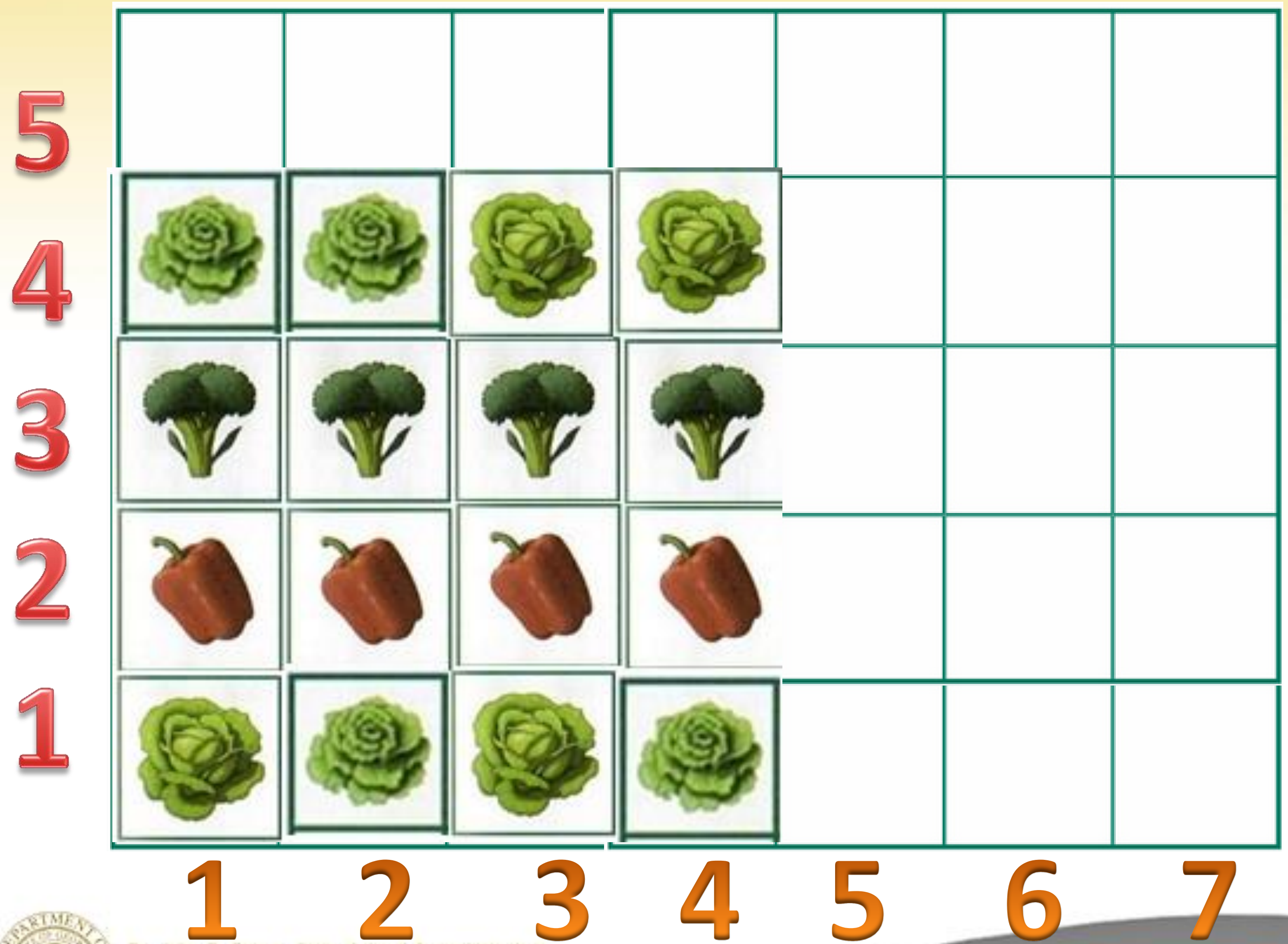
Access Level Examples

- $x^2 = 16$

1 2 3 4



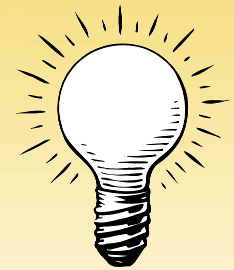
Access Level Examples



MCC9-12.F.IF.4

- **Interpret functions that arise in applications in terms of the context**
- **MCC9-12.F.IF.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and ~~periodicity~~.

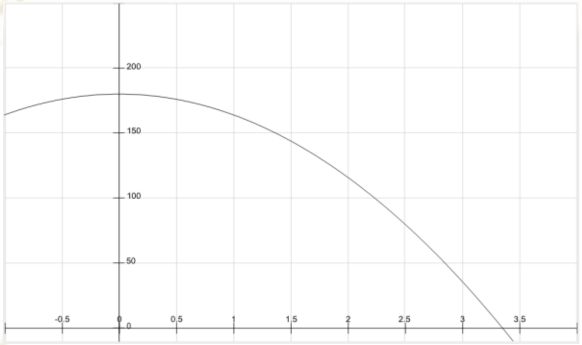
What is the Big Idea?



- In Analytic Geometry, the focus is on quadratic functions.
- Given a function, identify key features in graphs and tables including the intercepts; intervals where the functions are increasing, decreasing, positive, or negative; relative maximums and minimums, symmetries; end behavior, and periodicity.
- Students may be given graphs to interpret or produce graphs given an expression or table for the function, by hand or using technology.

Grade Level Example

- A rocket is launched from 180 feet above the ground at time $t = 0$. The function that models this situation is given by $h = -16t^2 + 96t + 180$, where t is measured in seconds and h is height above the ground measured in feet. Here is its graph:



-
  - What is a reasonable domain restriction for t in this context?
  - Determine the height of the rocket two seconds after it was launched.
  - Determine the maximum height obtained by the rocket.
  - Determine the time when the rocket is 100 feet above the ground.
  - Determine the time at which the rocket hits the ground.
  - How would you refine your answer to the first question based on your response to the second and fifth questions?

MCC9-12.F.IF.4
Unpacking the Standards

- For a function that models a relationship between two quantities, interpret (one or more at access level) key features of graphs and tables in terms of the quantities
  - Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

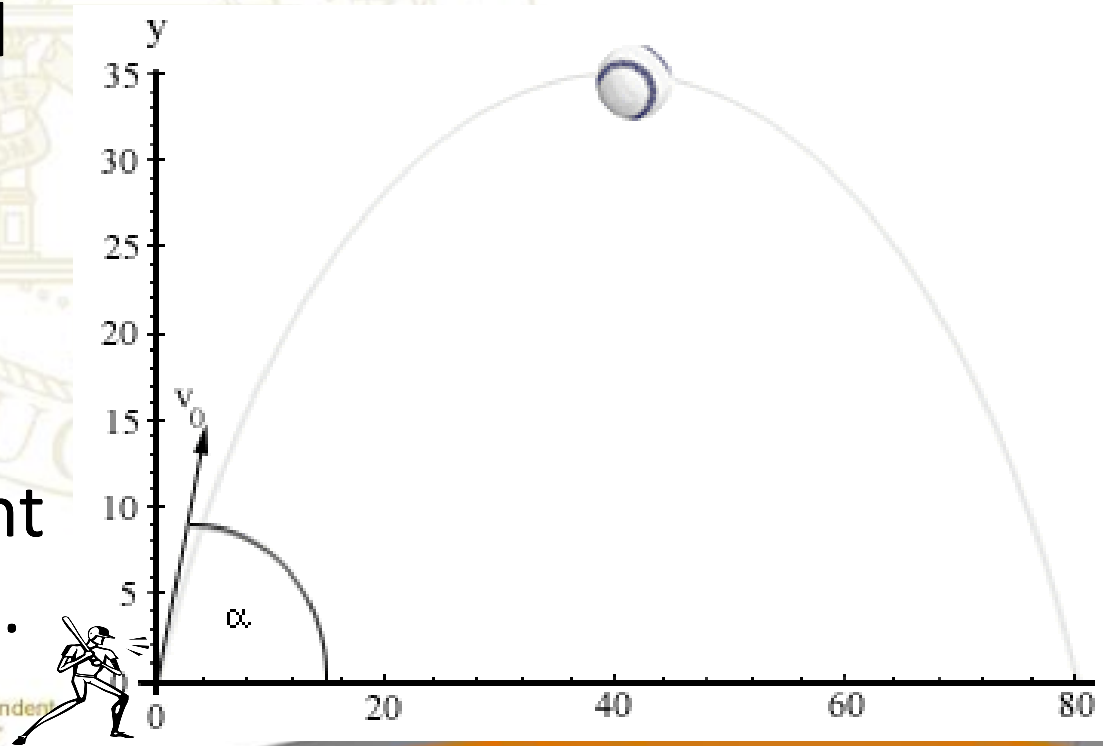
MCC9-12.F.IF.4
Unpacking the Standards

- For a function that models a relationship between two quantities, sketch graphs showing key features (one or more at access level) given a verbal description of the relationship.
  - Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

Access Level Examples

- This graph shows the path of the ball when Joe hit the ball. Place the ball on the highest point of the path.
- How far did the ball go? Place the ball where it hit the ground.

  Demonstrates maximum height and x intercept.

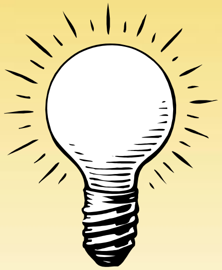


Domain of Statistics and Probability

MCC9-12.S.CP.1

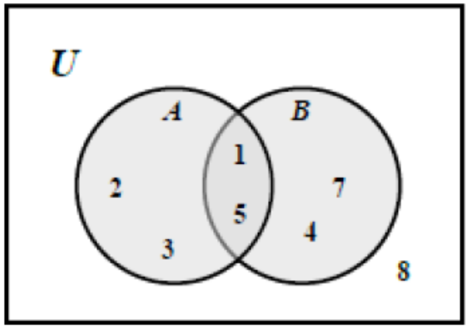
- MCC9-12.S.CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).

What is the Big Idea?



- Define a sample space and events within the sample space. (The entire set of events)
- Establish events as subsets of a sample space (events that meet specific conditions).
- Use correct set notation, with appropriate symbols, to identify sets and subsets.
- Define union, intersection, and complement for the events.
- **Interpret Venn diagrams that show relationships between sets within a sample space.**

Grade Level Example



- Draw Venn diagrams that show relationships
- between sets within a sample space.
-
- The **intersection** of two sets *A* and *B* is the set of elements that are common to both set *A* **and** set *B*. It is denoted by $A \cap B$ and is read "*A* intersection *B*".
- $A \cap B$ *in the diagram is* $\{1, 5\}$
- This means: BOTH/AND
-
- The **union** of two sets *A* and *B* is the set of elements, which are in *A* **or** in *B*, **or in both**. It is denoted by $A \cup B$, and is read "*A* union *B*".
- $A \cup B$ *in the diagram is* $\{1, 2, 3, 4, 5, 7\}$
- This means: EITHER/OR/ANY
- Could be both
- The **complement** of the set $A \cup B$ is the set of elements that are members of the universal set ⍰ but are not in $A \cup B$. It is denoted by $(A \cup B)$'
- $(A \cup B)$' in the diagram is $\{8\}$

MCC9-12.S.CP.1
Unpacking the Standards

- Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes
- Describe events as subsets of a sample space (the set of outcomes as unions ("or").
- Describe events as subsets of a sample space (the set of outcomes) as intersections ("and").
- Describe events as subsets of a sample space (the set of outcomes) as complements of other events ("not").

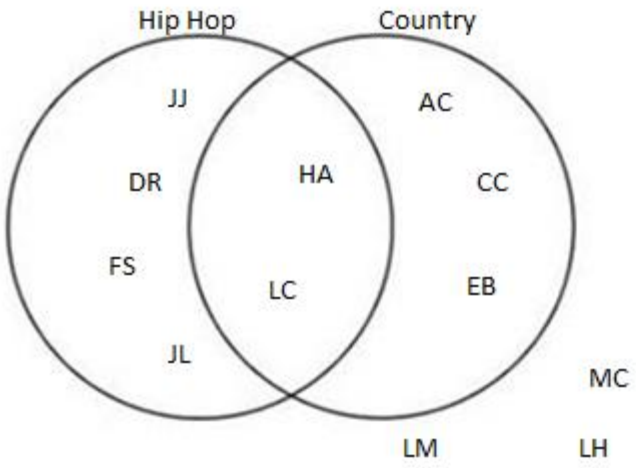
**This is not a sorting activity to place items—it is to interpret the Venn Diagram.

Access Level Examples

- *(In preparation for the task, students may help to place the items on the Venn Diagram, but that activity does not align to this standard).
- What music do students prefer? hip-hop, country, or neither?

Access Level Examples

- What kind of music do you listen to? Hip Hop, Country, or Neither. (They can like both)



Hip Hop	Country	Neither
JJ	AC	MC
FS	CC	LM
HA	HA	LH
DR	EB	
LC	LC	
JL		

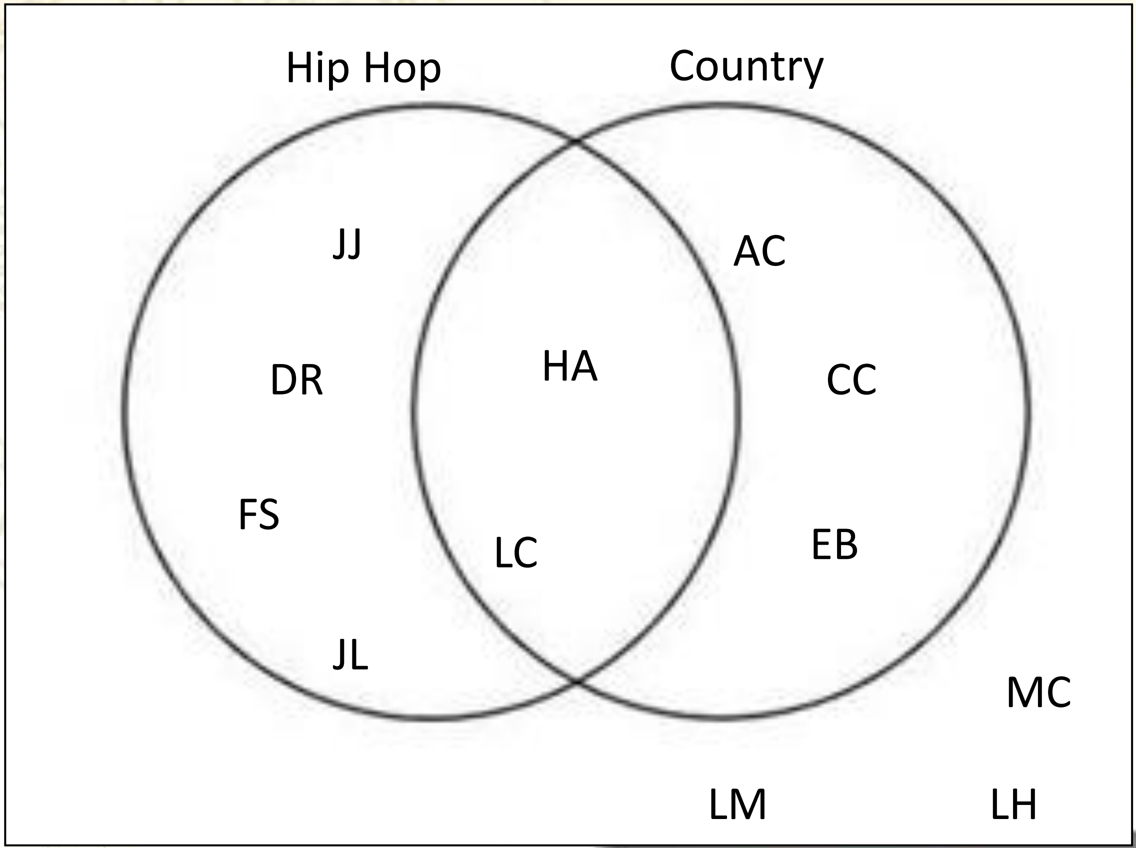
Access Level Examples

- What music do students prefer? hip-hop, country, or neither?

How many students liked Hip Hop? 6

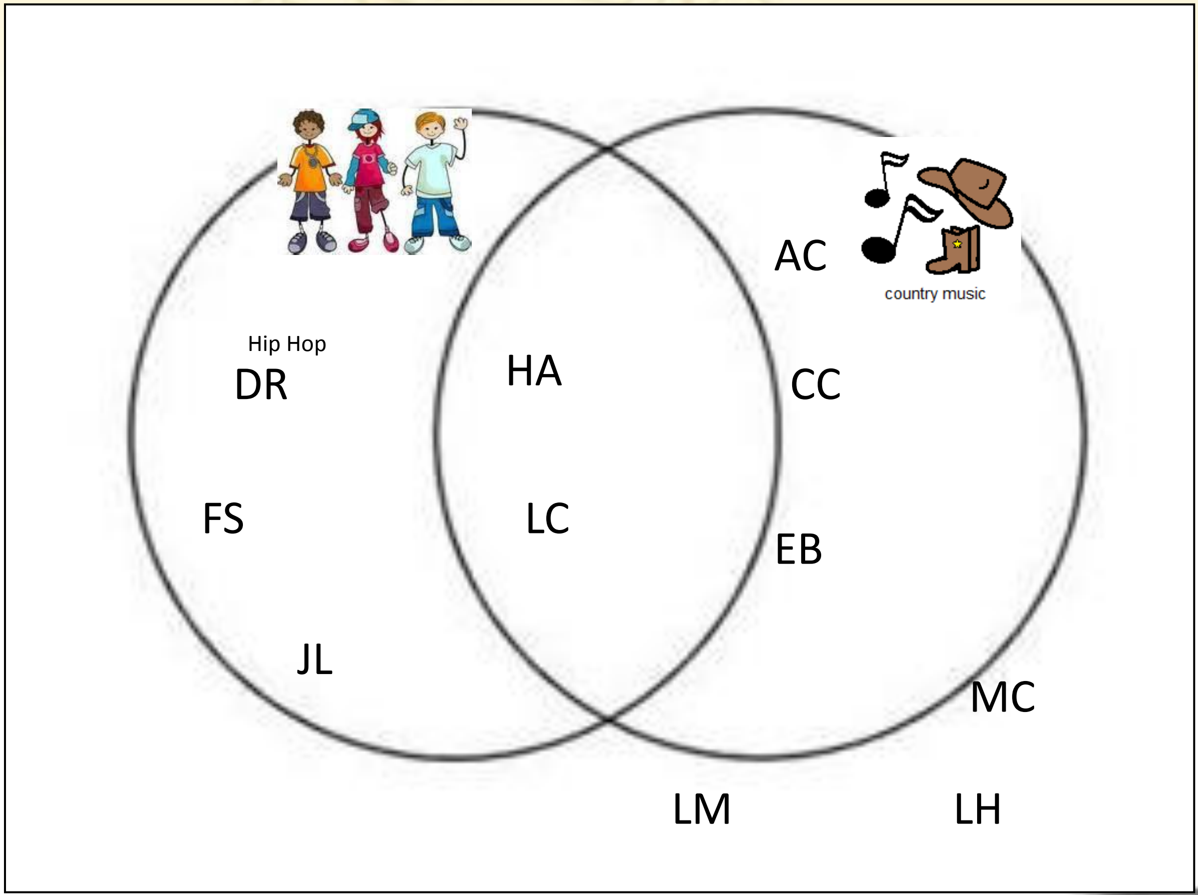
How many students liked Country? 5
How many students liked both Hip Hop and Country? 2

How many students did not like either Hip Hop or Country? 3
How many students only like Hip Hop? 4
How many students only like Country? 3
How many like Hip Hop, Country, or Both? 9



Access Level Examples

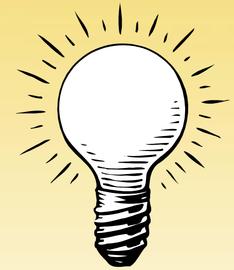
- What music do students prefer? hip-hop, country, or neither? Higher level students may determine:



MCC9-12.S.CP.6

- **MCC9-12.S.CP.6** Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.

What is the Big Idea?



- Calculate conditional probabilities using the definition: “the conditional probability of *A* given *B* as the fraction of *B*’s outcomes that also belong to *A*”.
- Interpret the probability based on the context of the given problem.

Grade Level Example

- A teacher gave her class two quizzes. 30% of the class passed both quizzes and 60% of the class passed the first quiz. What percent of those who passed the first quiz also passed the second quiz?
- A local restaurant asked 1000 people, "Did you cook dinner last night?" The results of this survey are shown in the table below.
-
-
- Determine what the probability is of a person chosen at random from the 1000 surveyed.
- a. cooked dinner last night
- b. was a male and did not cook dinner
- c. was a male
- d. was a female and cooked dinner last night

"Did You Cook Dinner Last Night?"		
	Male	Female
Yes	115	480
No	327	78

MCC9-12.S.CP.6
Unpacking the Standards

- Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.

Access Level Examples

- The teacher has a bag of student names. There are 10 students in the class.
- What is the probability of pulling Jane's name from the bag?
- First try, 1/10
- Second try, 1/9
- Third try, 1/8, etc. until her name is pulled.

Access Level Example

1 Ann	2 Jay	3 Joi	4 Erin	5 Haven
6 Bill	7 Jane	8 Mark	9 Chris	10 Ella

As each name is pulled, fill in the chart with the name at the end so the students can see the probability, e.g. 1/9, 1/8, etc.

References

- 1) https://www.math.ku.edu/~jmartin/courses/math105-F11/Lectures/chapter11-part3.pdf
- http://www.amathsdictionaryforkids.com/
- This web site has activities to help students more fully understand and retain new vocabulary.
-
- http://intermath.coe.uga.edu/dictnary/homepg.asp
- Definitions and activities for these and other terms can be found on the Intermath website. Intermath is geared towards middle and high school students.
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Kayse Harshaw
Education Program Specialist
Special Education Services and Supports
Georgia Department of Education
Atlanta, Georgia
sharshaw@doe.k12.ga.us