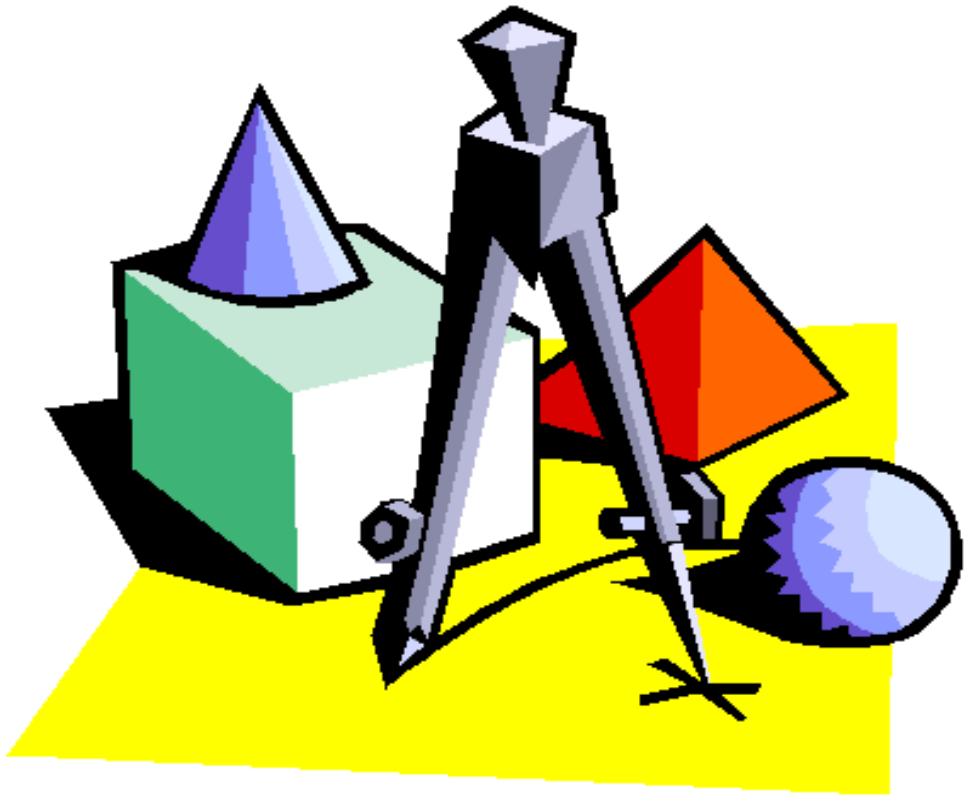
Geometry

Junior Mathematics
Study of Lines, 2D figures and 3D Objects
(Grades 3,4 & 5)

LEARNING LOG



http://lh4.ggpht.com/_QO6B-p2vuiI/S3WkEjTU6CI/AAAAAAAAAkw/vEi6jI5TxWA/geometry%5B1%5D.gif

Name: _____

Junior Geometry Learning Log

First Edition, December 2016
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This document edition will be used as a pilot resource to support innovative schools. The intent of sharing this first version with students, staff and families, is so we can gather further input for future revisions of this living curriculum. All we ask is that if you use these materials that you give credit to the author(s) of this initial work, in your introduction.

Acknowledgement: Many thanks to Headwaters Academy for taking part in the initial pilot of this resource.

PURPOSE of LEARNING LOG RESOURCE:

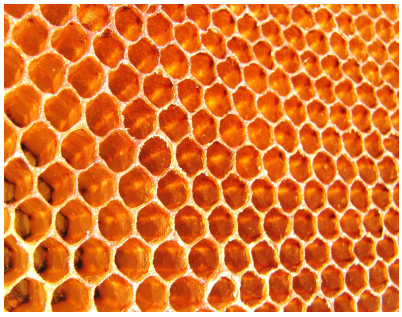
1. To support the Ontario Mathematics Curriculum
2. To support independent and paired study during station work or during home study (holiday or at-home interest/extended homework activities)
3. To add support as an enrichment or remedial resource (students can work at their own pace)
4. To provide a learning log (evidence of learning) built in to student resources

What's in each lesson/unit?

- ***Check In*** – (diagnostic quiz – to reduce repeated teaching)
- ***Essential Targets (ET)*** – state or provincial expectations
- ***Examples*** (patterns for examining the math)
- ***TECH CHECK*** (more ways and examples for practicing the math)
- ***REAL WORLD Problems*** (context for math)
- ***Fun and Games*** (activities for making memories)
- ***Reciprocal Teaching*** (talking and demonstrating 'like a teacher')
- ***GOT IT*** (learning log/notebook evidence of learning)
- ***Habit Check*** (checking in on how students are doing the math)
- ***Extensions*** (students can extend where lesson leads next)
- ***Master Quiz*** (sample unit quiz)
  Math Project (culminating task revealing applied mastery of many ET's)

The MATH Challenge!

Trailblazer (Expert)	450 + points
Pathfinder (Apprentice)	400 - 449 points
Rookie (Novice)	< than 400 points



https://fullerfuture.files.wordpress.com/2015/01/bucky-sacredgeometry-geometryofthebeehive5.jpg

Challenge	Maximum Points
Point and Grid Quiz	20
Lines and Angle Quiz	100
Figures and Shapes Quiz	50
2D Quad Quiz	50
Triangle Quiz	50
3D Quiz	100
Math Project	100
Learning Log Challenge (complete tasks in book)	10
Classroom Work	10
TOTAL	500

Each year your Math Challenge will include a different Math Project. Each project will be featured at the Geometry Fair at the end of Semester 3.

(a) Geo Board Game
(b) Bus Renovation Project
(c) Juno Set Design Project

During Math time, you will work on mini lessons with your teacher and also work independently on your Math Project during station work.

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A. Points in Space

CHECK-IN: Maybe you already know all this? Show your teacher what you know!
*Go to Page 18 and Try the Points in Space Test.
****It is okay to say "I don't know" ☺

- Read through the 'POINTS IN SPACE' *Geometry Glossary.*

GLOSSARY UP FRONT

point =
- a specific place in space
- no dimension
- no length
- no width
- no depth
- represented by a dot
- use a single capital letter to identify point

grid = lines that cross one another at right angles to form squares or rectangles

axis = A reference line used in a graph or coordinate system

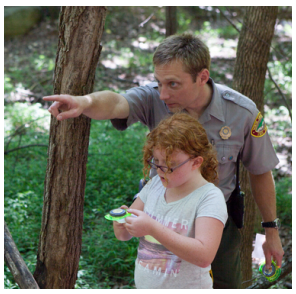
Cartesian coordinate plane. A plane that contains an *x*-axis (horizontal) and a *y*-axis (vertical), which are used to describe the location of a point. Also, called *coordinate plane*

coordinate grid = A plane with horizontal and vertical lines that intersect to form squares or rectangles. In a coordinate grid system (i.e. a road map), the representation of an object within the squares or rectangles describes the location of the object.

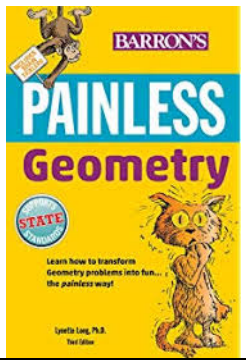
geometry = The study of mathematics that deals with the spatial relationships, properties, movement, and location of two- dimensional shapes and three-dimensional figures. The name comes from two Greek words meaning *earth* and *measure*

ordered pair. Two numbers, in order, that are used to describe the location of a point on a plane, relative to a point of origin (0, 0); i.e., (2, 6). On a coordinate plane, the first number is the horizontal.

BEARINGS
- Trailblazer (Expert)
- Pathfinder (Apprentice)
- Rookie (Ready to learn new stuff)



Painless Geometry Reference Book (pp. 3-19);
Painless Math Word Problems (pp. 207-208)



http://mtairynews.com/wp-content/uploads/2016/08/web1_160813_Compass-R1.jpg

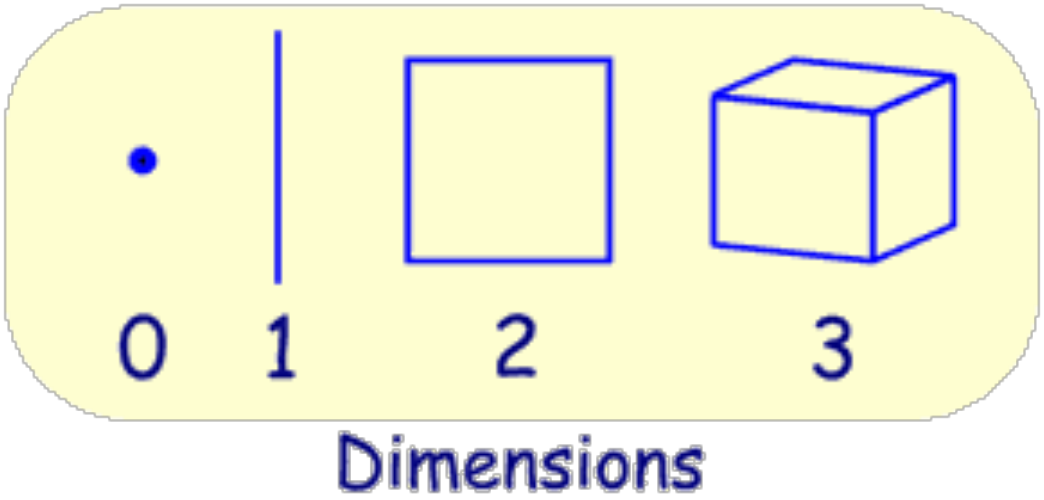
1. Get the Point

RULE: A point identifies a place in space. A dot represents a point. A point in math is identified by a capital letter.

I do not have length
I do not have width
I do not have depth
I look like a dot.
I have a specific place in space.
A capital letter is used to show my place.
What am I?

I think this is called a_____.

- Look at the image below and talk about the difference between 0-1-2-3 dimensions.



https://www.mathsisfun.com/geometry/images/dimensions.gif

2. Grids in Space

RULE: A grid is used to identify a point or series of points that make shapes. Grids can be made up of straight and curvy lines. Points on grids can be identified by a letter and a number or two numbers.

I am used to locate and identify specific points.
I am made up of vertical and horizontal lines.
I am used to find a point or location on a map.
I can be used with letters and numbers.
I can be curvy on a globe when I am formed by latitude and longitude lines.
I can be used to copy shapes and figures.
I can be used with numbers and letters.
I am used to play the game Battleships.
What am I?

I think this is called a_____.

A grid is formed by vertical and horizontal lines.

- Look at the treasure map record whether letters or numbers are used for:

(a) Horizontal Lines: _____

(b) Vertical Lines: _____

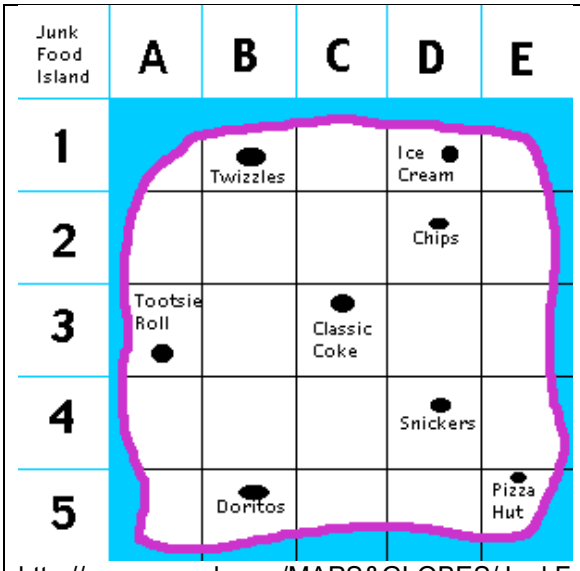
EXAMPLES

- Look at the map of Treasure Island and see if you and a partner can figure out the location of 3 locations below:

Blue Lagoon	D3
Smuggler's Cove	
Volcano Valley	
Treasure Cave	

http://5678dancestudio.com/wp-content/uploads/2016/02/treasure-map.png

- On Junk Food Island – there are 8 places to avoid. If you begin at A4, record a path that gets to as many healthy places as possible without going through unhealthy places.



http://www.mcwdn.org/MAPS&GLOBES/JunkFood.gif

Start at A4
Then go to

- Create a Fire Safety Plan for leaving your bedroom to get out of your house in case there is a fire.
- Details for directions can include:
    - How many steps do you walk forward, back, up/down (stairs)?
    - Do you turn right, left?
    - Use terms like rooms, doors, hallways, stairs…

How well did I do this task?	Trailblazer ☺ (Expert)	Pathfinder (Apprentice)	Rookie - Not Yet (Novice)

Cardinal Directions

- Look at the following "DIRECTION" words. Circle the 'Cardinal Directions' below.

https://www.google.ca/search?q=compass&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjsiu-rq8rQAhWIyoMKHQDmBLUQ_AUICCgB&biw=790&bih=610#imgrc=P7Yug_AKVk62cM%3A

FUN & GAMES:

- Re-write the 'right and left' directions using the language of cardinal directions – if the first turn is to the north.

Right and Left Directions	Cardinal Directions
To go to the library, you turn right at the street in front of your home. Then after three stop signs, turn left. Walk to the end of the end of the street and then turn right. The library is on the left hand side.	

- Create a sign that points to north, south, east and west to place outdoors.

http://discoverspringtexas.com/wp-content/uploads/2012/12/which-direction-should-your-Spring-Texas-home-face.jpg

Treasure Hunt

- Hide a Treasure Chest in the school yard for younger Learning Buddies to locate. Using cardinal directions, create a series of clues that helps your buddies find the treasure! Your clues will sound like:

"walk 5 steps north and 3 steps east…"

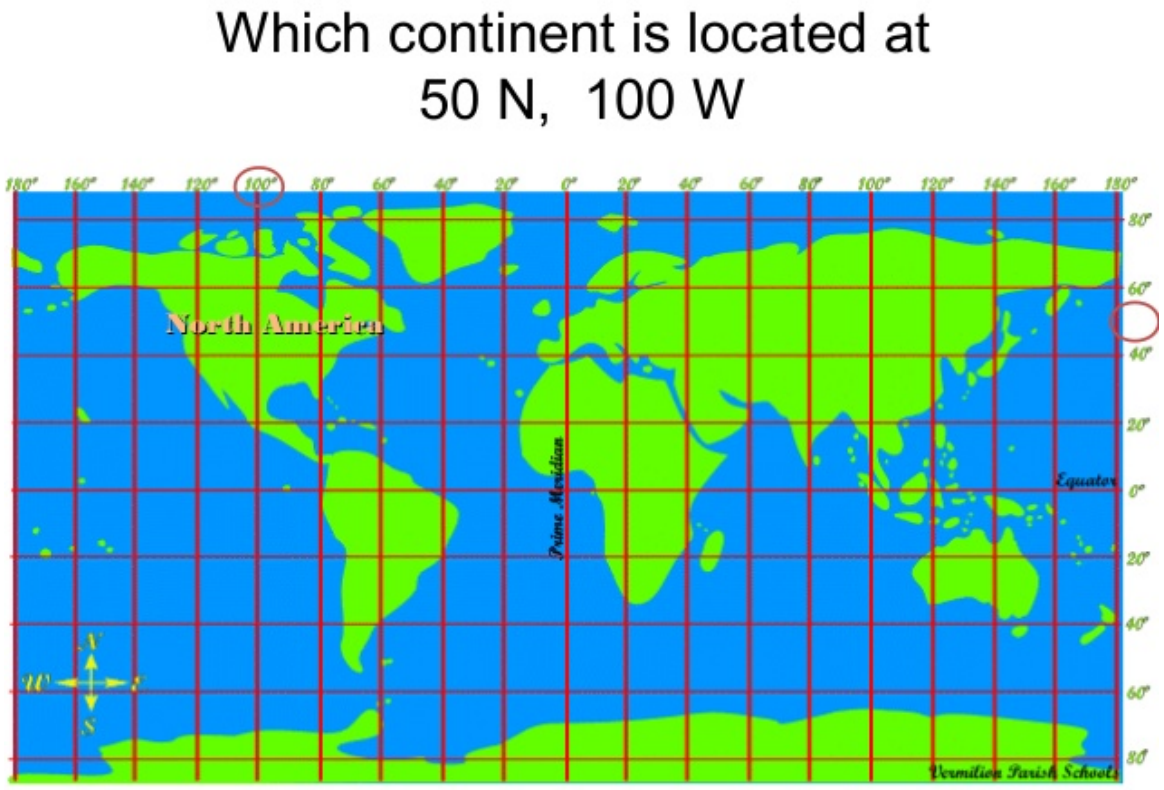
- Draw your plan by creating a grid here:

How well did I do this task?	Trailblazer ☺ (Expert)	Pathfinder (Apprentice)	Rookie - Not Yet (Novice)

Degrees as Coordinate Measures

Instead of finding a coordinate with a letter (A, B, C) and a number (1,2,3,4…), maps identify coordinates by degrees and parts of degrees.

- Which continent is at 50 degrees North and 100 degrees West?



http://image.slidesharecdn.com/longitudeandlatitude-130822195753-phpapp02/95/longitude-and-latitude-21-638.jpg?cb=1377201528

- What are 2 coordinates in:

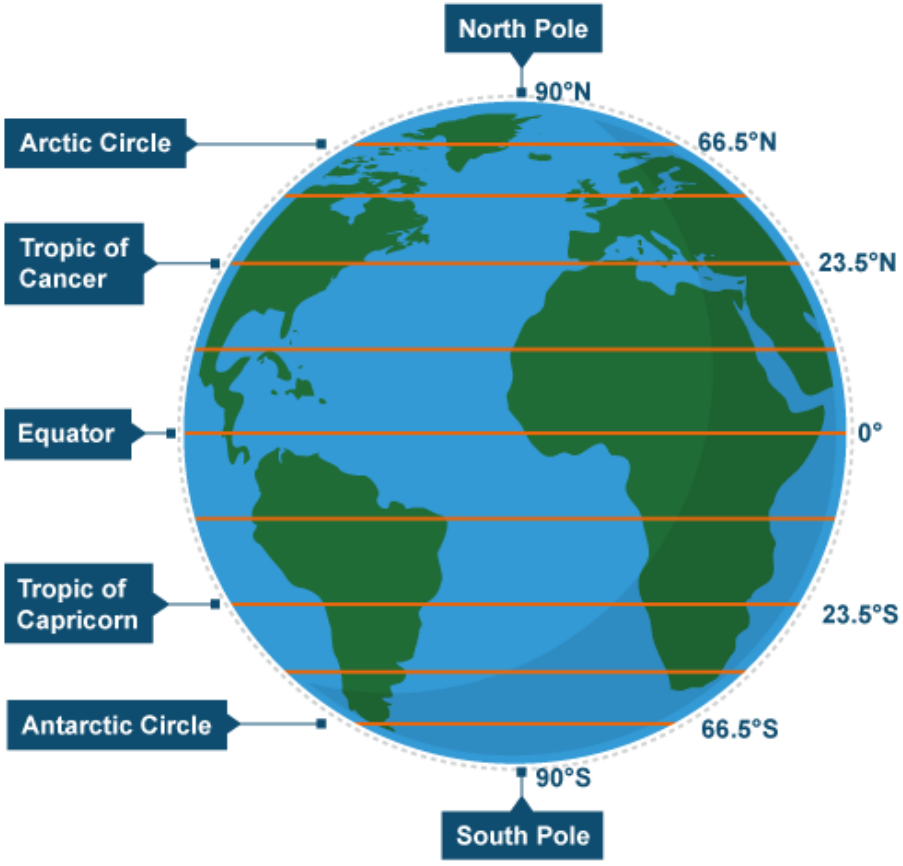
(a) Europe		
(b) South America		
(c) Africa		
(d) Asia		
(e) Australia		
(f) Antarctica		

Curving Horizontal Grid Lines

RULE: A 3Dimensional Globe shows grids made from curvy lines. These curvy lines are called lines of latitude and lines of longitude.

Horizontal grid lines are called lines of:

_____ _____ _____ I T U D E



https://s-media-cache-ak0.pinimg.com/originals/13/c4/9c/13c49c1626f118367e0bb0dd4f25c1c8.jpg

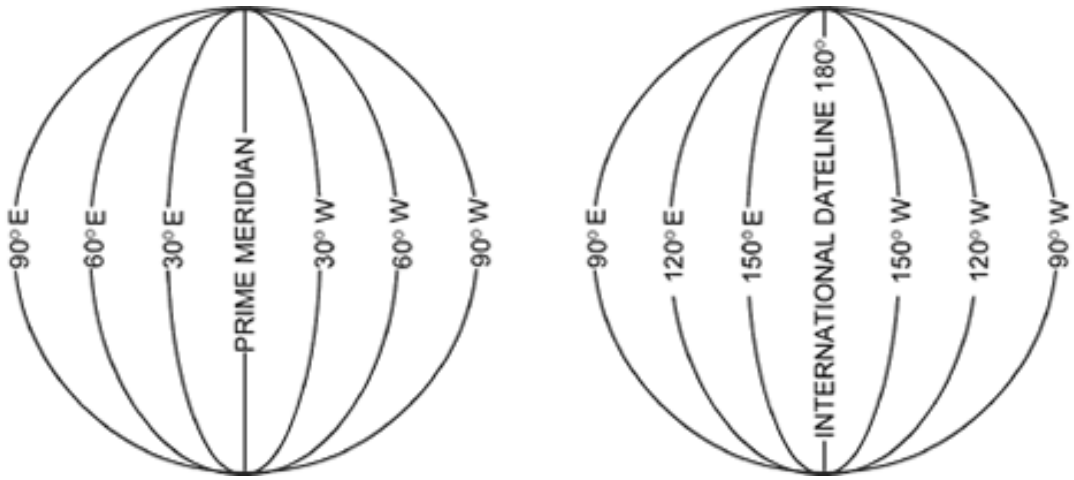
- Are the north and south poles lines of latitude? Yes, No.

They look like separate _____ _____ _____ _____ _____ _____.

Curving Vertical Grid Lines

Curving vertical lines are called lines of:

_____ITUDE



http://oneillseaodyssey.org/wp-content/themes/oneil/images/Longitude-Diagram.gif

Extension:

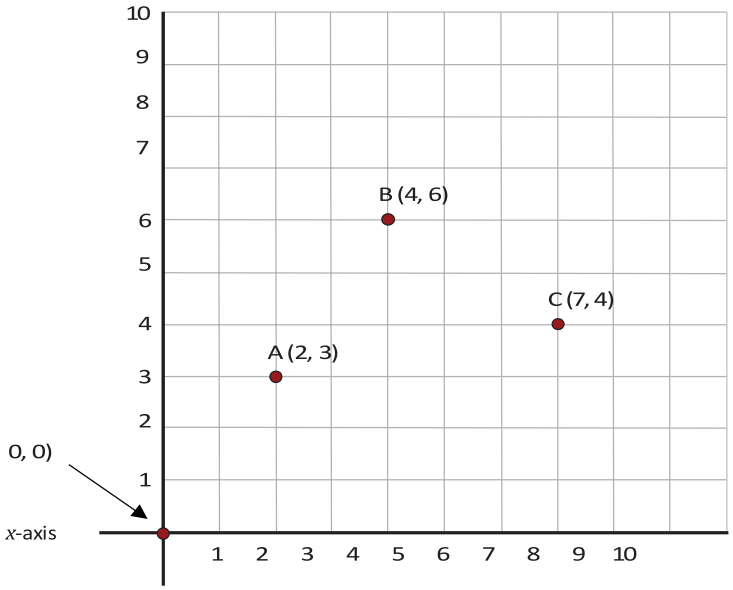
- Create a grid that places coordinates on a map of The Blue Mountain Trails Network. http://www.thebluemountains.ca/public_docs/documents/Trails-Brochure-Page1.pdf

RULE: Grid Lines can also be called the x axis (horizontal lines) and the y axis (vertical lines). The *x*-coordinate is always given first, then *y*-coordinate. They are in parenthesis and are separated by a comma (*x, y*). The **origin** is at intersection of *x*- and *y*-axes, represented as point (0, 0).

EXAMPLES:

Hundreds of years ago, Rene Descartes (1596-1650) identified points on a map with two numbers on a grid (4,2) he called "ordered pairs". ‹He called This grid the Cartesian plane – named after:

_____



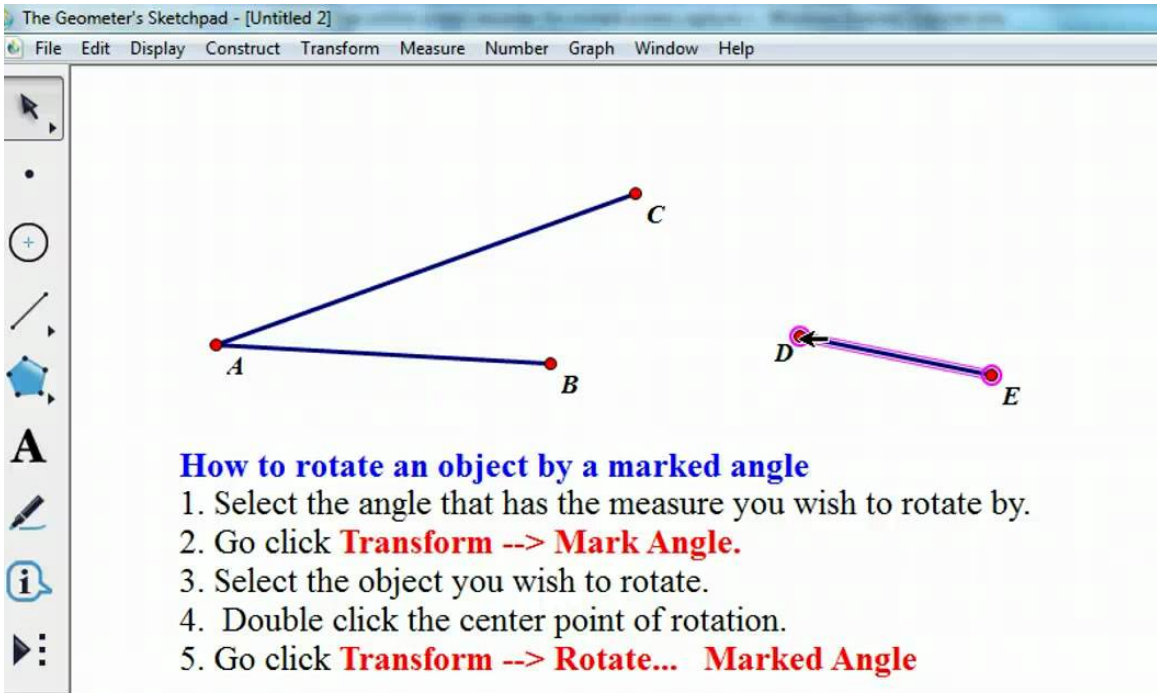
FUN & GAMES:

- Create a Geoship Game (like battleship) to reinforce location using both cardinal directions (north, south, east, west) and x and y axis to describe locations. Create a simple grid (5 x 5) and then try the larger 10 X 10 grid. Hide your 'geoship' shape on the grid now.

10									
9									
8									
7									
6									
5									
4									
3									
2									
1									
	A	B	C	D	E	F	G	H	I	J

TECH CHECK: http://www.mathsisfun.com/games/advanced-battleship-game.html

- Try using Geometer's Sketchpad:
  - moves the point of rotation
  - labels and displays coordinates. When the point is "dragged" or moved about the grid, the coordinates change as the point moves
  - What are patterns when points moved along line?



POINT and GRID QUIZ

1. What are at least 3 ways to define a 'point'. A point is:

- _____
- _____
- _____

2. What is an 'axis' in math?

An axis is: _____

_____

3. How does a grid help you find a location? A grid can help you find a location because: _____

_____

4. Vertical lines around the globe are called: _____

5. Horizontal lines around the globe are called: _____

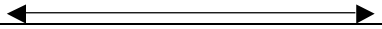
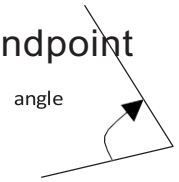
6. Complete one quiz and repeat until you can score at least 80%.

- http://www.bbc.co.uk/bitesize/quiz/q10093127
- http://www.bbc.co.uk/bitesize/ks3/maths/algebra/coordinates/activity/
- https://www.ixl.com/math/grade-4/coordinate-planes-as-maps

How well did I do this quiz?	Trailblazer ☺ (Expert)	Pathfinder (Apprentice)	Rookie - Not Yet (Novice)

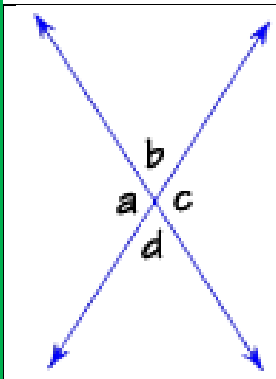
B. Lines and Angles

CHECK-IN: Maybe you already know all this? Show your teacher what you know!
*Go to Page 42 and try the Lines and Angles Quiz.
****It is okay to say "I don't know" ☺

GLOSSARY UP FRONT
plane = flat surface that continues in all directions
line = continuous points that go straight **indefinitely in two directions.** 
line segment. The part of a line between two points on a line. A B
acute angle = An angle whose measure is between 0° and 90°
acute triangle = A triangle whose angles all measure less than 90°.
obtuse angle - An angle that measures more than 90° and less than 180°.
right-angle = an angle of 90°, as in a corner of a square or at the intersection of two perpendicular straight lines
straight angle = an angle of 180° (part of a straight line)
adjacent angle = One of two angles that have a common vertex and common side
angle = • pair of 2 rays with same endpoint, rays forms sides of angle • shape formed by two rays or two line segments with a common endpoint • Measuring angles involves finding the amount of rotation between two rays or line segments with a common endpoint or vertex 
ray = has one endpoint that extends in one direction indefinitely
opposite rays = have 2 endpoints that extend indefinitely in opposite directions
parallel lines = two lines in the same plane that do not intersect
vertex = where two rays meet in an angle
rotation – when lines rotates away from line – creates an angle

3. Intersecting Lines

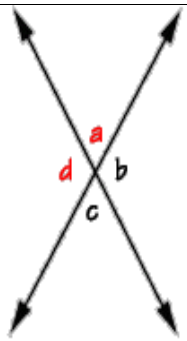
RULE: Vertical angles (opposite each other) are formed when two lines or line segments intersect. When two lines cross, the adjacent angles (next to each other) add up to 180 degrees.



$\angle b \cong \angle d$

$\angle a \cong \angle c$

Vertical Angles



$\angle a$ and $\angle d$
$\angle a$ and $\angle b$
$\angle b$ and $\angle c$
$\angle d$ and $\angle c$

Adjacent Angles

EXAMPLES:

If Angle ABC = 35 degrees is formed by two intersecting lines, then,

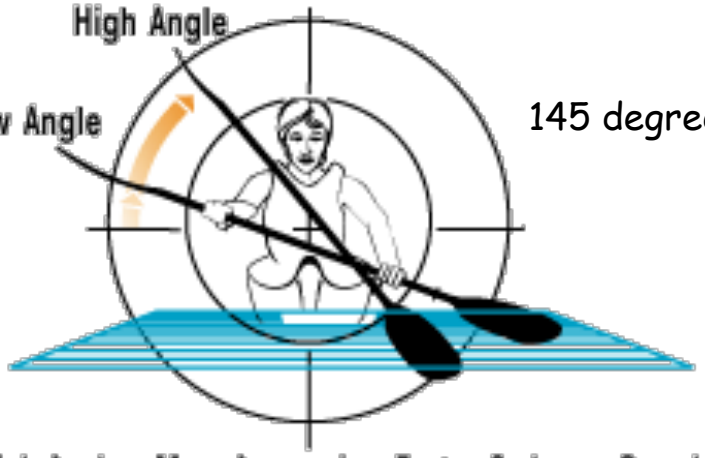
(a) what does the opposite angle equal?

(b) what would the adjacent angle equal?

Opposite angle = 35 degrees

Adjacent Angle = 180 – 35 = 145 degrees

http://www.austinkayak.com/blog/wp-



High Angle - More Aggressive, Faster Cadence, Speed
Low Angle - Common Paddling Style, Relaxed Cadence, Endurance

content/uploads/2014/03/HighLowangle13.gif\

FUN & GAMES: The Math and Science of Golf

http://pad1.whstatic.com/images/thumb/8/81/Hit-a-Golf-Ball-Step-2.jpg/aid3835591-728px-Hit-a-Golf-Ball-Step-2.jpg

Club Slope	
Putter	0°
Sand Wedge	56°
Pitching Wedge	47°
9 Iron	43°
8 Iron	39°
7 Iron	35°
6 Iron	31°
5 Iron	27°
4 Iron	24°
3 Iron	21°
5 Wood	20°
3 Wood	15°
Driver	10°

http://s.hswstatic.com/gif/golf-club-table.gif

This would be easy if everyone had the same swing! What happens when a human swings a golf club. They usually add or reduce the

_____ _____ _____ _____ _____ of the swing ☹

Food Angles

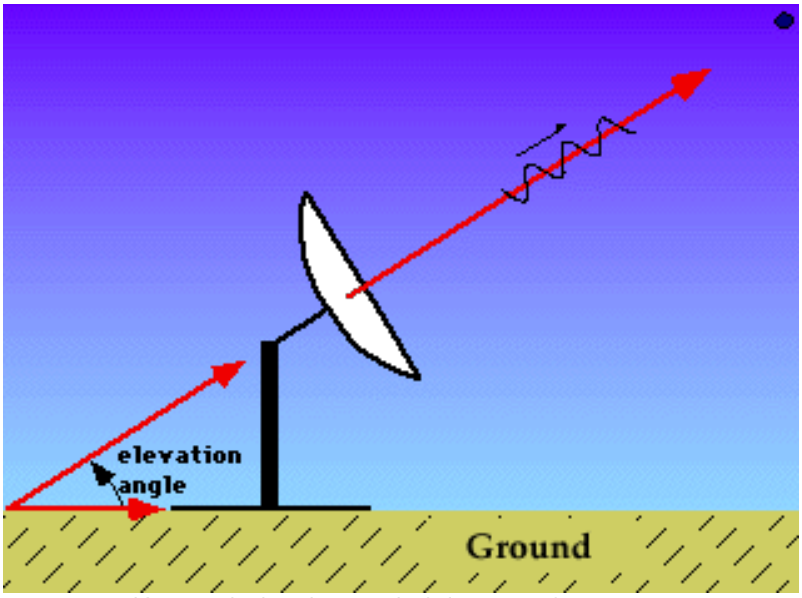
- Make or order a square and a round pizza.
- Use the pizza cutter to divide them as evenly as possible so everyone gets a slice and a square.
- Which pizza was more difficult to cut into equal portions?

https://img.buzzfeed.com/buzzfeed-static/static/2016-08/8/17/enhanced/buzzfeed-prod-fastlane01/enhanced-26392-1470693572-1.png

TECH CHECK:

- http://www.edhelper.com/math/math_fifth_grade_FIVE33.htm
- http://www.edhelper.com/math/math_fifth_grade_FIVE34.htm
- http://www.edhelper.com/math/math_fifth_grade_FIVE87.htm
- http://www.walkerart.org/ace/ed_activities/units_i/wac_l1i_linedesign/1learn.html

Painless Geometry Reference Book (pp. 55-59)



http://ww2010.atmos.uiuc.edu/Guides/rs/rad/basics/gifs/angl2.gif

GOT IT!

- Show how to determine the vertical and adjacent angles formed from two intersecting lines with the following angles:

(a) Angle ABC = 127 degrees

(b) …… Angle NBC = 83 degrees

(c) Angle XYZ = 19 degrees

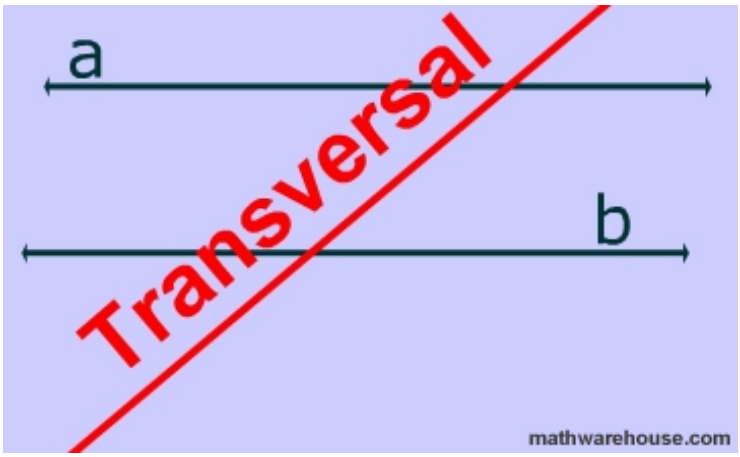
How well did I do this quiz?	Trailblazer ☺ (Expert)	Pathfinder (Apprentice)	Rookie - Not Yet (Novice)

Essential Target (ET) - Identify parallel lines.

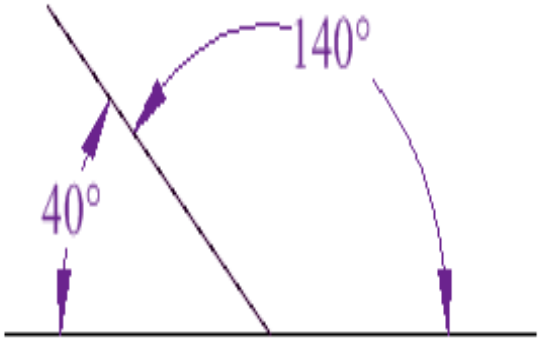
4. Parallel and Perpendicular Lines

RULE: Perpendicular lines form when lines intersect at right angles. Parallel lines can never intersect. Transversal lines intersect parallel lines by cutting through them – thus forming many different angles (Interior, Exterior, Complementary, Supplementary, Alternate, and Corresponding).

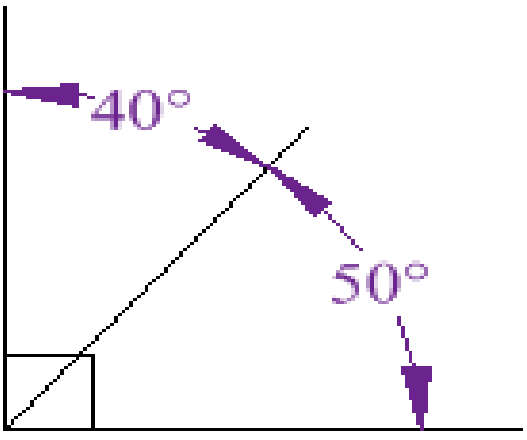
EXAMPLES:



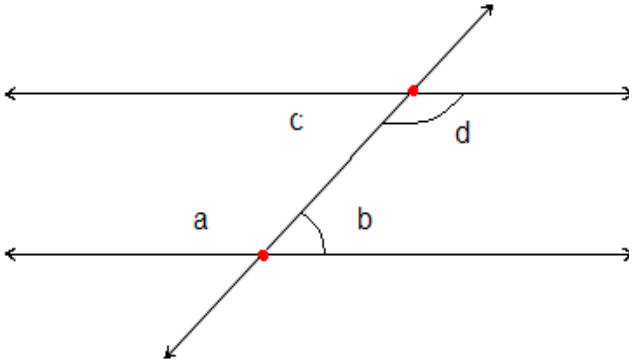
Supplementary Angles
(add up to 180 degrees)



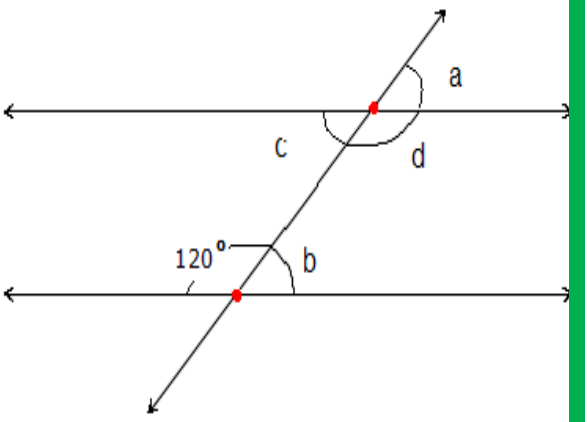
Complementary Angles
(add up to 90 degrees)



Interior Angles



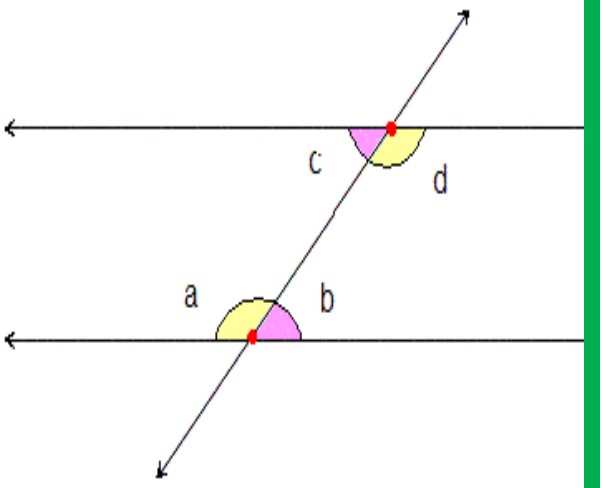
Exterior Angles



Alternate angles are equal
They form a Z shape.

Angle c = Angle b (Alternate Angles)

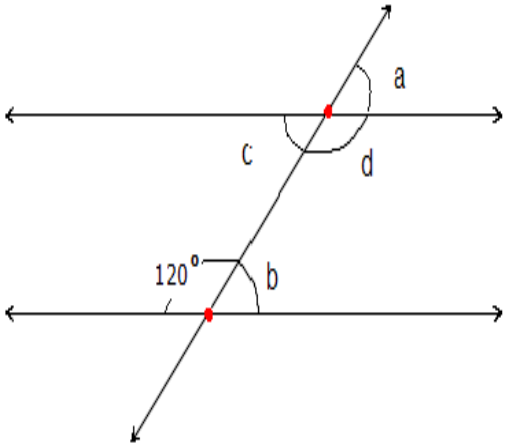
Angle a = Angle d (Alternate Angles)

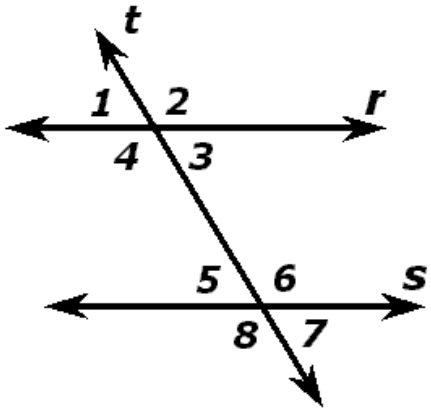


Corresponding angles are equal when the two lines intersected are parallel.

Angle b = Angle a (Corresponding Angles)

They form an F shape.





Supplementary Angles - (1 + 2), (4 +3), (5 +6), (8 +7), (1 + 4), (2+ 3), (5 + 8), (6 + 7)
There are 0 Complementary Angles.
Interior Angle 3 with Exterior Angles - 1,2 + 4
Interior Angle 8 with Exterior Angles - 5, 6 + 7
Alternate Angles (4 =6), (3 = 5)
Corresponding Angles = (1, 5), (4, 8), (6, 2), (5, 1)

TECH CHECK:

- http://www.mathsisfun.com/geometry/parallel-lines.html
- http://www.algebralab.org/lessons/lesson.aspx?file=Geometry_AnglesParallelLinesTransversals.xml
- http://www.shodor.org/interactivate/activities/Angles/
- http://www.mathwarehouse.com/geometry/angle/transveral-and-angles.php
- http://www.math.com/school/subject3/practice/S3U1L3/S3U1L3Pract.html
- http://www.math.com/school/subject3/practice/S3U1L5/S3U1L5Pract.html
- http://www.ies.co.jp/math/products/geo1/applets/kakuhei/kakuhei.html
- http://www.keymath.com/DG/dynamic/parallel_lines.html

Painless Geometry Reference Book (pp. 59-72)

RECIPROCAL TEACHING:

- "Like a teacher" explain how to you can measure and compare angles.
- Share examples and teach about measuring and comparing angles to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

GOT IT!

1. Angle AEP = _____ degrees because it is a

   _____angle to Angle _____.

2. Angle AEQ = ___ degrees because it is a

   _____angle to Angle _____.

3. Angle BFA = _____ degrees because it is a

   _____angle to Angle _____.

4. What is the corresponding angle for RFA? Angle _____.

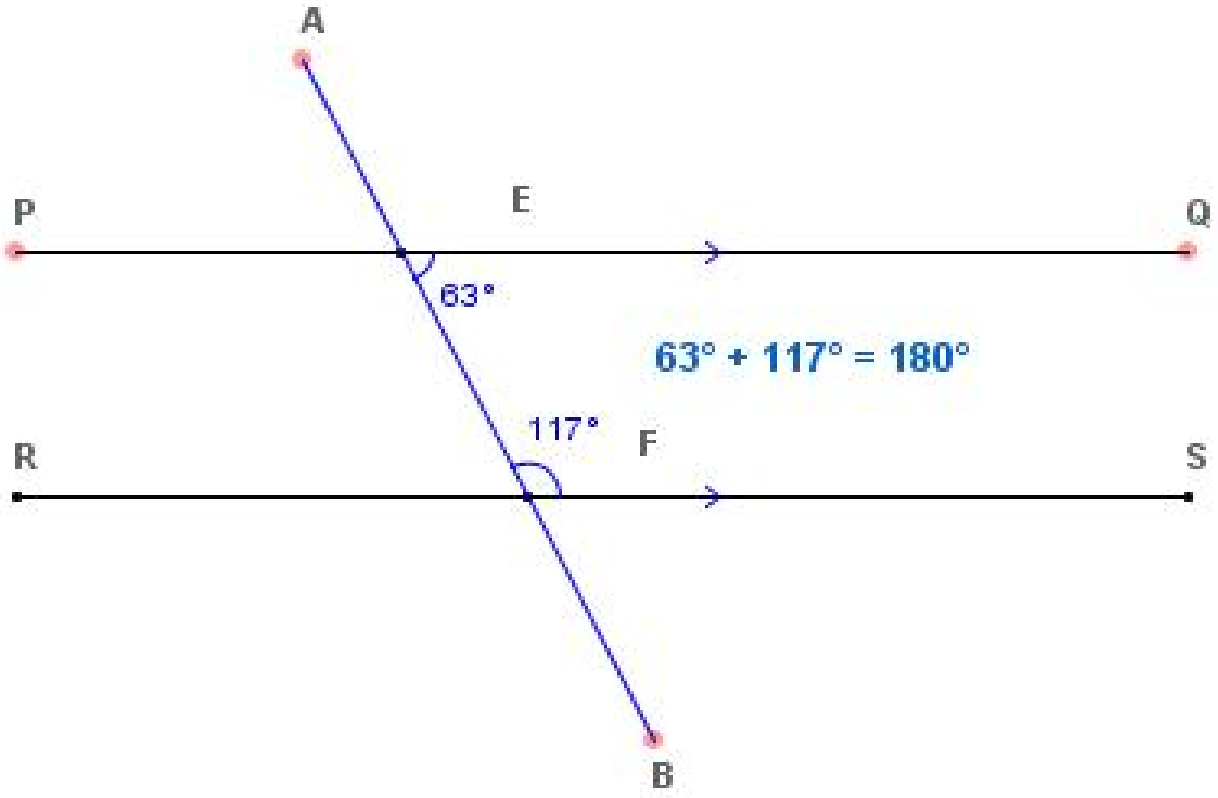
5. What are the interior and exterior angles?

   Interior angle: _____ Exterior angle: _____

6. What are the alternate angles?

   Alternative Angles: _____

7. Why are there no complimentary angles?



8. Draw a set of lines that are intersected by a transverse line. List the complementary, interior, exterior, alternate and corresponding angles.

9. Why do we need walls that are perpendicular to the floor?

http://superslim-system.com/images/img_0047405x270.jpg

8. What angles are formed when this floor meets the wall? _____

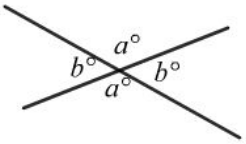
How well did you identify parallel lines.?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

Extension:_In England, they use the term "Opposite Angles" (See diagram below). What did we call it? _____

- What do you think a "Mnemonic" is? Now look it up in the dictionary. How does a 'mnemonic' help you learn?

ome Useful Properties of Angles ...

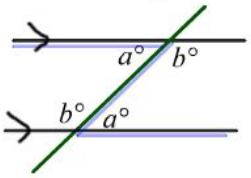
pposite Angles



When two lines intersect, the angles opposite each other at the point of intersection are congruent.

Mnemonic: X

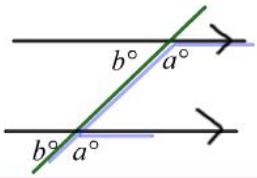
Alternate Angles



Angles on alternate sides of a transversal are congruent.

Mnemonic: Z

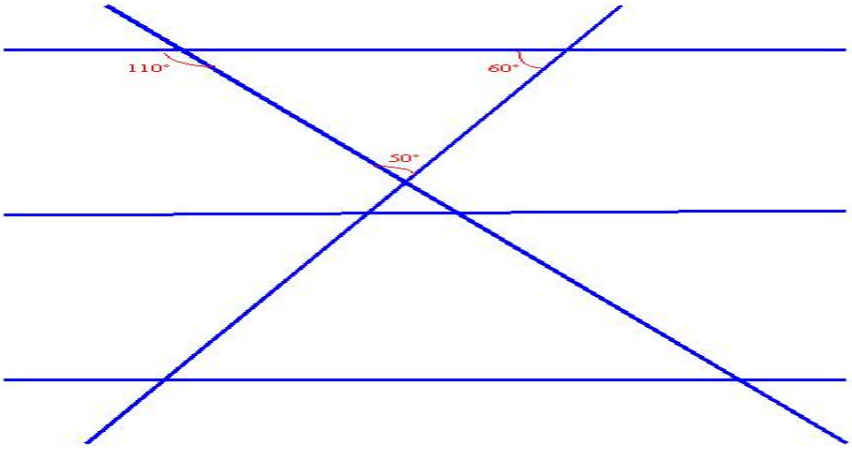
Corresponding Angles



Angles on coresponding sides of a transversal are congruent.

Mnemonic: F

- Fill in the measures of as many angles as you can.



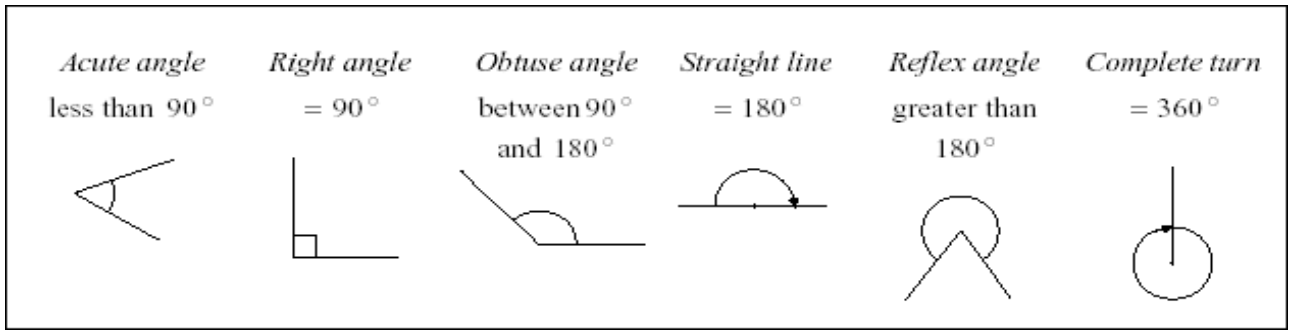
- Identify parallel lines within 2D figures.
- Classify angles (complementary & supplementary) & apply tests of congruency

5. Name that Angle (Measuring and Comparing Angles)

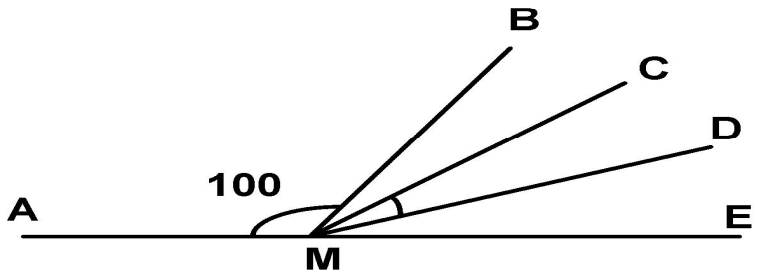
***RULE*:** To name an angle, you may need to look, add/subtract with degrees, and measure angles with protractors. You need to know that there are 360 degrees in a circle and 180 degrees in a straight line.

EXAMPLES:

- Take a look at the 'Angle Line-Up':



http://www.cimt.plymouth.ac.uk/projects/mepres/book8/bk8i11/bk8_11i1.htm



Angle CMB = Angle AMD Angle AMD + Angle CMA = 180°

Example of SAT question with angles:

In the figure, Angle AMB is 100°, angle BMD is 40° and angle CME is 60°.

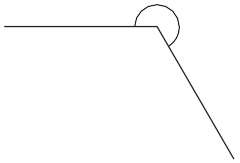
- What do you think is the value of angle CMD? (*Figure not drawn to scale)*
  (a) 20° (b) 30° (c) 40° (d) 50° (e) 80°

http://www.free-test-online.com/geometry-review

Answers:
If angle AMB is 100^{o}, then angle BME is $180^{o} - 100^{o} = 80^{o}$ BMC + CMD = 40^{o} BMC + CMD + DME = 80^{o}
If we subtract the 2 equations, DME = 40^{o} CMD + DME = 60^{o} BMC + CMD + DME = 80^{o}
If we subtract the 2 equations, BMC = 20^{o} CMD = BME - BMC - DME = $80^{o} - 40^{o} - 20^{o} = 20^{o}$

Extension: The outside angle is called the Reflex Angle. This is the angle that measures more than 180° and less than 360°.

reflex angle



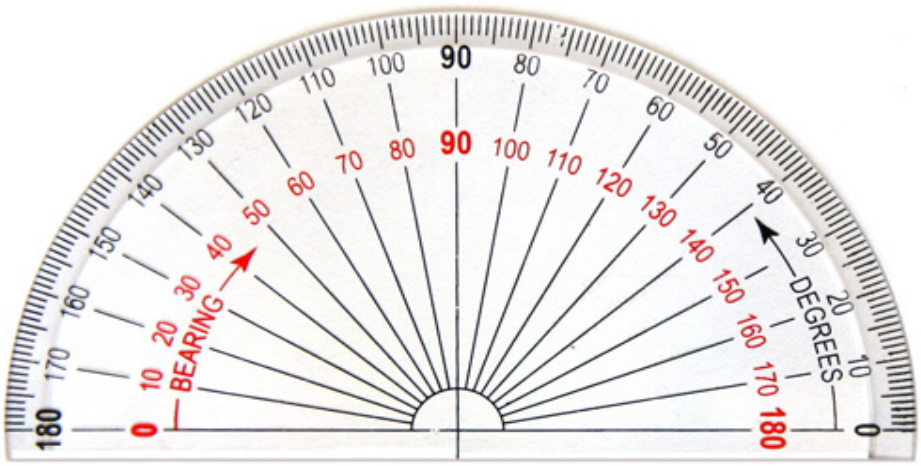
- Use a picture frame, a carpenter's square or another object with a right angle (90 degrees) to help draw an angle in the boxes below that is greater than, less than or equal to 90 degrees. Indicate if each angle is either acute, obtuse, right, straight or reflex.

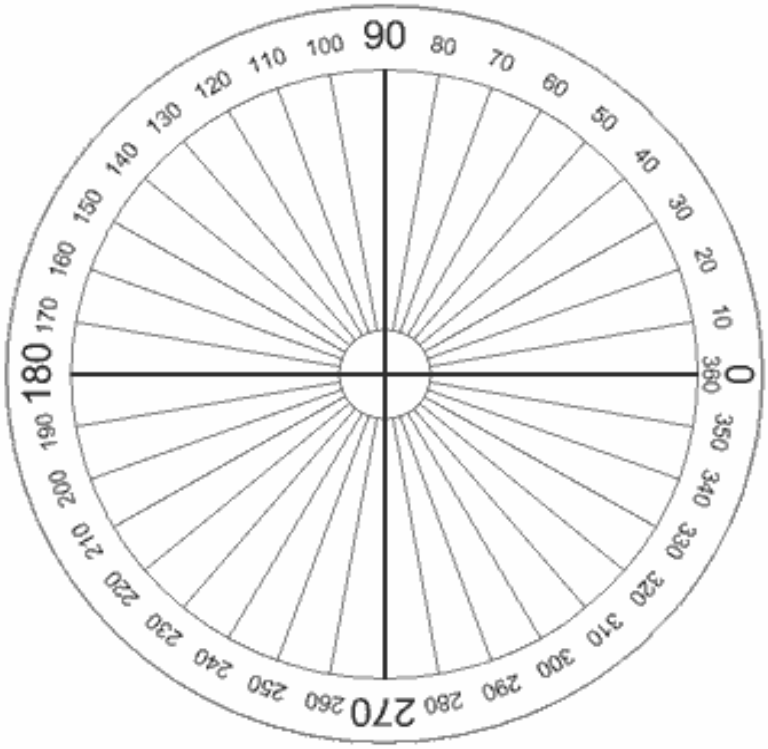
45 °	90 °	25 °

30 °	120 °	60 °
135 °	15 °	55 °
115 °	180 °	25 °

An angle is a measure of a turn, and can be classified by **degree of rotation.**

Measuring Angles using a Protractor. Listen and view the following You Tube from Jedi Teacher! http://www.youtube.com/watch?v=FeclDm7pVcI&feature=related

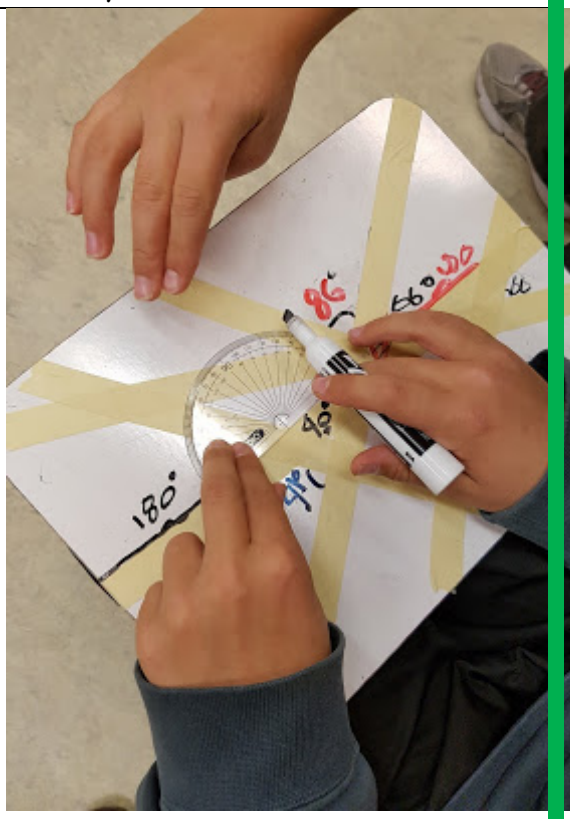




http://www.copernicusproject.ucr.edu/ssi/2007PhysicsRes/protractor.gif

FUN & GAMES: Tape Angles

- Use colourful or masking tape to tape lines that intersect across the whiteboard,
- Measure angles made by the tape.
- In pairs, use different colours and take turns measuring one angle at a time – or erasing and correcting inaccurate measures,



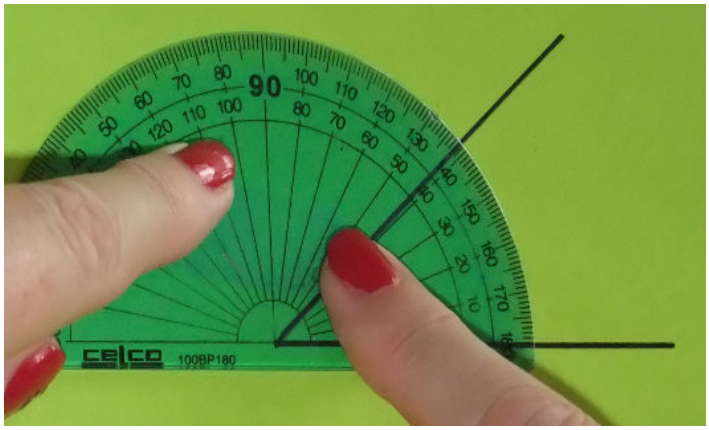
- Take a look at the following angles.

- Do you think these angles are…

  (a) different? OR
  (b) the same?

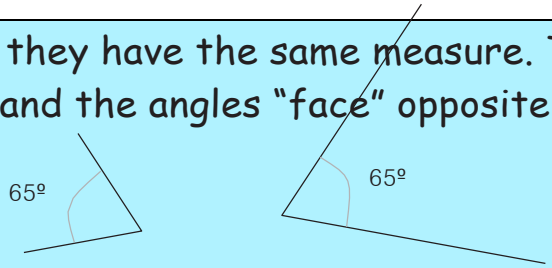
This is tricky because - the angles are all equivalent.
It is the line segments that are different.

- Measure to check it out!



http://www.mathsaccelerator.com/geometry/images/protractor.jpg

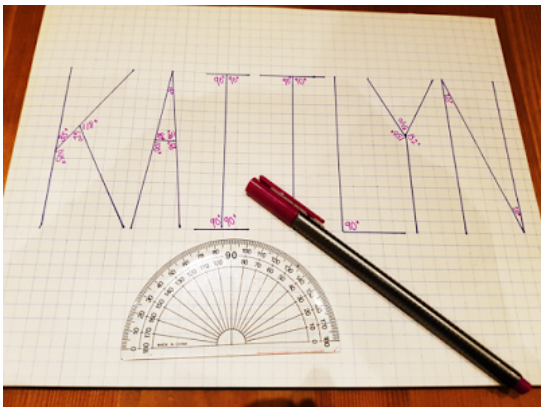
RULE: Two angles are congruent because they have the same measure. The fact that the rays are different lengths and the angles "face" opposite directions does not affect congruence.



FUN & GAMES: Building Letters with Angles

- Work with a younger buddy to make grid lines.
- What is the kind of angle made by intersecting lines in a grid?

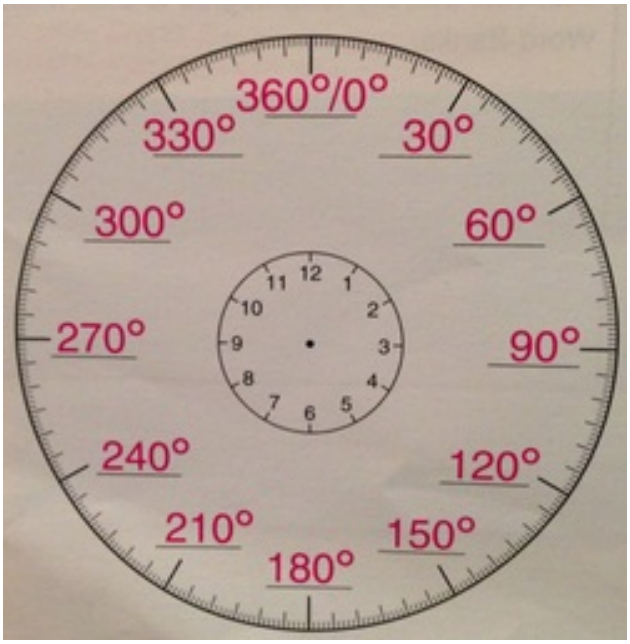
  _____ _____ _____ _____ _____ angle
- Use the lines to make name posters.



- Use a ruler to make the grid lines and the letters.
- Talk about which letters have the larger angles
- Show younger students how you measure angles in each letter
- Show your teacher adjacent, complementary and supplementary angles located within different letters.

TIME for Angles

- Make a protractor clock by making 2 protractors and dividing it into 12 sections.



http://weverworld.weebly.com/uploads/3/1/8/9/3189646/9327330.jpg

- What time do you think the following degrees are:

Degrees	12-hour clock	24-hour clock
60 degrees		
150 degrees		
180 degrees		
270 degrees		
300 degrees		

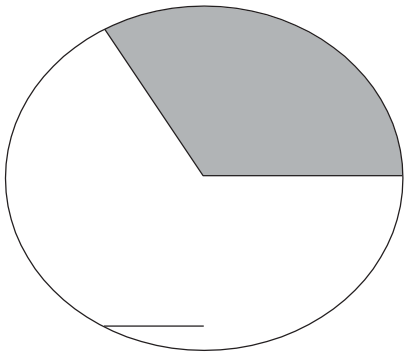
Angles on Spinners

- Look at Spinner A and Spinner B
- Do you think the spinner will land on Spinner A or B?

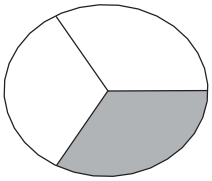
I predict the spinner will land in the coloured section more often in:
(a) Spinner A
(b) Spinner B
(c) Neither

- Make a large and small spinner with the same angles using pie plates.
- Spin the spinner 10 times on each and keep track of how often the spinner landed in the coloured area.

Spinner A



Spinner B



Solution: There should be no effect on where the spinner is larger or smaller – if the angles remain the same on both spinners.

- Did our class discover this finding? Yes No In some cases

TECH CHECK:

- http://www.amblesideprimary.com/ambleweb/mentalmaths/protractor.html
- http://www.math.com/school/subject3/lessons/S3U1L4GL.html
- http://www.math.com/school/subject3/practice/S3U1L4/S3U1L4Pract.html
- http://www.math10.com/en/tests/types-of-angles/typesofangles.html
- http://www.amblesideprimary.com/ambleweb/mentalmaths/angleshapes.html
- http://www.studyzone.org/testprep/math4/d/protractorl.cfm

Painless Geometry Reference Book (pp. 21-55)

RECIPROCAL TEACHING:

- "Like a teacher" explain how to you can measure and compare angles.
- Share examples and teach about measuring and comparing angles to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

GOT IT!

1. A Protractor is:
    a. A device used for making a perfect circle
    b. A device used for measuring circumference
    c. A device used for measuring the number of degrees in an angle
    d. A device used for measuring the number of degrees in a circle

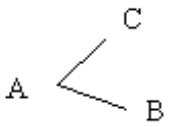
2. If an angle has 90 degrees, it is said to be:
    a. A right angle
    b. An obtuse angle
    c. An acute angle

3. An obtuse angle is:
    a. The same as a right angle
    b. More than 90 degrees
    c. Less than 90 degrees
    d. The same as an acute angle

4. This angle is:

    a. an acute angle
    b. a right angle
    c. an obtuse angle

5. When naming parts of this angle, which is correct?



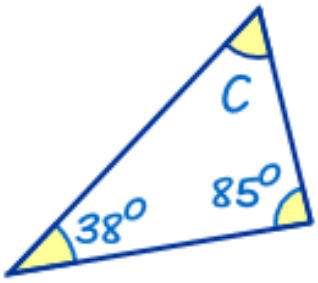
    a. ACB b. ABC c. CAB

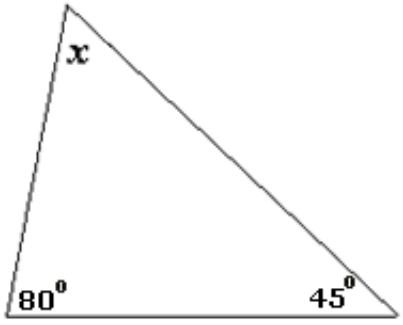
6. When measuring an acute angle, you should read the lesser number.
   a. True b. False

7. When measuring an obtuse angle, you should:
   a. Assume the angle is 90 degrees
   b. Read the larger number
   c. Read the smaller number

8. The marking for 90 degrees is
   a. A right angle
   b. At the very top of the protractor
   c. The only spot on the protractor where there is only one number
   d. All of these

9. Complete the following task to show you can find the missing angle in the following triangles:





C= _____ degrees X = _____ degrees

10. Now show your teacher how well you can read angles using a protractor:
http://henryanker.com/Math/Measurement/Protractor_Set_03.swf

How well did I do this task?	Trailblazer ☺ (Expert)	Pathfinder (Apprentice)	Rookie - Not Yet (Novice)

LINES and ANGLES QUIZ

1. Complete these quizzes to check your 'bearings':
   (a) http://www.quia.com/quiz/446727.html?AP_rand=339840366
   (b) http://www.mcwdn.org/Geometry/LinesQuiz.html

2. What is the difference between a line and a line segment:

- A line segment _____

  _____

- A line _____

_____

3. What are four different kinds of angles?

4. Show your teacher how to measure four types of angles using a protractor.

5. Complete the following quizzes:
   (a) http://www.math.com/school/subject3/S3U1Quiz.html
   (b) http://www.quia.com/quiz/446727.html?AP_rand=339840366
   (c) http://www.mcwdn.org/Geometry/LinesQuiz.html

How well did I do this task?	Trailblazer ☺ (Expert)	Pathfinder (Apprentice)	Rookie - Not Yet (Novice)

C. 2D FIGURES

CHECK-IN: Maybe you already know all this? Show your teacher what you know!
*Go to Page 72 and try the 2D Figures Quiz.
****It is okay to say "I don't know" ☺

GLOSSARY UP FRONT
polygon (regular) = all angles are equal; all sides are same length
irregular polygon = not all sides and all angles are equal
triangle = polygon with 3 sides
quadrilateral = polygon with 4 sides
pentagon = polygon with 5 sides
hexagon = polygon with 6 sides
heptagon = or septagon = polygon with 7 sides
octagon = polygon with eight (8) sides
diagonal = `line connecting two adjacent vertices
congruent = having the same size and shape
transformed shape = congruent to the original shape. Shapes that are transformed by reflection, translation, or rotation exhibit congruence
symmetry = line of symmetry divides a shape into two congruent parts that can be matched by folding the shape in half
order of rotational symmetry = number of times the position of a shape coincides with its original position during one complete rotation about its centre. (ie. a square has rotational symmetry of order 4)
Rotation - A rotation is a transformation that moves every point in a shape or figure around a fixed point
Reflection = A line of reflection acts as a mirror in the form of a perpendicular bisector so that corresponding points are the same distance from the line of reflection (**flip)**
Translation = A translation is a transformation that slides every point of a shape the same distance in the same direction
Spatial orientation = ability to locate and describe objects in space, and to carry out and describe transformations of objects
Spatial visualization = ability to imagine, describe, and understand movements of two- and three-dimensional objects in space

6.Classifying Polygons: Sides, Vertices, Angles and Diagonals

RULE: You can classify polygons according to the number of sides and vertices, the number of diagonals, and the number of degrees in each figure.

EXAMPLES:

# of Sides	Name	Picture	Sum of Interior
3	Triangle		180°
4	Quadrilateral		360°
5	Pentagon		540°
6	Hexagon		720°

http://images.slideplayer.com/15/4532016/slides/slide_8.jpg

# of Sides	Name	Picture	Sum of Interior
7	Heptagon		900°
8	Octagon		1080°
9	Nonagon		1260°
10	Decagon		1440°

http://images.slideplayer.com/15/4532016/slides/slide_9.jpg

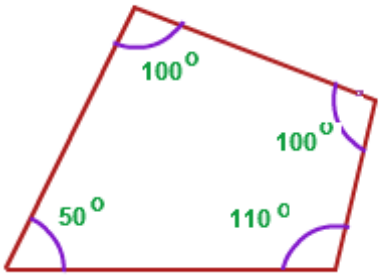
A polygon is the name for a figure.

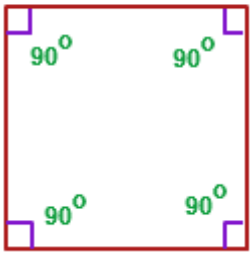
- Fill in the word polygon below:

_____ _____ _____ _____ _____ _____ _____

Regular polygons: all angles are equal, and all sides are the same length.
Irregular polygons: **not all angles are equal, and not all sides are the same length**.

These two figures are both quadrilaterals: the square is a regular polygon.

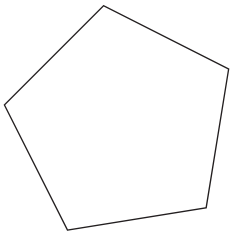


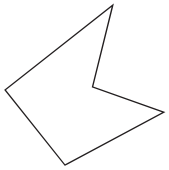


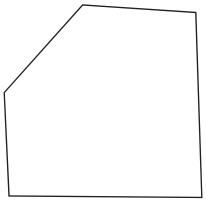
Would a rectangle be a regular or irregular polygon?

_____

- Put an "x" through a regular polygon.







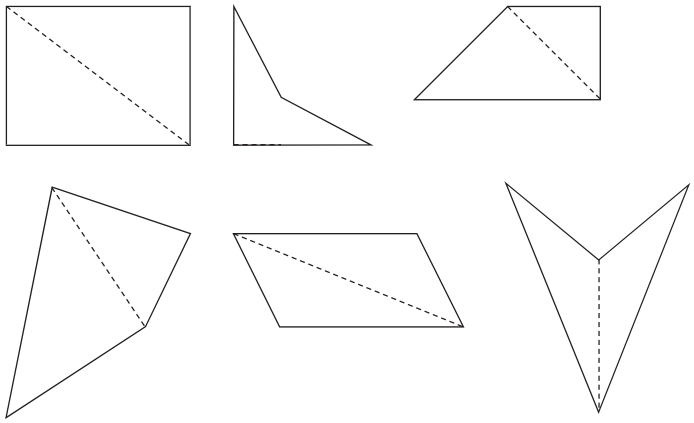
Angles form two line come together at the vertex.
Vertices refers to more than one point

- Fill in the word 'vertex' below:

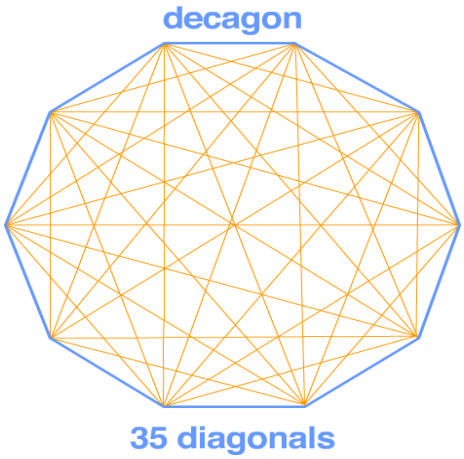
_____ _____ _____ _____ _____ _____

You can draw diagonals by joining two vertices.

Diagonals on polygons go from one vertex to another.
Think about the relationship between quadrilaterals and triangles.
All quadrilaterals can be decomposed into two triangles.



- Can you count the 35 diagonals in a decagon? (10-sided polygon).



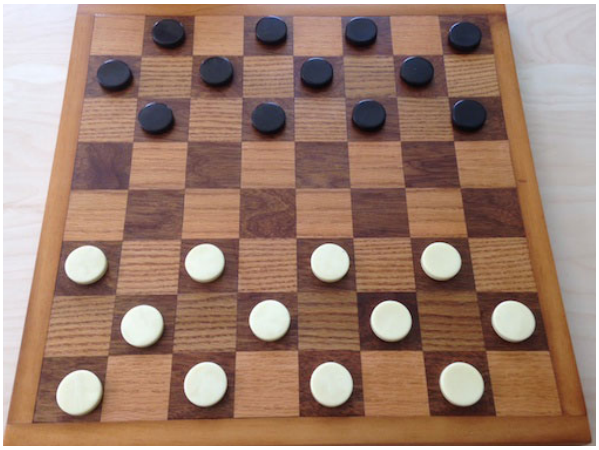
NOT - a polygon!

- Circle
- Open figure that is not closed in.

REAL WORLD STUFF:

Tessellation = is any pattern made of repeating shapes that covers a surface completely without overlapping or leaving any gaps.

A checkerboard is a tessellation made of squares. The squares meet edge to edge with no gaps and no overlapping areas.



http://pop.h-cdn.co/assets/cm/15/05/54cb34f08ddae_-_diy-checkerboard-01-0514-de.jpg

The pattern of bricks on a wall is a tessellation made of rectangles.

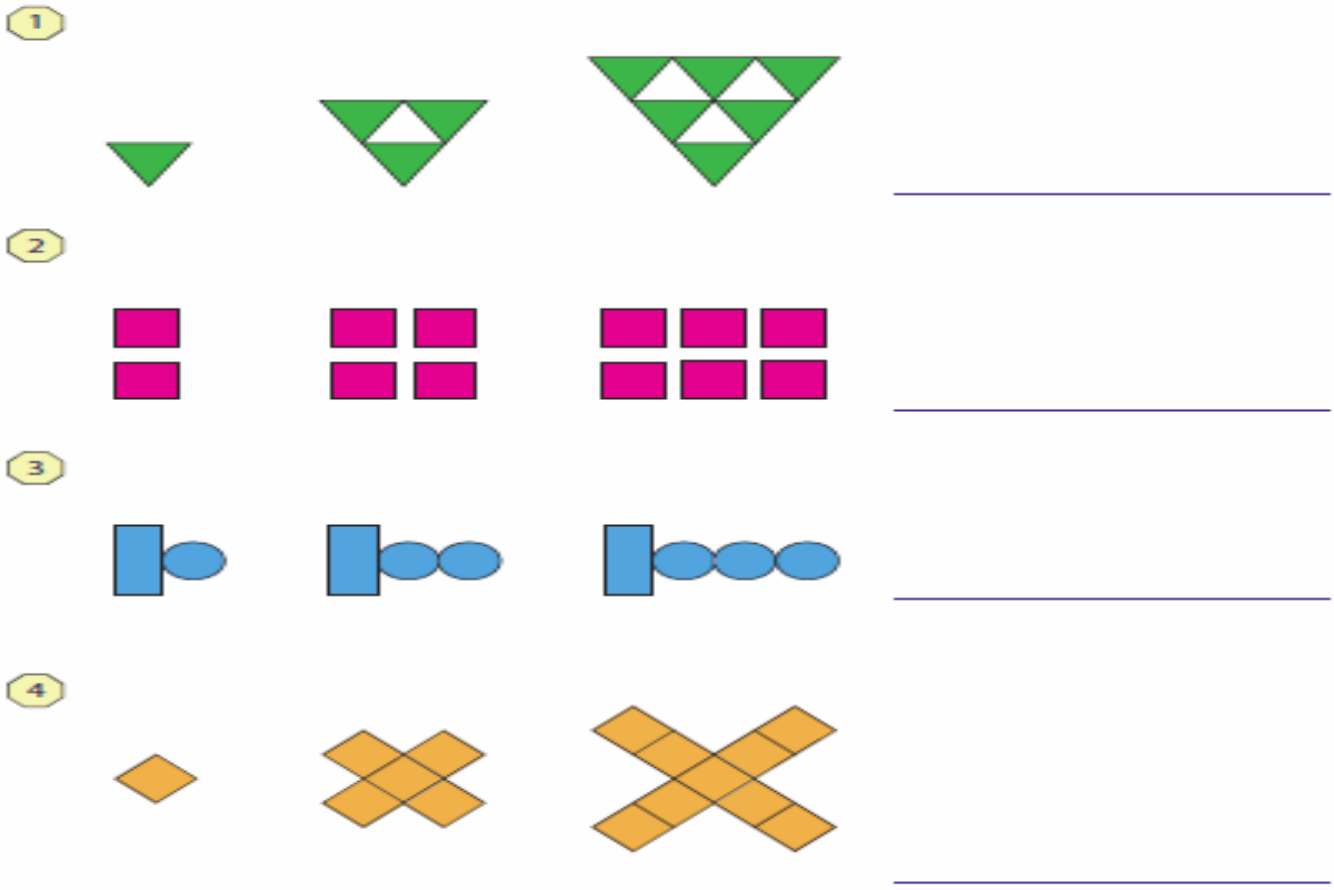
http://img.archiexpo.com/images_ae/photo-g/90648-8690815.jpg

Did you Know?
Over 2,200 years ago, ancient Greeks were decorating their homes with tessellations, making elaborate mosaics from tiny, square tiles. Early Persian and Islamic artists also created spectacular tessellating designs. More recently, the Dutch artist M. C. Escher used tessellation to create enchanting patterns of interlocking creatures, such as birds and fish.

Geometric Patterns

- Create a pattern block train by alternating one green triangle with one red trapezoid.
- Predict which block will be in the 30th place. _____

- What pattern will come next?



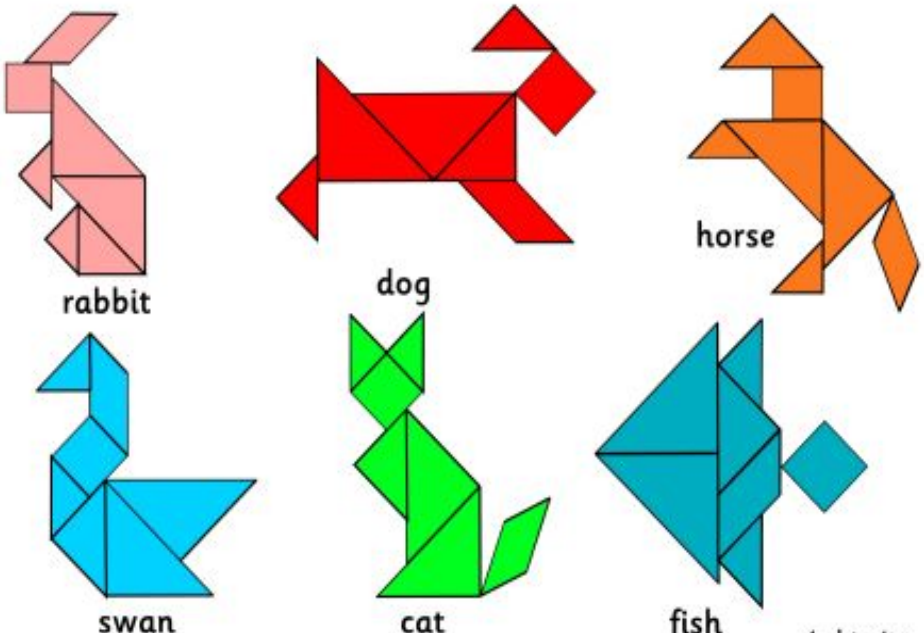
http://www.mathworksheets4kids.com/patterns/growing-type2-large.png

FUN & GAMES: Toothpick Square

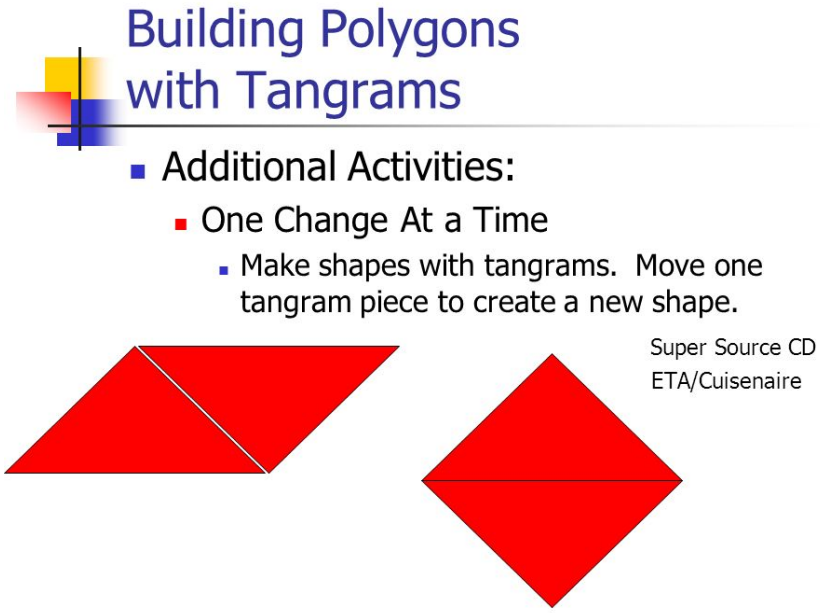
- Create toothpick squares that show the sequence 4, 7 and 10. What is the next number in the sequence? Represent this pattern with a picture of toothpicks, and on a number line.

Tangram Talent

- make the original square; make a chair, make a cat, make a dog, make a fish, make a rabbit, make a rocket…



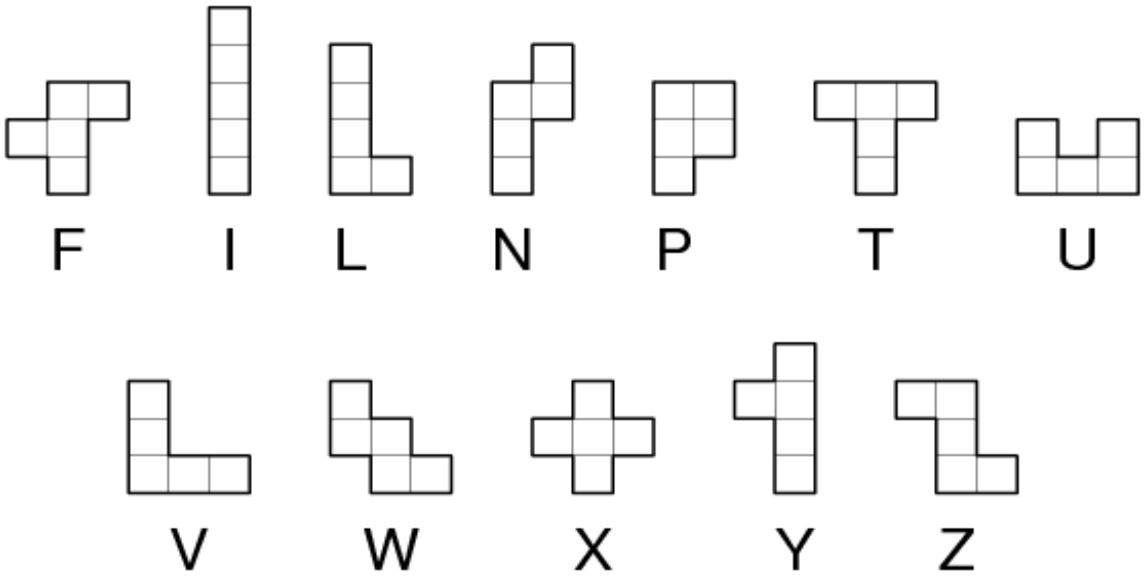
http://www.activityvillage.co.uk/sites/default/files/images/tangram_solutions_2_460_0.jpg



http://images.slideplayer.com/18/6185754/slides/slide_86.jpg

- Compose a hexagon using different numbers of smaller shapes.
- Make a house and place the tangram map below:

- Hands on: Make pentomines using maps – and then use pentomines to create images to create new maps.



http://wiki.logic-masters.de/images/6/61/Pentominos.png

Clock Wise

Everyone will be working in pairs to design a special class clock. Part of your proposal submission will involve becoming **Pattern Detectives**. You will need to prepare and present a report to the Pattern Commission on the geometric nature of the clock. The pair that comes up with the most patterns will be selected to design our class clock. Here are some hints to get you started on finding patterns!

What patterns do you see?

(a) between number of vertices and number of sides?

(b) between number of diagonals and increasing number of sides of polygons?

(c) Between the number of degrees and the increasing number of sides?

We propose that a clock features the following patterns:

TECH CHECK:

- https://www.youtube.com/watch?v=IaoZhhx_I9s
- https://www.youtube.com/watch?v=UeKN5-ogFTs
- https://www.mathplanet.com/education/geometry/points,-lines,-planes-and-angles/polygons
- http://www.mathsisfun.com/puzzles/jigsaw.html?img=morpho-butterfly.jpg&name=Morpho%20Butterfly
- http://www.mathsisfun.com/puzzles/jigsaw-puzzles-index.html

RECIPROCAL TEACHING:

- "Like a teacher" explain how different polygons have distinct sides and vertices.
- Share examples and teach about polygons to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

GOT IT!

- Fill in the chart below with your findings:

Polygon	Sides	Vertices
Triangle		
Quadrilateral		
Pentagon		
Hexagon		
Heptagon		
Octagon		
	9	9
Decagon		

- Create an irregular pentagon and hexagon.

My irregular pentagon	**My irregular hexagon**

- Draw a triangle, rectangle, pentagon and hexagon and then create diagonals inside each of these figures to discover the maximum number of diagonals for each polygon!

Polygon Image with diagonals	Total Diagonals	Polygon Image with diagonals	Total Diagonals
Triangle		Quadrilateral	

Polygon Image with diagonals	Total Diagonals	Polygon Image with diagonals	Total Diagonals
Hexagon		Octagon	

How well did I do this task?	Trailblazer ☺ (Expert)	Pathfinder (Apprentice)	Rookie - Not Yet (Novice)

7. Perimeter of Figures

RULE: The perimeter is the distance around an object. A farm or field tends to be square or rectangular in shape, so measuring for a fence to keep farm animals from crossing the road is fairly easy. You simply add up the distance of each side to find out how much fencing to buy!

EXAMPLES

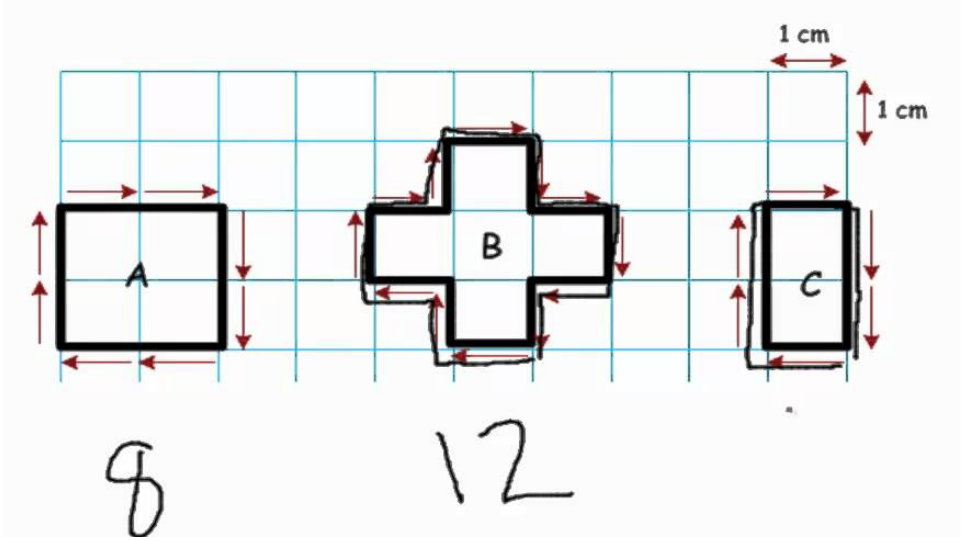


Figure C's perimeter will be: _____.

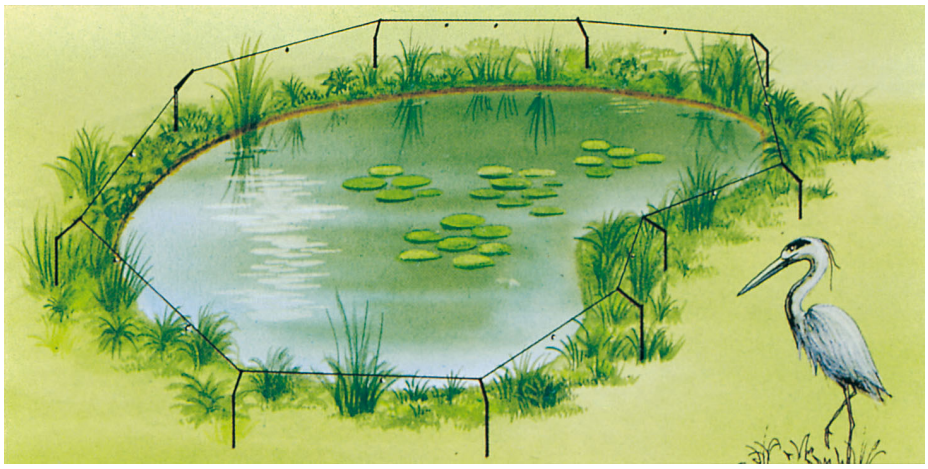
STEP OUTSIDE:

- Measure the perimeter of the play area using a standard measuring tape and a non-standard measure of your choice.
- Make a drawing and mark the lengths of each side using both standard and non-standard measures.
- Be creative with your non-standard measure!

Perimeter of Curved Figures

RULE: Sometimes fences are needed to go around a curved shape like a pond. You can then use string to measure around the curved lines – and then stretch out the string on a ruler or tape measure to find the perimeter.

REAL WORLD PROBLEM:



- Find a curved surface – and measure it with a string.
- Then place the string on a ruler or measuring tape to find out the distance around it.
- Draw and label the image of what you measured.

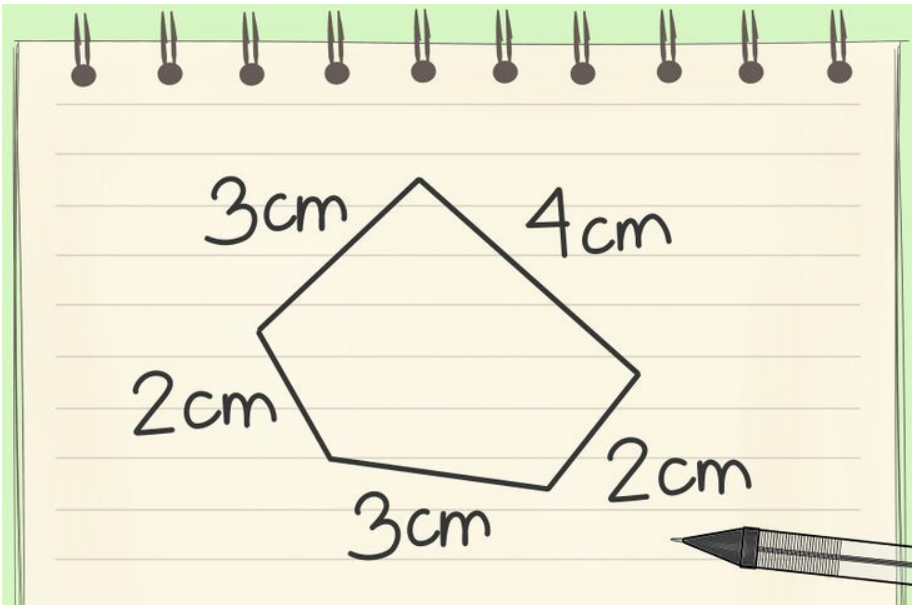
TECH CHECK:

- https://www.youtube.com/watch?v=6mopAgqjkVM
- https://www.youtube.com/watch?v=jmWRW05Bu6I
- https://www.youtube.com/watch?v=8BDkwmieBN0
- https://www.youtube.com/watch?v=AAY1bsazcgM
- https://www.khanacademy.org/math/basic-geo/basic-geo-area-and-perimeter/basic-geo-perimeter/v/introduction-to-perimeter

RECIPROCAL TEACHING:

- "Like a teacher" explain how to you can measure the perimeter of straight and curved figures.
- Share examples and teach about perimeter to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

GOT IT!

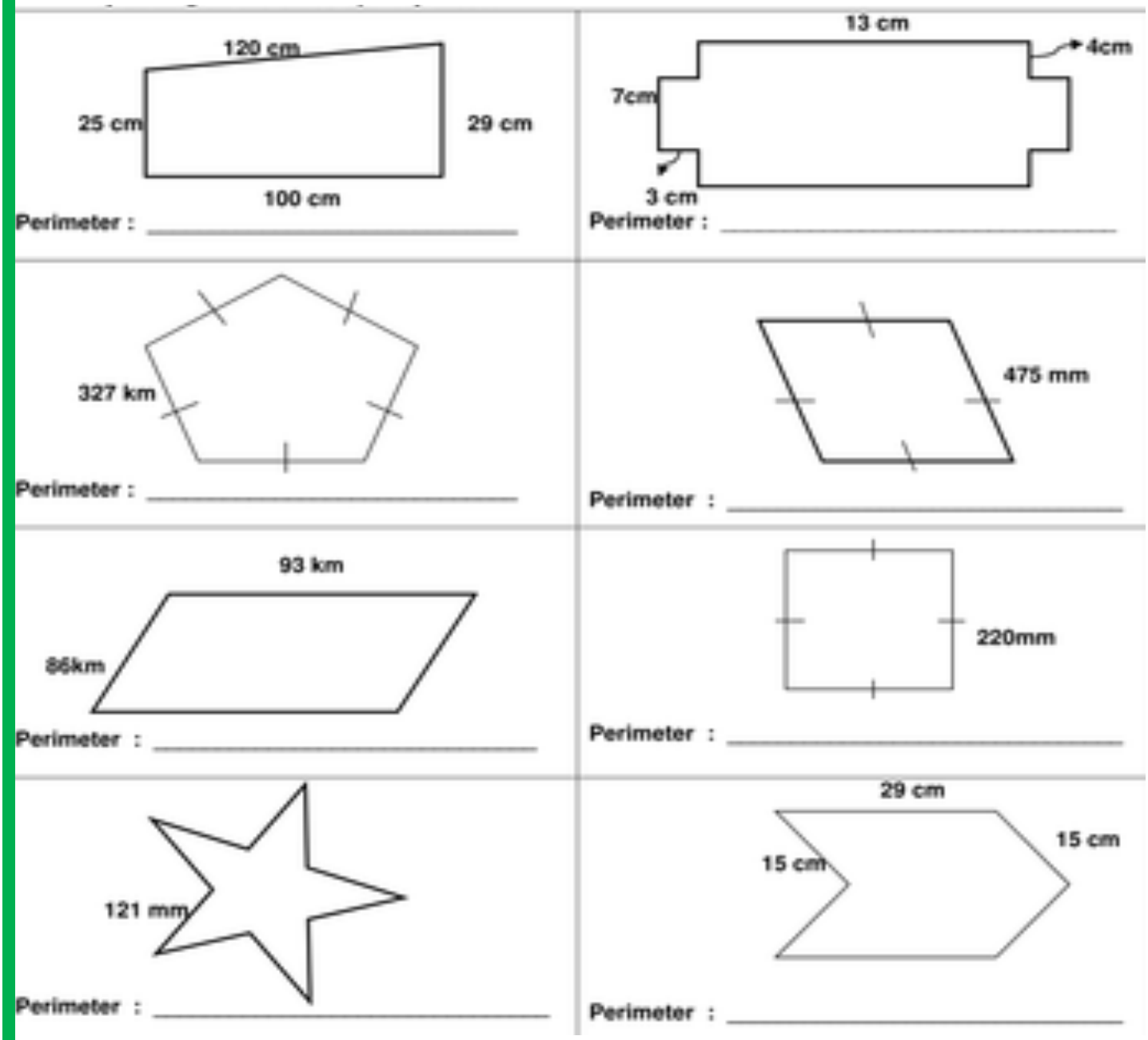


http://pad2.whstatic.com/images/thumb/0/02/Find-the-Perimeter-of-a-Shape-Step-1-Version-2.jpg/aid2830142-728px-Find-the-Perimeter-of-a-Shape-Step-1-Version-2.jpg

The perimeter around this irregular pentagon is:

_____ = _____cm

- Complete the perimeter for 3 images below:



https://d1uvxqwmcz8fl1.cloudfront.net/tes/resources/6186862/f3109690-13ec-42c9-bad0-d5e38f9cfee4/image?width=500&height=500&version=141767397400

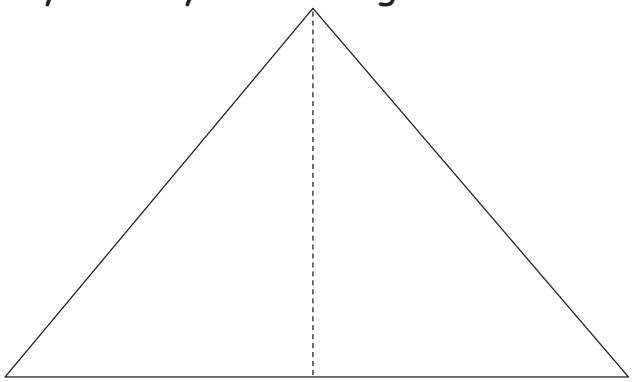
ET- Identify & construct bilateral symmetry & congruency in 2D figures.

8. Symmetry and Congruence

RULE: Polygons can be identified by the number of 'lines of symmetry'. Lines of symmetry divide the size of a shape exactly in half.

http://morganandshelbys100challenge.weebly.com/uploads/1/6/3/2/16322554/5503655_orig.g

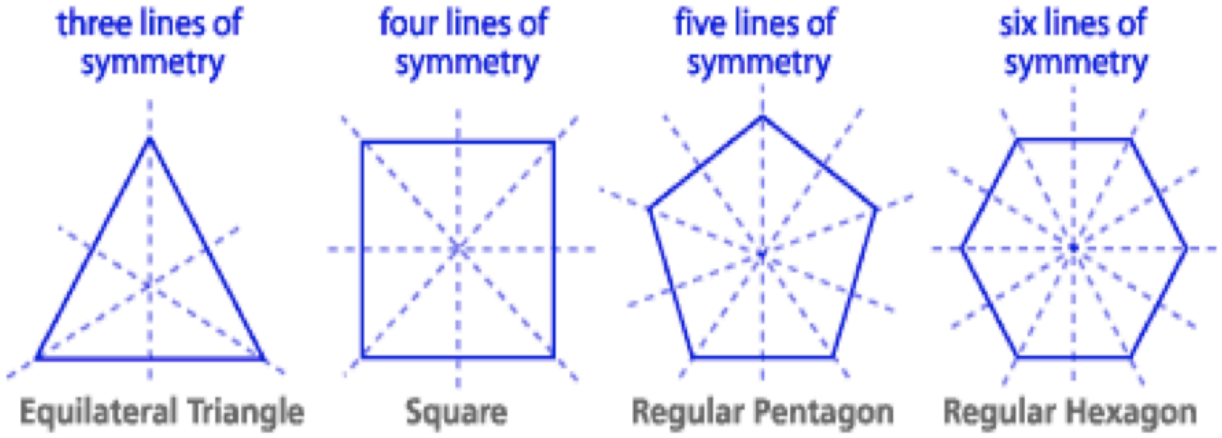
- Look at one line of symmetry in a triangle:



Q: How can you make a line of symmetry in this triangle without drawing or measuring?

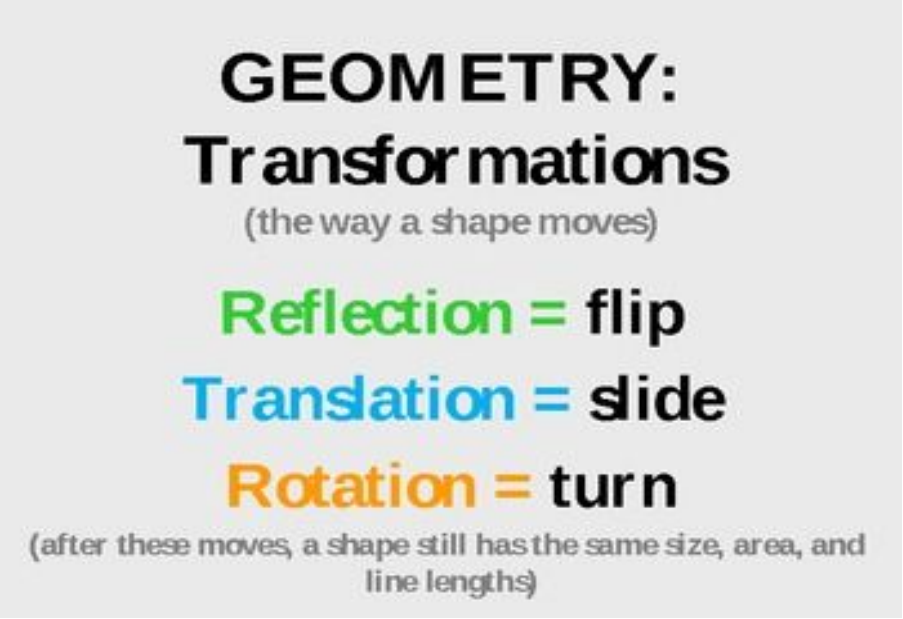
A: Fold it in half ☺

- Now take a look these examples of dotted lines of symmetry:



https://ylgarris.files.wordpress.com/2013/07/lines-of-symmetry-and-regular-polygons.pn

RULE: A transformation means that a figure or object is changing. Transformations happen by reflecting, translating, and rotating actions.



https://s-media-cache-ak0.pinimg.com/564x/85/3b/4c/853b4c5162357aa41e9e197b3f983633.jpg

(a) Reflections (Flips)

The reflection line can be drawn in any direction – horizontally, vertically, or diagonally at any angle. In a reflection the *original* shape has an *image* shape that is the same distance from the line of reflection as the original point, but is on the opposite side of the line.

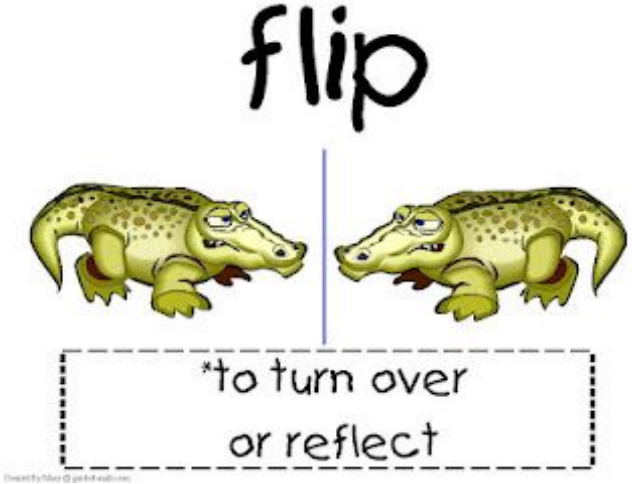
- Use a mirror to make a reflection of a triangle on grid paper.
- https://www.youtube.com/watch?v=__YKW5eBPVs

Mira = A transparent mirror used to locate reflection lines, reflection images, and lines of symmetry, and to determine congruency and line symmetry.

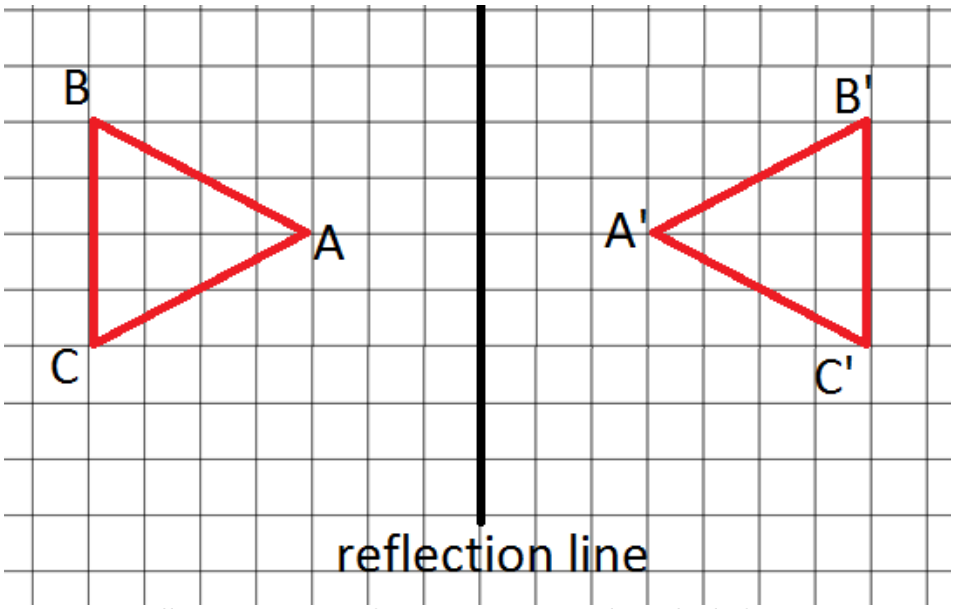
- What are two words that describe the line the Mira represents?

Line of _____

Line of _____



https://s-media-cache-ak0.pinimg.com/564x/aa/11/a3/aa11a349a8335209f353a05ddc7c4762.jpg



https://bakhmalamath9.files.wordpress.com/2014/05/reflection.png

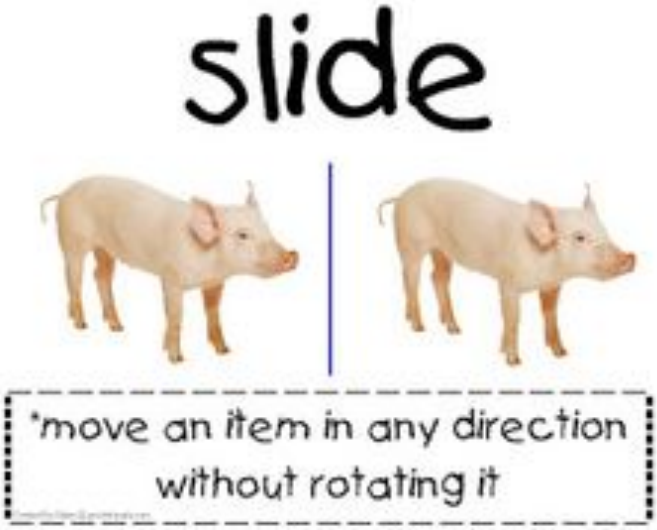
FUN & GAMES: Treescapes

- Take a piece of drawing paper and fold it in half.
- Place the paper on a clip board.
- Then go outside with a pencil and draw your favourite tree on the upper half of your paper.
- Then draw what surrounds the tree in the upper half of the paper.

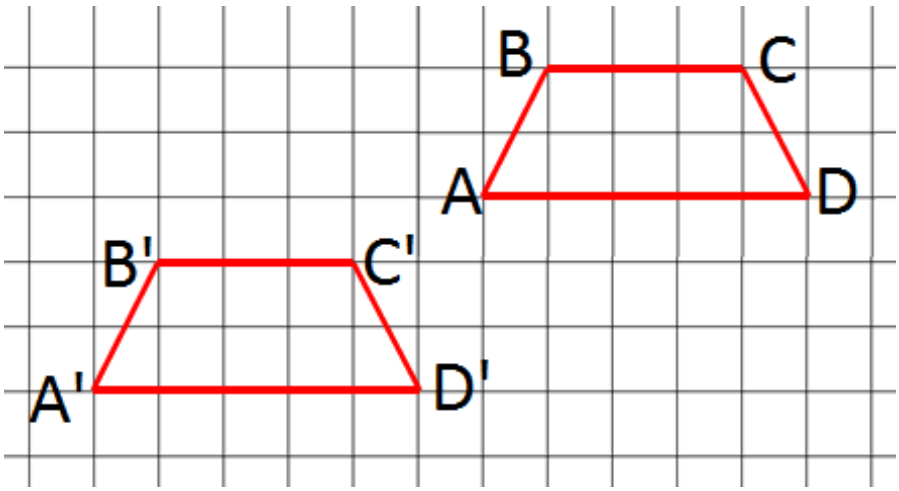
- Then return and paint you're the upper part of drawing.
- Before the paint dries fold it over to make a reflection image.
- Sign your masterpiece and post in a special place for all to see!

(b) Translations (slides)

A translation is a transformation that slides every point of a shape the same distance in the same direction. During a translation the orientation of the shape does not change and the *image* is congruent to the *original shape*. A translation can occur in any direction. Translations can be described by the distance and direction of the movement.



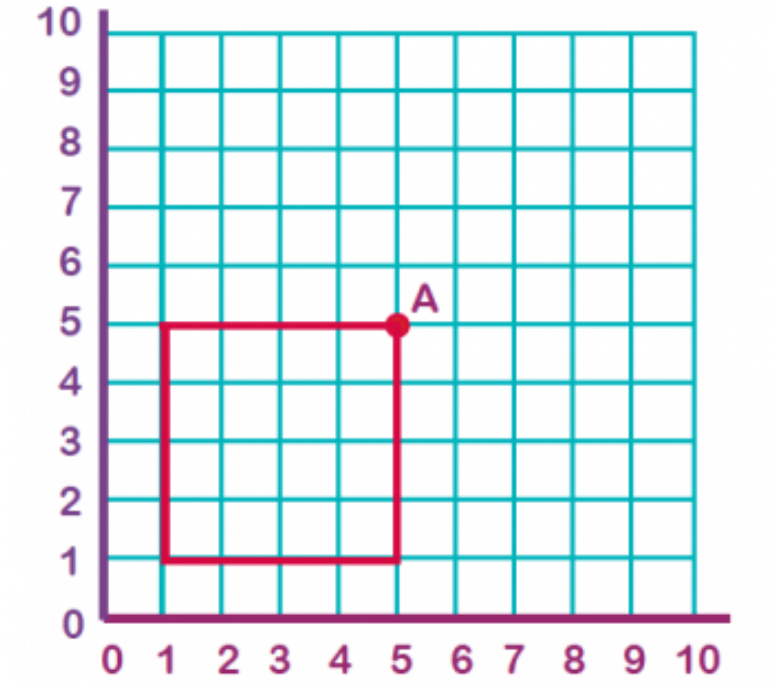
https://s-media-cache-ak0.pinimg.com/236x/72/db/86/72db86a4e6edba14441149f7a28de338.jpg



https://s-media-cache-ak0.pinimg.com/736x/4d/1d/f0/4d1df0e24573bd80bbb534a3da1b84c3.jp

It helps to view and describe translations using a grid.

- Translate this image to the right by 5 places.

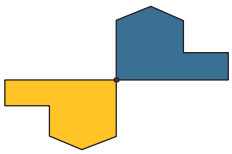


http://www.theschoolrun.com/sites/theschoolrun.com/files/content-images/translation_2_0.png

Rotations

A rotation is a transformation that moves every point in a shape or figure around a fixed point, often called the *origin* or *point of rotation*. A rotation creates an *image* that is congruent to the *original shape*. The point of rotation can be found anywhere on the plane, either outside the shape or within it.

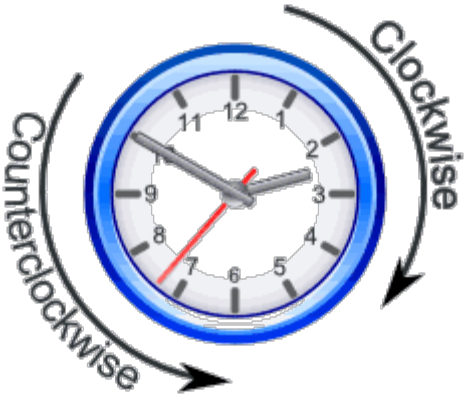
When the point of rotation is found at a vertex of the shape, the original shape and its image will share the point.

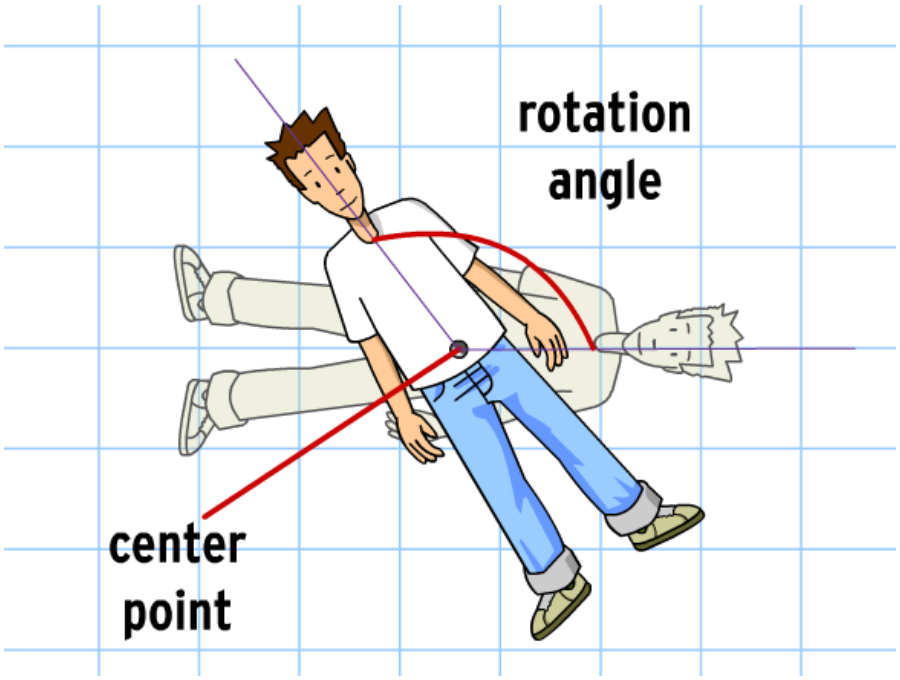


Rotations are fractions of turns. The yellow polygon is a rotation of a 1/2 turn, either clockwise or counterclockwise.

Rotations can be described in degrees (°).
A 1/2 turn is also a 180° rotation, and that 1/4 turn is a 90° rotation in either a clockwise or counterclockwise direction.

Rotating Around the Origin
A figure can rotate in a clockwise (curved to left) direction or a counterclockwise (curved to right) direction:





https://cdn.brainpop.com/math/geometryandmeasurement/transformation/screenshot2.png

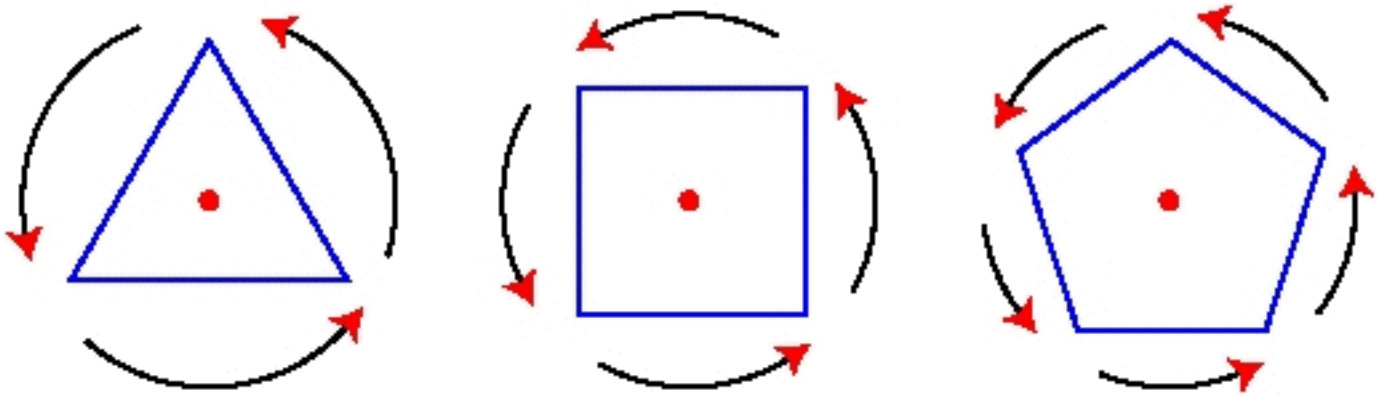
Rotational Symmetry is the number of turns it takes to rotate a figure back to its original position

- Look at how a square has rotational symmetry.

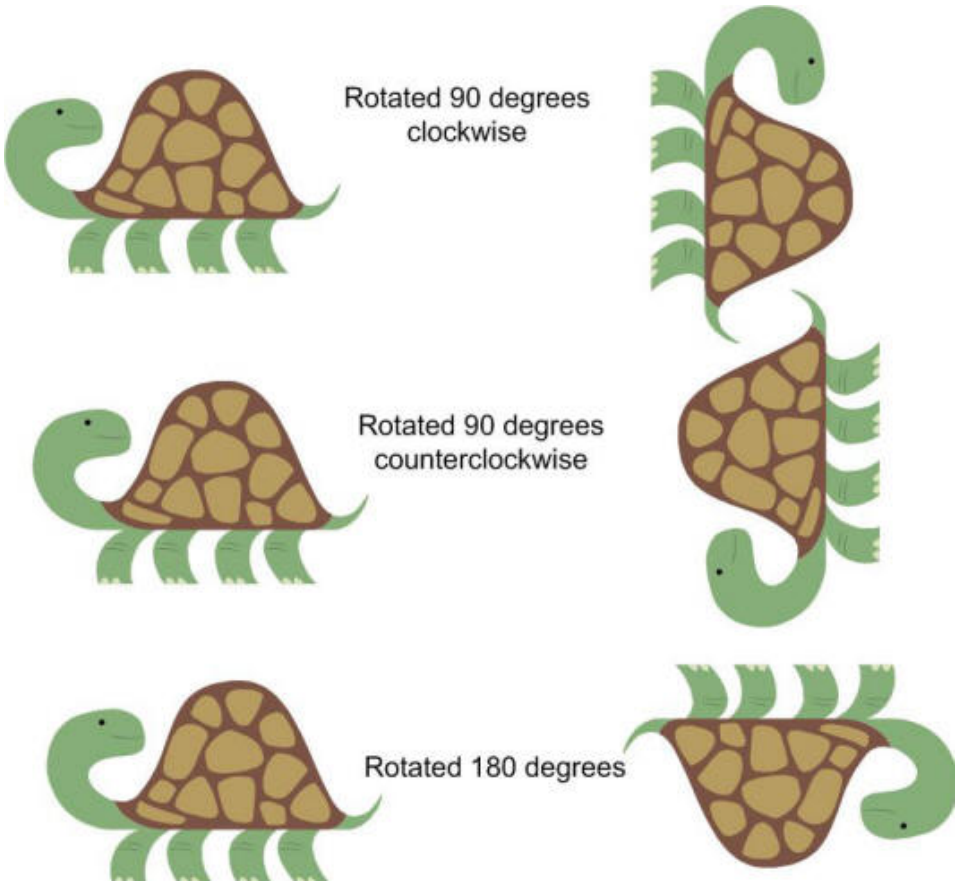
Original position

1/4 rotation 1/2 rotation 3/4 rotation Full rotation

When a square is rotated about its centre, its position matches its original position after a 1/4, 1/2, and 3/4 rotation. It has rotational symmetry of "4" because its position matches the original position four times during a complete rotation. All regular polygons have an order of symmetry equal to their number of sides – a square has an order of symmetry of 4, a regular hexagon has an order of rotational symmetry of 6, and so forth.



http://www.mathresources.com/products/insidemath/figures/symmet03.png



http://gignac.weebly.com/uploads/1/4/9/0/14902570/9616523_orig.jpg

- Create and analyze symmetrical designs by examining shape(s), using a variety of tools (e.g., pattern locks, Mira, geoboard, drawings), and identify the congruent shapes in the designs.

Extensions:

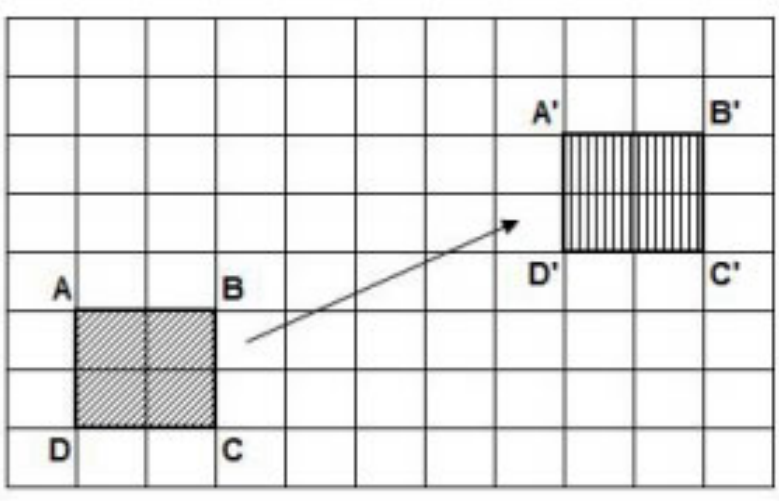
1. Sort polygons according to the number of lines of symmetry and the order of rotational symmetry, through investigation using a variety of tools (e.g., tracing paper, dynamic geometry software, Mira)
2. Discuss where/how the figures demonstrate reflection, translation and/or rotating a shape, or shapes, by 90° or 180°.

Congruency

RULE: When a figure is re-created to be exactly the same size and shape, we say both images are congruent.

A reflection can cause a change in the original position and orientation of a shape, but the reflected image can still be *congruent* to the original. It simply will be "facing" a different direction, and located in another position.

- Use 'ordered pairs' to make a shape and then use different 'ordered pairs' on the same grid to make a congruent shape. Show and explain to your teacher how this works.



http://www.onlinemathlearning.com/image-files/translation-g6.jpg.pagespeed.ce.gqKcK7z4hx.jpg

REAL WORLD PROBLEM:

- Where do you see congruent shapes in the world?

Spatial Ability

In math, it is important to develop your spatial ability. This means that you demonstrate both spatial orientation (locate objects in space and transform them) and spatial visualization (explain how 2D and 3D figures and objects can move in space).

Spatial orientation is the ability to locate and describe objects in space, and to carry out and describe transformations of objects. .

Spatial visualization is the ability to imagine, describe, and understand movements of two- and three-dimensional objects in space.

FUN & GAMES: Chess and other Spatial Games

- https://www.chesskid.com/learn-how-to-play-chess
- https://www.youtube.com/watch?v=KITEQZ5Sy4E
- http://www.mathsisfun.com/games/chess/index.php
- http://www.mathsisfun.com/games/towerofhanoi.html
- https://www.youtube.com/watch?v=t-uwGvx4V_A

Extension:

- Videotape young people putting a puzzle together.
- Then play back in slow motion sharing with your teacher when their 'learning buddy' was using reflection, translation and rotation to help solve the puzzle

TECH CHECK:

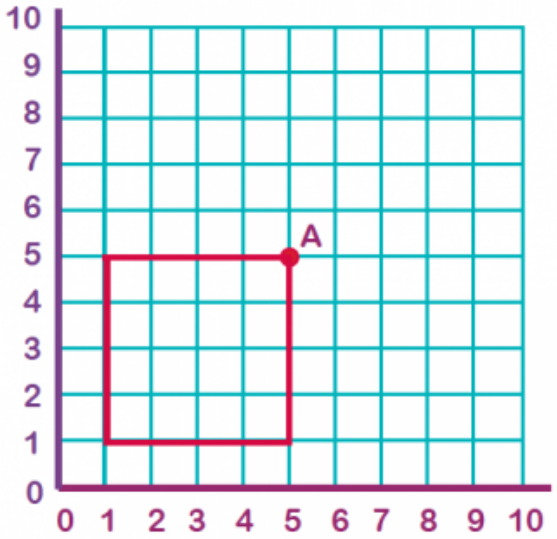
- https://www.youtube.com/watch?v=VJTxv-tRKj0
- https://www.youtube.com/watch?v=r3lN_BADmPQ
- https://www.youtube.com/watch?v=yH4HleVQInU
- https://www.youtube.com/watch?v=3MVv8jYfQmw
- https://www.youtube.com/watch?v=h7ZAQfNh8XA
- https://www.youtube.com/watch?v=as-dsfFjfBI
- https://www.youtube.com/watch?v=X5kRBYXHji4

RECIPROCAL TEACHING:

- "Like a teacher" explain each kind of transformation and how figures can be congruent.
- Share examples and teach about transformations and congruency to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

GOT IT!

- Translate this image upwards by 5 places.
- Describe how Point A moved from coordinate (5,5) when you moved the image to the right and then upwards.



To the right – Point A was translated to coordinate: ( )

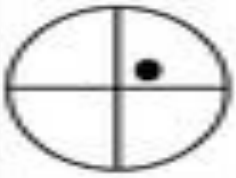
Upwards – Point A was translated to coordinate ( )

Figures may slide on an angle. Draw where the object would be if point A was translated up two spaces and to the right 4 spaces.

Point A would wind up at coordinate ( ).

- Can a quadrilateral have only three congruent angles? Try and figure this out by drawing examples. Explain what you think to your teacher.

- Complete the chart:

	FLIP	SLIDE	QUARTER TURN CLOCKWISE	HALF TURN CLOCKWISE
				
				
				
				
				

https://s-media-cache-ak0.pinimg.com/736x/12/4d/0a/124d0acff6ec580b39d470410fd44882.jpg

How well did you identify & construct bilateral symmetry & congruency in 2D figures?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

2D FIGURES QUIZ (Show your rough work _____/2)

1. What is the difference between a regular and irregular polygon?

A regular polygon is _____

An irregular polygon is _____

2. How many degrees do the angles add up to in a triangle?	3. How many degrees do the angles add up to in a hexagon?

4. What is the perimeter of forest that has the following dimensions:

900m, 650m, 1050m, 435m

5. How many diagonals in an octagon?	6. How many lines of symmetry in an octagon?

7. What is the difference between symmetry and congruence?

Symmetry is
Congruence is

8. What are three transformations?

9. Complete the following quiz:

- http://www.softschools.com/math/geometry/transformations/quiz/

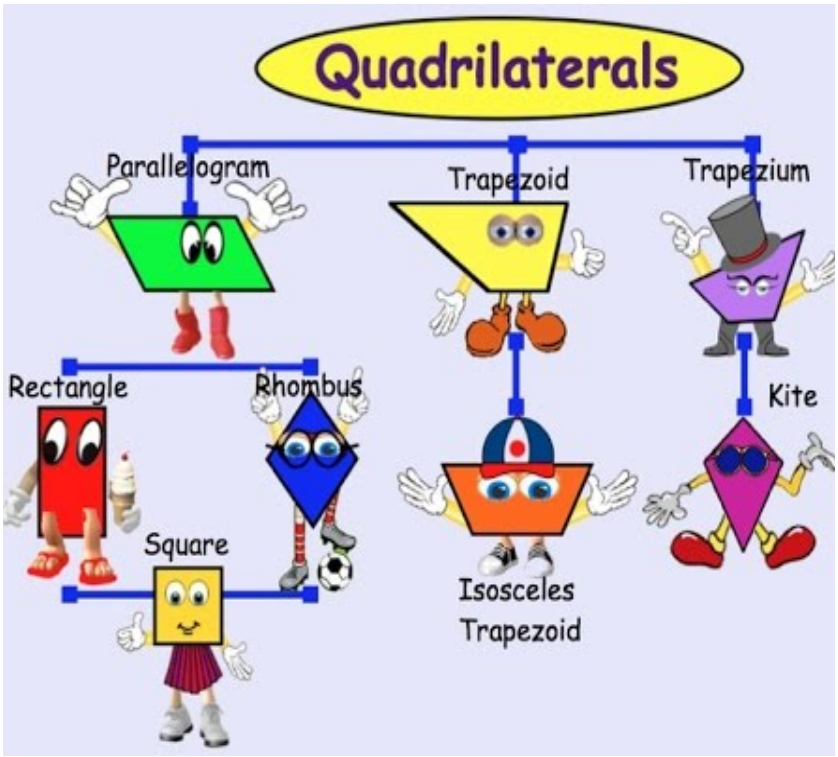
How well did you know about 2D figures?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

D. Quadrilaterals

CHECK-IN: Maybe you already know all this? Show your teacher what you know!
*Go to Page 92 and try the Quadrilateral Quiz.

****It is okay to say "I don't know" ☺

GLOSSARY UP FRONT
square = quadrilateral with 4 sides of equal length and 90 degree angles
rectangle = quadrilateral with 90 degree angles, opposite sides are parallel and of equal length
parallelogram =
rhombus =
trapezoid = a
kite = quadrilateral that is not a parallelogram, but has two pairs of equal sides that are adjacent to each other



https://i.ytimg.com/vi/1rqUJR_a6iU/hqdefault.jpg

9. Quadrilateral Figures

RULE: Quadrilaterals have 4 sides and 4 straight edges. The angles in quadrilaterals add up to 360 degrees.

- Identify the following figure in this poem?

Symmetrical I am
Quadrilateral I am
My angles are always right
Rectangle I am not
Equal sides and angles
What am I?

I think this might be a: _____.

- Look at the diagram below. With a partner, create 5 "What am I?" poems to place on cards to use for a quadrilateral card game.

Quadrilateral	Only 1 Pair of Parallel Sides	2 Pairs of Parallel sides	All sides must be congruent	Opposite sides are congruent	All angles must be right angles
SQUARE		✓	✓	✓	✓
RECTANGLE		✓		✓	✓
RHOMBUS		✓	✓	✓	
PARALLELOGRAM		✓		✓	
TRAPEZOID	✓				

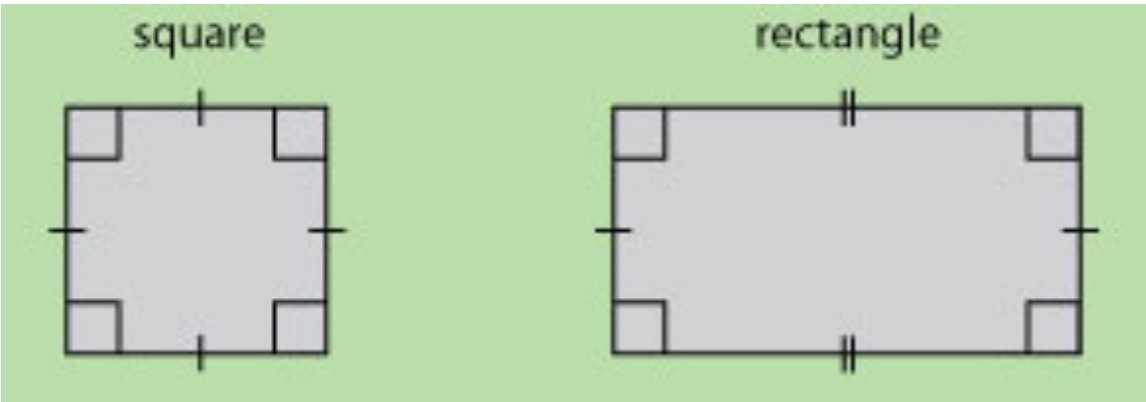
http://image.slidesharecdn.com/quadrilaterals-140824005011-phpapp02/95/quadrilaterals-21-638.jpg?cb=1408841440

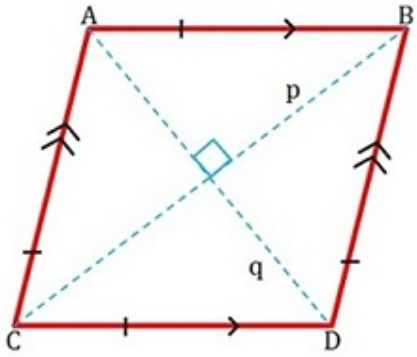
ET - Identify types of angles when constructing parallel intersecting lines.

10. Quads with Equal Lengths and Widths

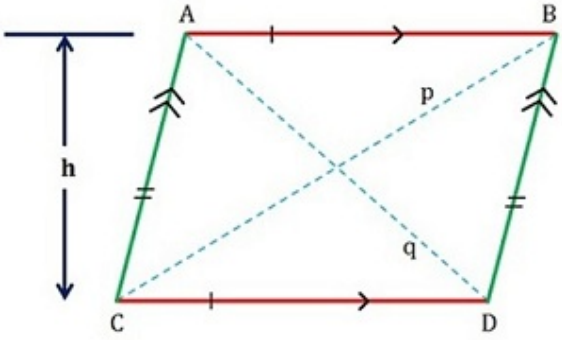
RULE: Squares are made up of 90 degree angles with 4 sides of equal length. Rectangles also have 90 degree angles, but the sides are not all equal in length. A rhombus does not have 90 degree angles (slant), but has sides of equal length. A parallelogram does not have 90 degree angles and the sides are not all equal in length. All four quadrilaterals have parallel pairs of sides.

EXAMPLES:





Rhombus



Parallelogram

- Using a ruler and protractor, construct a square, rectangle, rhombus and parallelogram.

How well did you complete this task?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

TECH CHECK:

- Find 4 websites that teach about 4 types of quadrilaterals:
- Rank them from your most to least favourite:

_____

_____

_____

_____

RECIPROCAL TEACHING:

- "Like a teacher" explain each kind of angle in 4 quadrilaterals. Share examples and teach about how a square and rectangle relate to the rhombus and parallelogram to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

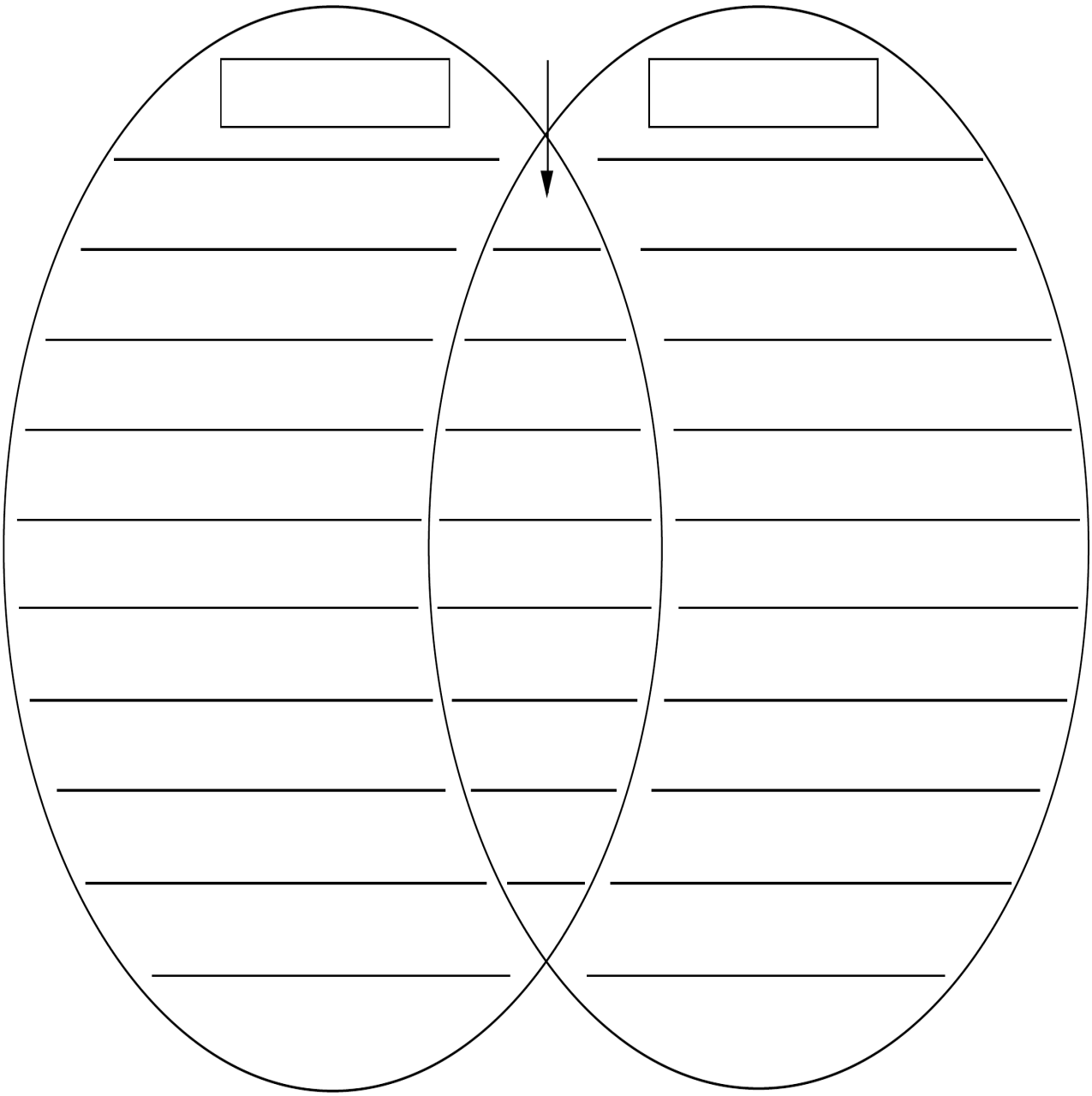
GOT IT!

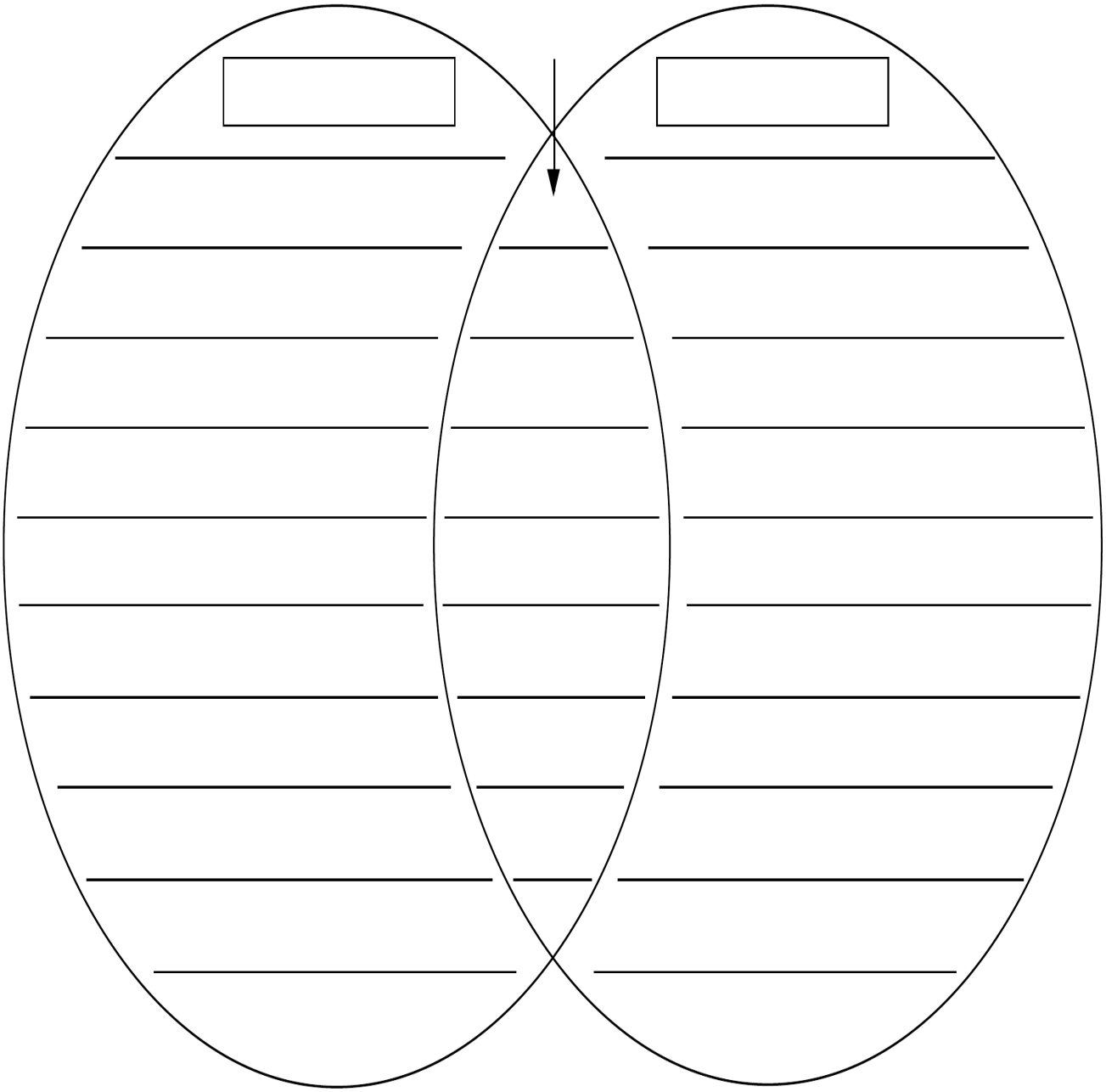
- Explain how a square is also a rectangle and a rhombus is also a parallelogram.

_____

_____

- Using the Venn diagrams, compare:
  (a) A square and a rectangle
  (b) A parallelogram and a rhombus
- Use these words: angles, length of sides, diagonals, lines of symmetry,congruent



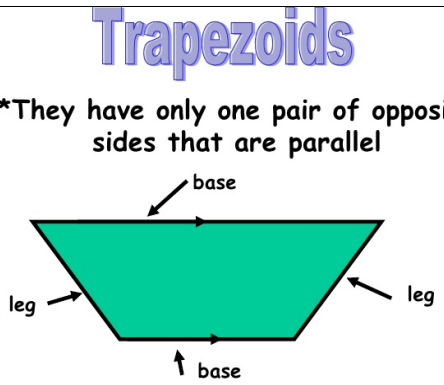


How well did I do this task?	Trailblazer ☺ (Expert)	Pathfinder (Apprentice)	Rookie - Not Yet (Novice)

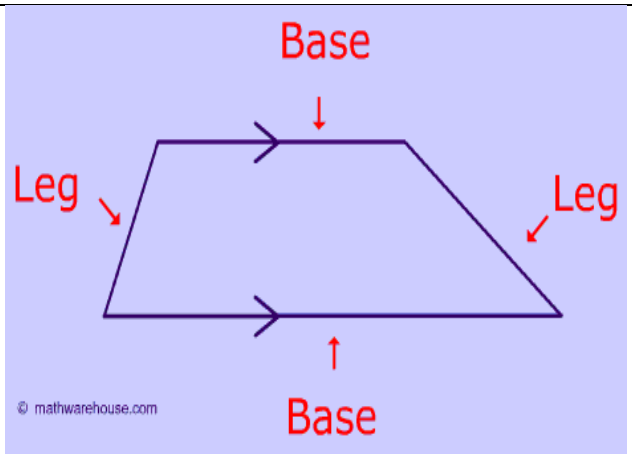
11. Trapezoids and Kites

RULE: Trapezoids are quadrilaterals because they have 2 bases that are parallel and 2 legs that are not.

EXAMPLES:

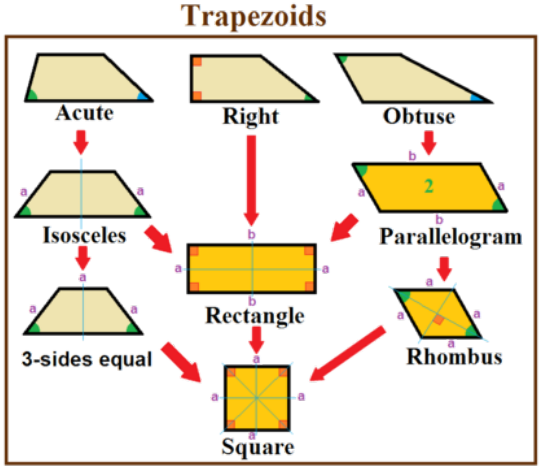


http://image.slidesharecdn.com/5-6trapezoids-100902113129-phpapp01/95/techmathi-56-trapezoids-2-728.jpg?cb=1283427132



http://www.mathwarehouse.com/geometry/quadrilaterals/trapezoid/picture-of-trapezoid.gif

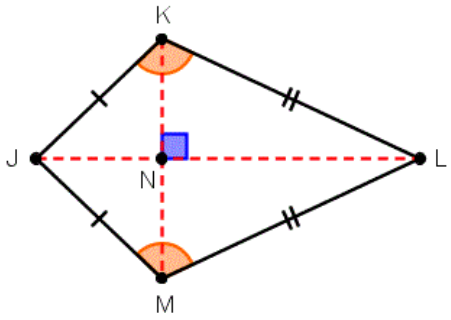
This image of the **isosceles trapezoid on the left** has two sides of equal length and two pairs of equal angles. Many trapezoids do not have pairs of equal angles (see right above)



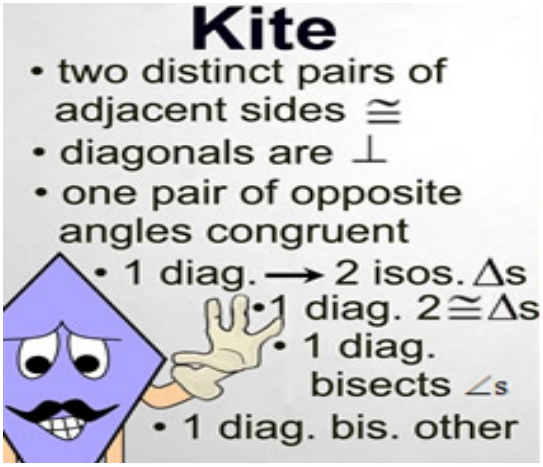
https://qph.ec.quoracdn.net/main-qimg-c2e62fe3b9bc13be580edca0a94d781a?convert_to_webp=true

Extension: Construct a trapezoid with a 45° angle and a side measuring 11 cm.

A **kite** looks a lot like a diamond (rhombus) – but it is different. A rhombus has two sets of parallel sides and a kit does not have any.

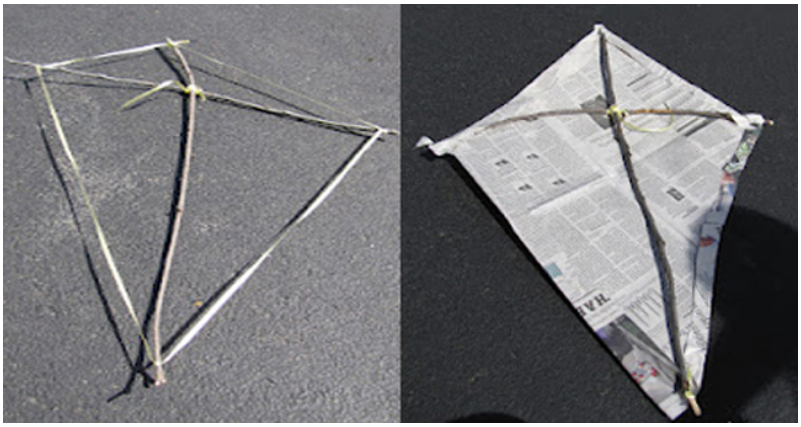


- Read what a kite does has:



http://www.mathbitsnotebook.com/Geometry/Quadrilaterals/kiteguy112a.jpg

- Make a kite using twigs and newspaper.



http://www-tc.pbs.org/parents/crafts-for-kids/files/2013/01/Kite-Final.jpg

You might want to check out these websites for more ideas on making kites:

- http://www.wikihow.com/Make-a-Kite
- http://www.my-best-kite.com/how-to-build-kites.html

STEP OUTSIDE:

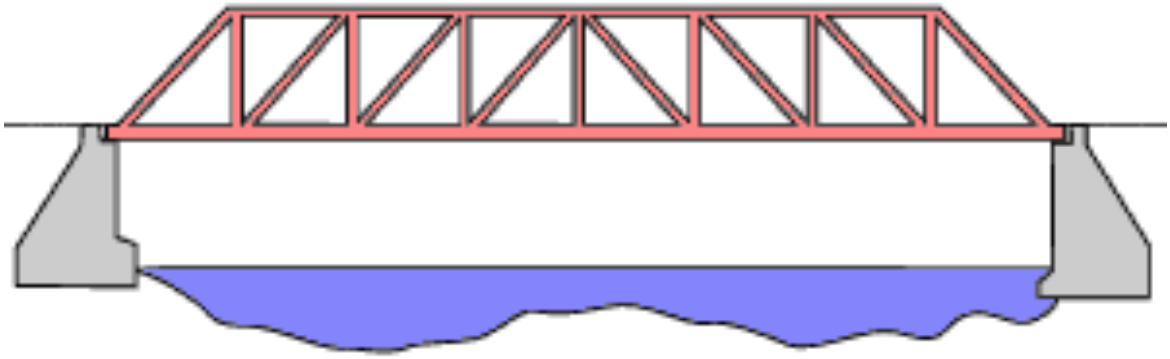
- Step outside and try out your kite!

TECH TIME:

- http://www.softschools.com/math/geometry/quadrilaterals/
- https://www.mathsisfun.com/geometry/trapezoid.html
- https://www.youtube.com/watch?v=JxkpNYPLSD4

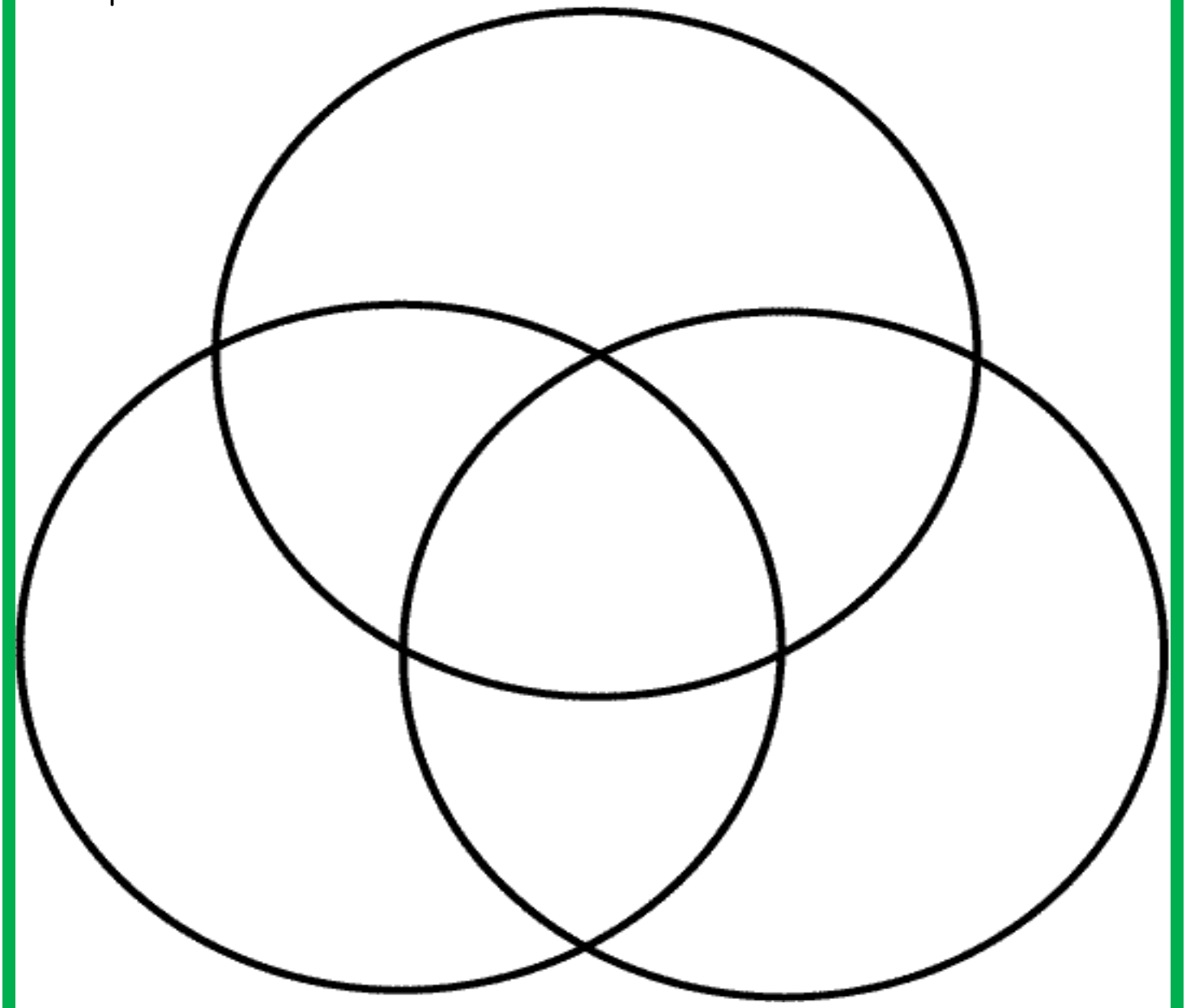
GOT IT!

- Record the names of the shapes inside this truss bridge:



https://s-media-cache-ak0.pinimg.com/originals/cc/fd/39/ccfd397e1ec322829e8e2f6c624b0f51.jpg

- Choose 3 quadrilateral figures - and place key points on a Venn diagram to compare them.



How well did I show my understanding of quadrilaterals?	Trailblazer ☺ (Expert)	Pathfinder ☺ (Apprentice)	Rookie – Not Yet (Novice) ☺

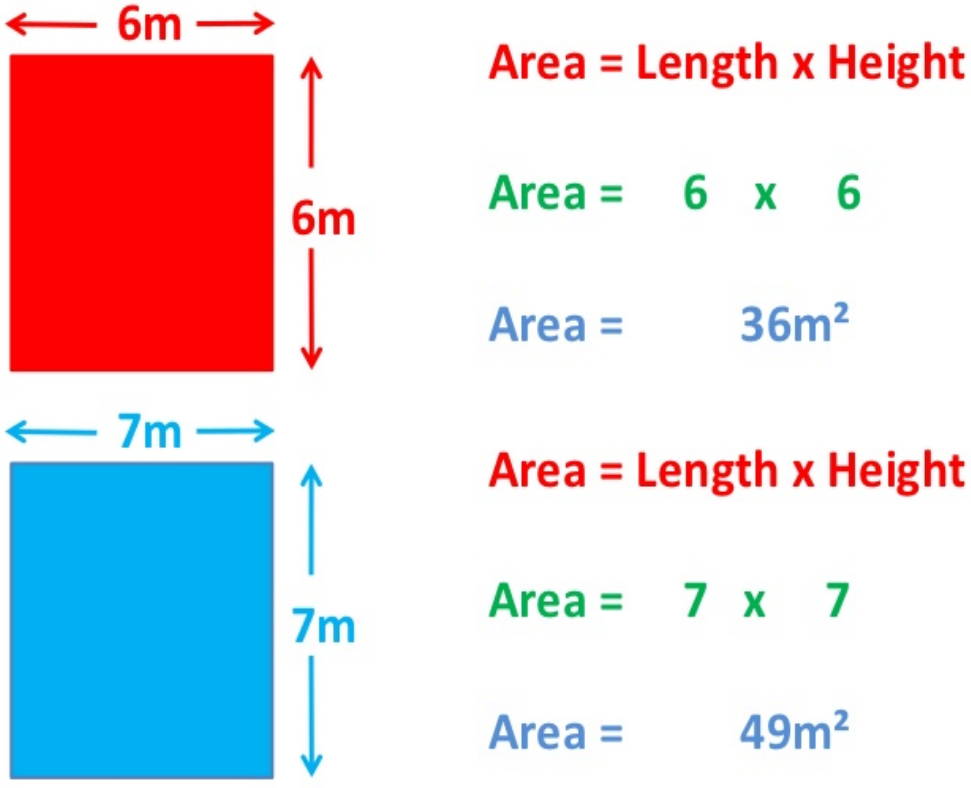
ET - Find missing side when one side given plus the area.

ET - Find area using length & width & compare area to perimeter.

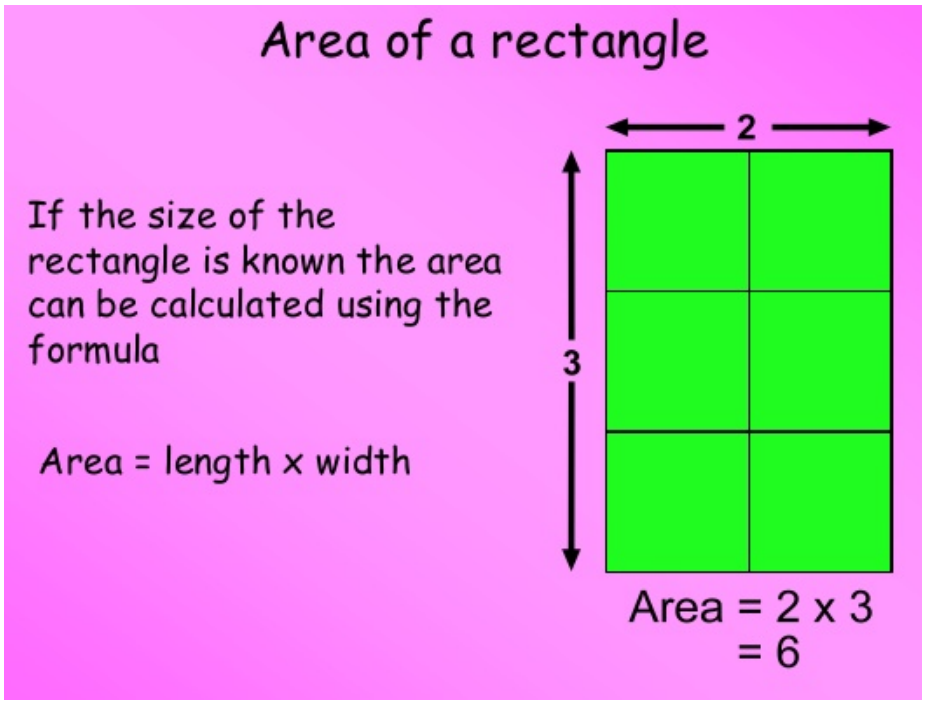
12. Measuring the Area inside Squares and Rectangles

RULE: The area inside the space of a square or rectangle is measured by counting the squares inside (the slow way) or multiplying the length x the width of the figure. The area is measured in units (cm, m, km, feet, hands, pebbles, sticks…) squared.

EXAMPLES:



http://image.slidesharecdn.com/areasbasic-120821033949-phpapp02/95/calculating-the-area-of-basic-shapes-3-728.jpg?cb=1345520444



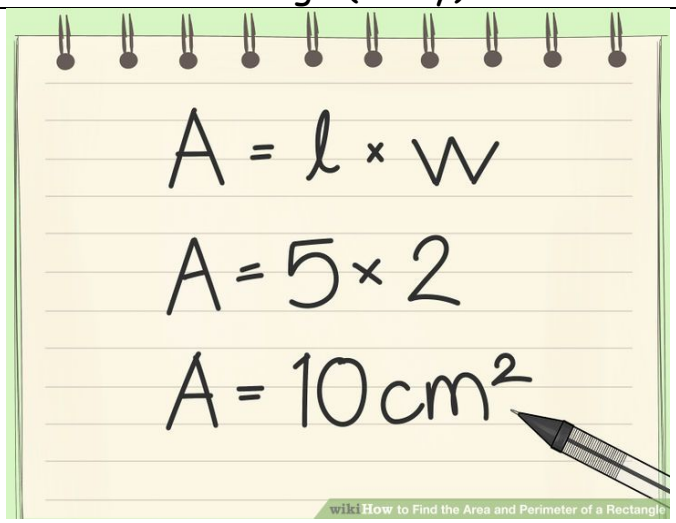
http://image.slidesharecdn.com/intro-revisionofareaofrectanglesrknowles2013-150101232152-conversion-gate01/95/intro-revision-of-area-of-rectangles-r-knowles-2013-7-638.jpg?cb=1420155383

FUN & GAMES: Hands Squared

(a) Measure a table using your hands (non-standard measure).

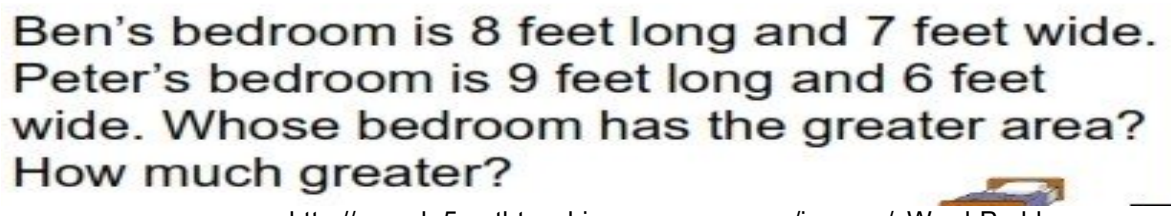
(b) Draw the table and print your formula and number sentence below to show how many 'hands squared' your table is!

- Draw the image (array) to show the area:



http://pad2.whstatic.com/images/thumb/2/28/Find-the-Area-and-Perimeter-of-a-Rectangle-Step-4-Version-2.jpg/aid1954108-728px-Find-the-Area-and-Perimeter-of-a-Rectangle-Step-4-Version-2.jpg

REAL WORLD PROBLEMS:

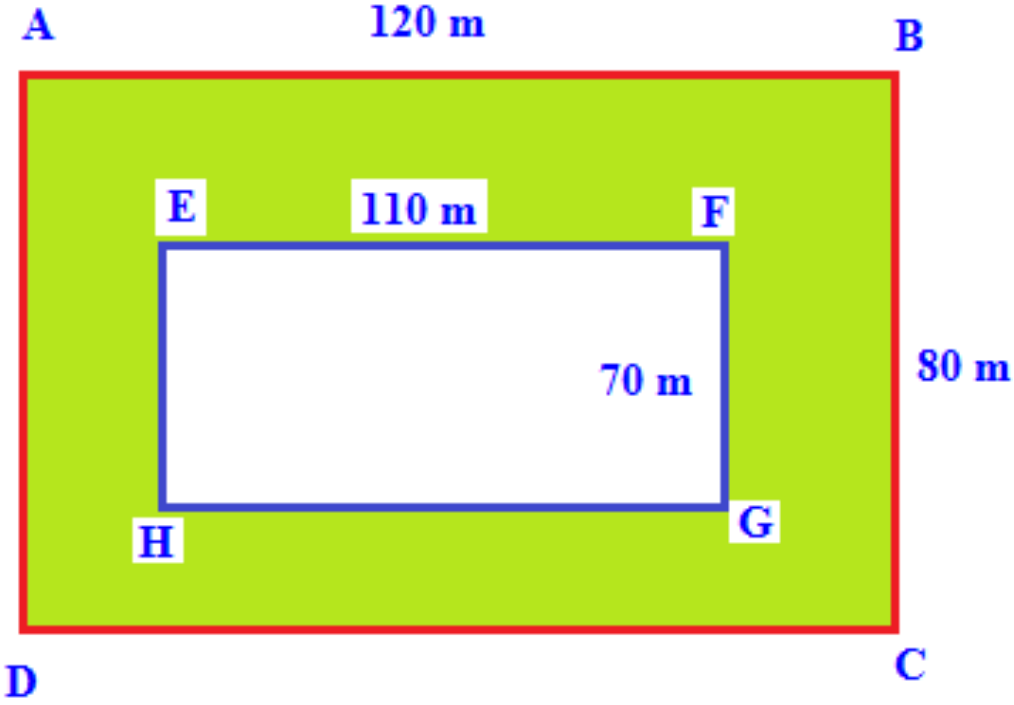


http://www.k-5mathteachingresources.com/images/xWord-Problems-Area_b.jpg.pagespeed.ic.JZ4lO5EzLp.jpg

- Imagine the following image is of a pool and the fence around it. A real estate agent will say the size of the pool is:

- _____

and the perimeter of the fence is: _____.



http://www.onlinemath4all.com/images/pathyway2.png

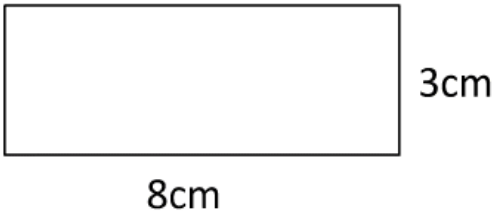
RECIPROCAL TEACHING:

- "Like a teacher" explain the difference between area and perimeter
- Share examples and teach how to find area to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

GOT IT!

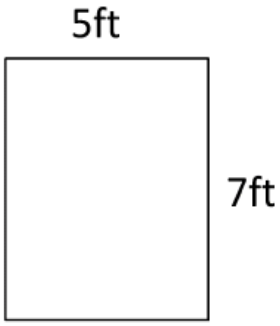
- Place the area for each figure inside the shape below:

1)



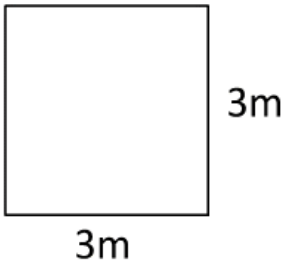
Area = _____ square cm

2)



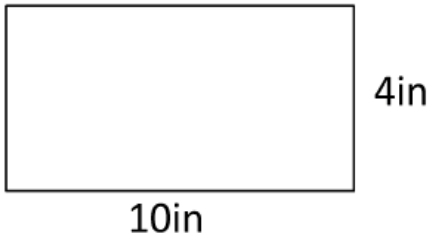
Area = _____ square ft

3)



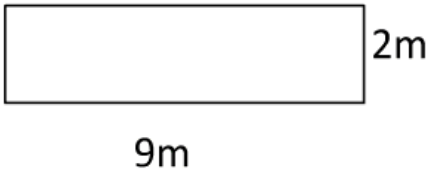
Area = _____ square m

4)



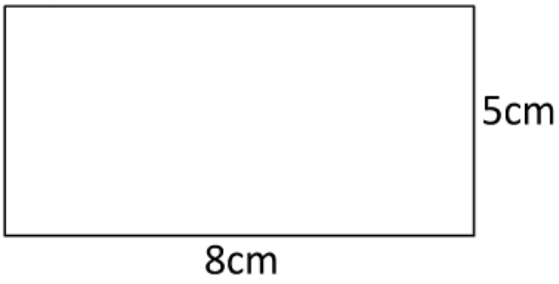
Area = _____ square in

5)



Area = _____ square m

6)



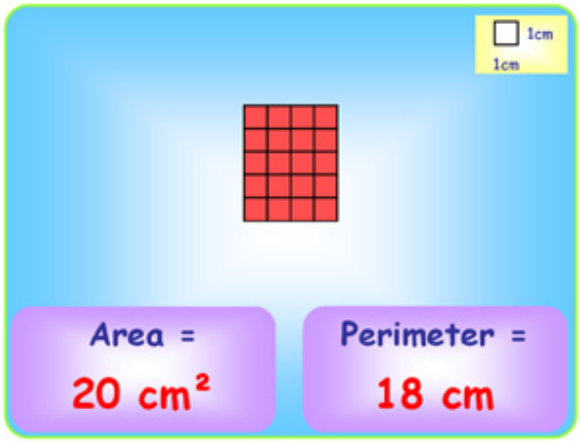
Area = _____ square cm

- Complete the following and then show your teacher using flat rectangular squares how your calculation is correct.

➢ 4cm (width) x 7cm (length) = _____cm squared (area)

➢ 2cm (width) x 11cm (length) = ____cm squared (area)

- What is the length and width of the following figure based on its area and perimeter (distance around the object)?



http://www.mentalstarters.co.uk/Yr%206%20Screenshots/Area%20and%20Perimeter.jpg

Length: _____ Width: _____

How well did you find missing side when one side given plus the area?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

How well did you find area using length & width & compare area to perimeter?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

QUADRILATERAL QUIZ

1. Complete this on-line quiz:
    1. http://www.softschools.com/math/geometry/quadrilaterals/quadrilateral_angles/

2. What are the four different kinds of quadrilaterals and what makes them distinct? (12 points)

3. Using the formula, calculate the area and perimeter of a rectangle that is 4m by 5m. (4 points)

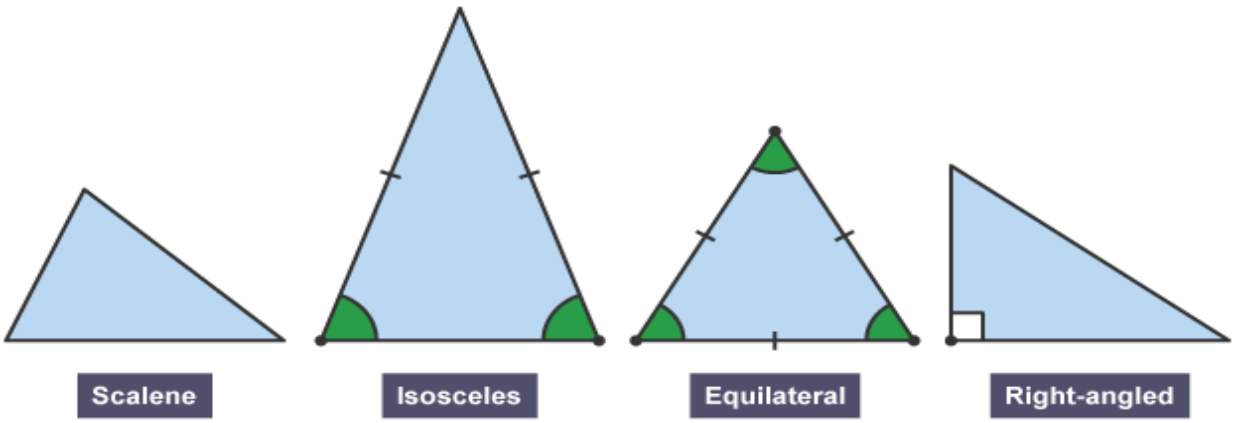
4. Create a "What am I?" poem for a rhombus. (4 points)

How well did I show my understanding of quadrilaterals?	Trailblazer ☺ (Expert)	Pathfinder ☺ (Apprentice)	Rookie – Not Yet (Novice) ☺

E. Triangles

CHECK-IN: Maybe you already know all this? Show your teacher what you know!
*Go to Page 113 and try the Quadrilateral Quiz.
****It is okay to say "I don't know" ☺

GLOSSARY UP FRONT
equilateral triangle = A triangle with three equal sides
isosceles triangle = A triangle that has two sides of equal length
obtuse triangle = A triangle with one angle that measures more than 90° and less than 180°
right triangle = A triangle with one 90-degree angle
scalene triangle = A triangle that has three unequal sides and angles
hypotenuse = the longest side of a right triangle, opposite the right angle

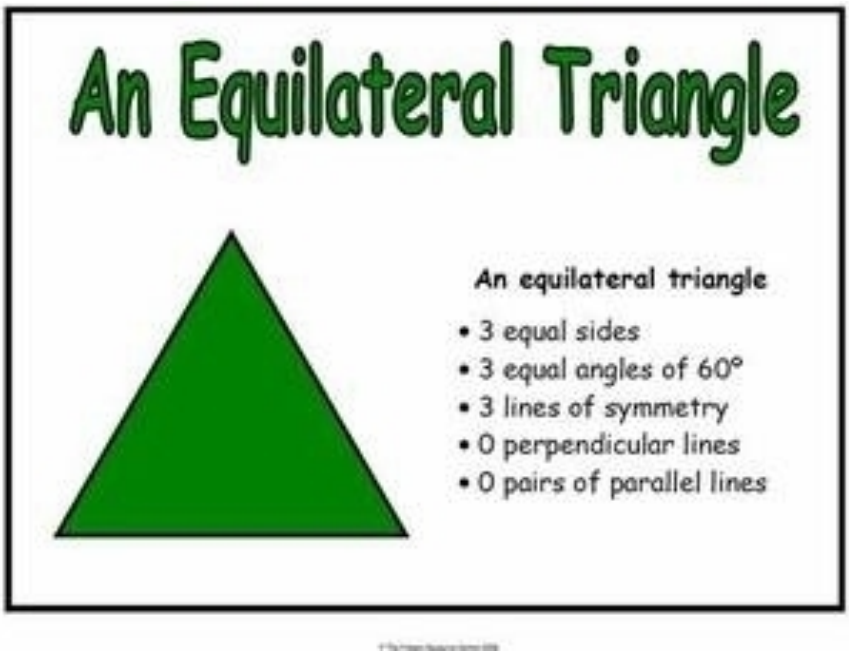


http://a.files.bbci.co.uk/bam/live/content/zsgw7ty/large

13. Equilateral Triangles

RULE: All angles inside triangles add up to 180 degrees. An equilateral triangle has three equal side lengths with three – 60 degree angles. Note: 60 + 60 + 60 = 180 degrees.

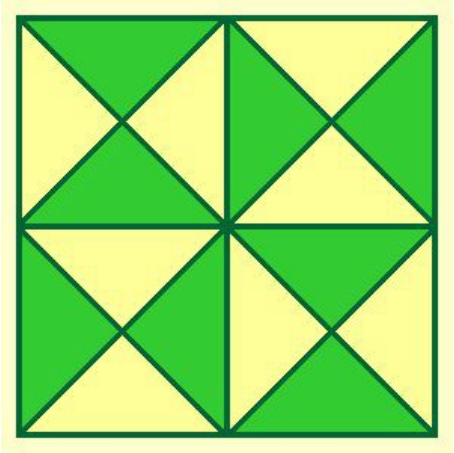
EXAMPLE:



https://sites.create-cdn.net/siteimages/6/6/6/66686/197516.jpg

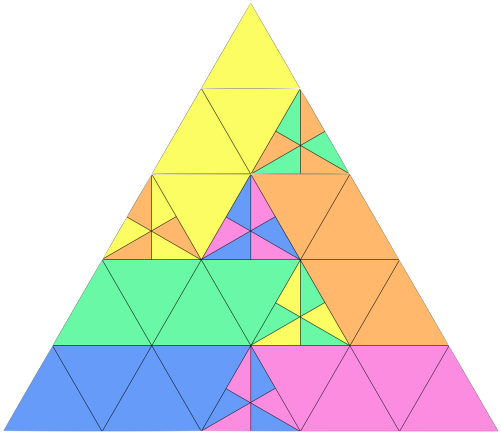
- Look at one way to code the triangle pattern below.

Going clockwise around starting on the top row:
ABAB BABA (top row)
BABA ABAB (bottom row)



Extension:

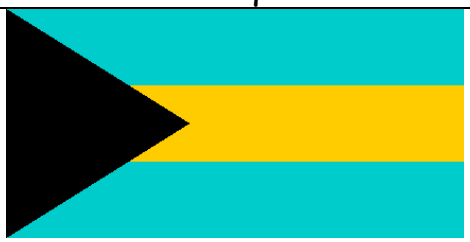
- Try and code the pattern of equilateral triangles below:



http://i.stack.imgur.com/6j9W7.png

FUN & GAMES:

- Which flags use equilateral triangles?
- Circle the equilateral triangle in the flags.



Bahamas Flag

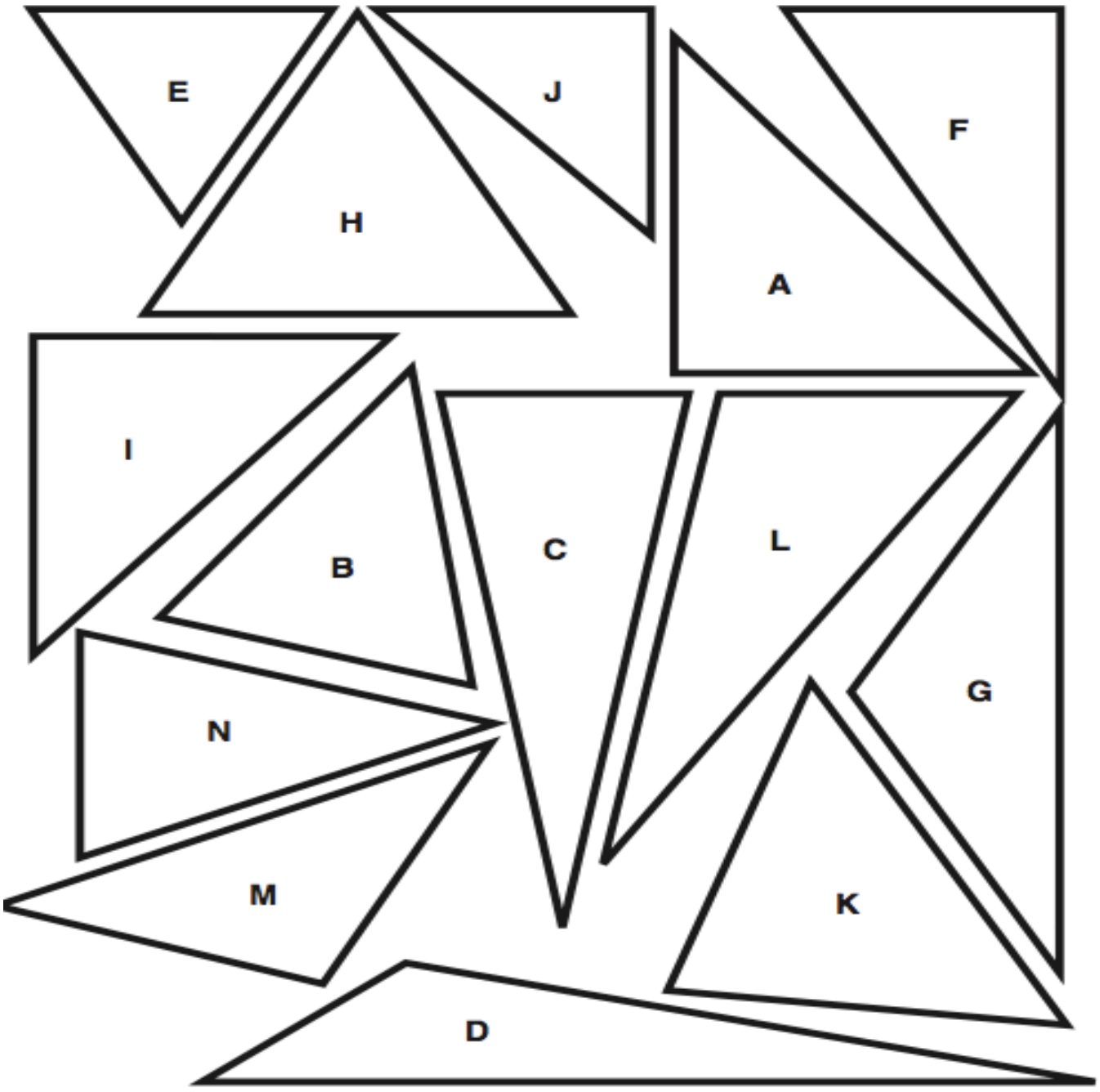
Canada's Centennial Flag

South African Flag

- Use a protractor to measure the angles to double check if the triangles you found have 60 degree angles.
- Show your teacher how you measure the 60 degree angles.

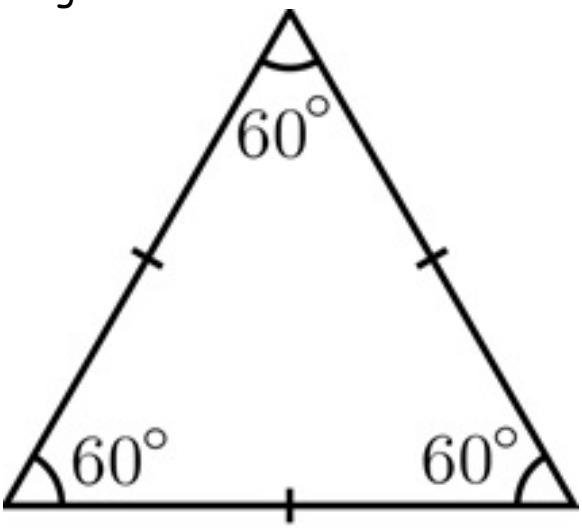
GOT IT!

- Colour in the equilateral triangles.



http://4.bp.blogspot.com/-i_cIMPwS5xo/TulENZGA4XI/AAAAAAAABXc/ntmgNsW7-FQ/s1600/Screen+shot+2011-12-14+at+5.49.26+PM.pn

- How do you know, without measuring, that the sides of the equilateral triangle are equal in length?



This triangle has sides with equal lengths because…

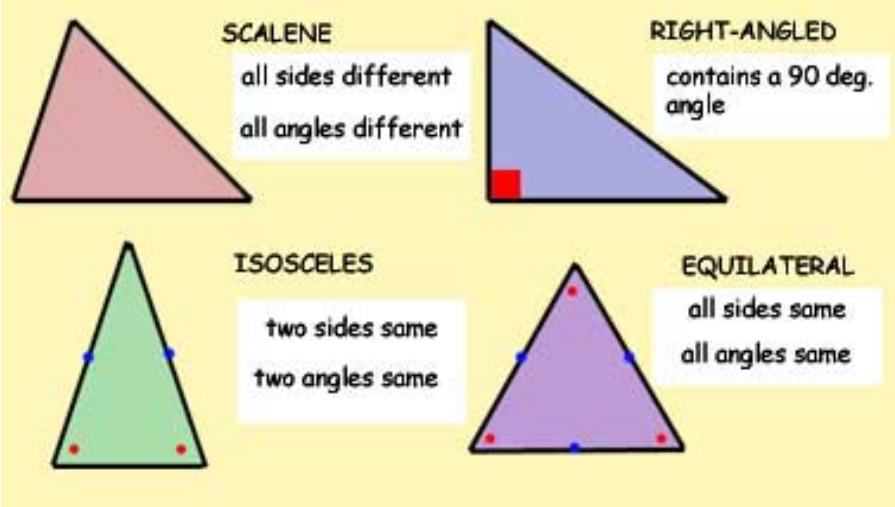
_____

How well did I show my understanding of equilateral triangles?	Trailblazer ☺ (Expert)	Pathfinder ☺ (Apprentice)	Rookie Not Yet (Novice) ☺

14. Comparing Isosceles, Scalene and Right Triangles

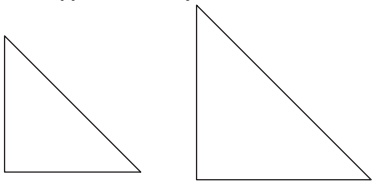
RULE: The isosceles triangle has two equal side lengths and two equal angles, but the scalene triangle has three different side lengths and three different angles. Right angle triangles must have one 90 degree angle; they can be isosceles when the other two angles are 45 degrees or they can be scalene right triangles when they have a 90 degree angle plus two different angles.

EXAMPLES:



http://www.gcsemathstutor.com/images/shapespace/ss-similarity-1.jpg

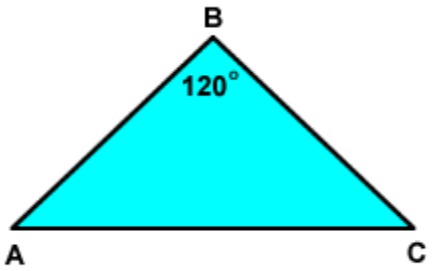
These triangles are not congruent. Although they are the same shape, they are not the same size.



http://www.mathopolis.com/questions/q.php?id=732&site=1&ref=/proof180deg.html&qs=732_1518_733_1519_2139_2140_3938_3939_2141_2142

This **isosceles triangle** has two equal sides and angles.

- Look at the triangle below with one obtuse angle of 120 degrees.
- What are the measures of angle BAC and angle BCA?



http://www.freemathhelp.com/images/lessons/isosceles1.gif

Step 1 - 180 degrees – 120 degrees = 60 degrees
Step 2 – 60 degrees divided by 2 or in $\frac{1}{2}$ = 30 degrees
Angle BAC and angle BCA = **30 degrees**.

TECH CHECK:

- https://www.youtube.com/watch?v=1k0G-Y41jRA
- https://www.youtube.com/watch?v=JQUTVgT9RXY
- https://www.flocabulary.com/unit/types-of-triangles/
- https://study.com/academy/lesson/types-of-triangles-their-properties.html
- https://www.khanacademy.org/math/basic-geo/basic-geometry-shapes/basic-geo-classifying-triangles/v/scalene-isosceles-equilateral-acute-right-obtuse

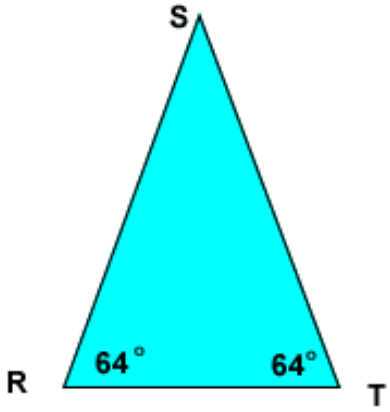
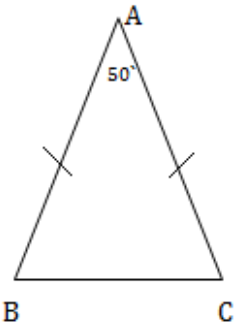
FUN & GAMES:

https://www.sheppardsoftware.com/mathgames/geometry/shapeshoot/triangles_shoot.htm
https://www.youtube.com/watch?v=QiUtYE0oFFk

RECIPROCAL TEACHING:

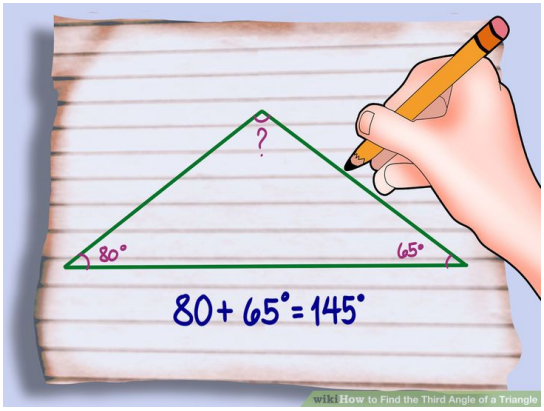
- "Like a teacher" explain the difference kind of triangles.
- Share examples and teach different kinds of triangles to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

GOT IT!

What is angle RST or angle TSR?	What are angles CBA and ACB = to?
	
http://www.freemathhelp.com/images/lessons/isosceles2.gif	https://breathmath.files.wordpress.com/2016/02/ex31.png?w=760

The **scalene triangle** has three different sides and three different angles.

- Look at the sample below that finds the missing angle.

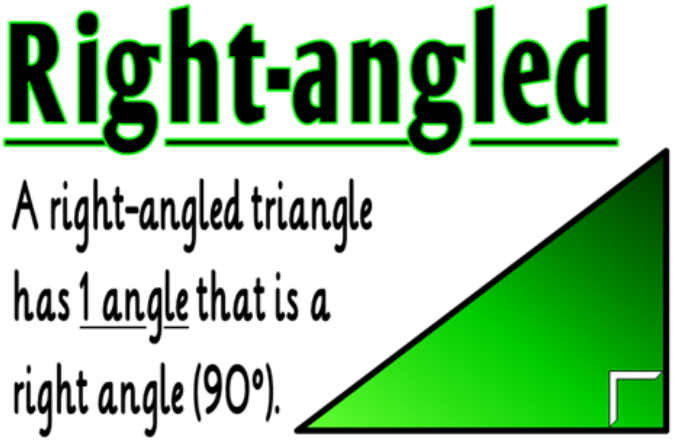


http://pad2.whstatic.com/images/thumb/d/d7/Find-the-Third-Angle-of-a-Triangle-Step-1-Version-2.jpg/aid546266-728px-Find-the-Third-Angle-of-a-Triangle-Step-1-Version-2.jpg

http://www.theschoolrun.com/sites/theschoolrun.com/files/u9/finding_angles_in_a_triangle.png

- Use a protractor, ruler, and pencil to construct a scalene triangle with a 30° angle and a side measuring 12 cm.

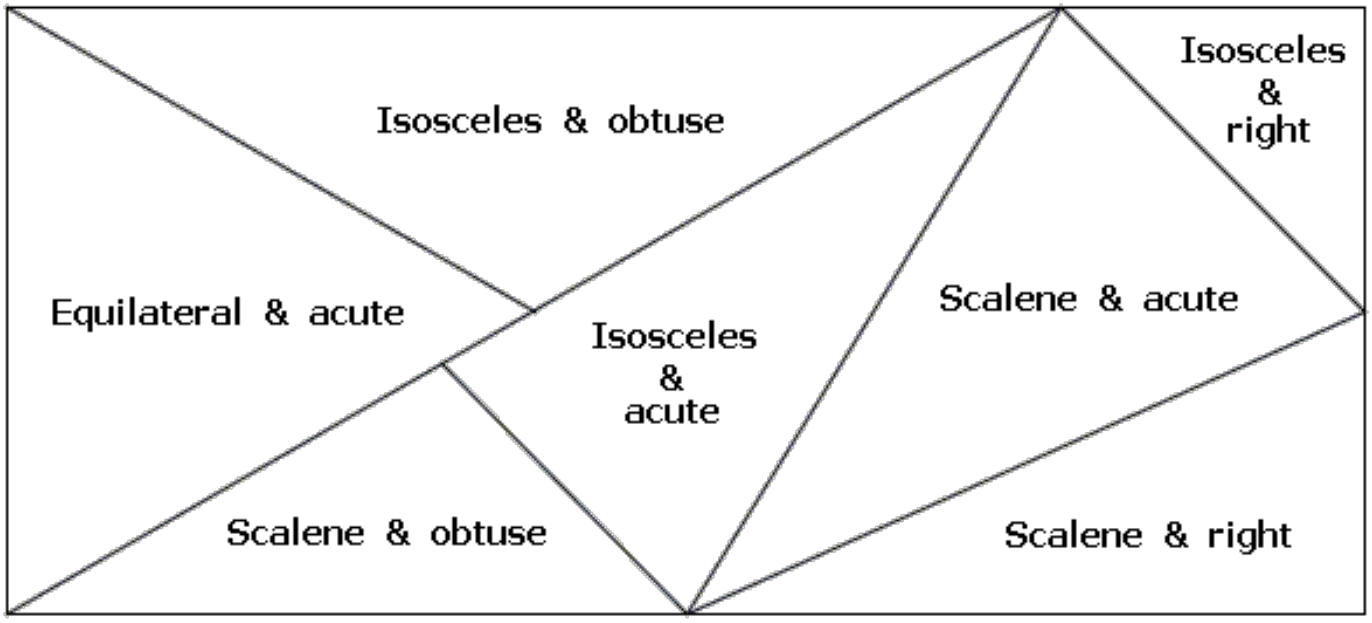
The **right-angled triangle** has one 90-degree angle. The other angles can be equal (isosceles right-angled triangle) or they can be different angles (scalene right-angled triangle).



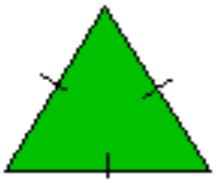
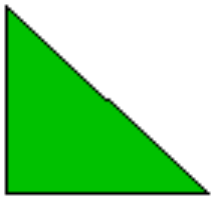
- Draw using a ruler and protractor an Isosceles Right-Angled Triangle and a Scalene Right-Angled Triangle.

Isosceles Right Angled Triangle	Scalene Right Angle Triangle

- Review the different kinds of triangles and angles in the following puzzle and poster:



http://www.cut-the-knot.org/triangle/TriangleClassification.gif

BY SIDE	BY ANGLE
Equilateral Triangle  -has three equal sides	Acute Triangle  -three angles < 90 degrees
Isosceles Triangle  -has two equal sides	Right Triangle  -has one right angle
Scalene Triangle  -has no equal sides	Obtuse Triangle  -has one angle >90 degrees

http://mrferrell.pbworks.com/w/page/14235870/f/triclass.gif

- Can you construct a triangle that is both a right triangle and an isosceles triangle? Show your teacher on a whiteboard surface.

Yes, I did on my own Yes I did (with help) Not Yet

- Describe an equilateral triangle without using the word 'sides'?

  An equilateral triangle _____

  _____.

- Can a triangle have more than one obtuse angle? Why or why not?

  A triangle ***can*** *or* ***cannot*** _____

  because _____

  _____

GOT IT!

- Are all scalene triangles also acute triangles? Explain.

_____

_____

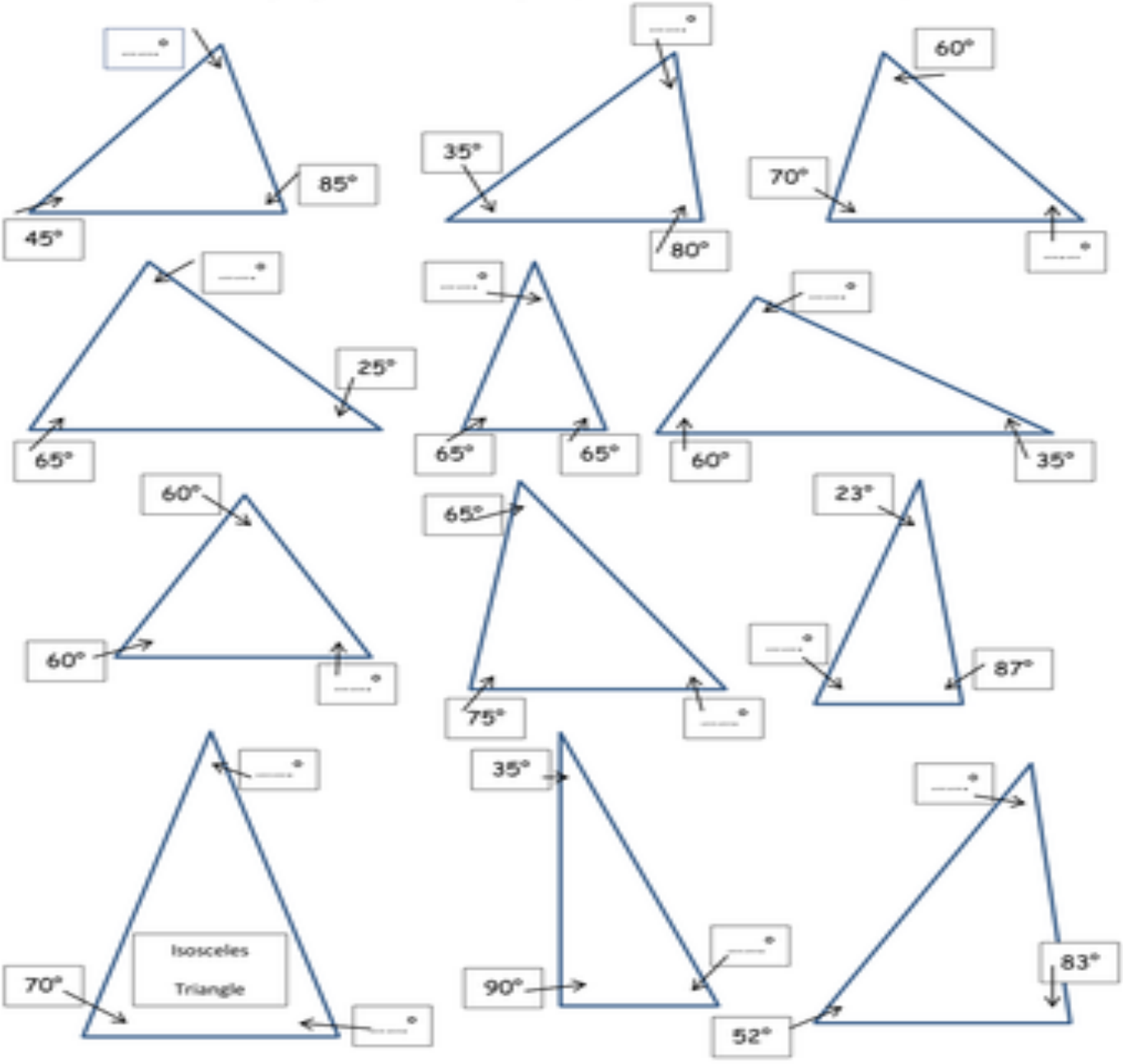
- Can an equilateral triangle be obtuse?

  Yes No

  Why or why not? _____

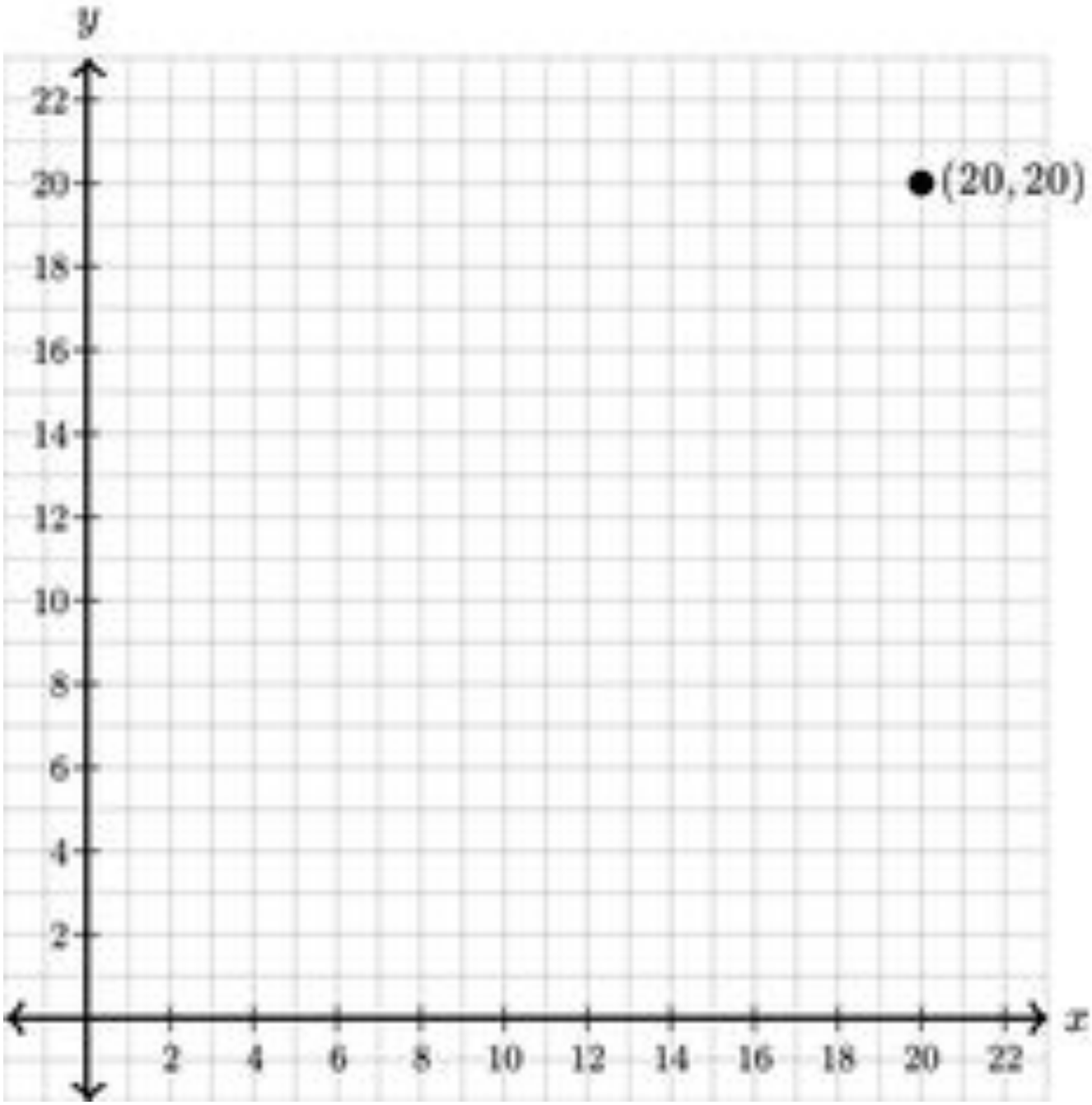
  _____

- Now select three scalene triangles and find the missing angles.



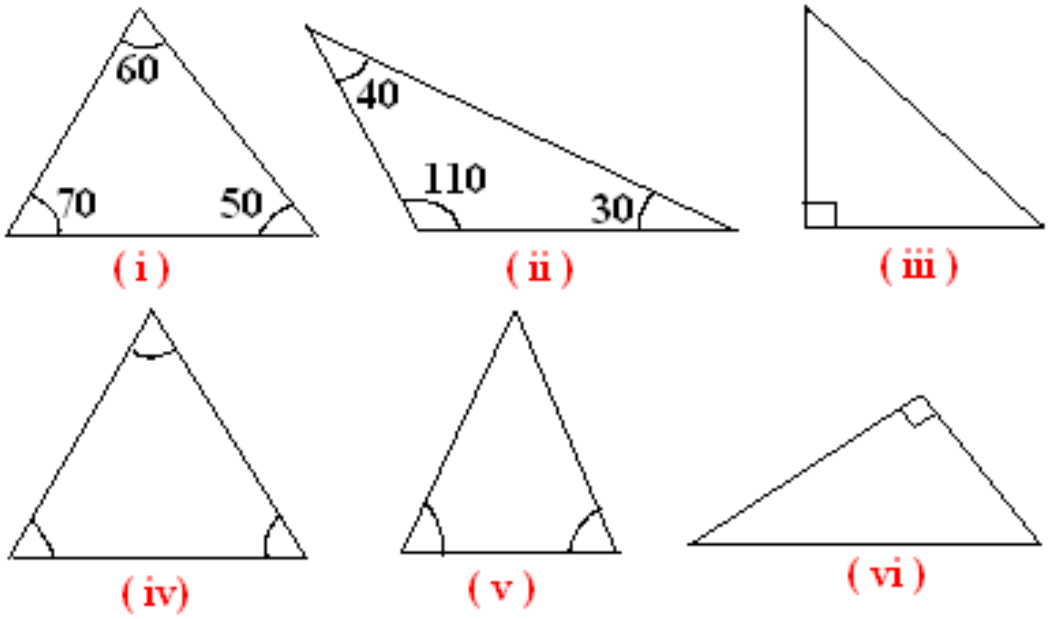
https://d1uvxqwmcz8fl1.cloudfront.net/tes/resources/7547400/9bcc38b0-2f94-4a44-ae96-16a1f135da2f/image?width=500&height=500&version=1444946838277

- Construct triangles, with the coordinate measures, for a scalene, isosceles, right and equilateral triangle in the grid below:



https://s-media-cache-ak0.pinimg.com/236x/e8/32/7f/e8327f1ef7d5f8268cb811dbd78503b4.jpg

- Classify the following triangles.



http://cdn-6.ask-math.com/images/types-of-triangles.png

(i)	
(ii)	
(iii)	
(iv)	
(v)	
(vi)	

How well did I identify different kinds of triangles?	Trailblazer ☺ (Expert)	Pathfinder ☺ (Apprentice)	Rookie Not Yet (Novice) ☺

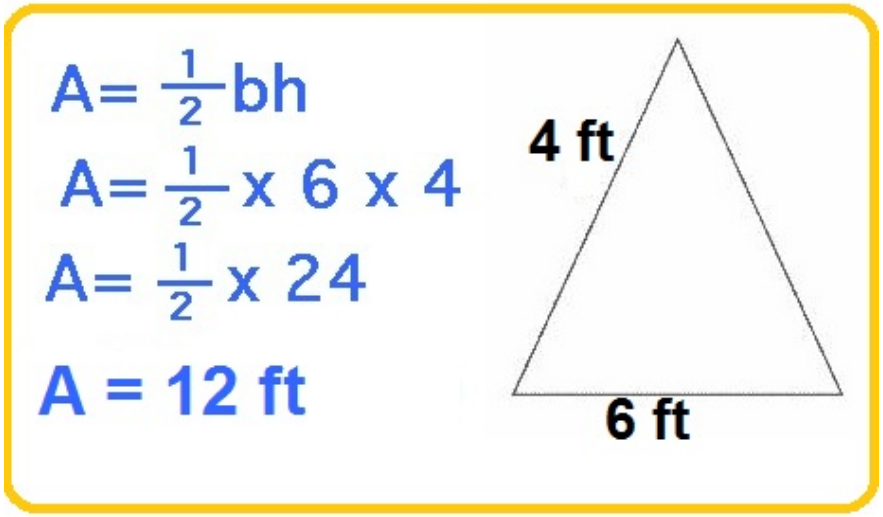
ET - Use fractions to find area of polygons.

15. Area of a Triangle, Rhombus and Parallelogram

RULE: The formula for the area of a triangle is base x height, divided by 2. To find the area of rhombus and parallelogram you multiply the base by the height.

EXAMPLE A: Area (A) of a Triangle:

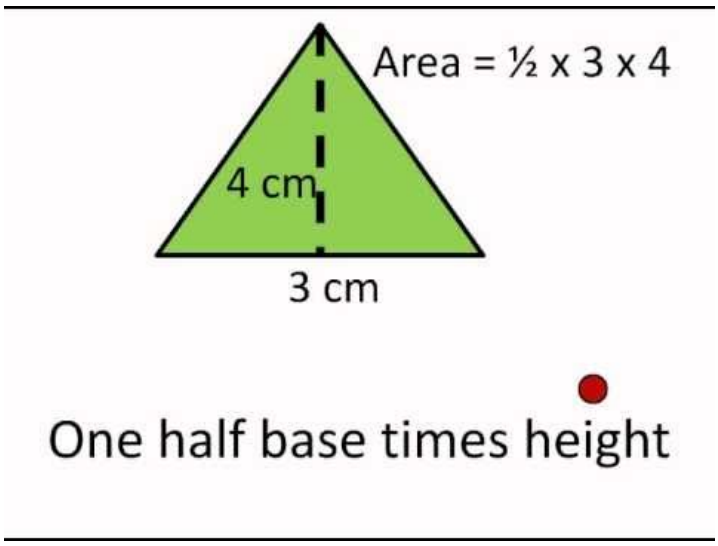
A = Area
b = base
h = height
ft = feet (unit used in the United States)



http://www.mathatube.com/images/triangle_formulas-123.jpg

How well did I show my understanding of equilateral triangles?	Trailblazer ☺ (Expert)	Pathfinder ☺ (Apprentice)	Rookie Not Yet (Novice) ☺

- Look at this example:
- Label the base and the height.
- Calculate the area.

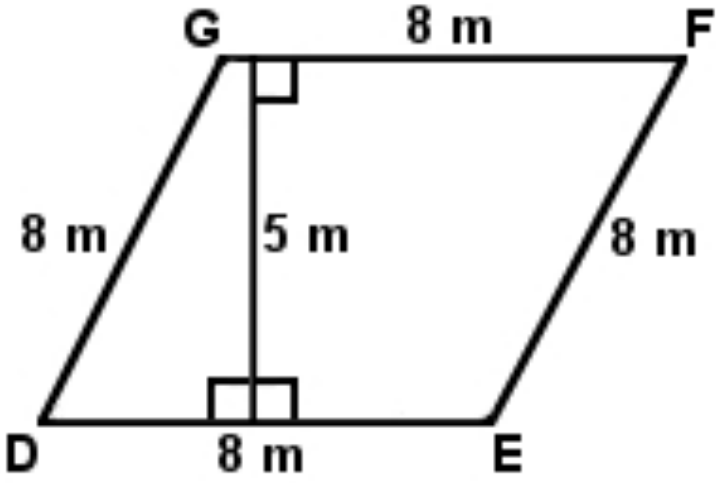


Area of a Rhombus

A (area) = b (base) x h (height)

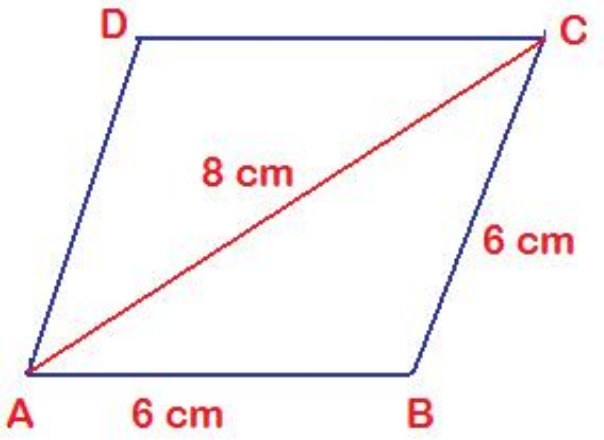
A = 8 (base) x 5 (height)

A = 40 square meters



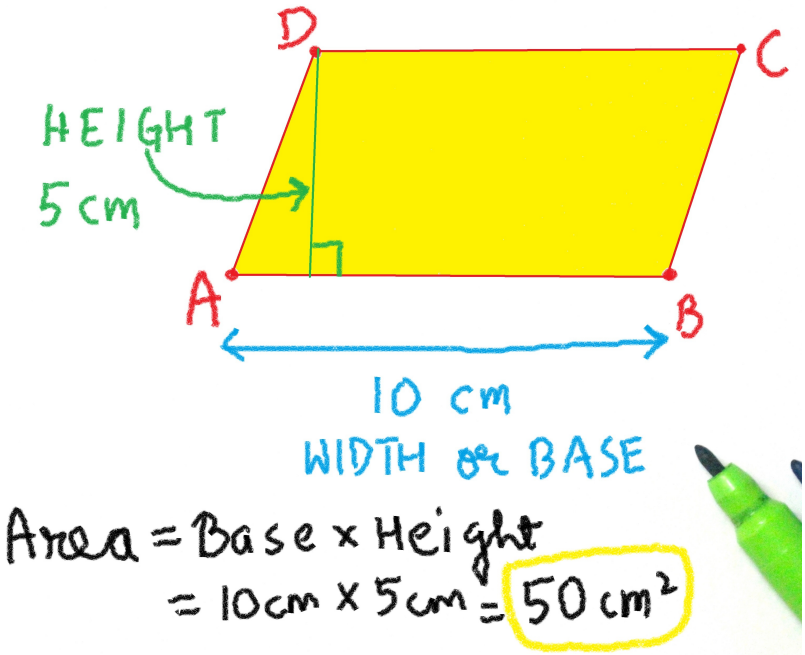
https://secure.starssuite.com/files/geo2010/Geom_12L_fig49.jpg

- Look at the image below.
- You are not provided with the height.
- Using what you know about the area of triangles, can you figure out what the area of this rhombus is – **without** using the rhombus formula?



http://s3.mnimgs.com/img/shared/ck-files/ck_557a72108d754.jpg

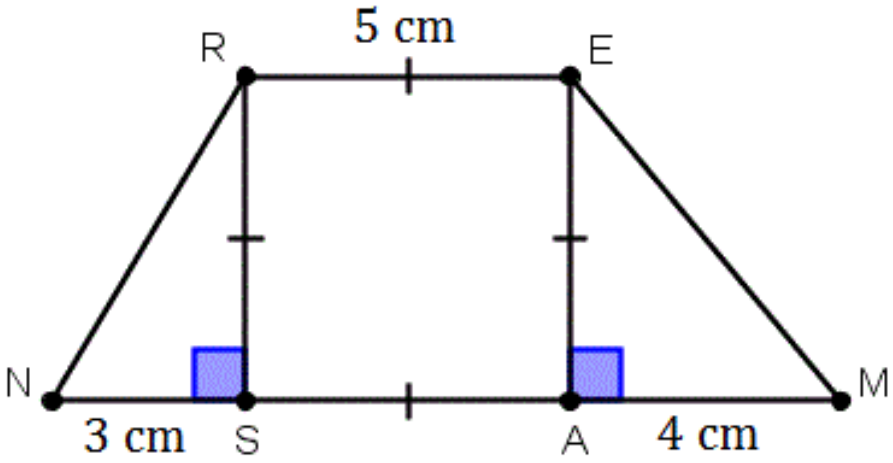
Area of a Parallelogram



http://applegaitvalleywalkers.com/p/2016/11/how-to-find-the-area-of-a-parallelogram-1g2btdlg.jpg

Extension:

- Using what you know about the area of triangles and rectangles, try to figure out what the area of this trapezoid might be.



https://dj1hlxw0wr920.cloudfront.net/userfiles/wyzfiles/6523cdf8-958d-444a-a5f3-0d3c7089dbff.gif

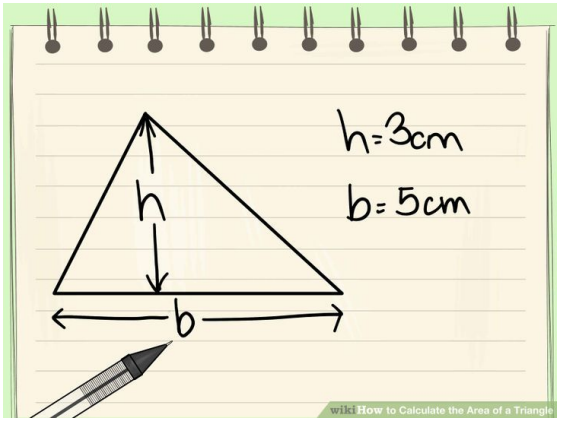
RECIPROCAL TEACHING:

- "Like a teacher" explain how to calculate the area of a triangle, rhombus and parallelogram.
- Share examples and teach how to find the area of a triangle, rhombus and parallelogram to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

GOT IT!

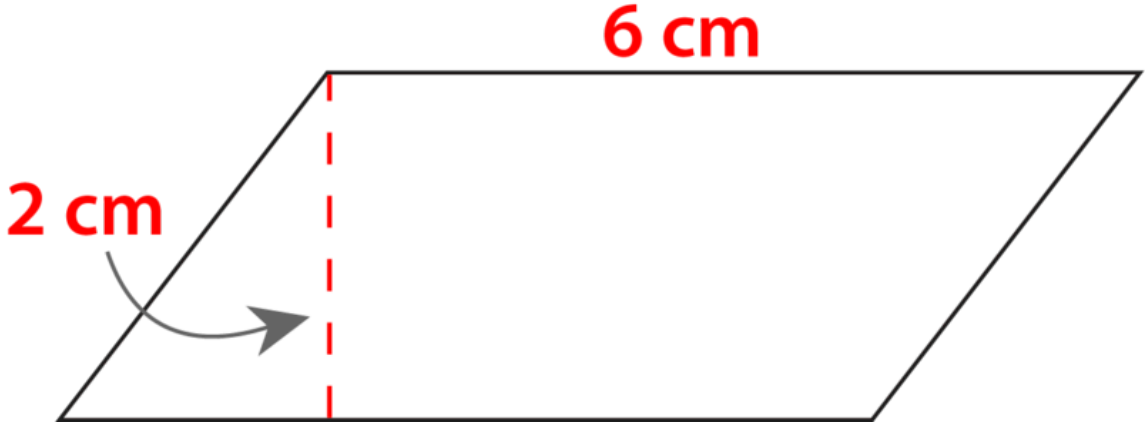
- Now find the area for this triangle.

http://pad1.whstatic.com/images/thumb/d/de/Calculate-the-Area-of-a-Triangle-Step-1-Version-4.jpg/aid278836-728px-Calculate-the-Area-of-a-Triangle-Step-1-Version-4.jpg



- What is the area of a rhombus with 7cm height and 10cm base.

- What is the area of the parallelogram below.



https://dr282zn36sxxg.cloudfront.net/datastreams/f-d%3A6ad1aa03ce987d557f6fda4ad0972f7b40c5cf6d4c123b3bdc8897fc%2BIMAGE%2BIMAGE.1

How well did you find the area of a triangles, rhombus and parallelogram?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

TRIANGLE QUIZ

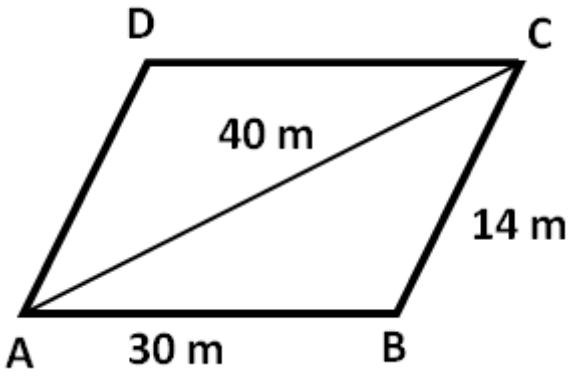
1. Complete this on-line quiz:
   - http://www.softschools.com/quiz_time/math/geometry/theme1.html
   - http://www.mathsisfun.com/triangle.html

2. What are the four different kinds of triangles and what makes them distinct. (8 points)

3. Using the formula, calculate the area of a triangle that has a base of 8cm, and a height of 5cm. (2 points).

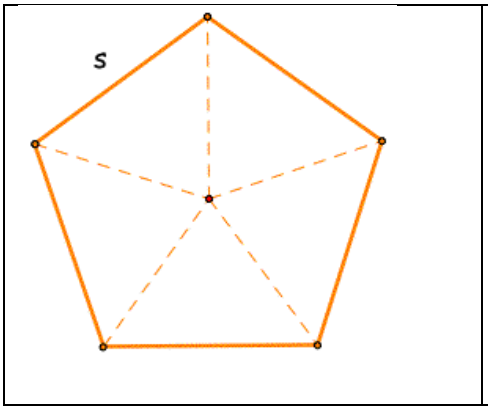
4. What is the area of a rhombus with one 4cm side?

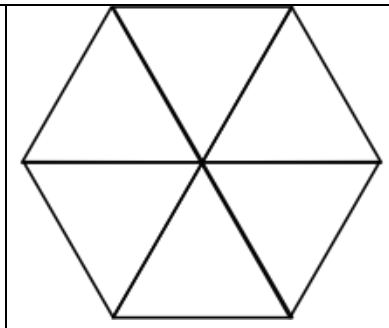
5. What is the area of this parallelogram?

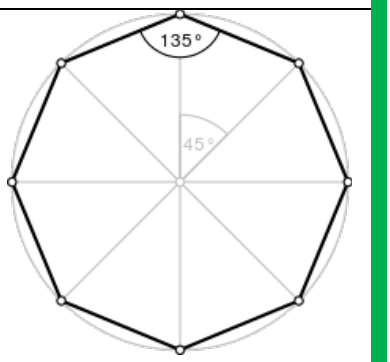


6. Complete the following quiz:
http://www.softschools.com/quiz_time/math/geometry/theme1.html

Bonus Question
If you know the sides of a pentagon, hexagon and an octagon are 8cm, and the base of a triangle inside each figure is 5cm, how can you figure out the area of each – based on what you know about triangles and rectangles?







How well did you understand triangles, parallelograms, and rhombuses?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

E. 3 Dimensional Objects

CHECK-IN: Maybe you already know all this? Show your teacher what you know!
*Go to Page 138 and try the 3D Objects Quiz.
****It is okay to say "I don't know" ☺

GLOSSARY UP FRONT
Face = One of the polygons that make up a polyhedron.
Edge=The intersection of a pair of faces in a three-dimensional figure
Diagonal = A line segment joining two vertices of a polygon that are not next to each other
Net = A pattern that can be folded to make a three-dimensional figure.
Prism = a solid geometric figure whose two ends are parallel and congruent polygons, called bases. Lines joining corresponding points on the bases are always parallel. The sides of prisms are always parallelograms
Polyhedra = three- dimensional figure with faces made up of polygons. The polyhedra include prisms and pyramids.
Cone = A three-dimensional figure with a circular base and a curved surface that tapers to a common point.
Cube = a symmetrical three-dimensional shape, either solid or hollow, contained by six equal squares.
Rectangular Prism = A solid (3-dimensional) object which has six faces that are rectangles. It has the same cross-section along a length, which makes it a **prism**
Triangular Prism = is a three-sided **prism**; it is a polyhedron made of a **triangular** base, a translated copy, and 3 faces joining corresponding sides
Tetrahedron = a solid having four plane triangular faces; a triangular pyramid
Square Pyramid = a three-dimensional geometric figure with a **square** base and four **triangular** sides that connect at one point; a **pyramid** with a **square** base
Pentagonal Prism = prism having two **pentagonal** bases and five rectangular sides.
Pentagonal Pyramid = pyramid with a **pentagonal** base upon which are erected five triangular faces that meet at a point (the vertex).
Platonic Solid = one of five regular solids (a tetrahedron, cube, octahedron, dodecahedron, or icosahedron)
Volume = the amount of space that a substance or object occupies, or that is enclosed within a container, especially when great
Surface Area = area of outer part or uppermost layer

ET - Identify objects using edges, sides & corners of 3D objects.

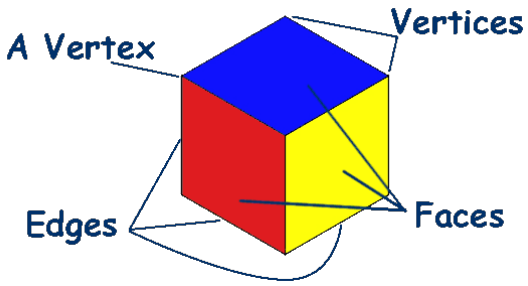
ET - Identify relationship between 2D & 3D objects.

16. Polyhedrons

RULE: There are three types of polyhedrons: platonic solids, prisms and pyramids. Polyhedrons have no curved surfaces. Euler's Formula can be used to describe how faces, vertices and edges of polyhedrons are linked:

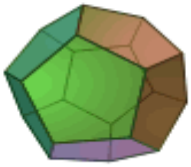
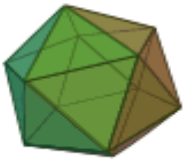
F (number of faces) + V (number of vertices) – E (the number of edges) = 2

EXAMPLES:



http://www.11plusforparents.co.uk/Maths/images/data/3d1.gif

(a) Platonic Solids

Tetrahedron (four faces)	Cube or hexahedron (six faces)	Octahedron (eight faces)	Dodecahedron (twelve faces)	Icosahedron (twenty faces)
				

https://malagabay.files.wordpress.com/2014/02/platonic-solids.gif

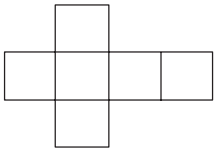
- All sides are flat
- All sides are the same length
- All angles are the same
- All faces are congruent

FUN & GAMES:

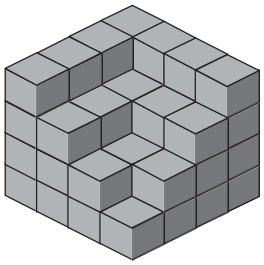
- Using a modelling clay or material, make models of each of the above platonic solids.
- Practice saying the names of each platonic solid
- Create labels for each solid and display them for classmates to see.

The Net: Blueprint for the Cube

- Create a cube out of paper using a net with the following shape.

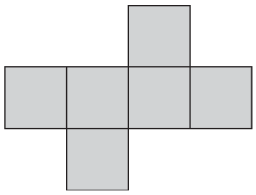


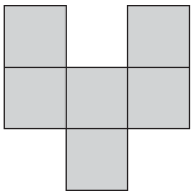
- Work with cubes to find out how many cubes would be needed to build this structure?

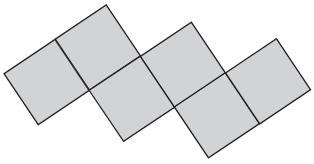


- Try to make a cube from the following nets.

A B C

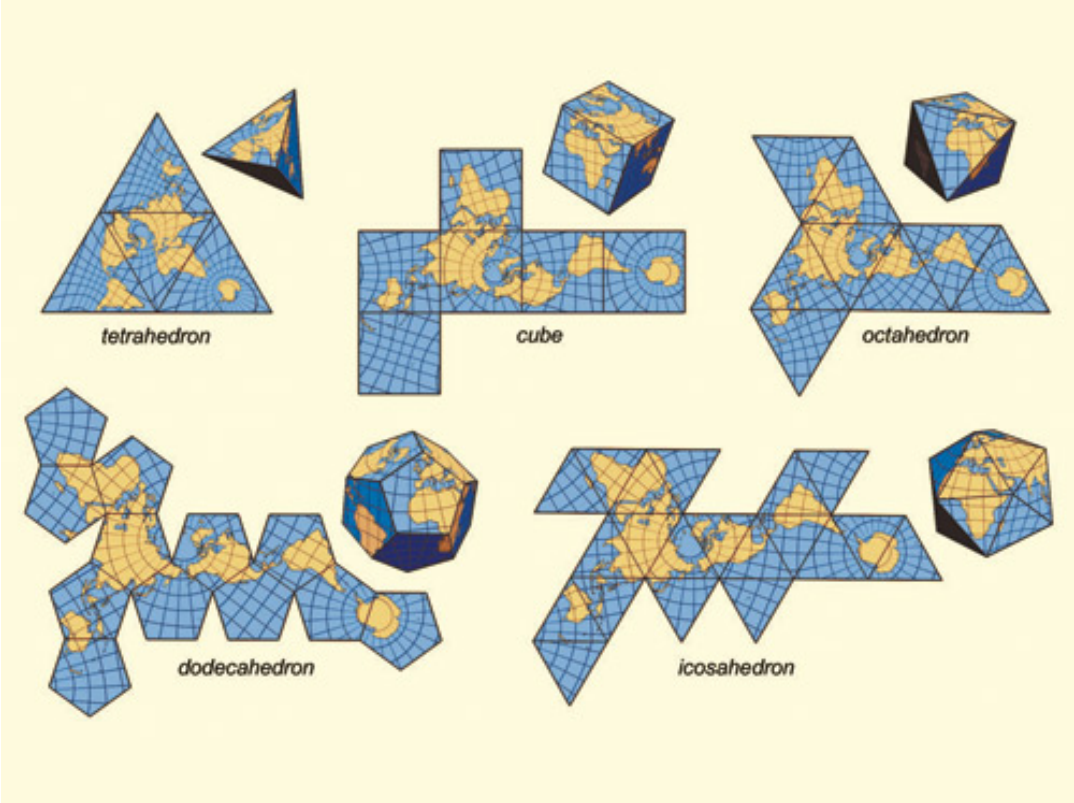






- Did A, B, and/or C surprise you? Explain ☺

- Look at the nets for each platonic solid.

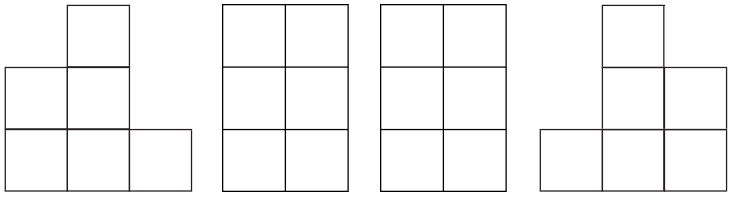


https://malagabay.files.wordpress.com/2014/02/platonic-solids.gif

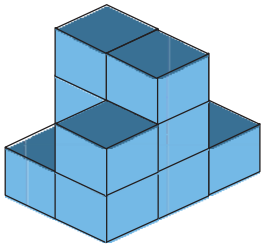
- Stack cubes together in a 3D space without leaving any gaps. To tessellate space, you fill it up. You can pack as many boxes into a truck or onto a market shelf as you can. Likewise, honeybees use all of the available space in their hive by building a tessellated pattern. https://s-media-cache-ak0.pinimg.com/736x/4d/1d/f0/4d1df0e24573bd80bbb534a3da1b84c3.jpg

Extension:

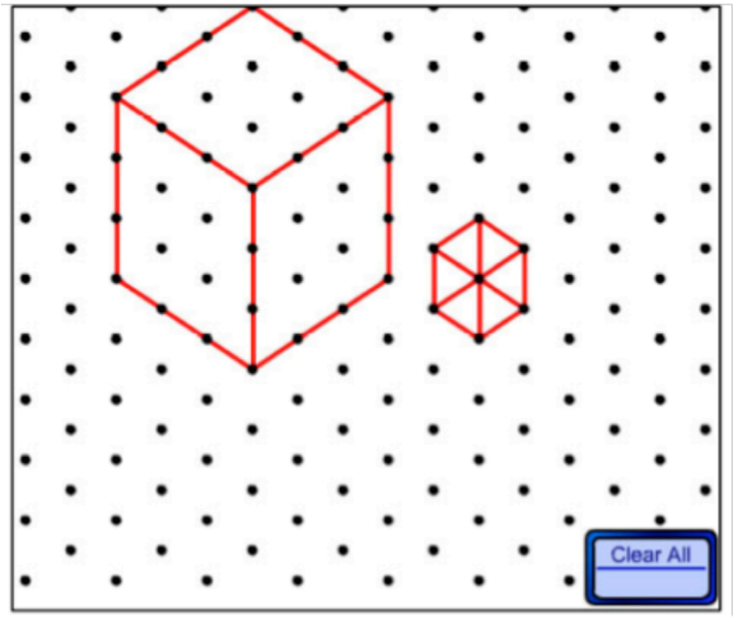
- Use interlocking cubes to see different views of a "building".
- Use blocks to build solid and sketch the three-dimensional view.
- Consider this example:



front left … right … rear



- Draw a 2D representation of a 3D solid using isometric grid paper.
- Given the isometric drawing sketch front, side, top, and rear views.



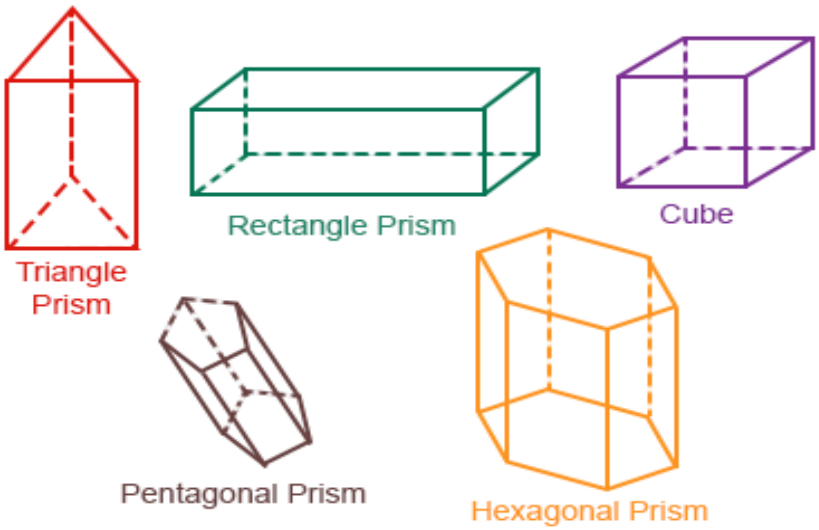
http://www.schools.nsw.edu.au/learning/7-12assessments/naplan/teachstrategies/yr2015/img/nm_3dsp_s3a_14_8a.jpg

- Make your own top view of a building made up of vertical stacks.

http://assets.inhabitat.com/wp-content/blogs.dir/1/files/2013/10/The-Interlace-by-OMA-and-Ole-Scheeren.jpg

Prisms

Prisms are named according to the shape of their bases. Some examples include rectangular prisms, triangular prisms, hexagonal prisms, and so forth. A special rectangular prism, with square faces congruent to the base, is known as a *cube*.

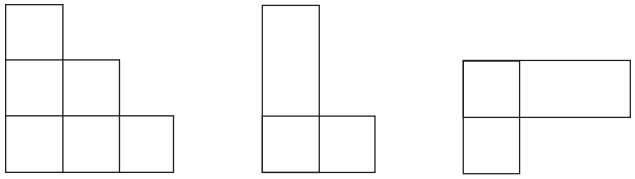


http://images.tutorcircle.com/cms/images/113/types-of-prisms.png

- What defines the different kinds of prisms:
  1. How many faces?
  2. How many edges?
  3. How many vertices?
  4. How many parallel sides?
  5. How many perpendicular edges?

- The line where two faces meet is called an *edge*.
- The vertex is a point at which two or more edges meet.
- Faces and edges of a figure can be described as being parallel or non-parallel to other faces and edges.
- Edges and faces can often be described as "at right angles" to other faces and edges. (perpendicularity)

- Use interlocking cubes to make the following:

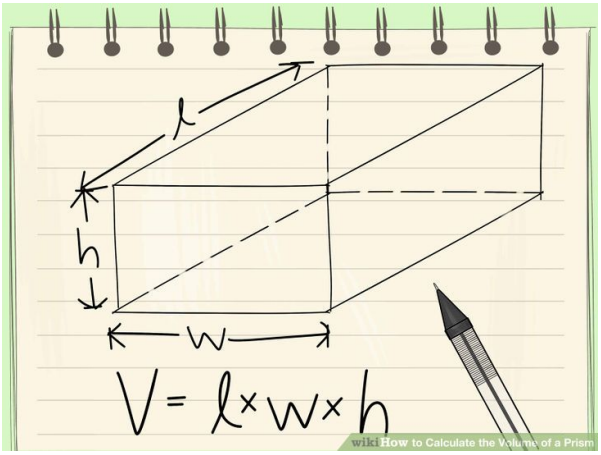


Front view Side view Top view

Rectangular Prism

A Rectangular Prism is a 3D (three dimensional) object that has six rectangular surfaces or 'faces', Rectangular prisms can be solids or they can be surfaces that contain a volume (V). The volume of a rectangular prism is calculated by multiplying the length (L) by the width (W) by the height (H):

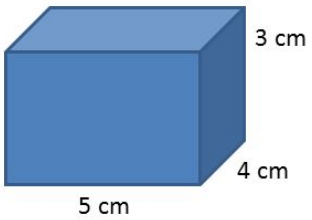
$$V = L \times W \times H$$



http://pad1.whstatic.com/images/thumb/2/2e/Calculate-the-Volume-of-a-Prism-Step-10-Version-3.jpg/aid421502-728px-Calculate-the-Volume-of-a-Prism-Step-10-Version-3.jpg

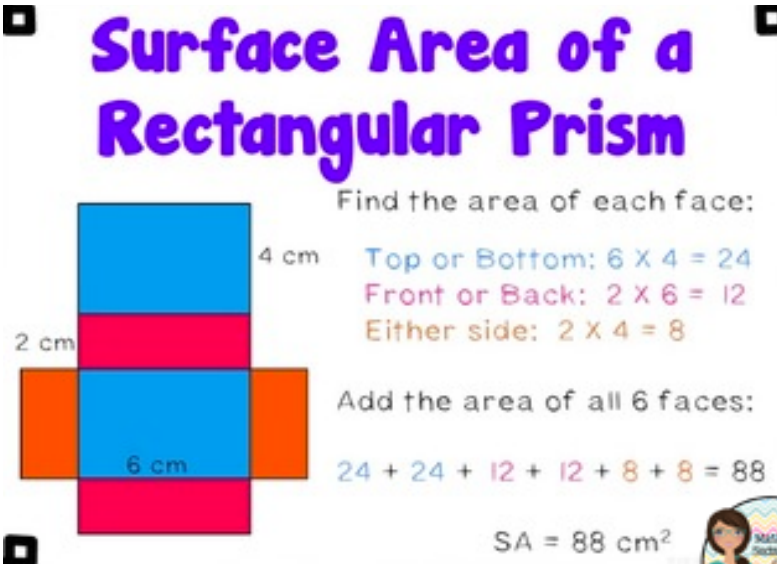
- Find the volume of the rectangular prism.

$V = l(w)(h)$
$V = 5(4)(3)$
$V = 60\ cm^3$



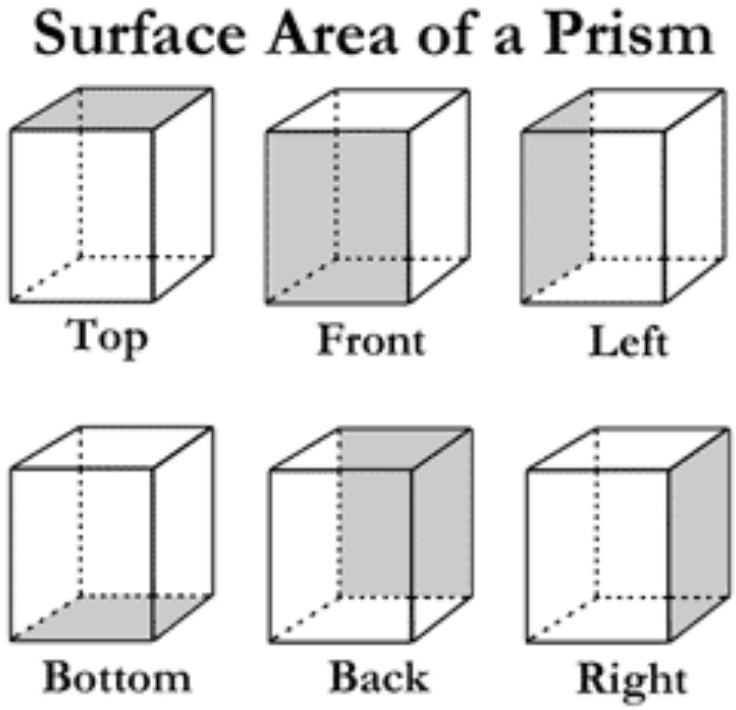
http://images.slideplayer.com/24/7005120/slides/slide_3.jpg

A Rectangular Prism can hold space and it can also have a surface area. To buy materials for the floor, walls and ceiling of a room, a builder must know what the area is of each surface in the rectangular prism. A rectangular prism has 4 sides and 2 ends. Opposite (adjacent) sides have the same area. The surface area is the sum of the areas of all six sides. The formula for the overall surface area of a rectangular prism is: Surface Area (SA) = Area of two sides + Area of two adjacent sides + area of the ends



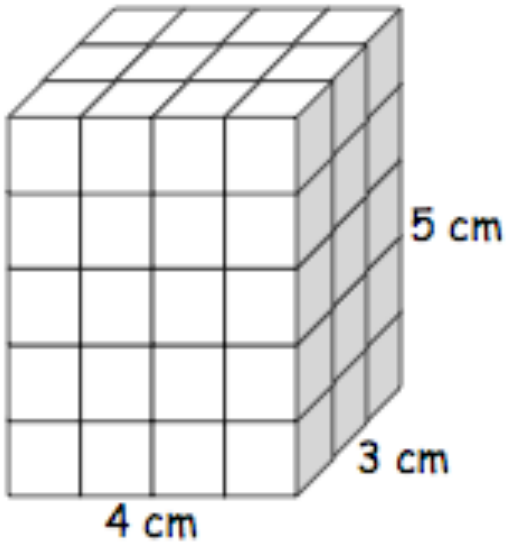
http://1.bp.blogspot.com/-P2RbbUihbP0/U2-MVVUA44I/AAAAAAAAEaY/9-TGSIpXy_M/s1600/pic212.jpg

To determine the surface area of a rectangular prism, think about the area of each face.



http://www.mathvillage.info/sites/default/files/VolSA/surface_set1/surface_files/image004.gif

- Now look at the example below to see how to calculate the surface area.



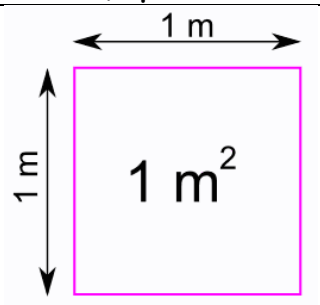
4 cm long, 3 cm wide and 5 cm high

(4 x 3 x 2) + (3 x 5 x 2) + (4 x 5 x 2)

= 24 + 30 + 40

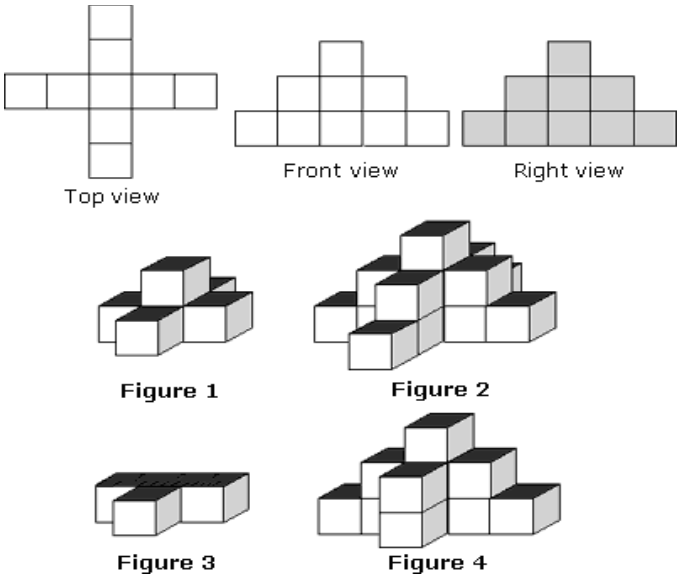
= 94 square cm or 94 cm^2

- Notice how Volume (V) is in cubic meters and the surface area is in square meters.

Volume (cubic meters)	Surface Area (square meters)
m^3 http://www.fileformat.info/info/unicode/char/33a5/square_m_cubed.png	 http://www.mathsisfun.com/definitions/images/square-m.gif

Extension:

- What does the top view of a prism tell you about the number of rectangular faces it has?

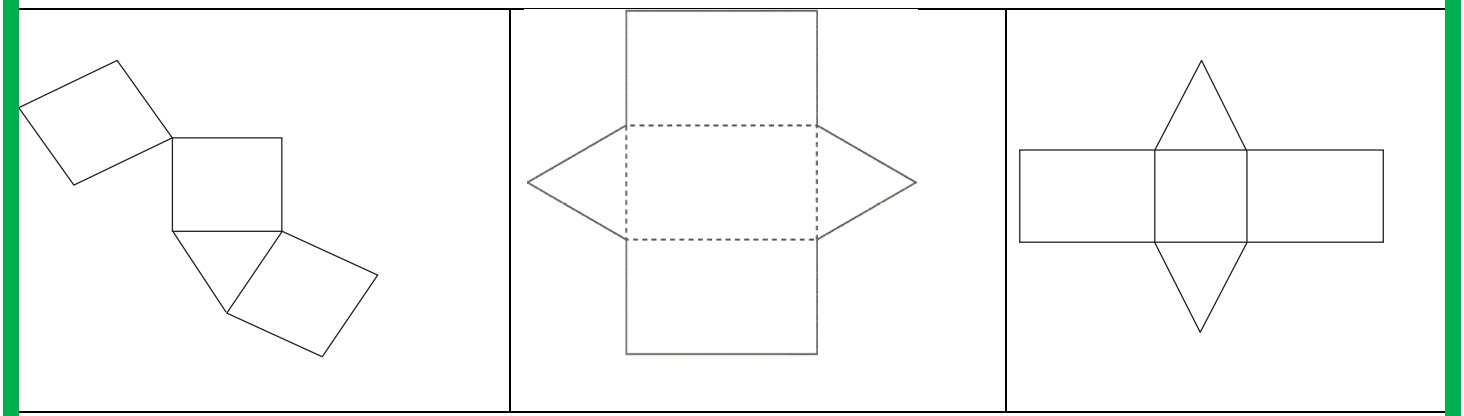


http://image.tutorvista.com/Qimages/QD/44739.gif

Triangular Prisms

A Triangular Prism is a 3D (three dimensional) object that has five surfaces or 'faces', two of which must be triangles and three must be rectangular surfaces. The formula for the volume of a rectangular prism is V = $\frac{1}{2}$ b (base) X h (height) X L (length).

- Try to create a triangular prism by folding these three nets:



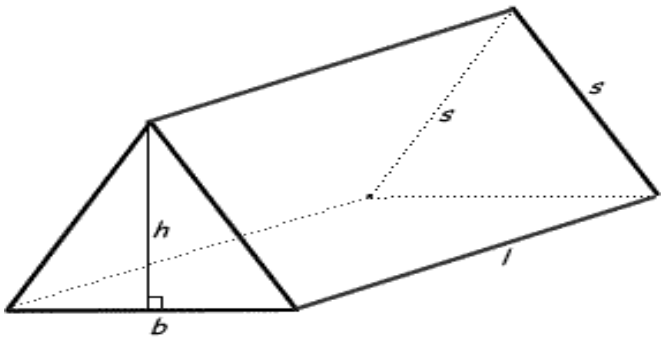
- Although two of the nets have the correct number and type of faces found in a triangular prism, two cannot be folded into one solid.
- Cross out the nets that do not work.
- Create a net from unfolding a paper triangular prism.
- Create a net of a triangular prism.

To find the surface area of a triangular prism you need to use this equation:

A = BH (base x height) + 2L (length X slant?) + LB (length X base)

Isosceles Triangular Prism

Surface Area $A = bh + 2ls + lb$



Volume $V = \frac{1}{2}(bh)l$

Triangular Prism:

- Number of faces: 5
- Number of edges: 9
- Number of vertices: 6

A triangular prism is a prism composed of two triangular bases and three rectangular sides.

TECH CHECK:

- http://www.aaamath.com/geo79_x9.htm
- http://www.shodor.org/interactivate/activities/SurfaceAreaAndVolume/
- http://www.aaamath.com/geo79_x1.htm
- http://www.ehow.com/video_4980158_calculate-volume-triangular-prism.html
- http://www.korthalsaltes.com/model.php?name_en=triangular%20prism
- http://www.youtube.com/watch?v=p3fQb7Ic3_0&feature=PlayList&p=BBADCEEBBB3A65F6&playnext_from=PL&index=1
- http://video.google.com/videoplay?docid=-5931818952547652165#

Painless Geometry Reference Book (pp. 235-236)

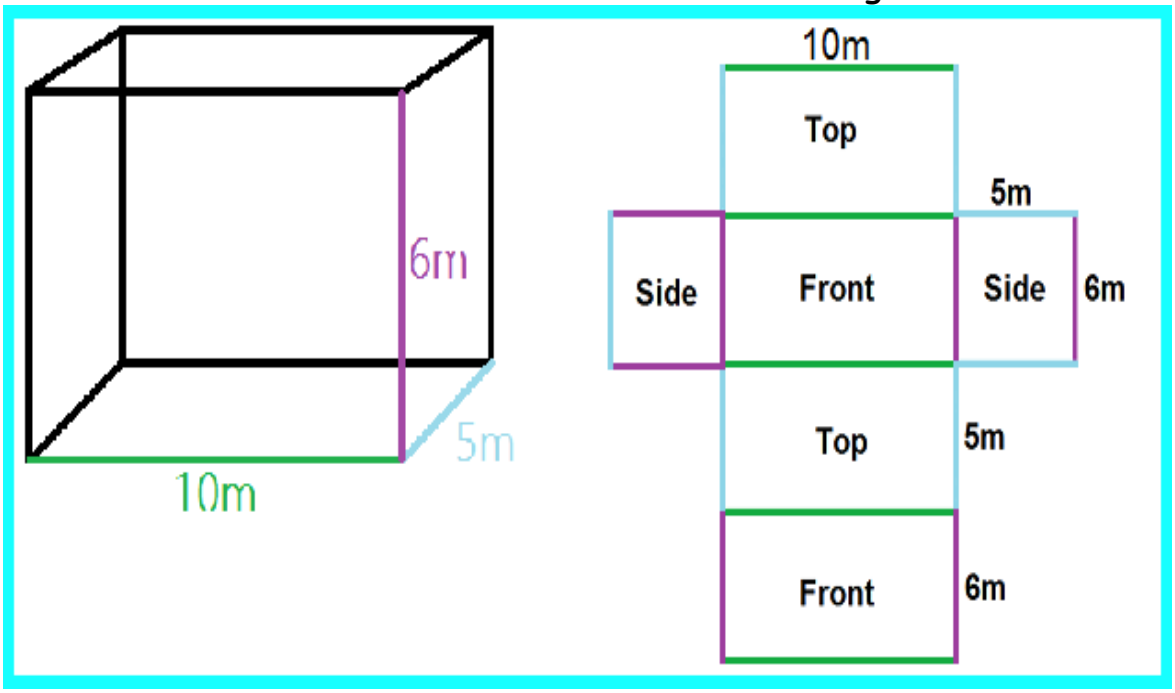
RECIPROCAL TEACHING:

- "Like a teacher" explain how you identify prisms and calculate their area.
- Share examples and teach about prisms and how to find their surface area to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

GOT IT!

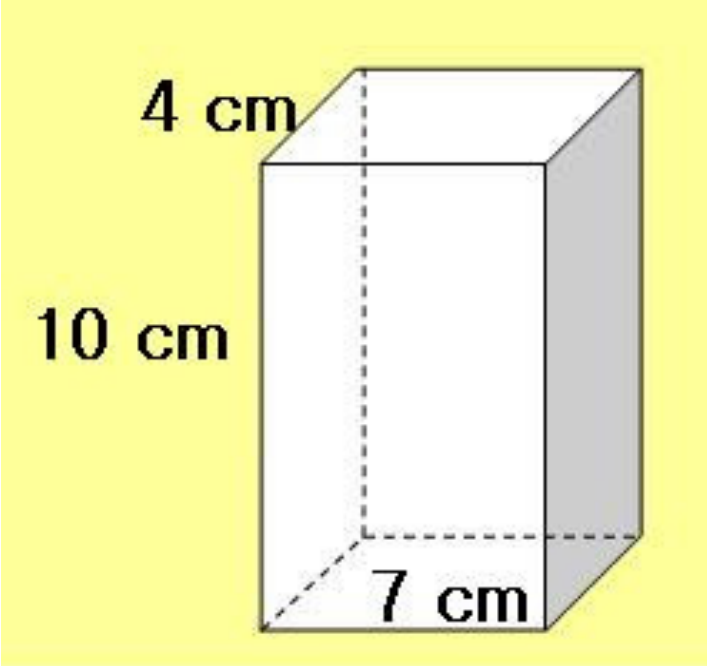
1) Make a rectangular prism using nets and describe the number of faces, edges, vertices, and perpendicular and parallel qualities.

2) Solve for the volume and surface area of the following:



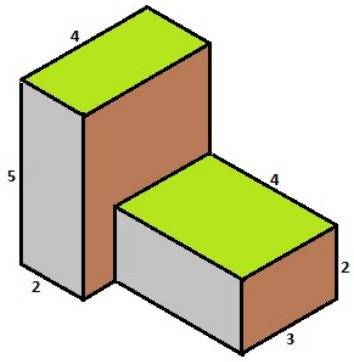
https://www.psdblogs.ca/jpodhaniuk/files/2014/05/rectangular-prism-surface-area-18h62je.png

3) Figure out the volume of the rectangular prism:

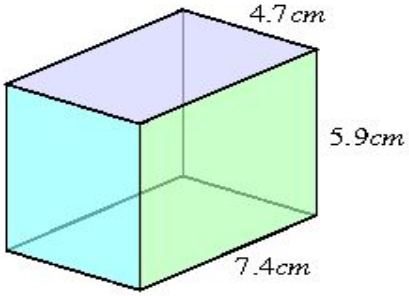


http://1.bp.blogspot.com/_0aAzD_t_m9E/StozDavLj2I/AAAAAAAAAJQ/tmxZoju_ExA/s400/RectangularPrism.jpg

4) How much is the volume of both of the spaces below:

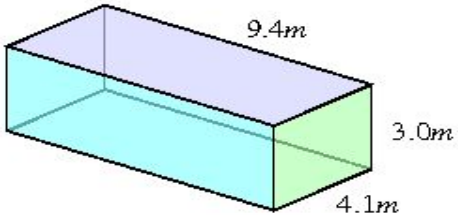


5) Find the volume of the following?



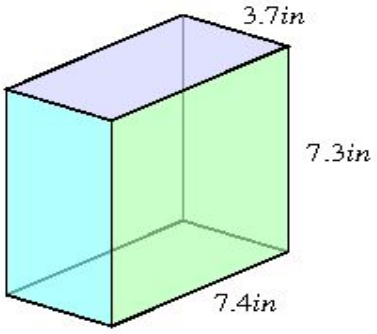
V: _____

SA: _____



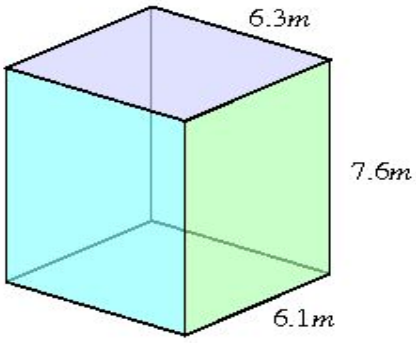
V: _____

SA: _____



V: _____

SA: _____

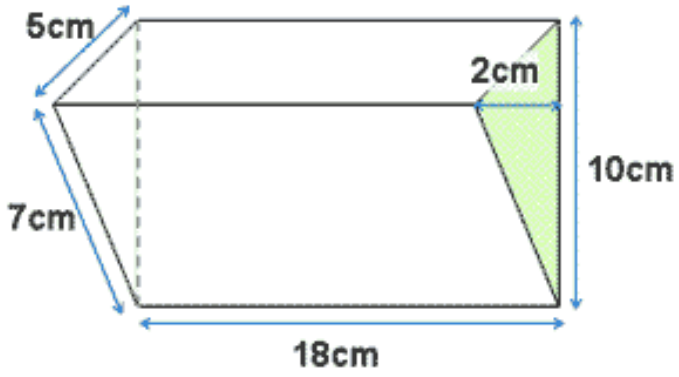


V: _____

SA: _____

https://s-media-cache-ak0.pinimg.com/originals/f0/93/19/f093198bbc08617e297d4f92f63b86bf.jpg

6)Find the surface area of the triangular prism below:



7) What is the volume of a triangular prism with a height of 2cm, a base of 1 cm and a length of 3 cm?

How well did you identify objects using edges, sides & corners of 3D objects?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

How well did you identify relationship between 2D & 3D objects?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

Extension:

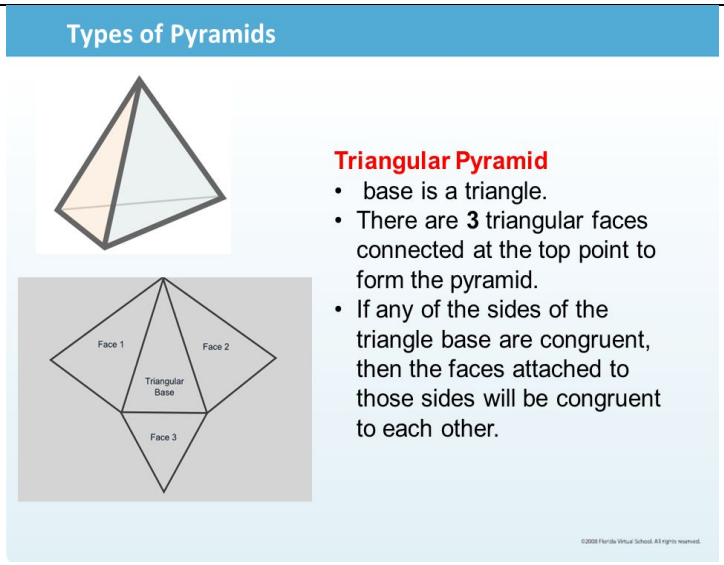
- Calculate volume & surface area of rectangular prisms.

ET - Identify & classify 3D objects.

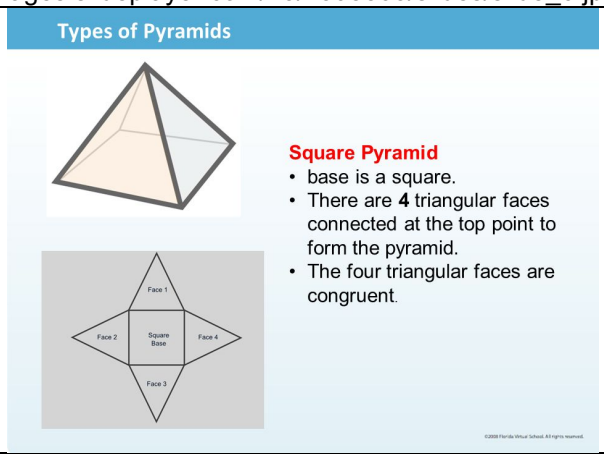
17. Pyramids

RULE: To find the surface area of a triangular pyramid you need to use the equation: $\frac{1}{2}$ x a (center of midpoint to side) x s (side) + 3/2 s (side) l (slant height). To find the volume of a pyramid you need to use this equation: 1/6 x a (center to midpoint) x b (base) x h (height).

EXAMPLE:



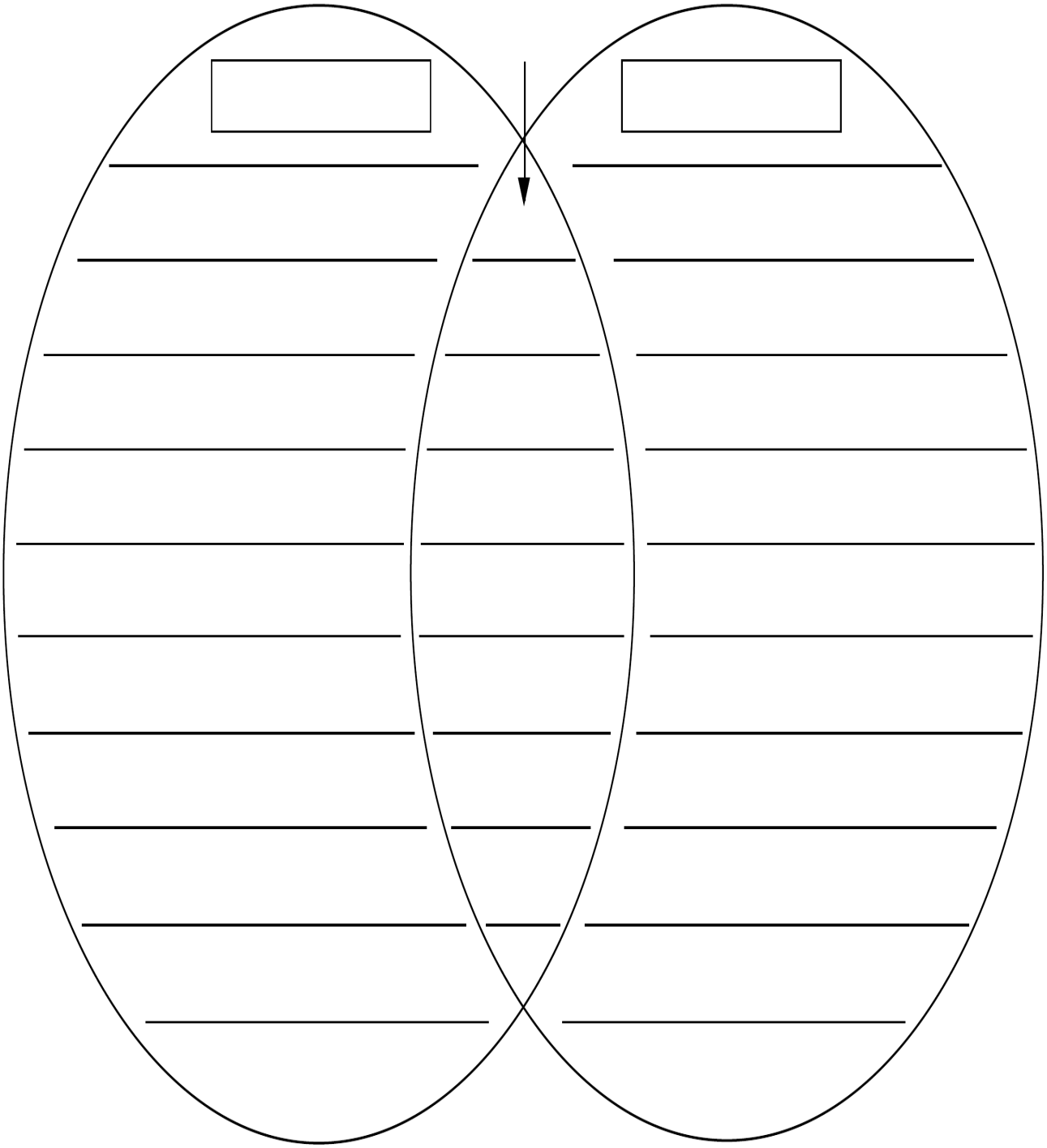
http://images.slideplayer.com/15/4598805/slides/slide_6.jpg



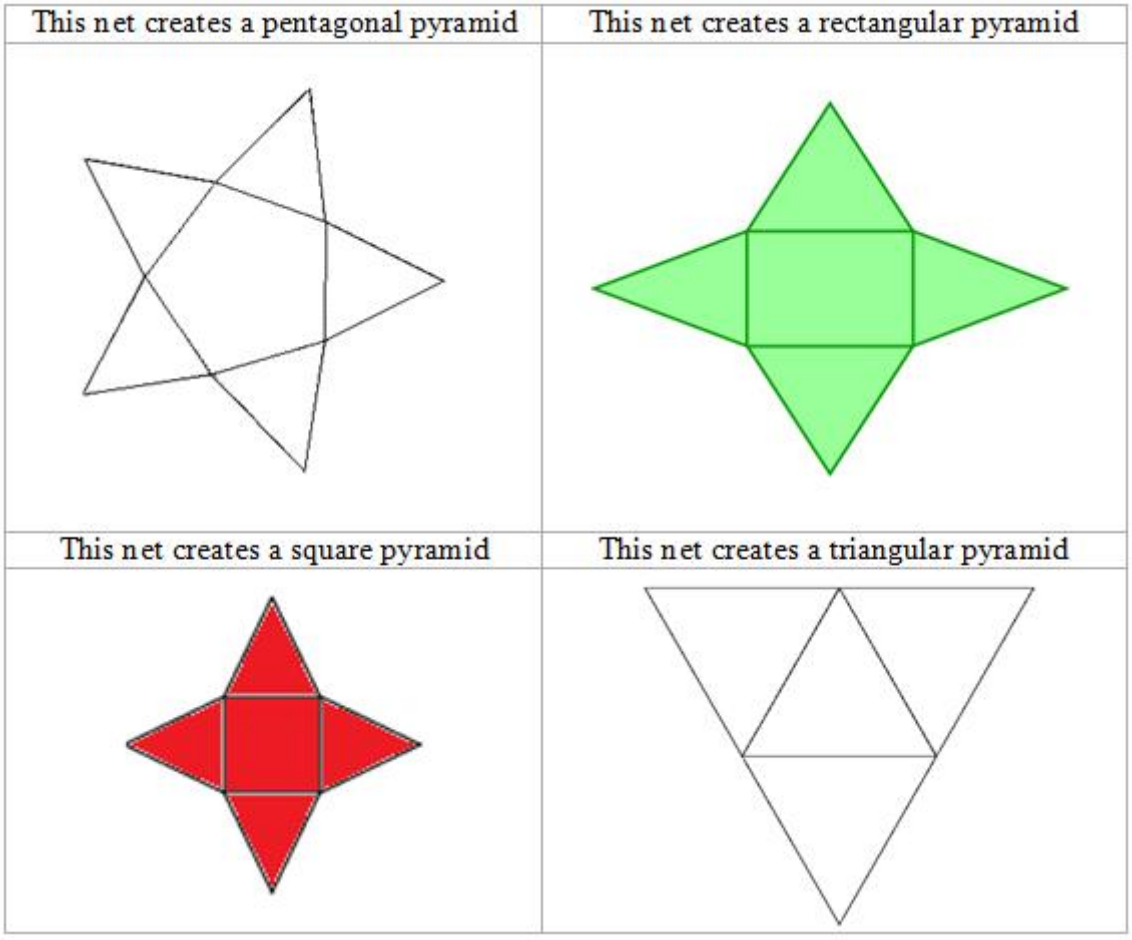
- A pyramid is a polyhedron whose base is a polygon and whose other faces are triangles that meet at a common vertex
- All pyramids have one base with triangular faces that meet at one common vertex (called apex)
- names of pyramids are named by shapes that form their bases. (triangular, square, hexagonal and octagonal pyramids)
- *tetrahedron* - special triangular pyramid where all faces are congruent equilateral triangles.
- All prisms have congruent parallel bases that are joined by rectangular faces.

- Compare what is the same and different between a pyramid and a prism

using the Venn Diagram below:



- Make the following pyramids from the following nets.



http://moodle.tbaisd.org/pluginfile.php/68895/mod_book/chapter/51138/pyramid%20nets.jpg

- Which net can be folded to form a triangular pyramid?

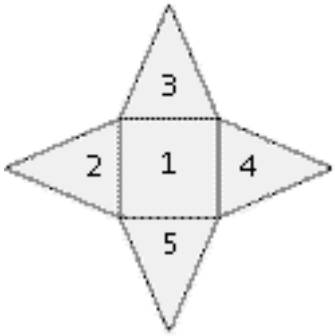


Figure 1

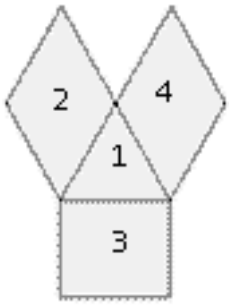


Figure 2

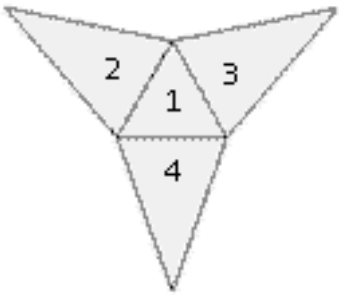


Figure 3

http://image.tutorvista.com/Qimages/QD/44711.gi

Surface Area of a Triangular Pyramid

Step 1: Find the area of the base.

Area of the base(A) = $\frac{1}{2}$ * a * s
= 0.5 * 2 * 3
= 3.

Step 2: Find the surface area of pyramid.
Surface Area of Triangle Pyramid
= A + ((3/2)sl) = 3 + ((3/2) * 3 * 5)
= 3 + (1.5 * 15) = 3 + 22.5 = 25.5.

Step 3: Find the volume of pyramid.
Volume of Pyramid
= (1/6) abh
= (1/6) * 2 * 3 * 4
= 0.17 * 24
= 4.08.

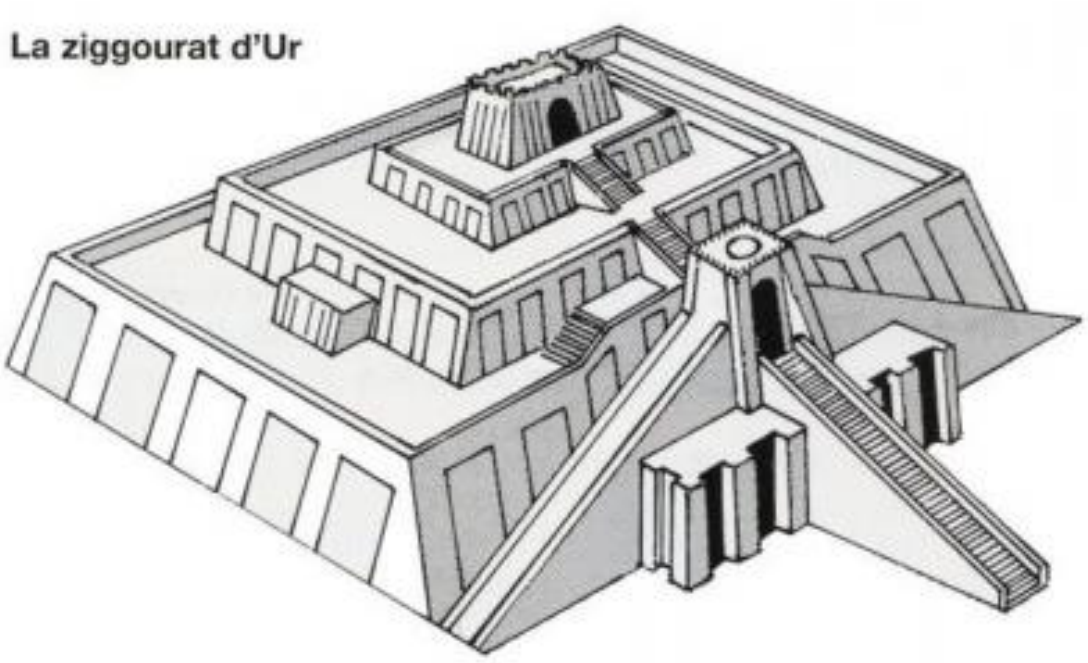
- Use real 3D materials to help make a chart or table to compare and sort prisms and pyramids by geometric properties. (i.e., number and shape of faces, number of edges, number of vertices)
- Make your own nets of three different pyramids using grid paper or isometric dot paper and post on a bulletin board.
- Build a structure from blocks, toothpicks, or other concrete materials, and describe it using geometric terms.

REAL WORLD PROBLEM:

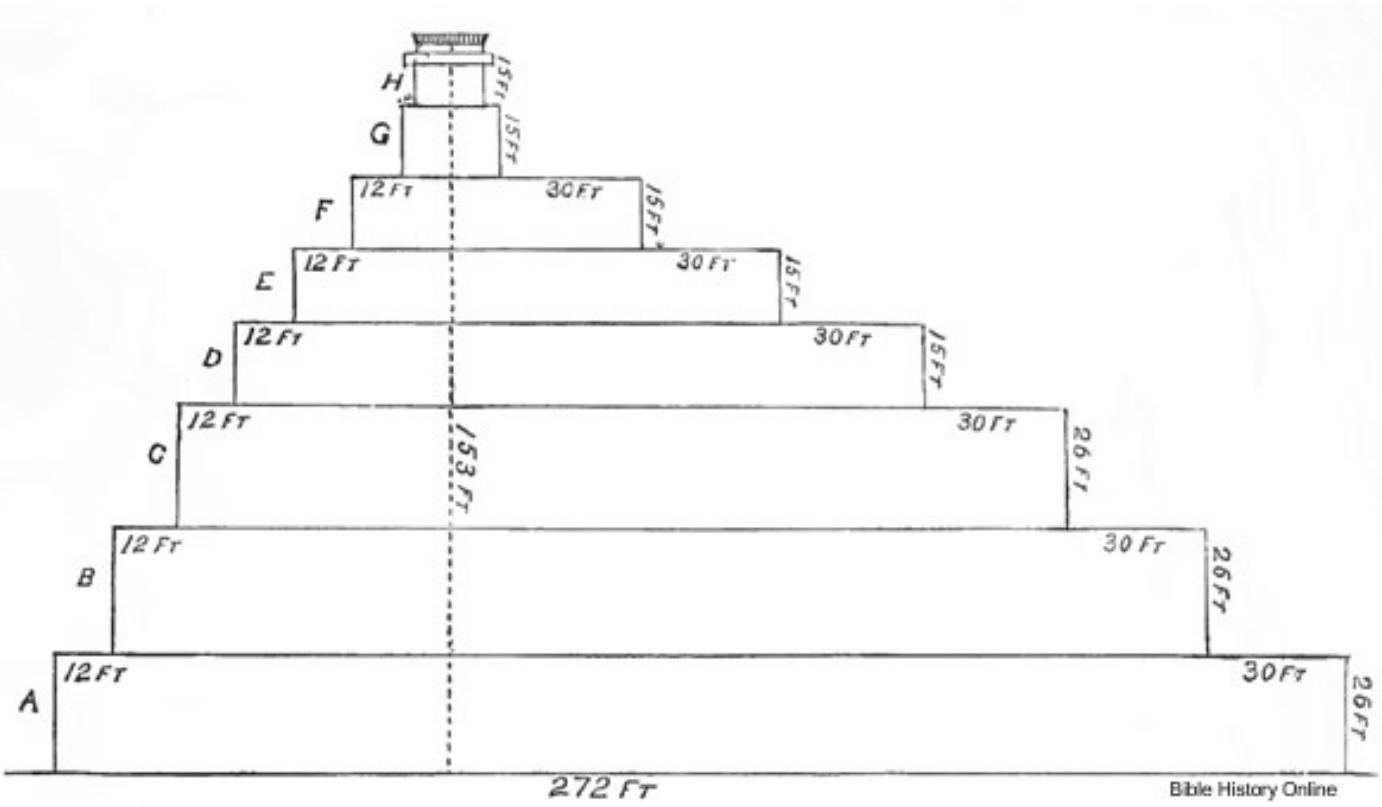
(a) A regular triangular pyramid has a height of 4 cm and a radius of 3 cm. What are the surface area and volume?

FUN & GAMES: Build a Ziggurat

Some ancient pyramids had sides that looked like stairs. In 2100 BC, the city of Ur, in Sumeria, had a ziggurat structure that was made of seven sun-baked bricks stacked in 7 layers, with each one smaller than the one below it. It was about 160 feet tall, and covered 30,000 square feet. At the top was a table and a couch for the moon goddess, Nanna.



http://www.merveilles-et-lieux-sacres-du-monde-antique.net/medias/images/ur4.jpg?fx=r_400_400



http://www.bible-history.com/biblestudy/ziggurat-bw-plan-9.jpg

- Imagine how a real estate agent might advertise for this place. How would you advertise this property using geometric terms?

TECH CHECK:

- http://easycalculation.com/area/learn-triangular-pyramid.php
- http://learner.org/interactives/geometry/3d_pyramids.html
- http://www.aaamath.com/B/g79_vox1.htm
- http://www.youtube.com/watch?v=UBRkGEO7HBU
- http://www.funtrivia.com/playquiz/quiz14712910d9bc0.htn

RECIPROCAL TEACHING:

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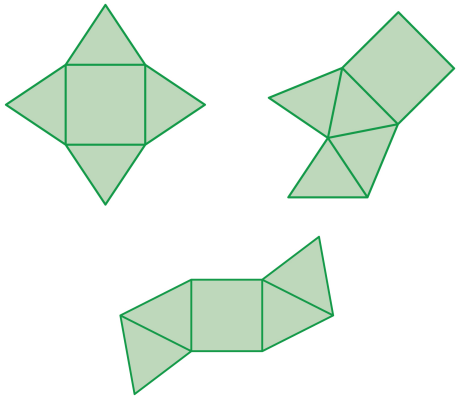
- Share examples and teach how to identify and classify 3D objects to a friend or family member.
- Use scrap paper or a notebook.
- Have your friend or family member change places and replay what you taught.

GOT IT!

1) Identify the following pyramids from their nets. Label these nets.



https://oercommons.s3.amazonaws.com/media/courseware/assets/G07/07-math-math-07-9780328761340-studio-articles-images-mth-7-4-20_tch_squarepyramid.jpg

2) A triangular prism has a base of 8 m, a slant of 9m and a radius of 4m. What is the volume of the triangular pyramid?

How well did you identify & classify 3D objects?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

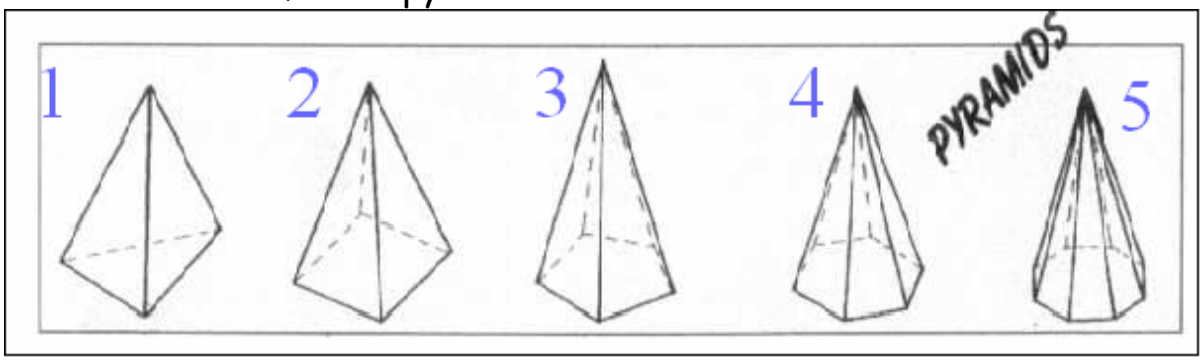
3D QUIZ

1. Complete this 3D Quiz
   - https://www.learner.org/interactives/geometry/testskills.html

2. What is the difference between a pyramid and a prism?

3. Make a net for a rectangular prism.

4. Record the name of each pyramid in the chart below:

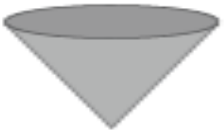


http://www.design-technology.info/graphics/img100.gif

1	
2	
3	
4	
5	

Choose the correct net for each solid shape.

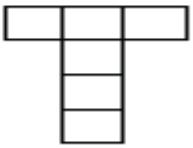
1)



a)

b)

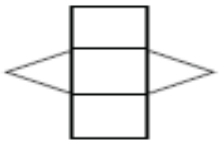
c)



2)

a)

b)



c)

3)

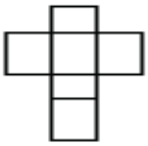
a)

b)

c)

4)

a)



b)

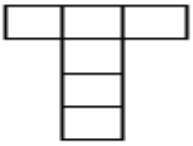
c)

5)

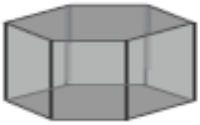
a)

b)

c)



6)



a)

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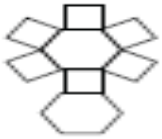

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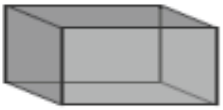
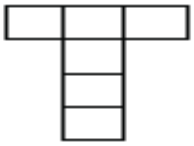
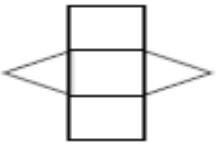


a)



b)

c)



How well did you identify & classify 3D objects?	Trailblazer (Expert)	Pathfinder (Apprentice)	Rookie (Not Yet)

F. Curves and Circular Shapes and Solids (Extension)

Find the definitions of the following:

- diameter
- radius
- circumference
- Pi
- cylinder
- sphere
- cone
- compass

NOTE: "circular prisms" = not included in most accepted definitions of prisms, since their bases are not polygons. You can define prisms as special *cylinders*. Cylinders are solids with two parallel bases connected by parallel elements. When the bases are polygons, the cylinders are prisms.

John Van de Walle (2005) considers pyramids to be special cases of *cones*. When the base is a polygon, the cone can be classified as a prism. Some consider cones to be pyramids with circular bases and only one face. Pyramids can have a common vertex that is directly over the base, or one that lies outside the base.

- Identify and describe real-life situations involving the circumference and diameter of a circle.

http://4.bp.blogspot.com/-pNkq_KIKoGw/T05AayHg7PI/AAAAAAAAAd4/Sx8keucfoV8/s1600/Pi+Day+Link+Up.jpg

Project Ideas for a Geo Fair

Self	1. Geo Board Game includes:	Teacher
	Mathematician Preparation and Design	
	Researched different kinds of game boards	
	Researched game companies to discover what to include and how to submit ideas for new games	
	Research patent requirements for new board games	
	Evaluated geometric shapes on 5 popular game boards	
	Creative title	
	Game included questions about points and grids	
	Game included questions about lines and angles	
	Game included questions about 2D figures	
	Game included questions about 3D solids	
	Used accurate geometric words and definitions	
	Used math books to find ideas	
	Used web to find ideas and images	
	Used images from the outdoors on game board	
	Used materials from nature	
	Used feedback from teacher about draft ideas	
	Good variety of different kinds of questions and challenges	
	Created easy to use answer sheet	
	Attractive use of color and geometric design	
	Used math tools (protractors and rulers) to create and measure accurate angles, spacing, and geometric shapes for game board	
	Created a survey to ask classmates for input about game	
	Modified prototype after gathering feedback	
	Geo Fair and Impact	
	Explained rules of games well	
	Classmates stayed on task while playing game	
	Classmates listed 3 things learned from game	
	Classmates gave it 3 Stars	
	SCORE	
TOTAL SCORE =	**Points (A, B, Not Yet)**	

Self	2. Bus Renovation Project includes:	Teacher
	Mathematician Preparation and Design	
	Explained how recycling a bus could be a useful space for learning	
	Researched different ways of renovating buses	
	Researched companies that make buses to compare new and used prices	
	Researched environmental uses for used buses	
	Made a list of things that would need to be removed from a bus in order to make the space a learning place	
	Created a catchy name for renovated bus	
	Measured dimensions of a bus inside and outside-length and width	
	Measured the volume and surface area of a bus inside and outside	
	Created a grid to show 2D shape of bus	
	Decided where tessellated figures and shapes could be used inside and outside the bus	
	Made a list of 3D solids that would be needed for inside the bus	
	Used web and math books to find ideas and images	
	Created a 3D model (prototype) of bus using both natural and man-made materials	
	Used accurate geometric words and definitions	
	Used feedback from teacher about draft ideas	
	Created interesting learning activities for use inside the bus	
	Included attractive use of color and geometric design	
	Used math tools (protractors and rulers) to create and measure accurate angles, spacing, and geometric shapes	
	Created a survey to ask classmates for input about bus	
	Modified prototype after gathering feedback	
	Took photographs of various views of prototype	
	Wrote a proposal for renovating a bus	
	Geo Fair and Impact	
	Explained geometrical nature of prototype	
	Classmates listed 3 things learned from prototype	
	Classmates gave prototype 3 Stars	
TOTAL SCORE =	**Points (A, B, Not Yet)**	

Self	3. Set Design Project includes:	Teacher
	Mathematician Preparation and Design	
	Research Juno Awards to gather starter ideas for a set design	
	Researched different ways of building sets for theatre, concerts and award shows	
	Researched companies that design "sets"	
	Compare which sets are more environmentally-friendly than others (complete a Venn diagram)	
	Made a list of things needed to build or purchase for set	
	Created a catchy name for set	
	Estimate dimensions of a set -length and width	
	Estimate the volume and surface area of various parts of a set	
	Created a grid to show 2D shape of bus	
	Decided where tessellated figures could be used for the set	
	Made a list of 3D solids that would be needed for inside the set	
	Used web and math books to find ideas and images	
	Created a 3D model (prototype) of set using both natural and man-made materials	
	Used accurate geometric words and definitions	
	Used feedback from teacher about draft ideas	
	Included attractive use of color and geometric design	
	Used math tools (protractors and rulers) to create and measure accurate angles, spacing, and geometric shapes	
	Created a survey to ask classmates for input about your set	
	Modified set design after gathering feedback	
	Select music to accompany model of "set" during Geo Fair	
	Took photographs of various views of set model	
	Wrote a proposal for your "set" and submit to Juno organizers	
	Geo Fair and Impact	
	Explained geometrical nature of set design	
	Viewer listed 3 geometric finds discovered in model of set	
	Classmates gave prototype 3 Stars	
TOTAL SCORE =	**Points (A, B, Not Yet)**	

Big Think

Date: _____

Dear Reader,
I have completed my first year of Geometry.

Did I make any mistakes? _____
Did I learn from making mistakes? _____

I am proudest about the work I did on page ___ because….

I think the trickiest part of this Math was….

because….

I enjoyed working (with others or on my own) because….

Did I teach well to my partner? _____

Sincerely,

My Math Learning Log:

___ used a ruler to underline steps

___ did rough work in spaces teacher can easily find

___ work was neat and easy to read

___ followed pattern recommended

___ completed Big Think and self-assessments

Classroom Work:

___ worked well with teacher during mini lessons

___ worked well on own at independent and choice stations

___ cooperated with classmates during paired and group work

___ asked for help when needed and/or offered help

___ took risks and was not afraid to learn from mistakes

Appendix A:
Ontario Ministry of Education and Training Mathematics Expectations

GEOMETRY AND SPATIAL SENSE

3C.1.1 use a reference tool (e.g., paper corner, pattern block, carpenter's square) to identify right angles and to describe angles as greater than, equal to, or less than a right angle (Sample problem: Which pattern blocks have angles bigger than a right angle?)

3C.1.2 identify and compare various polygons (i.e., triangles, quadrilaterals, pentagons, hexagons, heptagons, octagons) and sort them by their geometric properties (i.e., number of sides; side lengths; number of interior angles; number of right angles)

3C.1.3 compare various angles, using concrete materials and pictorial representations, and describe angles as bigger than, smaller than, or about the same as other angles

3C.1.4 compare and sort prisms and pyramids by geometric properties (i.e., number and shape of faces, number of edges, number of vertices), using concrete materials

3C.1.5 construct rectangular prisms (e.g., using given paper nets; using Polydrons), and describe geometric properties (i.e., number and shape of faces, number of edges, number of vertices) of the prisms.

3C.2.1 solve problems requiring the greatest or least number of two-dimensional shapes (e.g., pattern blocks) needed to compose a larger shape in a variety of ways (e.g., to cover an outline puzzle) (Sample problem: Compose a hexagon using different numbers of smaller shapes.)

3C.2.2 explain the relationships between different types of quadrilaterals (e.g., a square is a rectangle because a square has four sides and four right angles; a rhombus is a parallelogram because opposite sides of a rhombus are parallel)

3C.2.3 identify and describe the two-dimensional shapes that can be found in a three-dimensional figure (Sample problem: Build a structure from blocks, toothpicks, or other concrete materials, and describe it using geometric terms, so that your partner will be able to build your structure without seeing it.)

3C.2.4 describe and name prisms and pyramids by the shape of their base (e.g., rectangular prism, square-based pyramid)

3C.2.5 identify congruent two-dimensional shapes by manipulating and matching concrete materials (e.g., by translating, reflecting, or rotating pattern blocks).

3C.3.1 describe movement from one location to another using a grid map (e.g., to get from the swings to the sandbox, move three squares to the right and two squares down)

3C.3.2 identify flips, slides, and turns, through investigation using concrete materials and physical motion, and name flips, slides, and turns as reflections, translations, and rotations (e.g., a slide to the right is a translation; a turn is a rotation)

3C.3.3 complete and describe designs and pictures of images that have a vertical, horizontal, or diagonal line of symmetry (Sample problem: Draw the missing portion of the given butterfly on grid paper.).

4C.1.1 draw the lines of symmetry of two-dimensional shapes, through investigation using a variety of tools (e.g., Mira, grid paper) and strategies (e.g., paper folding) (Sample problem: Use paper folding to compare the symmetry of a rectangle with the symmetry of a square.)

4C.1.2 identify and compare different types of quadrilaterals (i.e., rectangle, square, trapezoid, parallelogram, rhombus) and sort and classify them by their geometric properties (e.g., sides of equal length; parallel sides; symmetry; number of right angles)

4C.1.3 identify benchmark angles (i.e., straight angle, right angle, half a right angle), using a reference tool (e.g., paper and fasteners, pattern blocks, straws), and compare other angles to these benchmarks (e.g., “The angle the door makes with the wall is smaller than a right angle but greater than half a right angle.”)

4C.1.4 relate the names of the benchmark angles to their measures in degrees (e.g., a right angle is 90º); — identify and describe prisms and pyramids, and classify them by their geometric properties (i.e., shape of faces, number of edges, number of vertices), using concrete materials.

4C.2.1 construct a three-dimensional figure from a picture or model of the figure, using connecting cubes (e.g., use connecting cubes to construct a rectangular prism)

4C.2.2 construct skeletons of three-dimensional figures, using a variety of tools (e.g., straws and modelling clay, toothpicks and marshmallows, Polydrons), and sketch the skeletons

4C.2.3 draw and describe nets of rectangular and triangular prisms (Sample problem: Create as many different nets for a cube as you can, and share your results with a partner.)

4C.2.4 construct prisms and pyramids from given nets; — construct three-dimensional figures (e.g., cube, tetrahedron), using only congruent shapes.

4C.3.1 identify and describe the general location of an object using a grid system (e.g.,“The library is located at A3 on the map.”)

4C.3.2 identify, perform, and describe reflections using a variety of tools (e.g., Mira, dot paper, technology)

4C.3.3 create and analyse symmetrical designs by reflecting a shape, or shapes, using a variety of tools (e.g., pattern locks, Mira, geoboard, drawings), and identify the congruent shapes in the designs.

5C.1.1 distinguish among polygons, regular polygons, and other two-dimensional shapes

5C.1.2 distinguish among prisms, right prisms, pyramids, and other three-dimensional figures

5C.1.3 identify and classify acute, right, obtuse, and straight angles

5C.1.4 measure and construct angles up to 90º, using a protractor

5C.1.5 identify triangles (i.e., acute, right, obtuse, scalene, isosceles, equilateral), and classify them according to angle and side properties; — construct triangles, using a variety of tools (e.g., protractor, compass, dynamic geometry software), given acute or right angles and side measurements (Sample problem: Use a protractor, ruler, and pencil to construct a scalene triangle with a 30° angle and a side measuring 12 cm.).

5C.2.1 identify prisms and pyramids from their nets

5C.2.2 construct nets of prisms and pyramids, using a variety of tools (e.g., grid paper, Polydrons, computer application).

5C.3.1 locate an object using the cardinal directions (i.e., north, south, east, west) and a coordinate system (e.g.,"If I walk 5 steps north and 3 steps east, I will arrive at the apple tree.")

5C.3.2 compare grid systems commonly used on maps (i.e., the use of numbers and letters to identify an area; the use of a coordinate system based on the cardinal directions to describe a specific location); — identify, perform, and describe translations, using a variety of tools (e.g., geoboard, dot paper, computer program)

5C.3.3 create and analyse designs by translating and/or reflecting a shape, or shapes, using a variety of tools (e.g., geoboard, grid paper, computer program) (Sample problem: Identify translations and/or reflections that map congruent shapes onto each other in a given design.).

3D.1.5 represent simple geometric patterns using a number sequence, a number line, or a bar graph (e.g., the given growing pattern of toothpick squares can be represented numerically by the sequence 4, 7, 10, …, which represents the number of toothpicks used to make each figure)

4D.1.4 make predictions related to repeating geometric and numeric patterns (Sample problem: Create a pattern block train by alternating one green triangle with one red trapezoid. Predict which block will be in the 30th place.)

4D.1.5 extend and create repeating patterns that result from reflections, through investigation using a variety of tools (e.g., pattern blocks, dynamic geometry software, dot paper).

5D.1.1 create, identify, and extend numeric and geometric patterns, using a variety of tools (e.g., concrete materials, paper and pencil, calculators, spreadsheets)

5D.1.4 make predictions related to growing and shrinking geometric and numeric patterns (Sample problem: Create growing L's using tiles. The first L has 3 tiles, the second L has 5 tiles, the third L has 7 tiles, and so on. Predict the number of tiles you would need to build the 10th L in the pattern.)— extend and create repeating patterns that result from translations, through investigation using a variety of tools (e.g., pattern blocks, dynamic geometry software, dot paper).

Extensions

6C.1.1 sort and classify quadrilaterals by geometric properties related to symmetry, angles, and sides, through investigation using a variety of tools (e.g., geoboard, dynamic geometry software) and strategies (e.g., using charts, using Venn diagrams)

6C.3.1 explain how a coordinate system represents location, and plot points in the first quadrant of a Cartesian coordinate plane

6C.3.3 create and analyze designs made by reflecting, translating, and/or rotating a shape, or shapes, by 90º or 180º (Sample problem: Identify rotations of 90° or 180° that map congruent shapes, in a given design, onto each other.)

6D.1.5 extend and create repeating patterns that result from rotations, through investigation using a variety of tools (e.g., pattern blocks, dynamic geometry software, geoboards, dot paper)

6C.1.2 sort polygons according to the number of lines of symmetry and the order of rotational symmetry, through investigation using a variety of tools (e.g., tracing paper, dynamic geometry software, Mira)

6C.1.3 measure and construct angles up to 180° using a protractor, and classify them as acute, right, obtuse, or straight angles

6C.3.2 identify, perform, and describe, through investigation using a variety of tools (e.g., grid paper, tissue paper, protractor, computer technology), rotations of 180º and clockwise and counterclockwise rotations of 90°, with the centre of rotation inside or outside the shape

8B.2.4 solve problems involving the estimation and calculation of the circumference and the area of a circle

6C.2.2 sketch, using a variety of tools (e.g., isometric dot paper, dynamic geometry software), isometric perspectives and different views (i.e., top, side, front) of three-dimensional figures built with interlocking cubes.

6C.2.1 build three-dimensional models using connecting cubes, given isometric sketches or different views (i.e., top, side, front) of the structure (Sample problem: Given the top, side, and front views of a structure, build it using the smallest number of cubes possible.)

6C.1.4 construct polygons using a variety of tools, given angle and side measurements (Sample problem: Use dynamic geometry software to construct trapezoids with a 45° angle and a side measuring 11 cm.).

Appendix B:
Creative Images of Renovated Buses

https://s-media-cache-ak0.pinimg.com/originals/a2/7a/6f/a27a6f9d0ba3b410c3199adcc3d28bc3.jpg

https://s-media-cache-ak0.pinimg.com/736x/15/fa/ec/15faec449436ca6a25bb871c645e8082.jpg

http://www.edugains.ca/resourcesLNS/GuidestoEffectiveInstruction/GEI_Math_K-6_GeomSpatialSense_Gr4-6/Guide_Geometry_Spatial_Sense_456.pdf