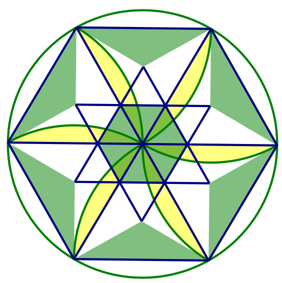
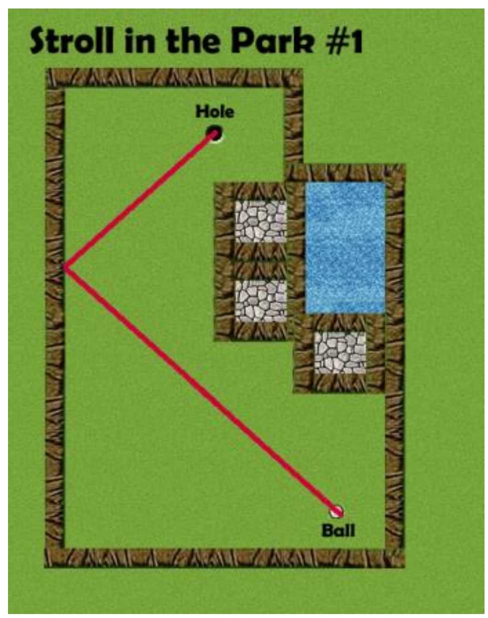
Understanding Transformations & Common Core Objectives through Activities

Experience the activities that develop deep connections to the foundation common core objectives and the essential transformations -- Construction Math Art, Symmetry Flag Design, Reflection Mini-Golf, Kaleidoscope Imaging, Tessellations, and Picture Dilation. Come and experience the fun… and remember why we enjoy teaching geometry so much.

Introduction

I am currently teaching in the classroom at this time. I teach at Advanced Technologies Academy, a public High School in Las Vegas Nevada. I teach 3 Algebra II and 3 Geometry Honors. In 2009, I received two prestigious awards in education; I was named a Presidential Awardee for Teaching Excellence and as well a Milken Educator of the Year. In 2013, I created a curriculum to match the new Common Core Curriculum and formed the website, geometrycommoncore.com. These materials are now used in 47 different states across the US and are a major tool in moving forward the acceptance of the new standards.





1. Outline (10 minutes)
- Introductions (Page 1)
- Why? (Page 2)

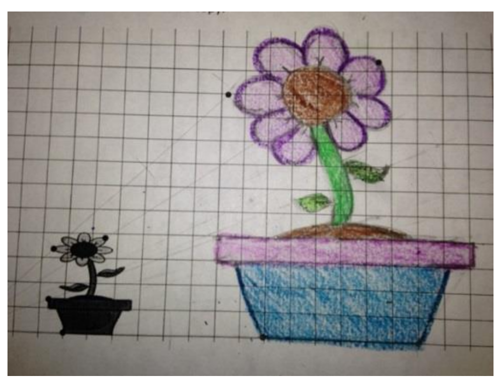
2. Content (65 minutes)

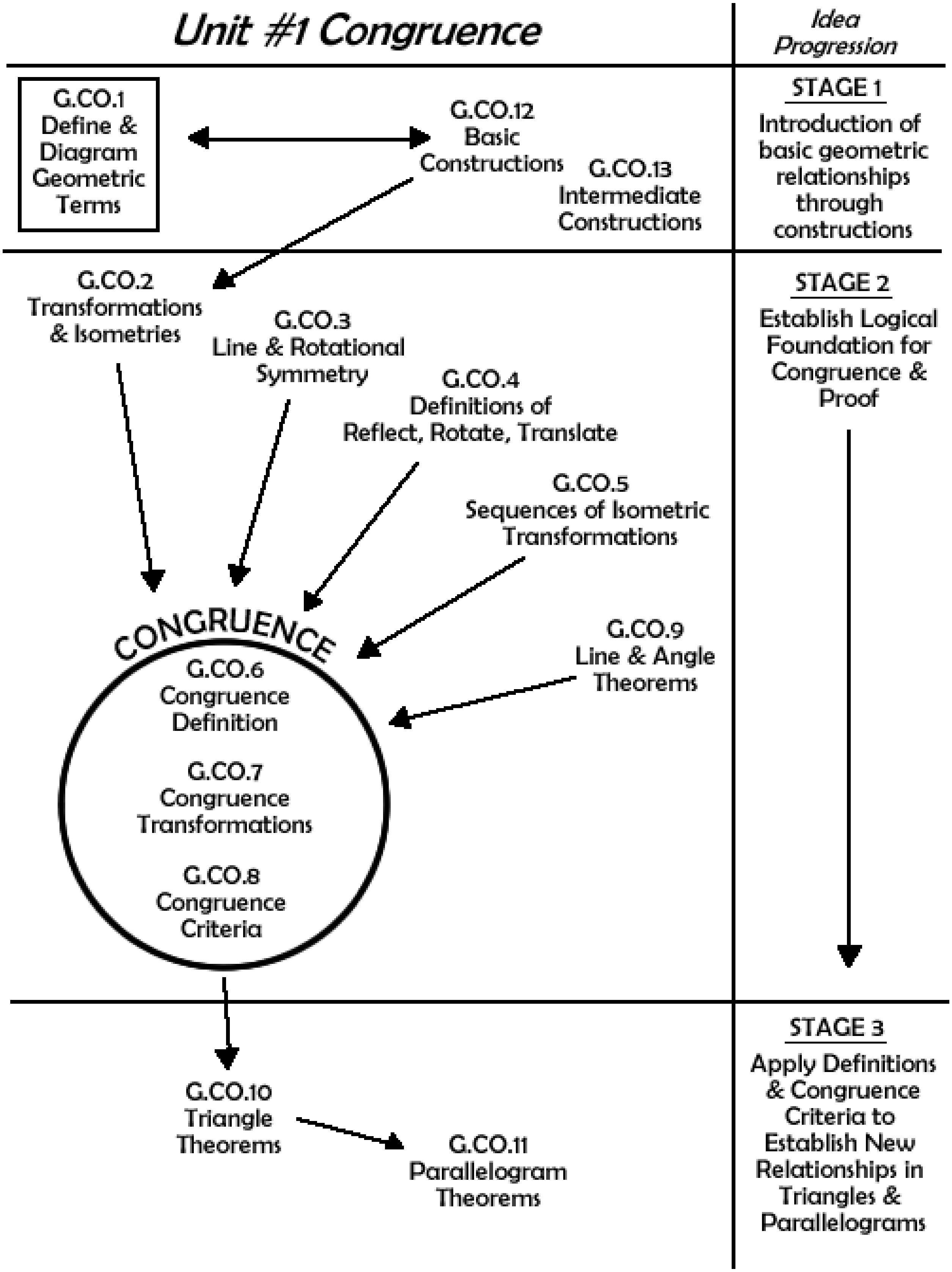
- **G-CO.A.13** (Inscribed Regular Polygons)
  - **<u>Math Art</u>** (15 mins) (Pages 3 – 6)

- **G-CO.A.3** (Symmetry)
  - **Quadrilateral Activity** (10 mins) (Pages 7 – 8)
  - **<u>Flag Project</u>** (10 mins) (Pages 9 – 10) (Pages 23 – 24)

- **G-CO.A.5** (Transformations)
  - **<u>Mini-Golf</u>** (15 mins) (Pages 11 – 16)
  - **<u>Treasure Hunt</u>** (Pages 17 – 18)

- **G-SRT.A.1** (Dilation)
  - **<u>Dilating a Picture</u>** (15 mins) (Pages 19 – 22)

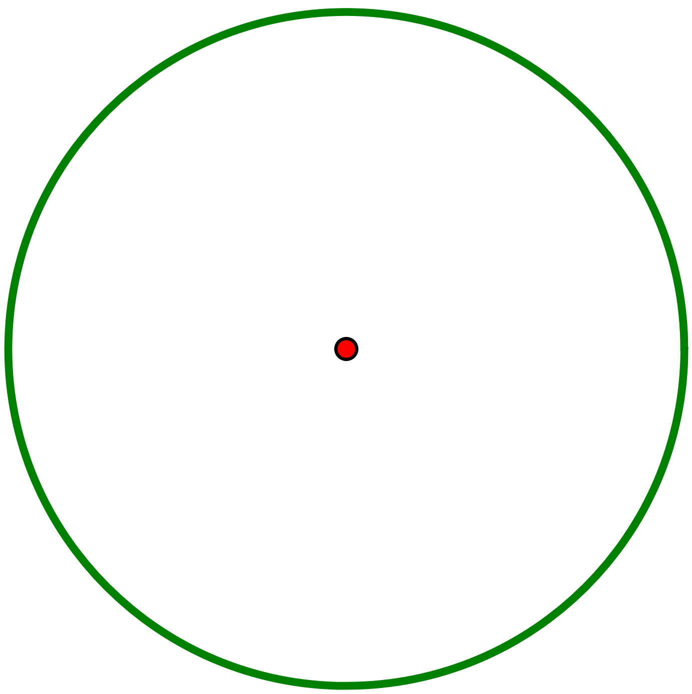



Unit #1 Congruence
Idea Progression
G.CO.1 Define & Diagram Geometric Terms
G.CO.12 Basic Constructions
G.CO.13 Intermediate Constructions
STAGE 1
Introduction of basic geometric relationships through constructions
G.CO.2 Transformations & Isometries
G.CO.3 Line & Rotational Symmetry
G.CO.4 Definitions of Reflect, Rotate, Translate
G.CO.5 Sequences of Isometric Transformations
G.CO.9 Line & Angle Theorems
CONGRUENCE
G.CO.6 Congruence Definition
G.CO.7 Congruence Transformations
G.CO.8 Congruence Criteria
STAGE 2
Establish Logical Foundation for Congruence & Proof
G.CO.10 Triangle Theorems
G.CO.11 Parallelogram Theorems
STAGE 3
Apply Definitions & Congruence Criteria to Establish New Relationships in Triangles & Parallelograms

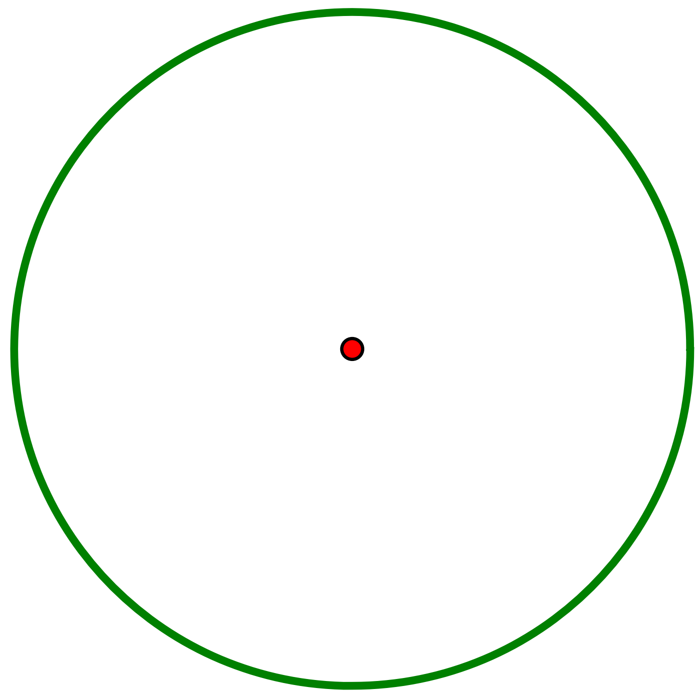
OBJECTIVE – G.CO.D.13 – Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Construct the requested inscribed polygons.

a) Construct an equilateral triangle inscribed in the provided circle using your compass and straightedge.



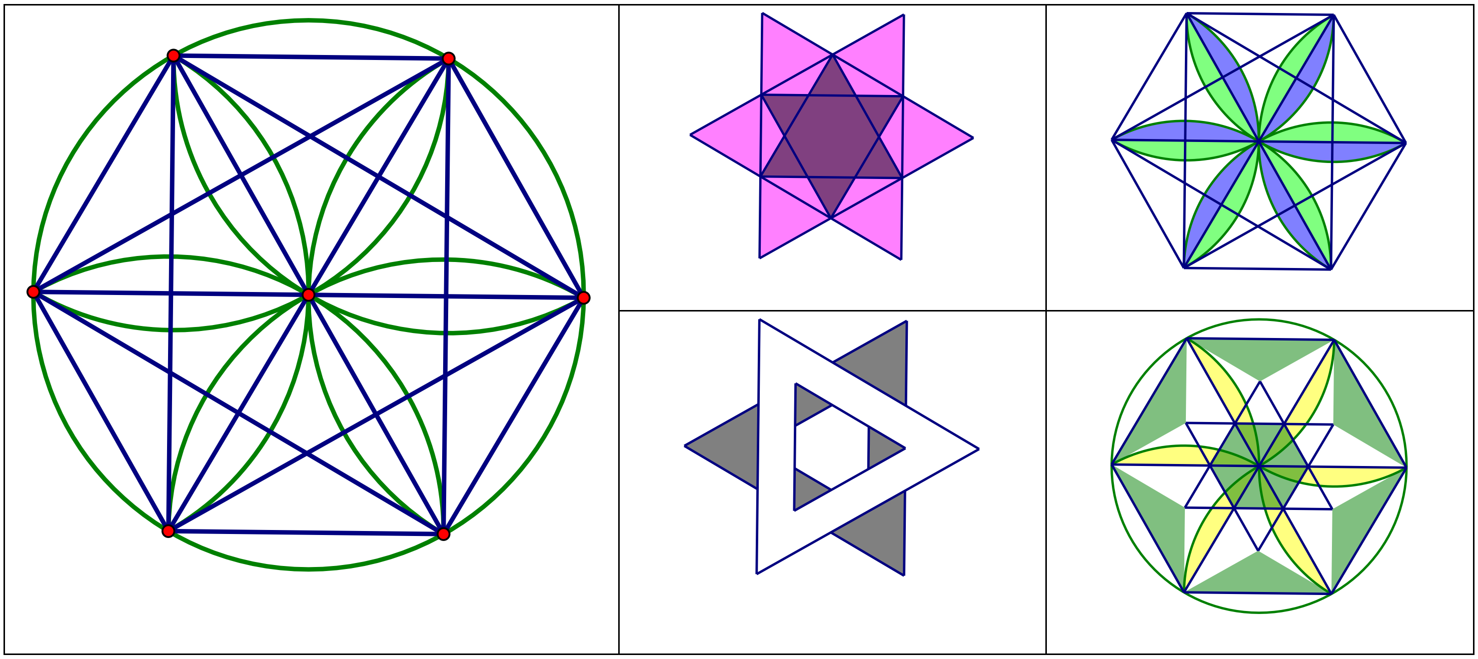
b) Construct a square inscribed in the provided circle using your compass and straightedge.



Why does this construction work?

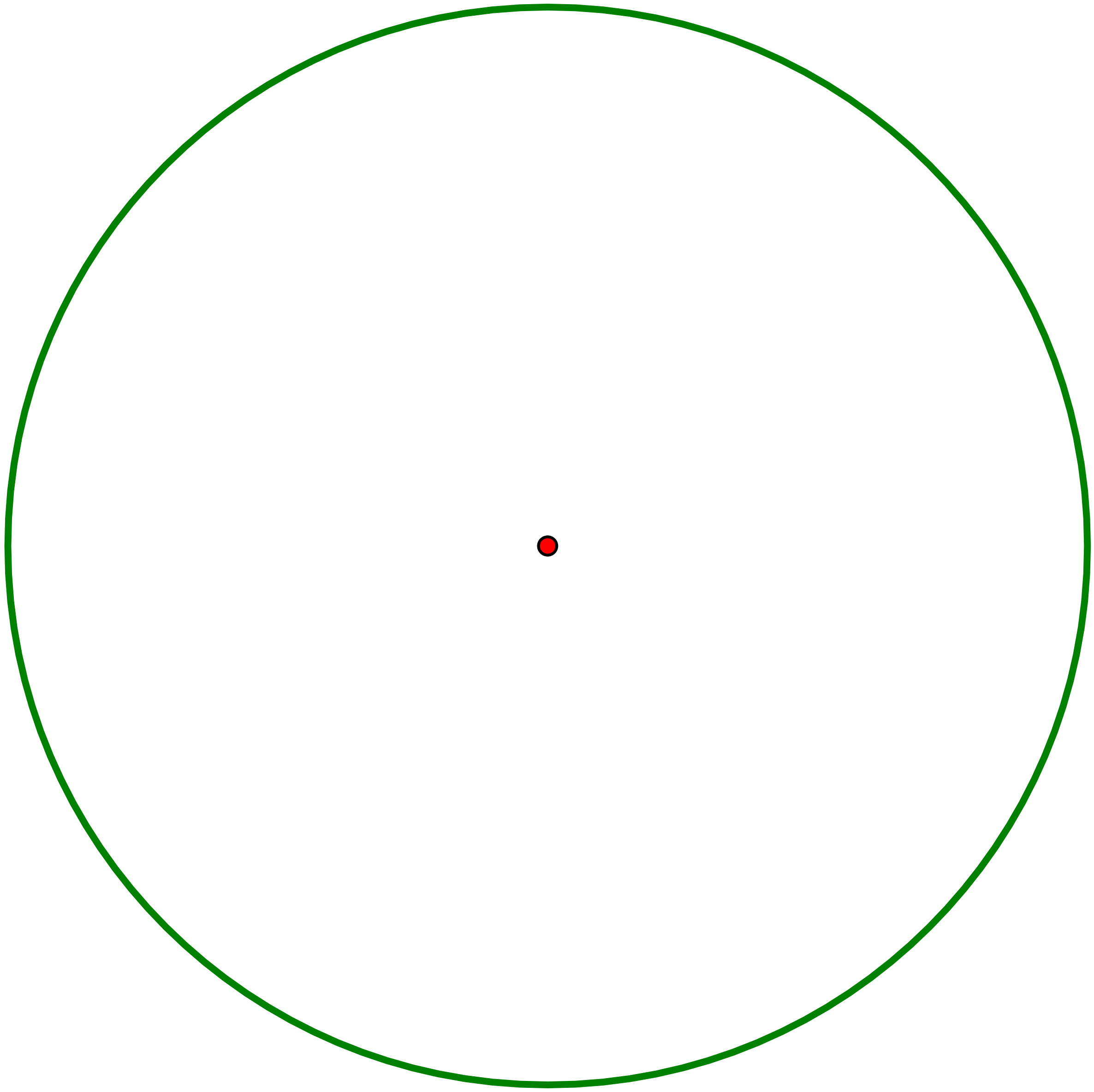
THE MATH ART PROJECT – Now that you know the basics of constructions you have the ability to create some very cool Geometric Art. Using just the construction of the inscribed hexagon (and the addition of a few segments and arcs) you can create a number of very interesting designs. Here are a few examples of Geometric Art. (The QR code and/or the link take you to an introduction video.)

http://bit.ly/gcod13art



Practice Area (Shading & coloring change the look of the shape…. Also symmetry is very appealing to the eye.)

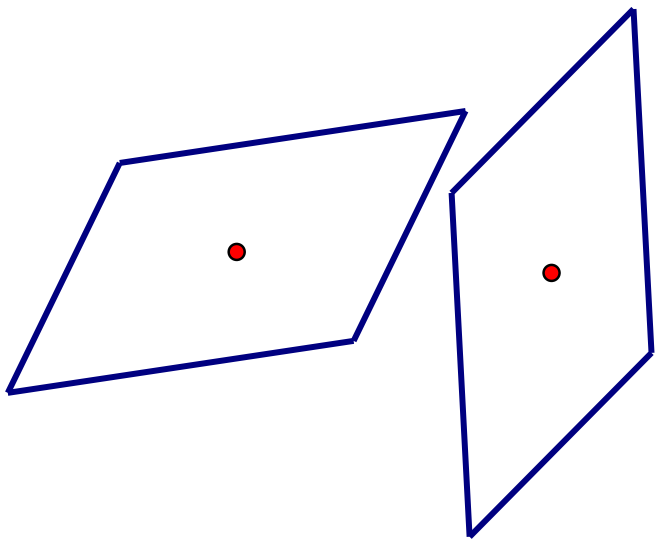
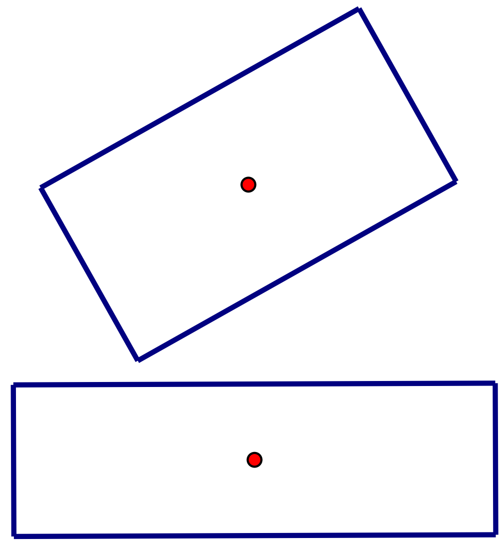
Category	**Exemplary**	**Proficient**	**Unsatisfactory**	**Score**
	4 points	*2 points*	*0 points*	
Use of Compass	All arcs are drawn with a compass	Some arcs are drawn with a compass	Student did not use a compass	
Use of Straightedge	All segments are drawn with a straightedge	Some segments are drawn with a straightedge	Student did not use a straightedge	
Complexity	Student used more than 10 lines or arcs	Student used more than 5 lines or arcs	Student used less than 5 lines or arcs	
Visual Appeal	Student colored more than 75% of areas with colors other than black, white, or gray	Student colored more than 50% of areas with colors other than black, white, or gray	Student colored less than 50% of areas with colors other than black, white, or gray	
Care	• All lines are clean • coloring is with the lines • eraser marks are not visible	2 out the 3 exemplary conditions are met	1 or less of the exemplary conditions are met	

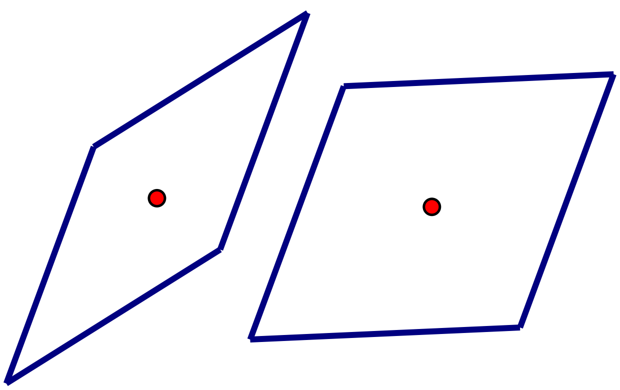
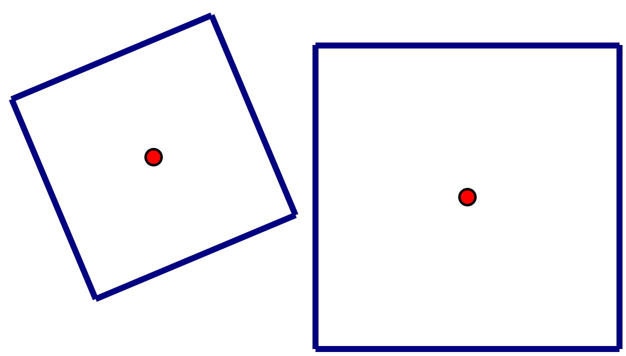


OBJECTIVE - G.CO.A.3 -- Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

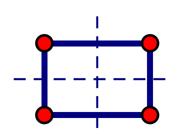
To determine reflection symmetry, after copying the shape on the patty paper attempt folding the patty paper so half of the shape carries onto itself. If this can happen then there is reflectional symmetry – find all lines of reflectional symmetry.

To determine rotation symmetry, place your patty paper copy exactly onto of the quadrilateral that you just copied. Pin the center of the quadrilateral with your finger or pencil and then begin rotating the patty paper. I suggest placing a symbol at one of the vertices so you can easily track how much you have rotated the shape.

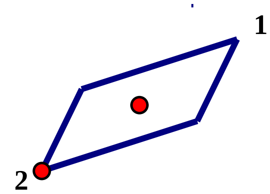
PARALLELOGRAM	RECTANGLE
	

RHOMBUS	SQUARE
	

In the chart below, draw a diagram showing **ALL** lines of reflectional symmetry for that quadrilateral and then fill in the number of lines of symmetry you found.



In the chart below, draw a diagram listing **ALL** locations where the rotation symmetry occurred. Remember if a shape has no rotational symmetry, then its order is 1.



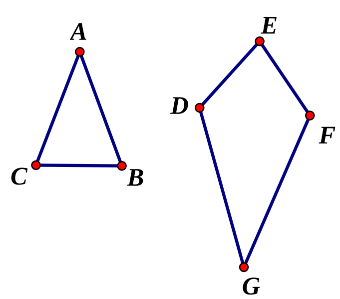
QUADRILATERAL SYMMETRIES SUMMARY CHART

	Reflection Symmetry Diagram	Reflection Symmetry Summary	Rotation Symmetry Diagram	Rotation Symmetry Summary
Parallelogram		The number of lines of symmetry is _______________		Rotation order ________ Rotation angle ________
Rectangle		The number of lines of symmetry is _______________		Rotation order ________ Rotation angle ________
Rhombus		The number of lines of symmetry is _______________		Rotation order ________ Rotation angle ________
Square		The number of lines of symmetry is _______________		Rotation order ________ Rotation angle ________

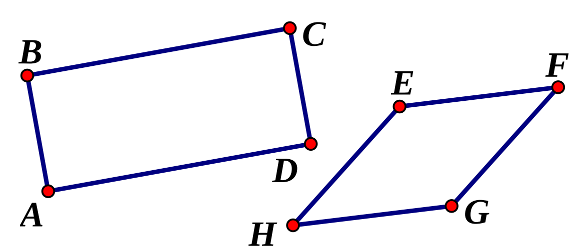
Why do you think symmetry introduced early?

Why do you think in the symmetry objective it focuses on the parallelogram family?

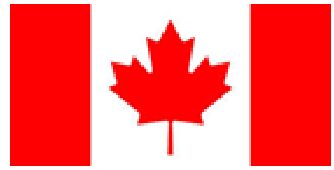
If you have one line of symmetry, what can you conclude about the figure/shape?



If you have two lines of symmetry, what can you conclude about the figure/shape?



THE FLAG PROJECT -- Flags are often great example of symmetry. Search in the internet to find the flags of the world. Find flags that meet the criteria provided below. Sketch and color the flag and provide the name of the county. For example, the Canadian Flag has 1 line of symmetry. You are not allowed use this Canada, Trinidad & Tobago, Thailand, Ukraine, or Qatar for your answers because I use them as examples. Also you cannot use a flag more than once on this activity.



Flag Site: http://www.sciencekids.co.nz/pictures/flags.html

(Flag Site) **(Introduction)**

Introduction: http://bit.ly/gcoa3flag

1. LINE SYMMETRY

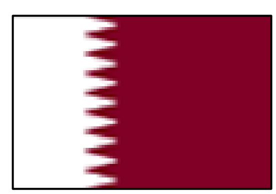
0 LINES OF SYMMETRY	1 LINE OF SYMMETRY	2 LINES OF SYMMETRY	2 LINES OF SYMMETRY
Country ______________	Country ______________	Country ______________	Country ______________

2. ROTATION SYMMETRY

ORDER 2	ORDER 2	2 LINES & ORDER 2	2 LINES & ORDER 2
Country ______________	Country ______________	Country ______________	Country ______________

3. Determine the reflection and rotation symmetries of the provided flags.

(Colors must match to be symmetrical and you can NOT use these flags for questions #1 and #2)

Trinidad & Tobago	Thailand	Ukraine	Qatar
			
Lines of Symmetry	Lines of Symmetry	Lines of Symmetry	Lines of Symmetry
________________	________________	________________	________________
Rotation Order	Rotation Order	Rotation Order	Rotation Order
________________	________________	________________	________________

4. Most flags are rectangular in shape. Can you find countries that have:

a) a square flag ____

b) a non-rectangular/square flag ____

5. What does the all-white flag mean? ____

6. What is the study of flags called? __________________

7. What is the name of the flag that is black and has a skull and cross bones on it? __________________

8. Which country once had a national flag that was a solid green color and nothing else? _________________

9. a) **Design your own flag.** The flag must have symmetry – you can choose how much symmetry it has and whether it is rotational or reflectional symmetry. Color and Detail the Flag!! Use symbols, colors and shapes that somehow represent you and your country.

b) Explain why you designed it the way you did.

c) Described the symmetries found in your flag.

Online flag designer kit http://www.flag-designer.appspot.com/

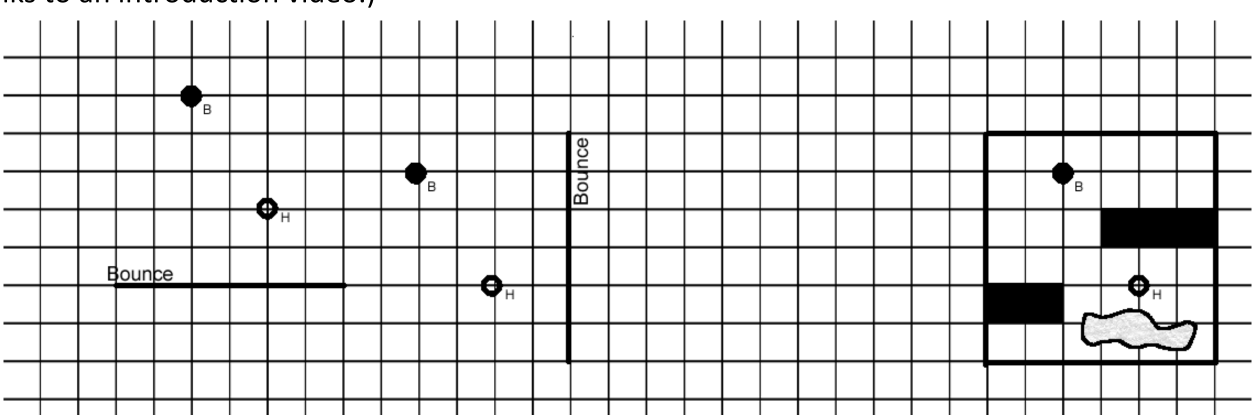
OBJECTIVE - G.CO.A.5 -- Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

CLASSIC MATH PROBLEM

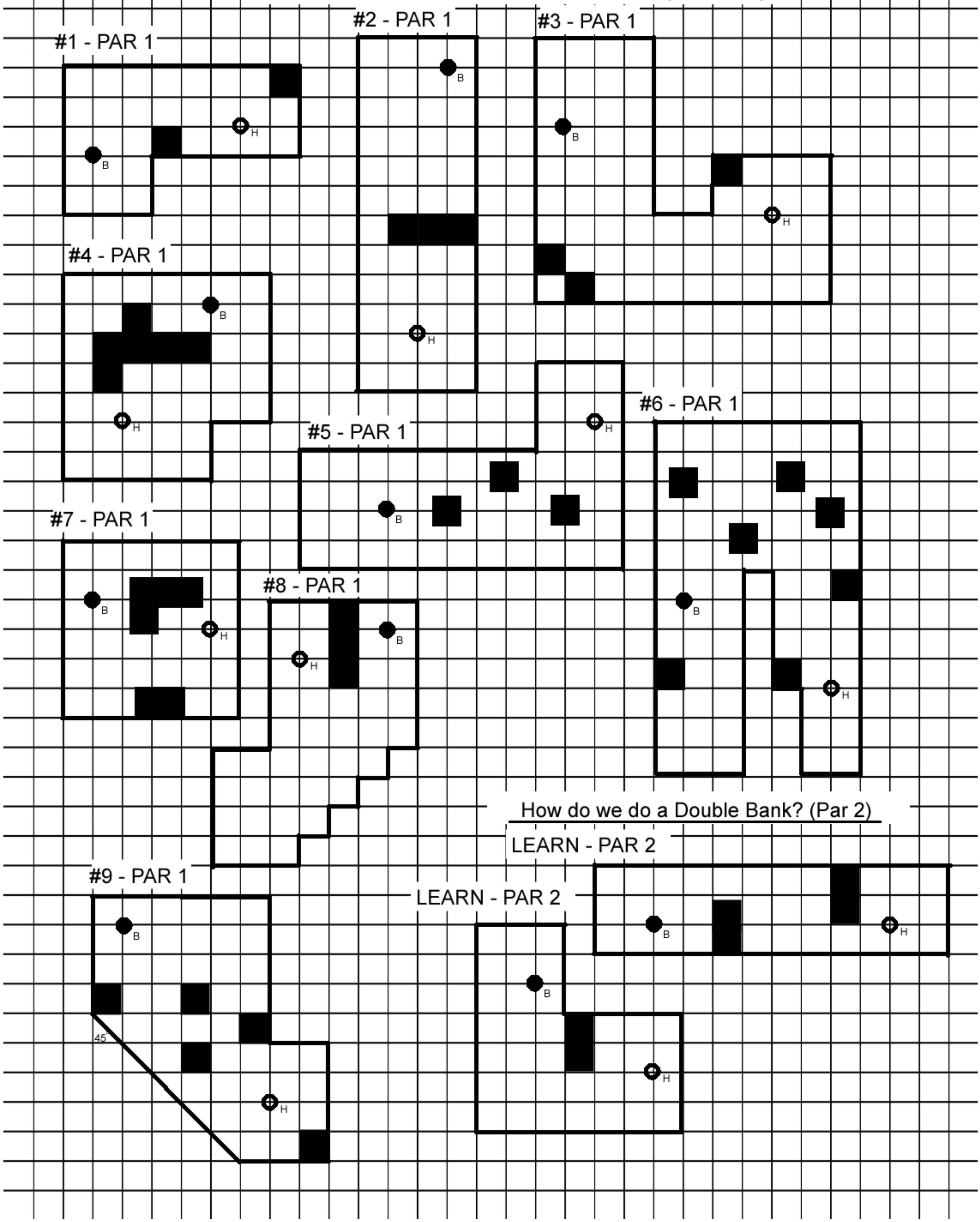
Eddie is on his way home but he promised his mother that he would catch a fish for dinner. Eddie is late and so he wants to walk the least distance from where he is to the river, and from the edge of the river to his home. Find the location along the edge of the river that will create the shortest distance to walk. Also determine that distance in millimeters.

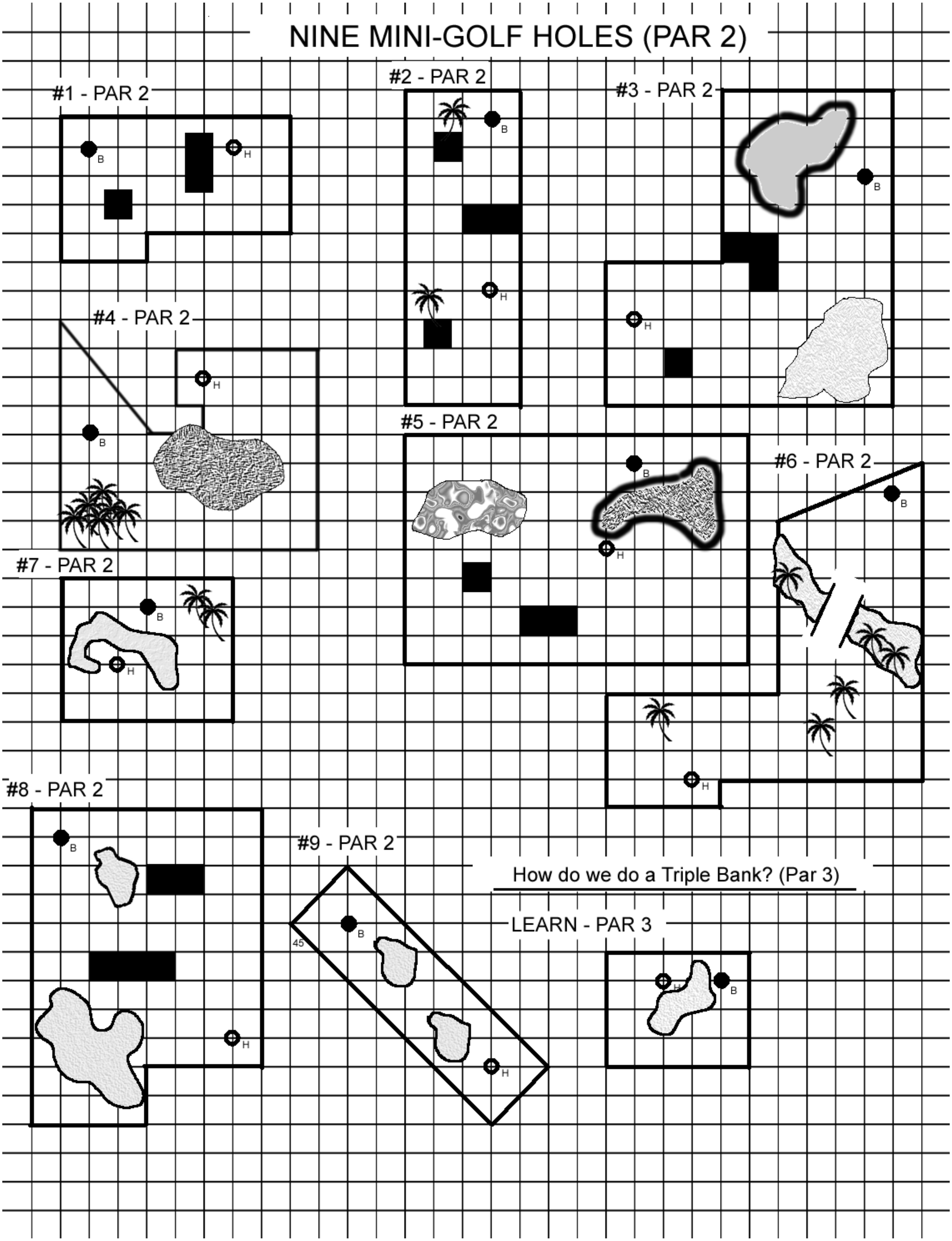
MINI-GOLF (http://bit.ly/gcoa5mini)

Mini-Golf has some nice connections to transformations… in particular the reflection. The isometric characteristics of a reflection preserve the angles and distance. (The QR code links to an introduction video.)

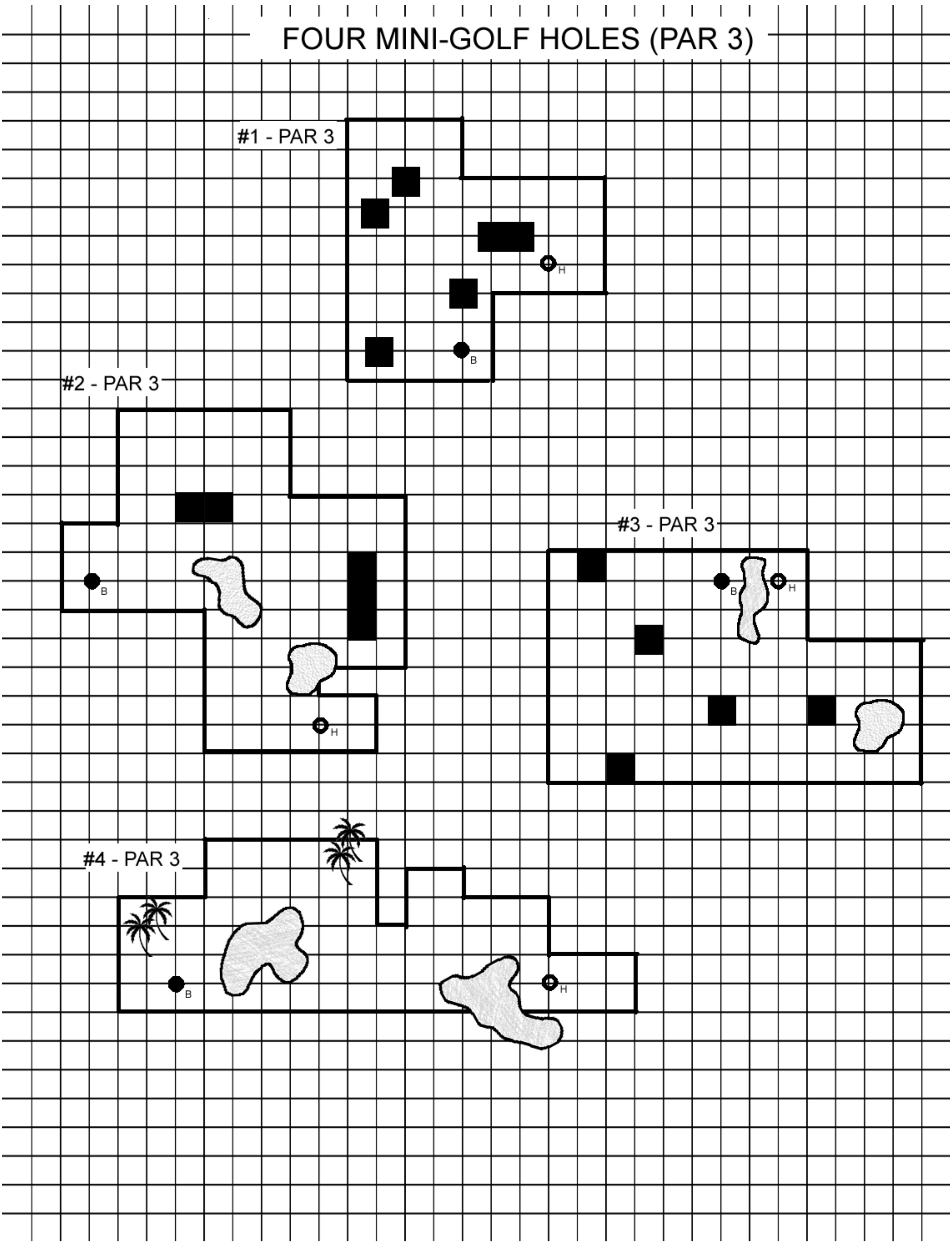


NINE MINI-GOLF HOLES (PAR 1)




NINE MINI-GOLF HOLES (PAR 2)
#1 - PAR 2
#2 - PAR 2
#3 - PAR 2
#4 - PAR 2
#5 - PAR 2
#6 - PAR 2
#7 - PAR 2
#8 - PAR 2
#9 - PAR 2
45
How do we do a Triple Bank? (Par 3)
LEARN - PAR 3
B
H

FOUR MINI-GOLF HOLES (PAR 3)



Objective:

Design 6 holes of a mini-golf course using reflections.

Hole Requirements:

2 Single Bank Holes (Par 1) **3** Double Bank Holes (Par 2) **1** Triple Bank Holes (Par 3)

Project Requirements:

1. This title page with your name and period on it.
2. The rough draft of all six holes **with the solutions/answers on it.**
3. The final copy of all six holes:
   - Do not put any answers on the final copy (only on the rough draft)
   - Place the holes on the grid paper so that if someone was to attempt them there would be enough space. (Suggestion: use 2 sheets of graph paper to place the 6 holes)
   - Color, Detail, Theme…. Jazz up the hole with obstacles, landscape, sand traps, water, etc…
   - Label each hole with its PAR… Par 2 means double bank, etc…..

Project Rubric:

STUDENT NAME: ________________________________ **PERIOD:** __________

Title Page Included	**1**		/1
Rough Draft Included (All 6 holes diagramed)	**1 2 3 4 5 6**		/6
Solutions on Rough Draft are Mathematically Correct	**1 2 3 4 5 6**		/6
Final Copy (Deep Quality Color)	**1 2 3**		/3
Final Copy (Addition of Details)	**1 2 3 4**		/4
***Bonus (Upgraded the Triple Bank)**	**1**	**TOTAL ------->**	/20

YOU TRY ONE…. OR TWO…

OBJECTIVE - G.CO.A.5 -- Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

http://bit.ly/ggtmap1

TREASURE MAP #1

(1) From your starting position (YOU) walk half the distance to the shipwrecked boat (Point C)

(2) From that location walk the same distance and direction as from the base of the mountain (Point D) to the hut (Point F).

(3) From that location rotate 90° counterclockwise about the base of the mountain (Point D)

(4) From that location reflect yourself over the line formed between the base of the mountain (Point D) and the double palm trees (Point E).

(5) From there walk the same distance and direction as it is from the hut (Point F) to the rock pile (Point A).

(6) From there walk half the distance to the single palm (Point B).

Place a **LARGE RED X** in this location.


You
A
B
C
D
E
F
N
E
S
W

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

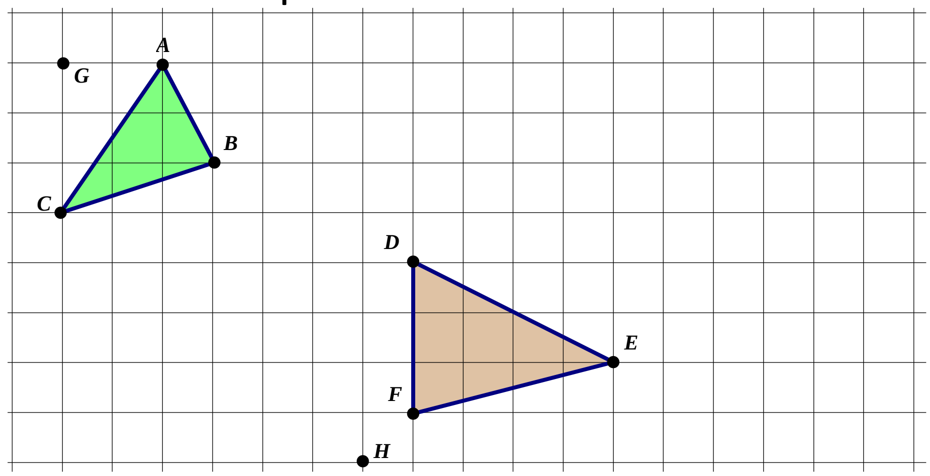
What happens when the center of dilation is outside the shape?

a) Dilate ΔABC from G using a scale factor of 2

$D_{G,2}(\Delta ABC)$

b) Dilate ΔDEF from H using a scale factor of 2

$D_{H,2}(\Delta DEF)$

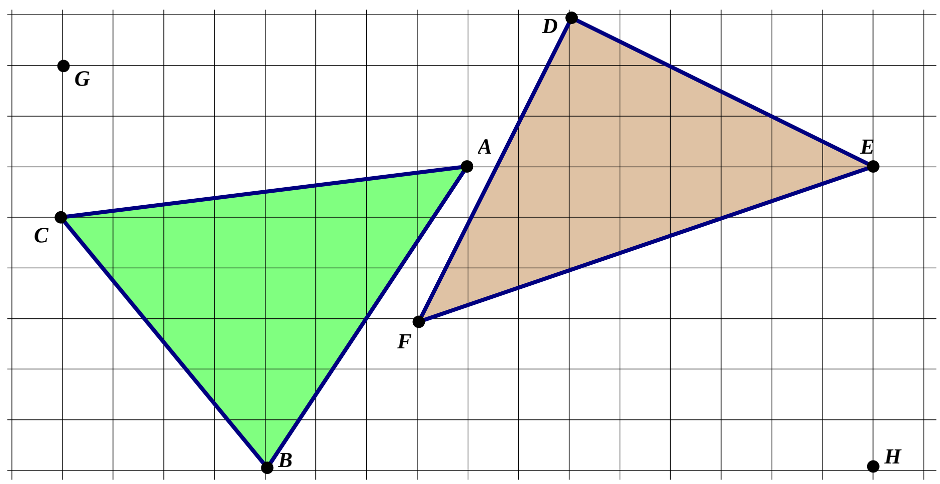


c) Dilate ΔABC from G using a scale factor of ½

$D_{G,\frac{1}{2}}(\Delta ABC)$

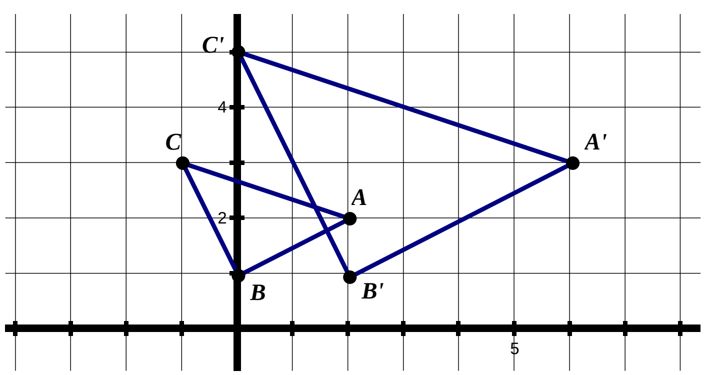
d) Dilate ΔDEF from H using a scale factor of $\frac{1}{3}$

$D_{H,\frac{1}{3}}(\Delta DEF)$

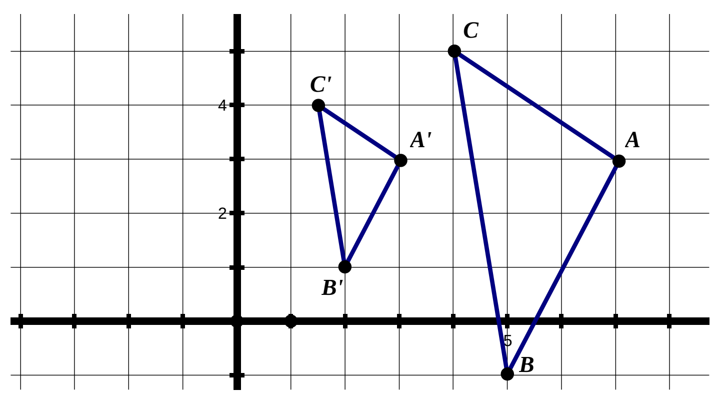


Work backwards to find the center of dilation, and also determine the scale factor.

a) Center (______ , _______) Scale Factor = _____



b) Center (______ , _______) Scale Factor = _____



Dilating Pictures

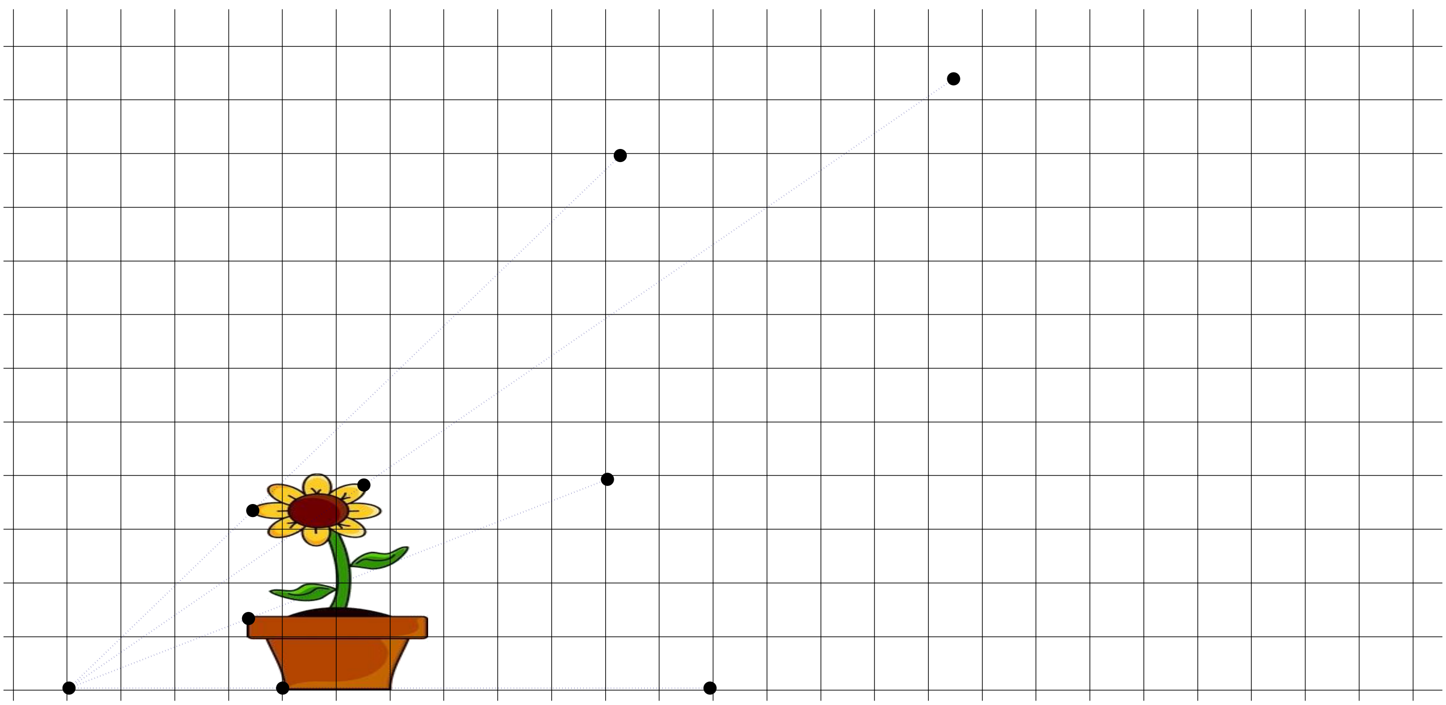
Activity Video

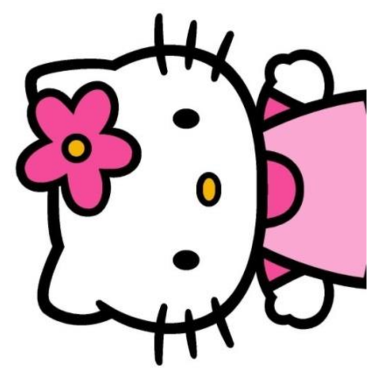
http://bit.ly/gsrta1act1

How do I do it?

Pick a number of key locations along the edge of the shape and then dilate those points by the correct scale factor. A compass can make this quite easy. Measure the distance to the pre-image point from the center of dilation and then mark the remaining lengths on the ray.

So for example in the plant example below measure using your compass to a point on the pre-image and then mark **two more** of those lengths along the ray to get three times the pre-image length. Notice to create a scale factor of three I needed a total of three equal measure the length of the pre-image distance (the pre-image distance from the center and then two more). I have done a few points to get you started. Do enough points to finish the basic outline of the shape and then 'rough' in the rest. Color the final scaled copy.





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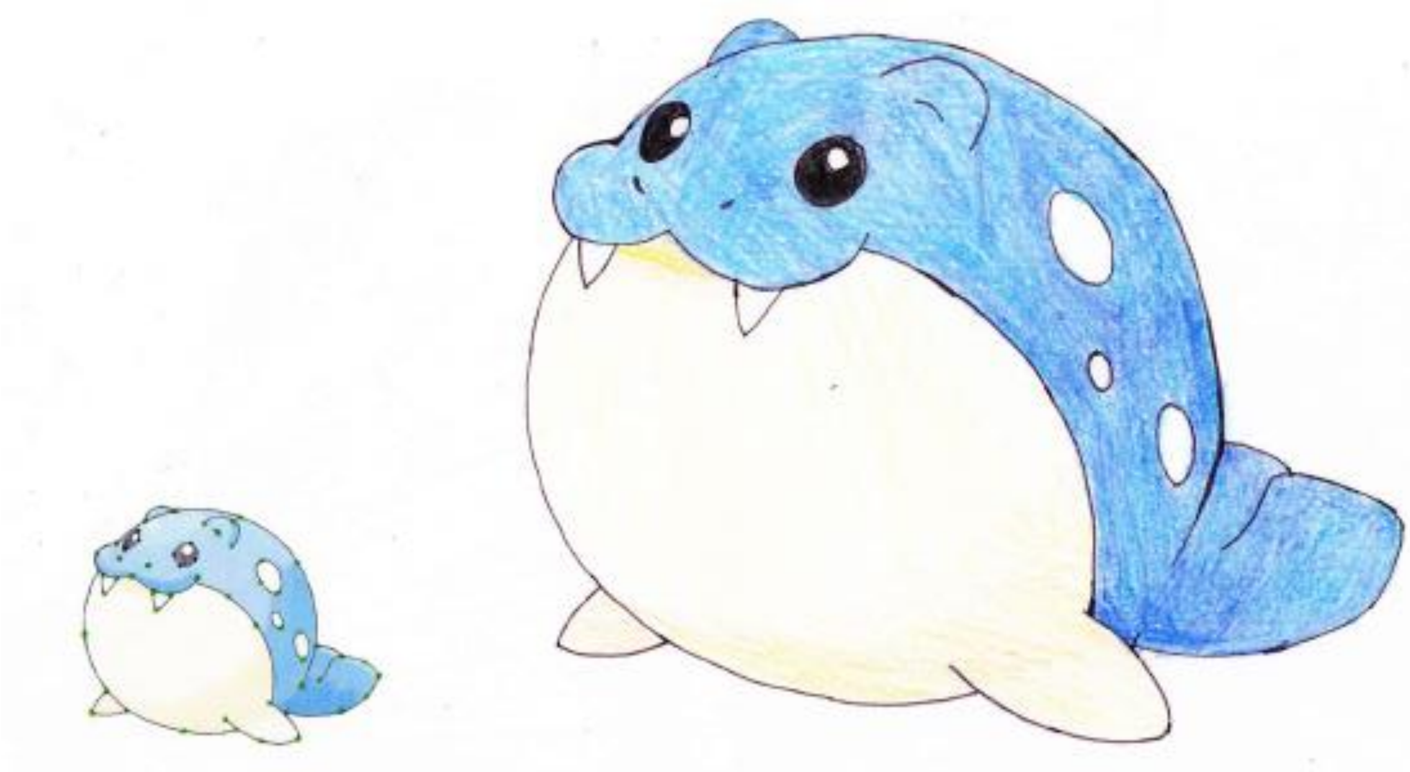
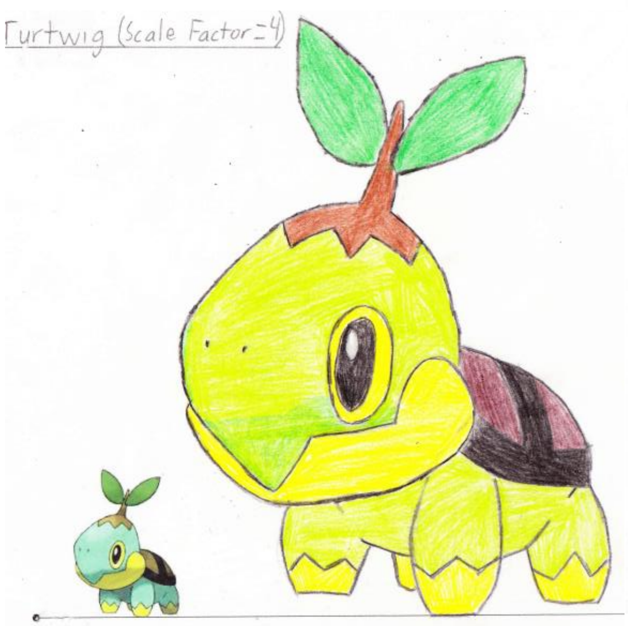
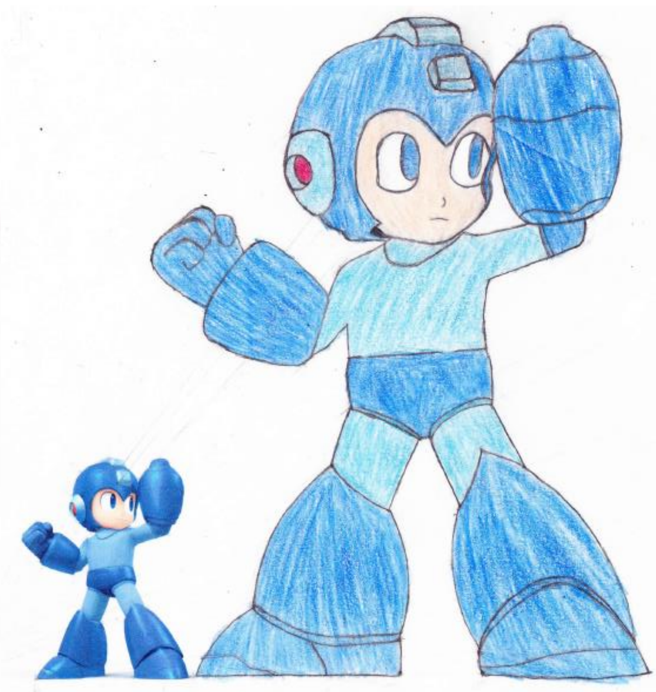
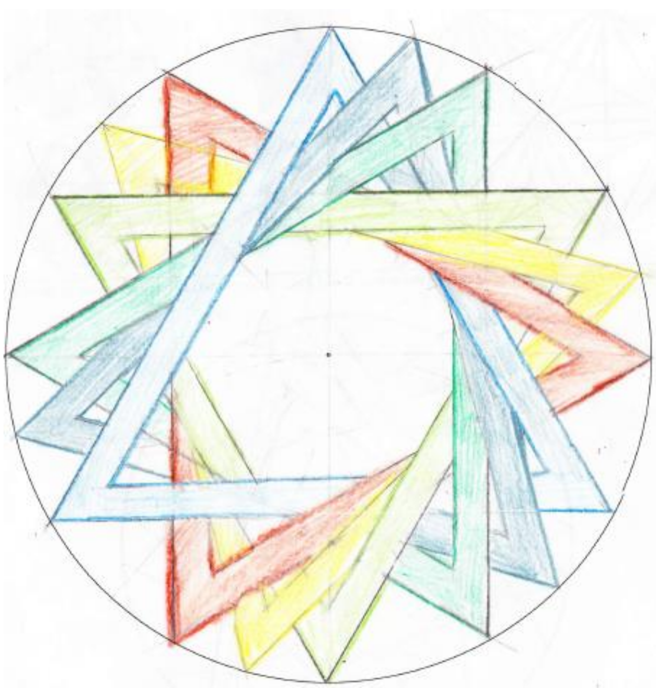
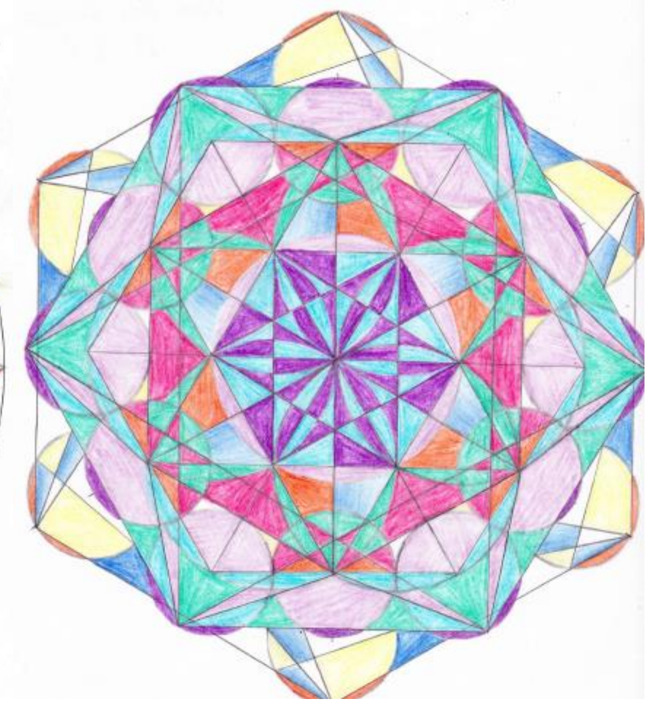
Afghanistan	Albania	Algeria	Andorra	Angola	Antigua & Barbuda	Argentina	Armenia
Australia	Austria	Azerbaijan	Bahamas	Bahrain	Bangladesh	Barbados	Belarus
Belgium	Belize	Benin	Bermuda	Bhutan	Bolivia	Bosnia & Herzegovina	Botswana
Brazil	Brunei	Bulgaria	Burkina Faso	Burundi	Cambodia	Cameroon	Canada
Cape Verde	Cayman Islands	Central African Republic	Chad	Chile	China	Colombia	Comoros
Cook Islands	Costa Rica	Croatia	Cuba	Cyprus	Czech Republic	Democratic Republic of Congo	Denmark
Djibouti	Dominica	Dominican Republic	East Timor	Ecuador	Egypt	El Salvador	England
Equatorial Guinea	Eritrea	Estonia	Ethiopia	Fiji	Finland	France	Gabon
Georgia	Germany	Ghana	Greece	Greenland	Grenada	Guam	Guatemala
Guinea	Guinea-Bissau	Guyana	Haiti	Honduras	Hong Kong	Hungary	Iceland
India	Indonesia	Iran	Iraq	Ireland	Israel	Italy	Ivory Coast
Jamaica	Japan	Jordan	Kazakhstan	Kenya	Kiribati	Kuwait	Kyrgyzstan
Laos	Latvia	Lebanon	Lesotho	Liberia	Libya	Liechtenstein	Lithuania

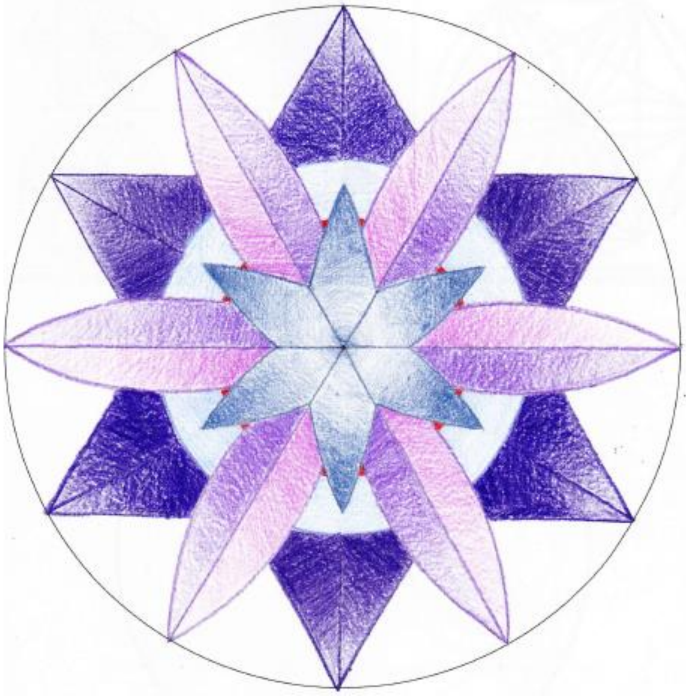

Luxembourg
Macedonia
Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Mauritania
Mauritius
Mexico
Moldova
Monaco
Mongolia
Montenegro
Morocco
Mozambique
Myanmar (Burma)
Namibia
Nauru
Nepal
Netherlands
New Caledonia
New Zealand
Nicaragua
Niger
Nigeria
North Korea
Norway
Oman
Pakistan
Palau
Palestine
Panama
Papau New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Puerto Rico
Qatar
Republic of Congo
Romania
Russia
Rwanda
Saint Kitts & Nevis
Saint Lucia
Saint Vincent and the Grenadines
Samoa
San Marino
Sao Tome and Principe
Saudi Arabia
Scotland
Senegal
Serbia
Seychelles
Sierra Leone
Singapore
Slovakia
Slovenia
Solomon Islands
Somalia
South Africa
South Korea
South Sudan
Spain
Sri Lanka
Sudan
Suriname
Swaziland
Sweden
Switzerland
Syria
Taiwan
Tajikistan
Tanzania
Thailand
The Gambia
Togo
Tonga
Trinidad & Tobago
Tunisia
Turkey
Turkmenistan
Tuvalu
Uganda
Ukraine
UAE
United Kingdom
United States
Uruguay
Uzbekistan
Vanuatu
Venezuela
Vietnam

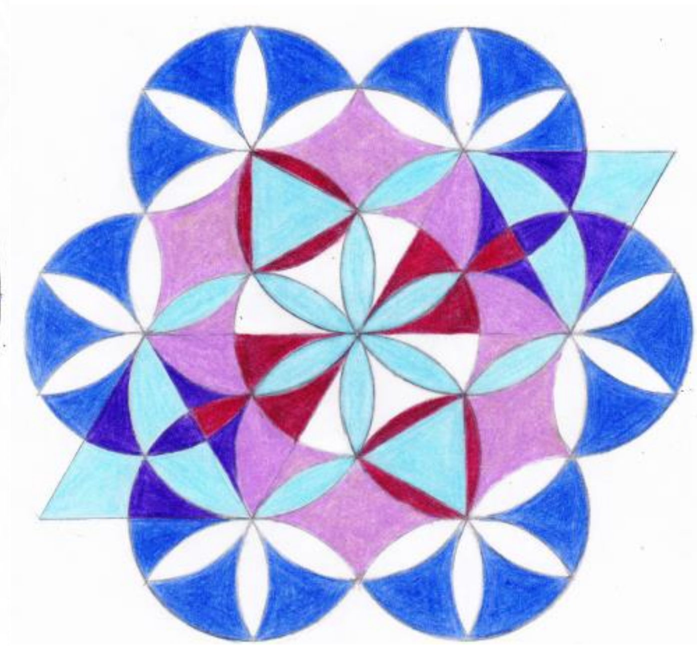


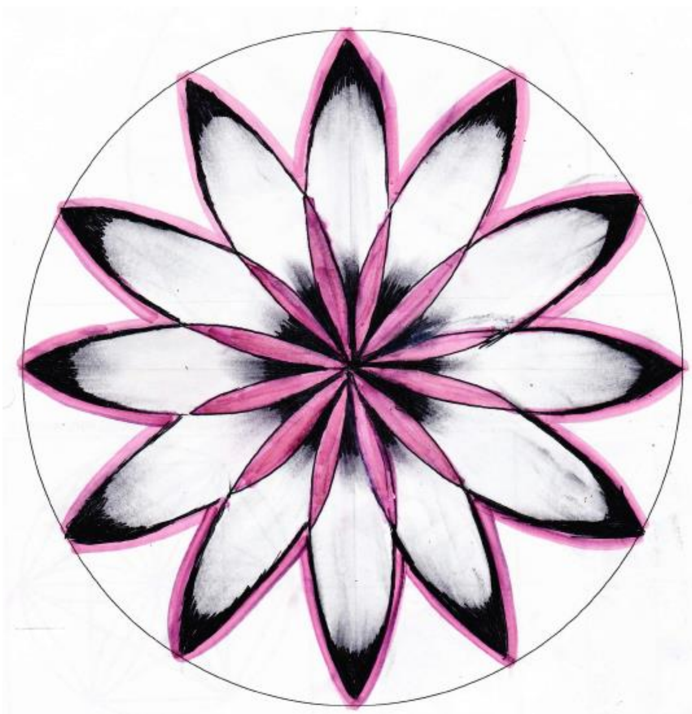

Turtwig (Scale Factor=4)

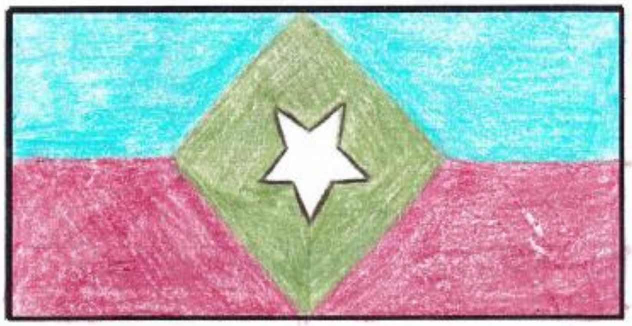

Ling-Kurie
7
2015

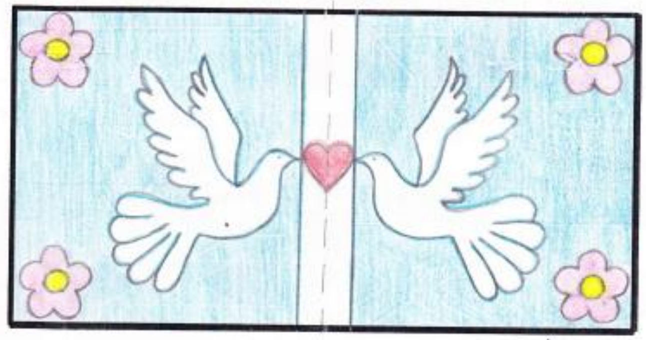





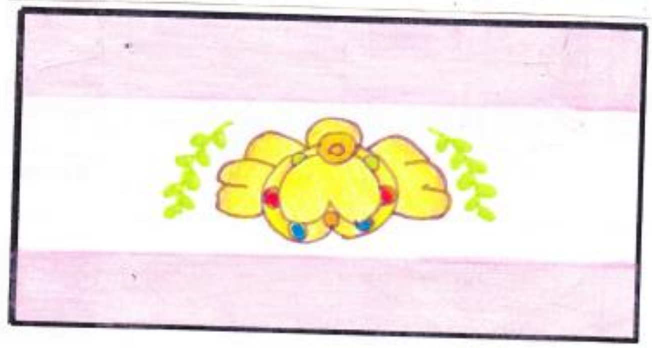


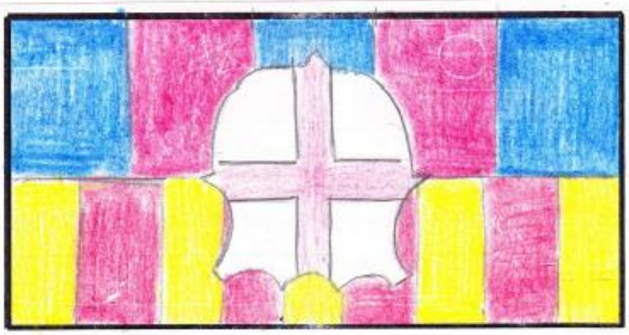


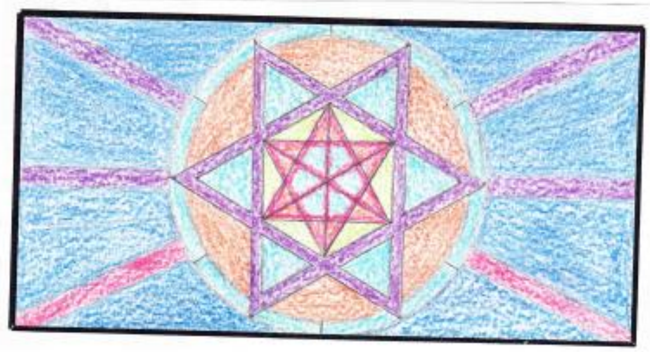


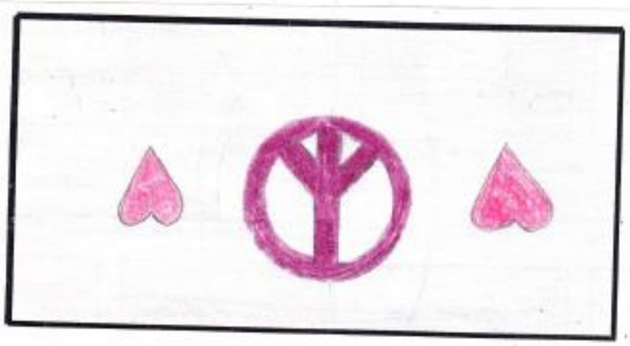


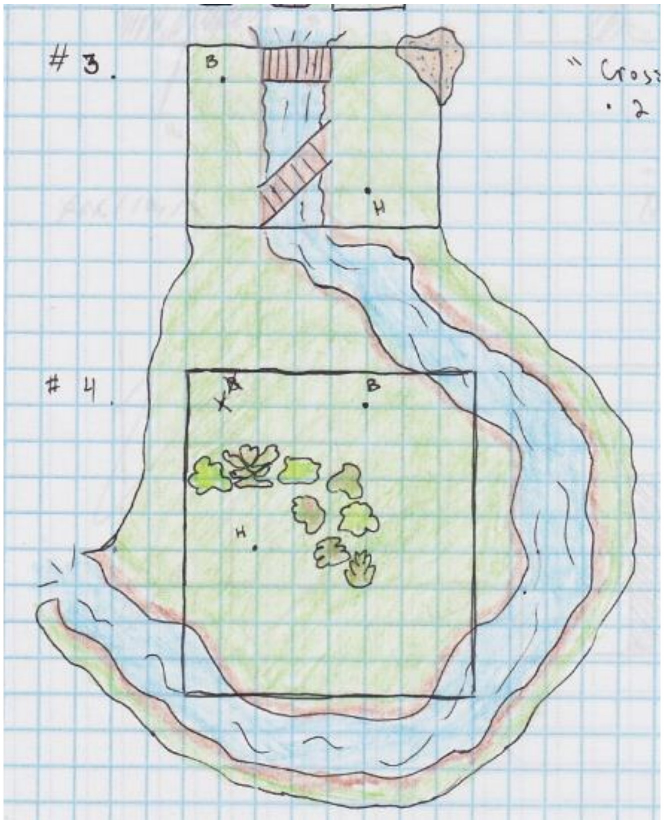












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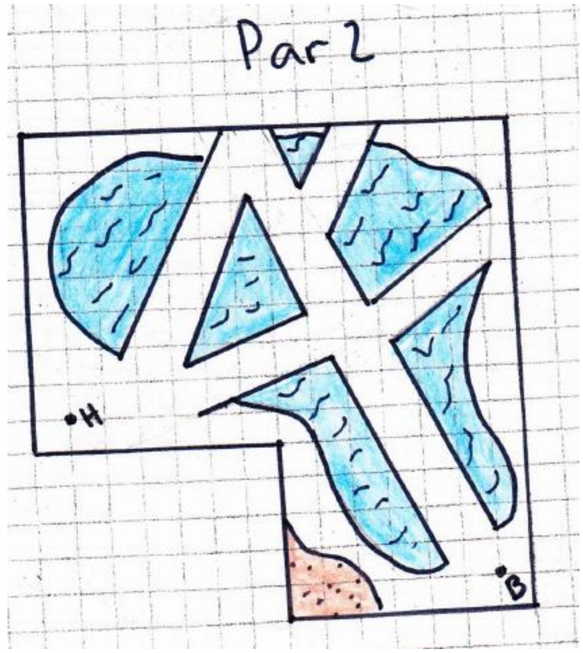

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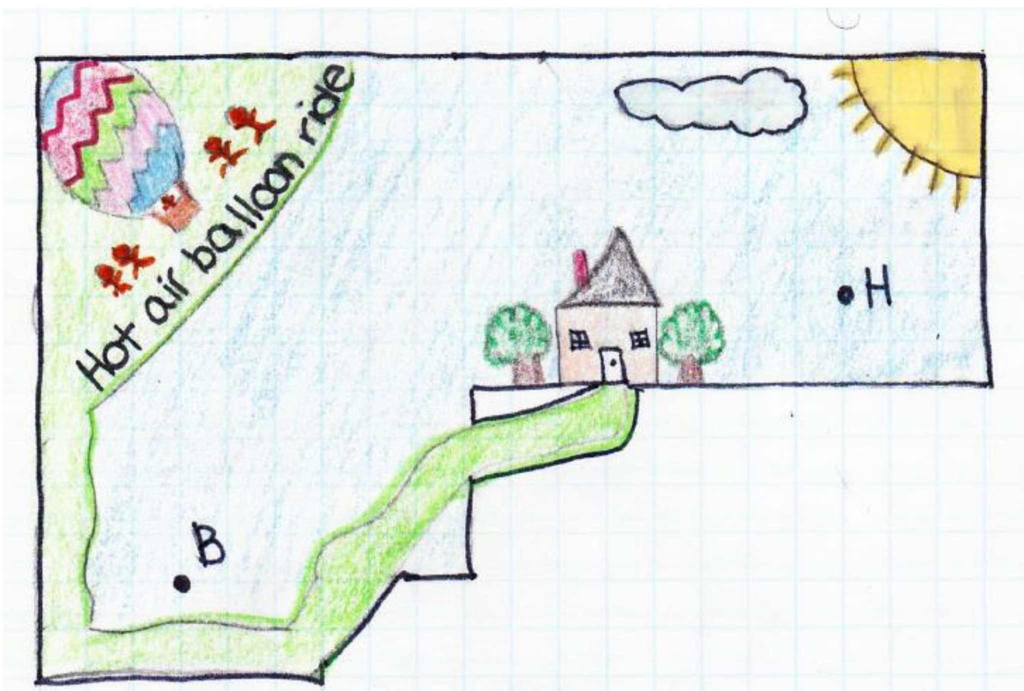

Hot air balloon ride
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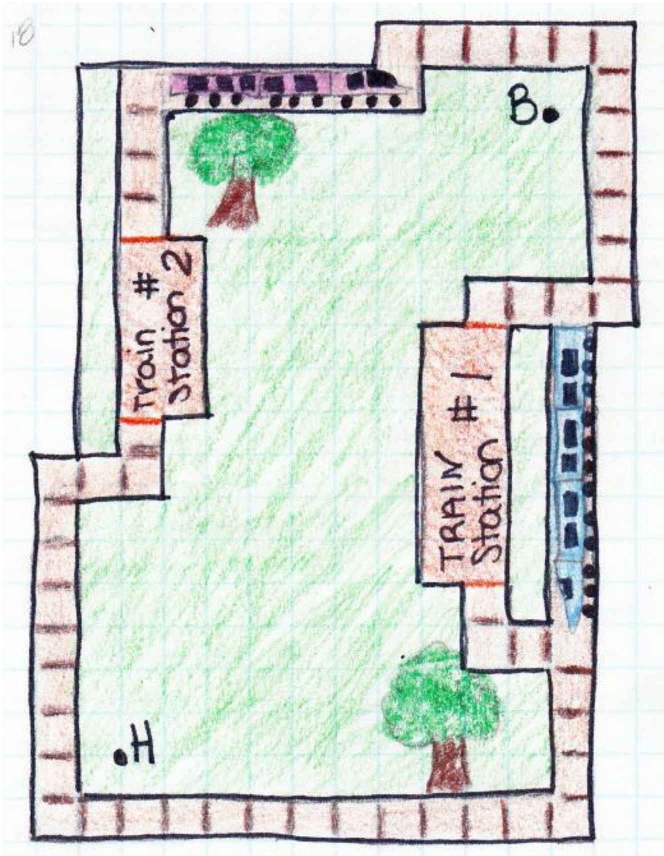
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TRAIN # 1 Station
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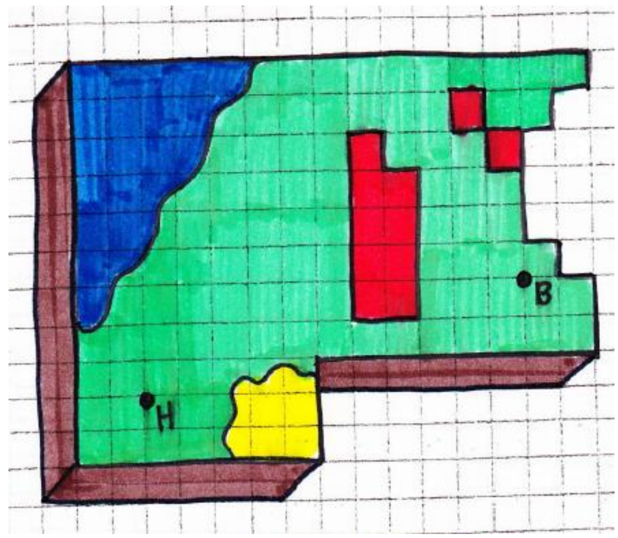
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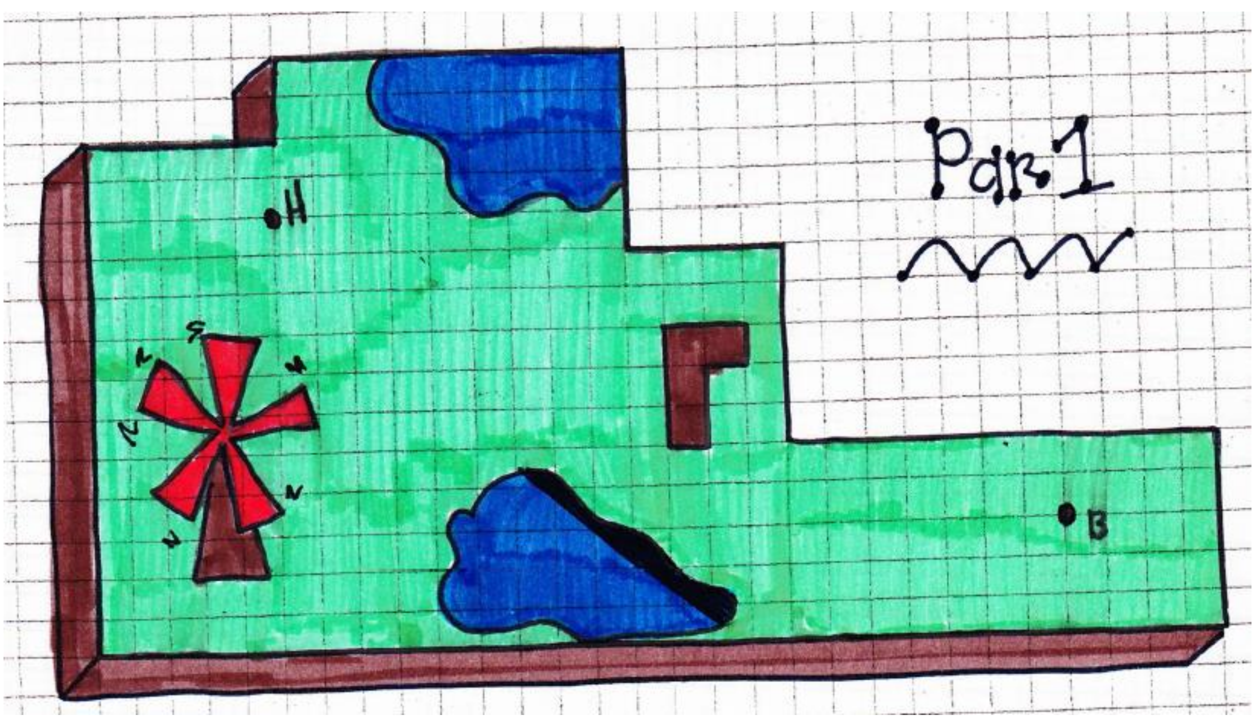
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