THE GLOBAL LEADER IN MAGNETIC CONSTRUCTION TOYS
MAGFORMERS

TRANSFORMATION GAME | TEACHER GUIDE

Lesson Title:	Transformations Game	**Grade Level:**	High School

Common Core Standards and Standards for Math Practice:

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

G.CO.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.

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

SMP 3: Construct viable arguments and critique the reasoning of others.
SMP 6: Attend to precision.

Teacher Preparation:

- Build a grids for this activity for each group. See directions and diagrams in Notes.
  - Photocopy the grid for each group. If possible, laminate each grid.
- Each group will need 1 whiteboard marker if the grid is laminated.
- Each group will need a minimum of the following Magformers:
  - 5 squares
  - 2 equilateral triangles
  - If the grid is not laminated, twice the number of pieces will be needed.
- *Optional: Additional shapes can be used for Part 3. Having several 2x1 and 3x1 rectangles for each group makes this activity much easier for the students. One trapezoid and one rhombus per group might be needed for Part 4.*

Magformers Used: *(not to scale)*

 Square	 Equilateral triangle
 Rhombus	 Rectangle (2x1)
 Trapezoid	 Super-rectangle (3x1)

Brief Overview of the Lesson:

Part 1: Students observe the effects of transformations on shapes. Part 2: Students play a game in which they show two shapes are congruent by finding a series of transformations that carry one shape to the other. Part 3: Students create their own Transformation Game. Part 4: Students answer a few questions on transformations.

Teacher Notes:

- Prepare the full-size grid needed for this activity. Each group will need one grid.
  - Draw a full-sized square using 36 square Magformers as shown in Diagram 1.
  - Place the square on butcher paper and trace around the outside and mark the length of each square piece along the perimeter. Use a yard stick to draw vertical and horizonal lines, using the marks you created as guides, in order to make a grid with 100 squares, as shown in Diagram 2.
  - Draw axes on the grid, as shown in Diagram 3.
  - Photocopy the grid for each group. If possible, laminate each grid.

Diagram 1

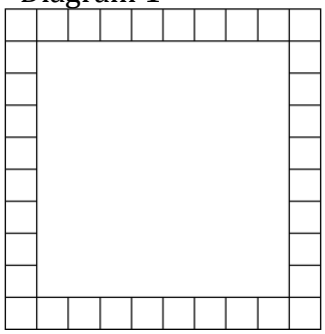


Diagram 2

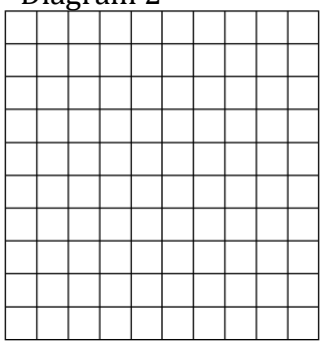
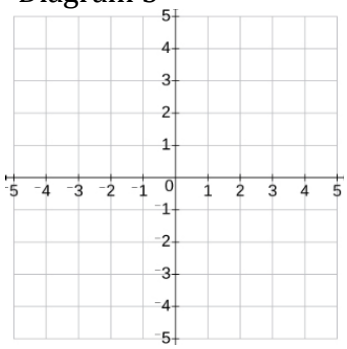


Diagram 3



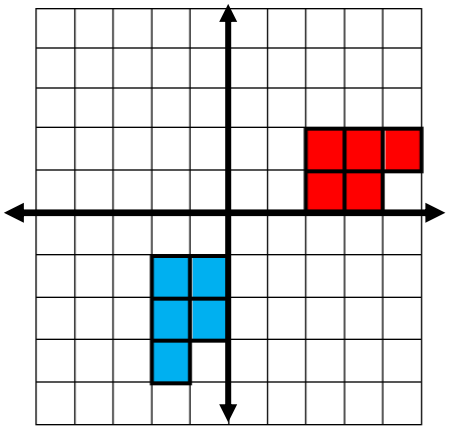
- Each round in Part 2 has many different solutions which naturally allows for differentiation in instruction.
  - This allows the teacher to challenge advanced students to find the least number of moves for each round. Meanwhile, struggling students can focus on just finishing the round with simpler moves.
  - After the game is played, invite students to present multiple ways of solving each round. In some classes, it might be appropriate to completely remove the competition aspect of the game and focus on finding multiple ways to solve each puzzle.

PART 1: REVIEWING TRANSFORMATIONS

For each set of transformations, create the blue shape out of Magformers and place it on the corresponding spot on your Magformers grid. Perform the listed transformations on your Magformers shape in order listed. Draw the transformed Magformers shape in the corresponding place on the grid below.

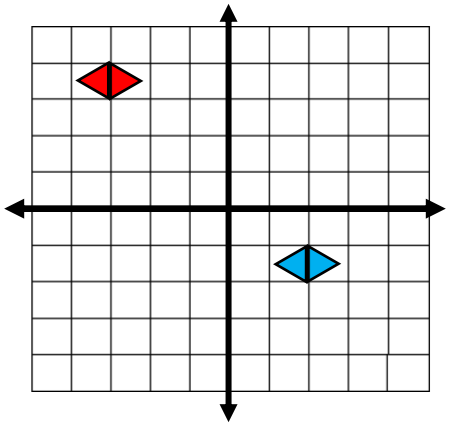
Transformations Set #A

1. Place your Magformers shape on your grid.
2. First translate the shape 2 units to the left.
3. Translate 1 unit up.
4. Rotate your Magformers shape 90° clockwise around the point (-2, 0).
5. Reflect your shape over the x-axis.
6. Sketch your transformed Magformers shape on the grid provided to the right.



Transformations Set #B

1. Place your Magformers shape on your grid.
2. Reflect the shape over the line y = 1.
3. Reflect the shape over the y-axis.
4. Translate the shape to the left 1 unit.
5. Sketch your transformed Magformers shape on the grid provided to the right.



PART 2: THE TRANSFORMATION GAME

A two-dimensional figure is congruent to another figure if the second can be obtained from the first by a sequence of rotations, reflections, and translations.

Directions for the Transformations Game

- For each round, your group will prove that the two shapes are congruent by finding a sequence of transformations that will carry Shape A onto the Shape B.
- After completing 6 rounds, find the sum of the number of moves your group used on each round. The team with the lowest score wins.
- Transformation game rules:
  - Translating the figure up 2 units left, right, up, or down counts as ONE move.
  - You may only translate in one direction per move.
  - You may translate no more than 2 units per move.
  - If rotating the figure, you must specify the number of degrees, direction (clockwise or counterclockwise), and the point of rotation.
  - If reflecting the figure, you must specify the line of reflection.

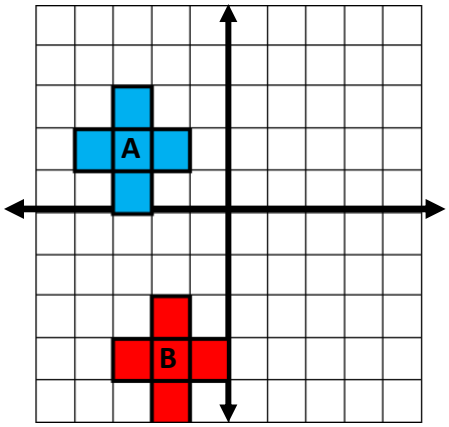
Transformations Game Round #1

Number of move(s) used in this round: 2

List of move(s) used:

Sample student response:

1. Reflect over y = -1
2. Translate right 1 unit



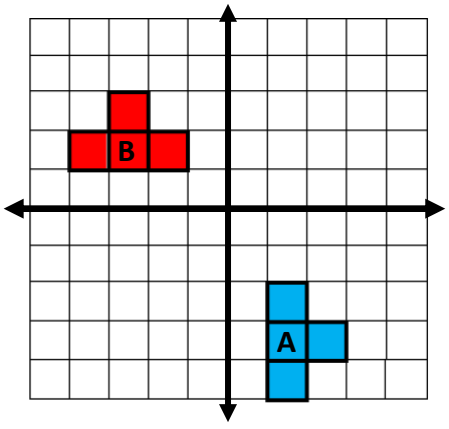
Transformations Game Round #2

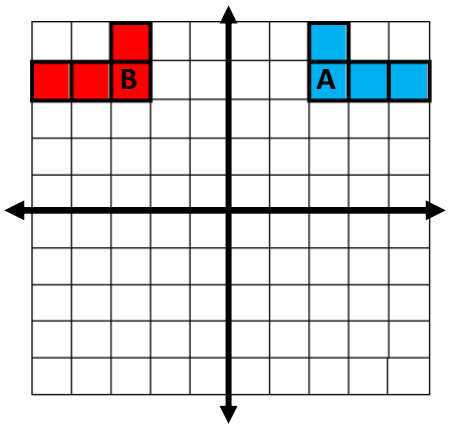
Number of move(s) used in this round: 1

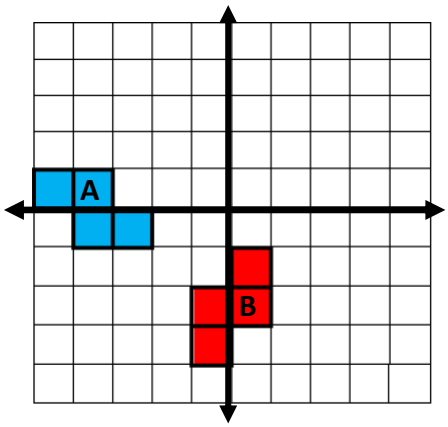
List of move(s) used:

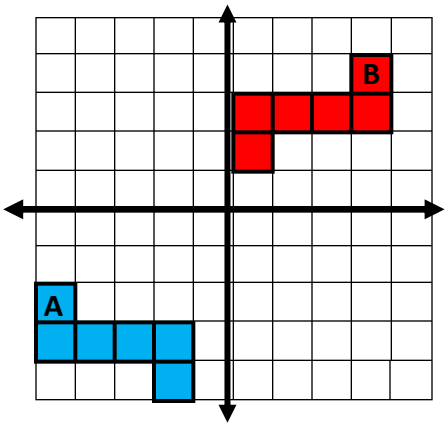
Sample student response:

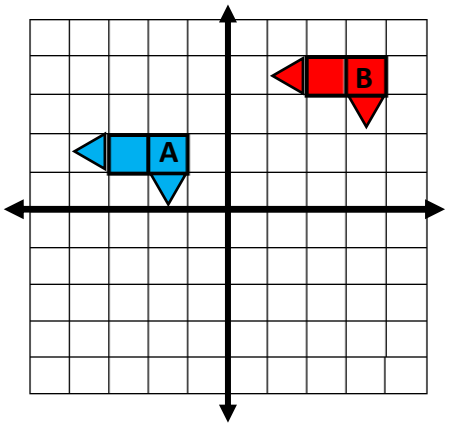
Rotate 90° counterclockwise around (-3, -3)



Transformations Game Round #3	
Number of move(s) used in this round: 1	
List of move(s) used: *Sample student response:* Reflect over x=0	

Transformations Game Round #4	
Number of move(s) used in this round: 1	
List of move(s) used: *Sample student response:* Rotate 90° clockwise around (-3, -3)	

Transformations Game Round #5	
Number of move(s) used in this round: 2	
List of move(s) used: *Sample student response:* 3. Rotate 180° around (-½, -1), 4. Reflect over y = 2.	

Transformations Game Round #6	
Number of move(s) used in this round: 3	
List of move(s) used: *Sample student response.* 1. Reflect over x = ½ 2. Reflect over x = 3 3. Translate up 2.	

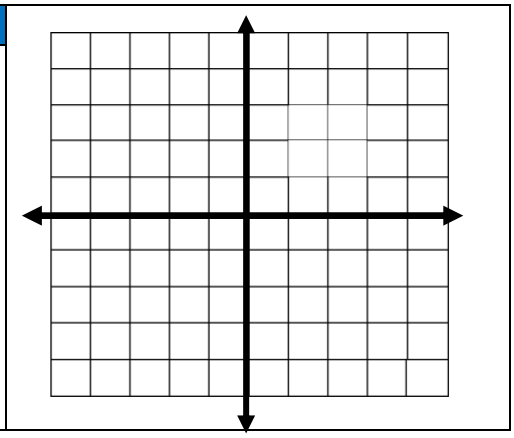
Total number of moves used in all 6 rounds:	

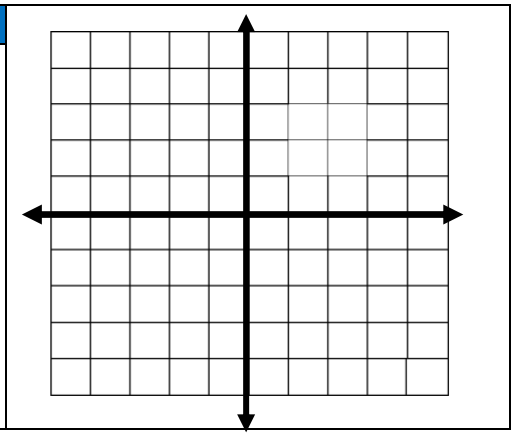
Which round of the game did you find least challenging? Which round did you find most challenging? Why do you think this was?

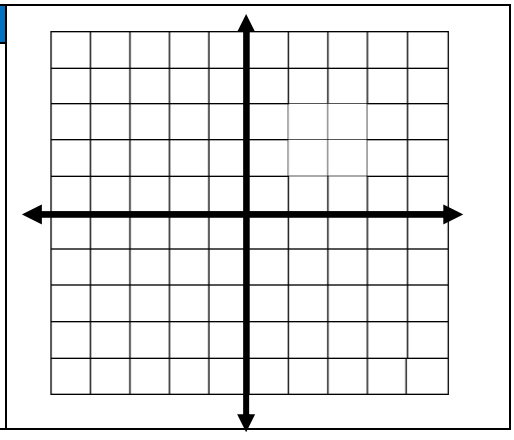
Answers will vary.

PART 3: CREATE YOUR OWN

Create three Transformation Games. Challenge a friend to complete them.

My Transformation Game #1	

My Transformation Game #2	

My Transformation Game #3	

PART 4: REFLECTION

1. Xavier creates a Transformation Game challenge that can be solved in 2 moves. He accidentally records the moves in the wrong order. Will switching the order of 2 moves make the outcome sometimes, always, or never different? Explain.

   Sample student response: Sometimes. If the moves were two translations, the result would be the same if the order was switched. If you switch the order of the moves "Translate left 2" and "Reflect over the line x = 2" on the shape in Round 1, the result would be different.

2. Felicity sets up a Transformation Game by placing two super-rectangle Magformers (3 unit x 1 unit piece) on the gameboard. After trying to solve her game, George claims that Felicity has created an impossible game. Could George be correct?

   George is wrong.

   Sample student response: The two shapes are congruent so there must be a series of transformations that will map each shape to the other.

PART 5: HIRO'S GAME

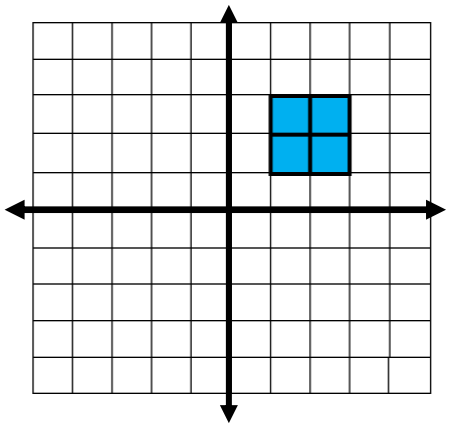
Hiro has a new idea for a game. He creates and places a Magformers shape on the grid. The goal of the game is to think of as many single-move transformations as you can that will carry the shape onto itself. Rotation angles must be more than 0 degrees and less than 360 degrees. Play Hiro's game:

Hiro's Game #1: Square

List of single transformation moves possible:

Sample student responses:

- Rotate 90° clockwise around (2,2).
- Rotate 180° around (2,2).
- Rotate 90° counterclockwise around (2,2).
- Reflect over x = 2.
- Reflect over y = 2
- Reflect over y = x
- Reflect over y = -x + 4

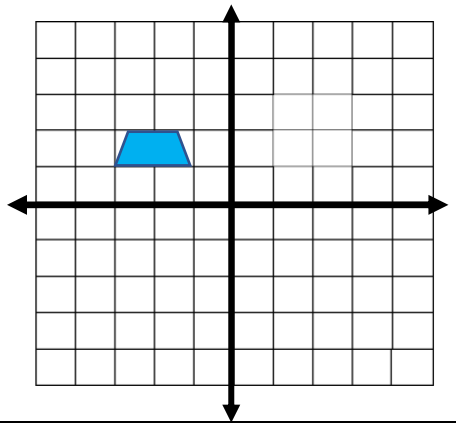


Hiro's Game #2: Trapezoid

List of single transformation moves possible:

Sample student responses:

- Reflect across x= -2



Create Your Own Hiro's Game