Transformation Games

These are a set of activities/games to help visualize geometric transformations (or rigid motions)—movements of an object that do not change the size or shape of the object. The 3 rigid motions we will use in this game are translations (slides), rotations (turns), and reflections (flips).

Set up the game

Materials: cm grid paper, scissors, ruler, tracing paper or deli paper, Mira (optional), number cube (optional)

1. Cut out a 16 cm x 16 cm game grid out of cm grid paper. Draw a horizontal line and a vertical line across the middle of the game grid as your x- and y-axes.
2. Cut out 3 right triangles with legs 1 cm and 2 cm. One of these will be your basic piece and the other 2 are images.
3. After you get good at the transformations, you can cut out copies of non-right scalene triangles or other irregular polygons. For these, use a ruler to make straight edges and place the vertices on intersections of cm grid paper.

Warm-up

1. Place one paper triangle (the original) with its vertices at A(3, 1); B(4, 1); and C(4, 3). Take turns with a partner trying to place an image triangle (a copy), at the appropriate location and in the proper orientation after transforming the original in one of the 6 ways listed below. In the table below, take note of the coordinates of the vertices of the triangle after the transformation. **Return the original to the starting position before doing the next one.**

A. A translation (slide) to the left of 2 cm (or other distance).
B. A translation (slide) up of 5 cm (or other distance).
C. A reflection (flip) across the y-axis. (You can check with a Mira).
D. A reflection (flip) across the x-axis.

E. A rotation (turn) of 90° counterclockwise about the origin. (You can check with a piece of tracing paper spun around the origin).
F. A rotation (turn) of 90° clockwise about the origin.

	A (3, 1)	B (4, 1)	C (4, 3)
Translate left 2 cm			
Translate up 5 cm			
Reflect across x-axis			
Reflect across y-axis			
Rotate counter-clockwise around origin 90 degrees			
Rotate clockwise around origin 90 degrees			

2. With a partner, take turns placing the original triangle in any of the other 3 quadrants or with vertices that allow the triangle to span 2 quadrants. Experiment with the 3 types of rigid motions (transformations), taking notice of how the coordinates of the image change from the original to the image.

   Write 3 or more conjectures regarding how each transformation affects the original. Notice under what conditions the quadrant changes under transformations. How do the sides of the shape change? How do the coordinates change or stay the same?

3. Which transformations (or combinations of transformations) accomplish the same result? Give examples to demonstrate what you found.

Hide and Seek Game 1

1. After you are comfortable transforming the basic right triangle in lots of different ways, place it on your grid in any location and in any orientation (with vertices at grid intersections). Have your opponent place his basic right triangle on his grid anywhere and in any orientation (with vertices at grid intersections).
2. Next, place an image triangle on your opponent's grid. You are trying to "hide" the image so that it takes several moves (transformations) for your opponent's triangle to find its match. Place it so that the vertices are on grid intersections.
3. Your opponent is doing the same…."hiding" your image triangle on your grid so that it takes you several moves to find your match.
4. You and your opponent take turns, each player working only on his own grid trying to reach the "hidden" triangle. On your turn, you can make **one** of the transformation moves of your triangle in an attempt to "seek" its image. After your move, you leave your triangle where it is until your next turn.

    A. A translation (slide) to the left or right of any distance.
    B. A translation (slide) up or down of any distance.
    C. A reflection (flip) across the y-axis. (You can check with a Mira).
    D. A reflection (flip) across the x-axis.
    E. A rotation (turn) of 90° counterclockwise about the origin. (You can check with a piece of tracing paper spun around the origin).
    F. A rotation (turn) of 90° clockwise about the origin.

5. The winner is the player whose original triangle "finds" its hidden image (matches the orientation and location exactly) in the fewest moves (transformations).

How many moves and which moves will it take to match up the original and its image? Explore and see what you can figure out. Keep track of some interesting findings.

Hide and Seek Game 2

1. This game is a variation of game 1. It can be played with one cm grid board by "hiding" one triangle on the grid. Each player places his own "seeker" on the same board, in any other quadrant than the one containing the hidden triangle.
2. Players take turns rolling a number cube to determine which transformation they can make on their turn.
    a. 1 = A translation (slide) to the left or right of any distance.
    b. 2 = A translation (slide) up or down of any distance.
    c. 3 = A reflection (flip) across the y-axis. (You can check with a Mira).
    d. 4 = A reflection (flip) across the x-axis.
    e. 5 = A rotation (turn) of 90° counterclockwise about the origin. (You can check with a piece of tracing paper spun around the origin).
    f. 6 = A rotation (turn) of 90° clockwise about the origin.
3. At the end of each turn, a player's seeking triangle stays where it is until the next turn. The first player to match his triangle with the "hidden" one on his turn is considered the winner.