Lesson Title: Reflections on the Coordinate Plane **Date:_____**

Subject: Pre-Algebra, Algebra I, or Geometry
Topic: Horizontal & Vertical Reflections on Coordinate Plane
Grade: Secondary **Designer:** Paul Gibbins

Stage 1 – Desired Results

Lesson Overview: In this lesson, students will observe what happens when a segment is reflected over the x-axis or the y-axis. Emphasis will be on the horizontal and vertical changes to the graph, and the ways in which that change is represented in the coordinates of the graph.

Standards Addressed:
CCSS 6NS.6.b:
b) Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes.

CCSS 8.G.A.1 & 8.G.A.2:
1.) Verify experimentally the properties of rotations, reflections, and translations:
   a) Lines are taken to lines, and line segments to line segments of the same length.
   b) Angles are taken to angles of the same measure.
   c) Parallel lines are taken to parallel lines.
2) Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

CCSS G-CO.3 & G-CO.4
3) Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
4) Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

Enduring Understanding:	**Essential Questions:**
Graphs Reflected Over the Y-Axis: • Horizontal change to the graph • All x-coordinates on the reflected graph are opposites of the x-coordinates on original graph • All y-coordinates are unchanged Graphs Reflected Over the X-Axis: • Vertical change to the graph • All y-coordinates on the reflected graph are opposites of the x-coordinates on original graph • All x-coordinates are unchanged	• How are the coordinates of a graph changed when the graph is reflected over the x-axis? • How are the coordinates of a graph changed when the graph is reflected over the y-axis?
Students will need to: • Know graphing on the coordinate plane • Understand the concept of lines of symmetry • Know how to identify the x-intercept and y-intercept of a graph	**Students will be able to:** • Identify reflections as a change in sign of the coordinate(s) of a graph. • Draw the reflections of a simple geometric shape over the x-axis or the y-axis

<table>
<tr><th colspan="2">Stage 2 – Assessment Evidence</th></tr>
<tr><td>Performance Tasks:
In this activity students will be asked to:
Predict what will happen to a new graph based upon prior experience.
Predict the changes to the coordinates of points when the graph is reflected over either the x or y-axis
Create written reflections comparing their answers to the correct solution</td><td>Other Evidence:
To be decided by the teacher.</td></tr>
<tr><th colspan="2">Stage 3 – Learning Plan</th></tr>
<tr><td>Lesson Procedure:
This lesson could be used as an introduction to the concept of reflections or for a lesson introducing the concept of reflections or a means of reinforcement of prior learning.

The student portion of the lesson will require approximately 20 minutes. Additional time will be needed for follow-up based upon the needs of the class as determined by the teacher.

The student responses on page 4 and page 6 would be artifacts that demonstrate their understanding of the main concepts as stated in the discussion questions below. Printing page 4 would have the advantage of including the graphs created by the students. These printed responses could be included in the student's math journal or used as evidence of learning for homework.</td><td>Required Materials:
Computer for each student.

(Optional) A printer to document student responses to open response questions, their prediction graphs, and/or concept overview pages.

(Optional) Math journal to record answers to some open response questions, such as page 4 and 6. Some teachers may consider this an appropriate place to keep a record of the students work in case they are needed for review, etc.</td></tr>
<tr><td>Possible Discussion Questions for Students:
1. How would you describe reflecting a graph over the x-axis?
2. How would you describe reflecting a graph over the y-axis?
3. A graph containing the points A(3, -2) & B(-1, -5) is reflected over the x-axis. What are the coordinates of corresponding points on the graph of the reflection?
4. A graph containing the points L(2, 3) & M(-4, -6) is reflected over the y-axis. What are the coordinates of the corresponding points on the graph of the reflection?</td><td>Sample Answers to Discussion Questions:
1. Reflecting over the x-axis is a horizontal change to the graph with the x-axis serving as a line of symmetry. The y-coordinates of the points reflected are the opposite while the x-coordinates are unchanged.
2. Reflecting over the y-axis is a vertical change to the graph with the y-axis serving as a line of symmetry. The x-coordinates of the points reflected are the opposite while the y-coordinates are unchanged.
3. A'(3, 2) & B'(-1, 5)
4. L'(-2, 3) & M'(4, -5)</td></tr>
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