Flips, Turns, and Slides: Adventures with Transformations

Student/Class Goal
Students interested in taking the GED test or entering higher education will want to perform the attributes of transformations.

Outcome (*lesson objective)*
Introduce students to the concepts of transformations and explore the attributes of reflections, translations and rotations in the real world and on a coordinate grid.

Time Frame
Four 45 minute classes

Standard *Use Math to Solve Problems and Communicate*

NRS EFL 3-6

COPs	**Activity Addresses Components of Performance**
Understand, interpret, and work with pictures, numbers, and symbolic information.	Students work with symbolic information when they plot points and construct shapes on a coordinate grid.
Apply knowledge of mathematical concepts and procedures to figure out how to answer a question, solve a problem, make a prediction, or carry out a task that has a mathematical dimension.	Students are required to problem solve to determine where the various points would be. In addition they must determine which transformation has occurred.
Define and select data to be used in solving the problem.	Students must determine what coordinates to use when locating the new point.
Determine the degree of precision required by the situation.	Students recognize that graphing must be precise.
Solve problem using appropriate quantitative procedures and verify that the results are reasonable.	Students visually determine if the shape is reasonable.
Communicate results using a variety of mathematical representations, including graphs, charts, tables, and algebraic models.	Students are able to explain how they came up with their answers and recognize examples of transformations in their lives.

Materials
Coordinate Grid Paper
Graph boards, if available
Geo boards and rubber bands, if available (geo boards are a good way for students to practice all these concepts)
Flips/Reflections Handout
Fun With Translations Overhead
Translations…What Did I Do? Handout
Transformations Handout
Transformations Rubric
Spatial Sense Teacher Resource

Learner Prior Knowledge
The lesson on *Let's Plot Points* provides a knowledge base of the coordinate grid.

Teacher Preparation
Make your own erasable coordinate grids – Laminate a coordinate grid and mark with dry erase or vis-à-vis markers (check your lamination) or make overheads on a copier, glue to cardstock and insert in a sheet protector (many can be written on). Teacher can make various shapes to use with Steps 2, 3 and 4 by copying *Flips/Reflections* handout on colored paper to easily fit on grid.

Instructional Activities
Step 1 - Ask the students if they or any of their children ever played with Transformers toys. Discuss what a Transformer is – a toy that changes its appearance by moving the parts. Tell them that during the next few classes, they will learn about three mathematical transformations: flips, turns and slides.

Step 2 - **Flips/Reflections** Ask how many people looked in a mirror before they left their home today. What did they see when they looked in the mirror? (Their reflection.) Share with the students that a reflection or flip is one type of transformation. Discuss what happens if they move their hands toward the mirror. If they move their hands all the way to the mirror, their fingers and the fingers of their reflection will touch. Also point out that mirrors show us in reverse. You can write a few numbers on a sheet of paper and invite students to look at the numbers in a mirror. By comparing reflections occurring with mirrors to reflections on the coordinate grid, the students have a better understanding of reflections (flips).

Have students practice flipping shapes on grid paper. Use a small shape and physically flip it over the *x* and *y*-axis. Be sure to practice with both axes. Start with the object touching an axis for the flip, and then gradually move the shape further away. Let students draw shapes on their coordinate grid, and then pass their paper to a partner to draw the reflection. Ask pairs of students to label the vertices of a shape and to find the reflection of each point over both the *x* and *y* axes. Ask students to complete the handout *Flips/Reflections* by choosing a shape of their choice.

Step 3 - **Turns/Rotations** When studying turns and rotations, I reminisce about a game I played as a kid. One child would hold the hand of a friend. The first child would twirl around spinning the child whose hand they were holding. After a number of spins they would release the child's hand and they would spin off. This game reminds me of the transformation: rotation or turn. Like in the game, in a rotation, one point remains in the same location and the rest of the shape rotates around this focus point. Ask the students for other examples of things in real life that rotate.

Practice working with rotations. Construct a large coordinate grid on a bulletin board or piece of cardboard. Rotate a shape cut out of paper on the grid. *(Make sure your shapes match the size of the squares on your coordinate grid so the vertices meet a coordinate.)* A push pin can make sure the shape rotates on just one point. Move the push pin and make other points the point of rotation. If you taped a life-size coordinate grid on your floor (see the lesson *Let's Plot Points*), let 3 or 4 people form a shape. Connect them by holding heavy twine. Let the shape rotate around a point (student).

Step 4 - **Slides/Translations** You may want to relate the slides/translations to moving furniture. The shape (furniture) stays the same, but you shove it around a room. Using the *Fun with Translations* overhead, review the numbers of each quadrant. Ask the students to think about how they can move the shape from quadrant III to quadrant I. Encourage them to talk to another student about what they could do. Ask the students to share their ideas with the class. "If we want to move point (-1,-1) to point (5, 5) what would we need to do?" Get suggestions from the class. Hopefully, some will say to add 6 to both the *x* and *y* coordinates. (Students would only come up with this answer if they are familiar with operations with integers.) Students might "move" the shape 6 squares to the right and 6 squares up to physically "add" 6 to each coordinate. Practice translating shapes to new locations, using the overhead and student graph boards. If you taped a life-size coordinate grid on your floor (see the lesson *Let's Plot Points*), let 3 or 4 people form a shape. Connect students by having them hold heavy twine. Let the shape "translate" to a specific location. Practice lots of examples so students understand that to translate a shape each point will move in the same distance in the same direction. Assess the students' knowledge by completing *Translations…What Did I Do?* handout.

Step 5- Assess the students in either of these two ways.

- Using the *Transformations* handout, follow the directions to construct 3 different shapes and then demonstrate the requested transformation. Ask students to explain how they figured out their answers. For higher level students, allow them to choose their own shape and transformation. This activity can be assessed with *Transformations* Rubric
- Use GED problems involving translations, reflections and rotations as an assessment.

Assessment/Evidence (*based on outcome)*
Students complete the assessment activity to be evaluated with the Transformations Rubric and/or complete GED format exercises.

Teacher Reflection/Lesson Evaluation
Not yet completed.

Next Steps
The Microsoft Word Drawing Tool allows students more practice with transformations as they rotate, reflect and flip shapes horizontally and vertically.

Technology Integration
Coordinate Grid Paper http://www.donnayoung.org/math/c-grids.htm
Coordinate Grid Paper http://www.printfreegraphpaper.com/
Coordinate Grid Paper http://themathworksheetsite.com/coordinate_plane.html
What Is Your Coordinate?
http://www.nsa.gov/academia/_files/collected_learning/middle_school/geometry/whats_your_coordinate.pdf
Transformations http://socrates.acadiau.ca/courses/educ/reid/Geometry/Symmetry/Transformations.html
Transformations in Geometry http://www.lessonplanet.com/lesson-plans/transformations
Transformations Lesson Plans http://www.lessonplanet.com/lesson-plans/transformations

Purposeful/Transparent
All activities relate to the student's goal of understanding turns, flips and slides.

Contextual
Students discuss where in their experience they have seen these relationships.

Building Expertise
Lesson builds of previous student life experiences along with Eureka lesson *Let's Plot Points.*

Spatial Sense
Teacher Resource

Spatial Sense can be defined as an intuition about shapes and the relationships among shapes. Individuals with spatial sense have a feel for the geometric aspects of their surrounding and the shapes formed by objects in the environment. Spatial sense includes the ability to mentally visualize objects and spatial relationships – to turn things around in your mind. It includes a comfort with geometric descriptions of objects and position. People with spatial sense appreciate geometric form in art, nature and architecture.

Symmetry is a balance or correspondence between various parts of an object; the term symmetry is used both in the arts and sciences. In art and design, it is used loosely to mean a kind of balance in which the corresponding parts are not necessarily identical but are similar. A mathematical operation, or transformation, that results in the same figure as the original figure (or its mirror image) is called a symmetry operation. Such operations include reflection, rotation, and translation. A symmetry operation on a figure is defined with respect to a given point (center of symmetry), line (axis of symmetry) or plane (plane of symmetry).

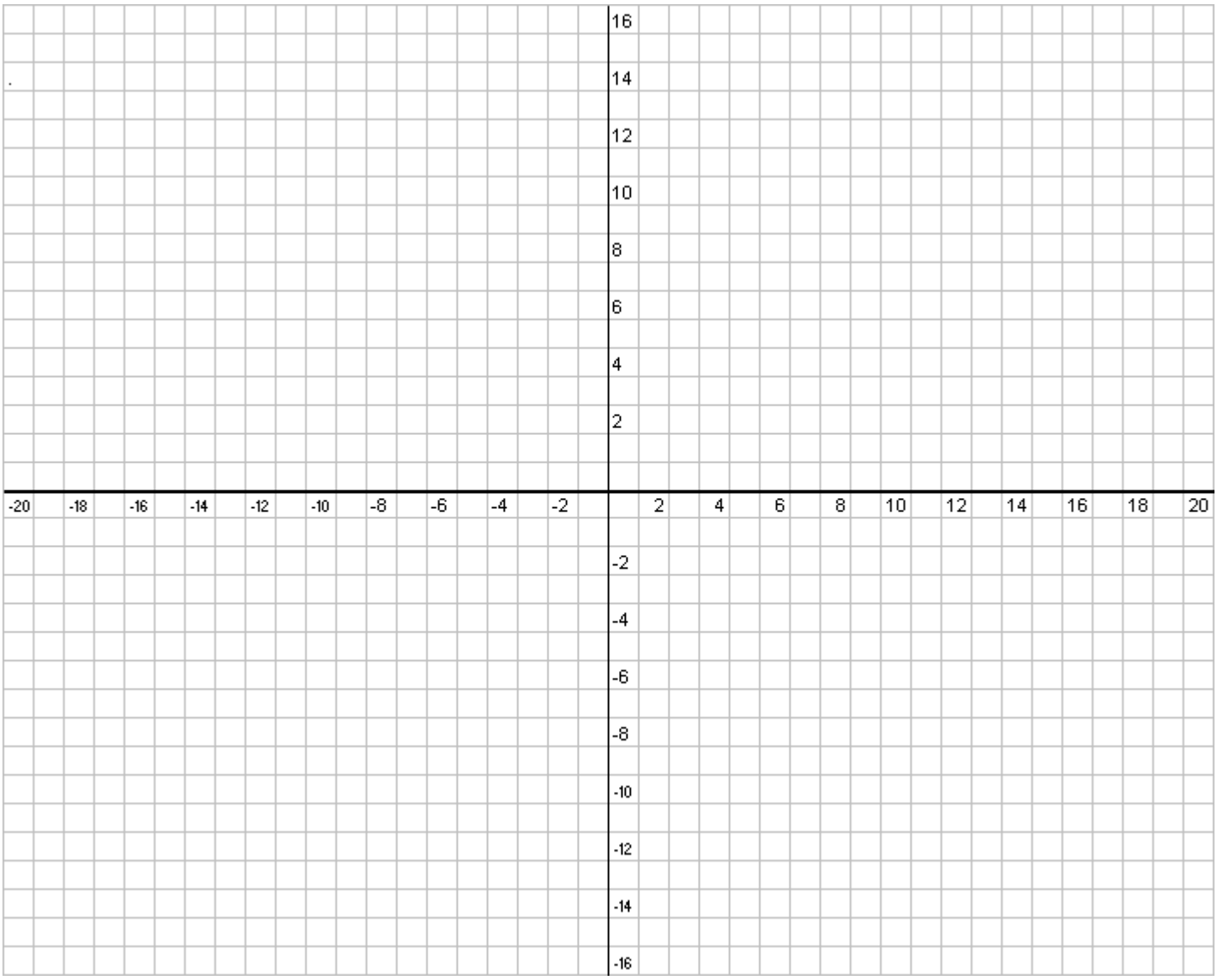
A **reflection (flip)** is a transformation in which each point of a figure has an image that is the same distance from the line of reflection as the original figure. The concept of reflections surrounds us in our everyday life. We can find reflection symmetry in architecture, nature, sports, and graphic design, for example. We can see our own reflection by using a mirror or looking into a pool of water. Kaleidoscopes and periscopes use reflections to produce beautiful symmetric designs.

A **rotation (turn)** is a transformation in which every point of a figure moves along a circular path around a fixed point that is called the ***center of rotation***. Lines that are drawn from a point and its image to the center of rotation form an angle that is always the same measure. This angle is called the ***angle of rotation***. To achieve a better understanding of this concept of rotation, you may want to experiment with rotating figures on the coordinate plane. We can observe rotational symmetry on the face of a clock, a windmill, and the tires of cars. Designs created by rotations can be found in quilts, fabrics, rugs, and various logos. In the field of geometry, regular polygons have rotational symmetry.

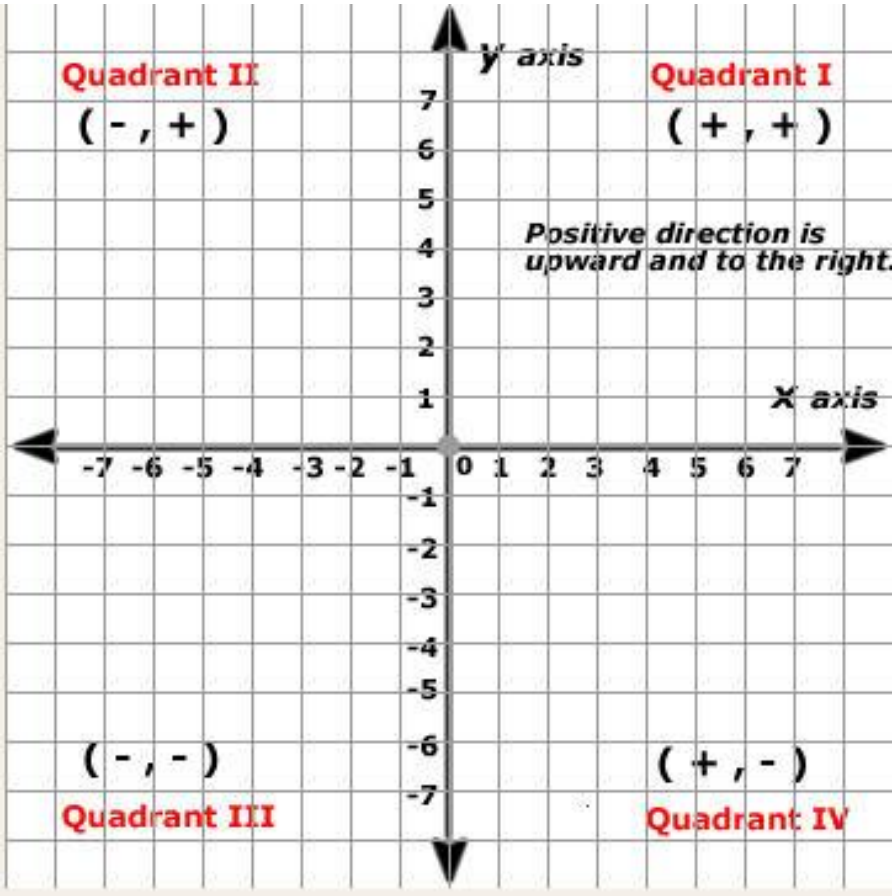
A **translation (slide)** is a transformation that slides each point of a figure the same distance and the same direction. This is the result when a figure is reflected over a pair of parallel lines. Translations have a multitude of applications in our everyday life. In the field of mathematics, translations can help us to understand the transformation of algebraic functions. Translations play an important part in graphic design and manufacturing. We are surrounded by samples of translations in the design of fabrics, wallpaper, and floor tiling. Examples of translations can also be found in sheet music.

Student Activity Have students share with the class photographs or examples of flips, slides and turns that they find in nature and in their community. Create a display or bulletin board to spotlight their finds.

Flips/Reflections
Step 2

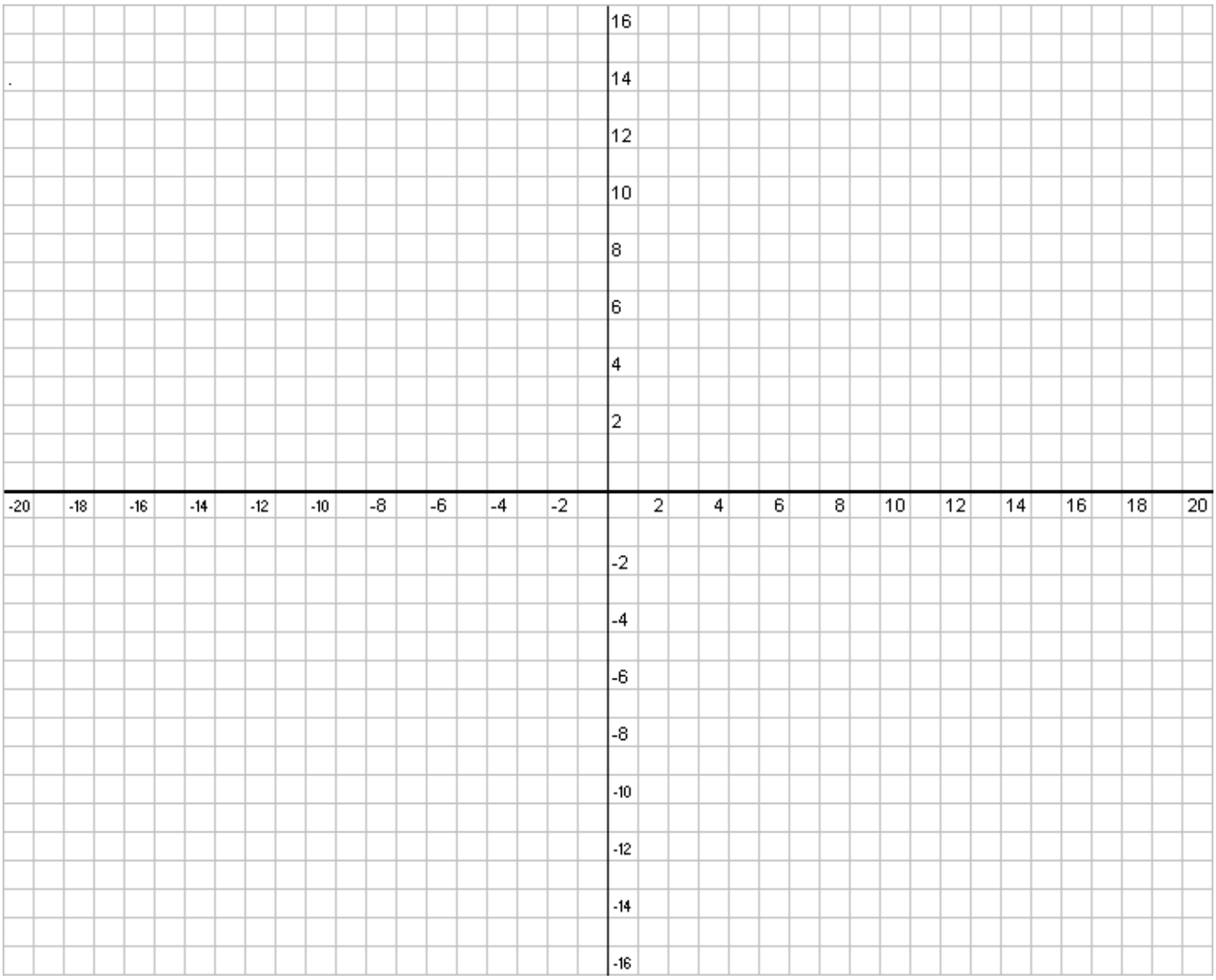


Fun with Translations
Step 4



Fun With Translations Overhead

Translations…What Did I Do? Overhead
Step 4



Plot the triangle formed with the following 3 points: (-6, 6), (-2, 6), and (-4, 2). Label this triangle A.

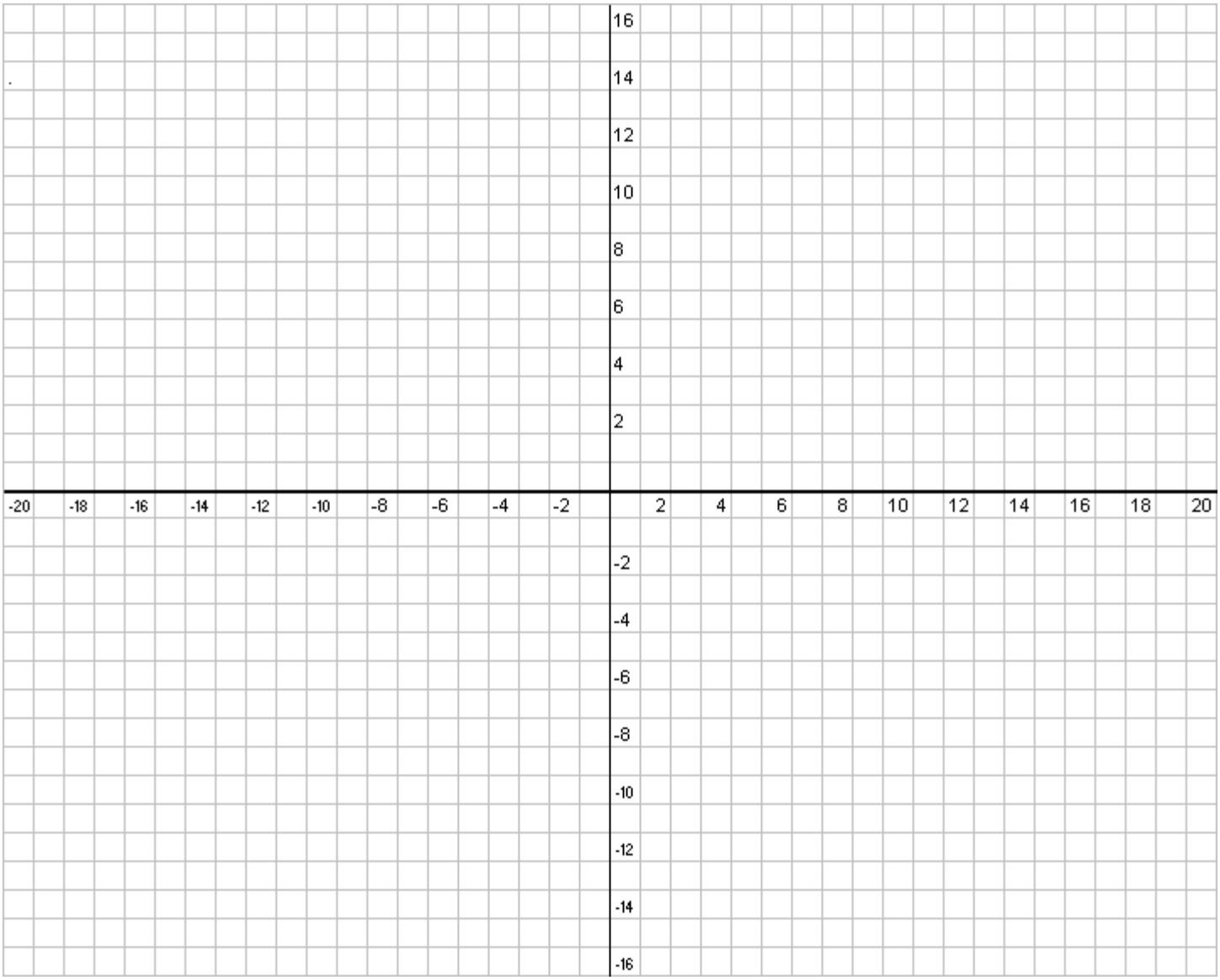
Plot the triangle formed with the following 3 points: (2,-1), (6,-1), and (4,-5). Label this triangle B.

In the space below and on the back, explain how you would translate triangle A to the location of triangle B.

Translations…What Did I Do? Handout

Transformations
Step 5

Using the coordinate grid, plot the shapes identified below. Transform each shape as described.



Shape A (-9, -3), (-9, -11) and (-16, -11).
Rotate Shape A 90° on point (-9, -3). Draw the shape in its new location.

Shape B (3, 1), (5, 5), (9, 1) and (11, 5).
Reflect Shape B over the *x*-axis. Draw the shape in its new location.

Shape C (-10, 5), (-10, 11), (-6, 5) and (-3, 11).
Slide Shape C so point (-3, 11) is now at (18, 16). Draw the shape in its new location.

Write an explanation or share with a peer the steps you took to transform each shape.

Transformations Rubric

Evaluate the students' understanding of flips, turns and slides by using the rubric scoring guide:

3 points -- Student accurately transforms shape with understanding of size, position and orientation
2 points -- Student transforms shape with partial understanding and accuracy
1 point -- Student can not transform shape with understanding or accuracy

	Shape A	Shape B	Shape C	Total
Flips				
Turns				
Slides				

Name _____ **Date** _____