Transforming Triangles

Summary

Students will graph translations (slides) and reflections (flips) on a coordinate plane.

Main Core Tie

Mathematics Grade 6

Strand: THE NUMBER SYSTEM (6.NS) Standard 6.NS.8

Materials

- *Transforming Triangles* worksheet
- *Rotating Triangles* *worksheet*

Ruler

Pencil

Additional Resources

Book

- *Visions of Symmetry: Notebooks, Periodic Drawings, and Related Work of M.C. Escher* , by Doris Schattschneider; ISBN 0-7167-2126-0

Video

- *The Fantastic World of M.C. Escher* , directed by Michele Emmer; ASIN: 6303146767

Additional Media

- *M.C. Escher Sun and Moon*
  Puzzle, by iproject (available from http://www.iproject.com/, P.O. Box 101, 3740 AC Baarn, Holland, Telephone: +31-35-5418041, Fax: +31-35-5411766); Item# ES-1020

Background for Teachers

Students should understand the following vocabulary for this activity:
rotation (turn)--The image of a figure that has been "turned" as if on a wheel.
translation (slide)--The image of a figure that has been slid to a new position without flipping or turning.
reflection (flip)--The mirror image of a figure that has been "flipped" over a line.
transformation--The act of changing the form or appearance of an object.
clockwise--In the same direction as a clock's hands move.
counterclockwise--In the opposite direction as a clock's hands move.
In *Webster's Dictionary*, the word "transform" is defined as "to change or convert." Students should understand that rotations, translations, and reflections are all types of transformations.
Maurits Cornelis (M.C.) Escher (1898-1972) was an architect and graphic artist. He continually invented new visual constructions to challenge the conventional perception of spatial relationships. Escher's fascination with drawing figures that tile together perfectly led to numerous tessellation drawings that involve the repetition of one or more shapes that connect together in asymmetrical relationship.

Intended Learning Outcomes

2. Become mathematical problem solvers.
6. Represent mathematical situations.

Instructional Procedures

Invitation to Learn

(This activity requires adequate physical space.) Have students stand where they can spread their arms out and not touch anyone. Give them the following directions:

Slide one step to the right.
Turn your body 1/2 turn to the left.
Slide three steps to the left.
Turn your body 1/2 turn to the right.
Lie on your back on the floor.
Flip over onto your stomach.
Stand up and turn completely around once.
Sit down in your seat.

Instructional Procedures

Explain to students that just as they were transforming their bodies by *sliding, turning*, and *flipping* them, they can also transform geometric shapes in math.
Introduce or review the following vocabulary: rotation, translation, reflection, transformation, clockwise, and counterclockwise (see background information).
Discuss that a reflection (flip) is accomplished by graphing the opposite of each coordinate (reflections across the x-axis change each y-coordinate into its opposite).
Distribute a *Transforming Triangles* worksheet to each student.
Instruct the class to graph and label a triangle with the following coordinate points in Grid 1: A(-5,4), B(-3,5), C(-2,1).
Also in Grid 1, have students create triangle ABC by translating (sliding) triangle ABC 7 units right and 6 units down. Label the points. Translation = A(2,-2), B(4,-1), C(5,-5).
Graph and label a triangle with the following coordinate points in Grid 2: D(1,1), E(4,5), F(5,3).
Reflect (flip) triangle DEF across the x-axis and label the points in Grid 2. Reflection = D(1,-1), E(4,-5), F(5,-3).
Graph and label a triangle with the following coordinate points in Grid 3: G(1,-4), H(4,-2), I(4,-5).
Reflect (flip) triangle GHI across the y-axis and label the points in Grid 3. Reflection = G(-1,-4), H(-4,-2), I(-4,-5).
Pair students up and pass out a privacy folder to each pair.
Students draw and label triangle JKL in Quadrant IV of Grid 4 (they choose the coordinate points).
Have each student create triangle JKL by sliding triangle JKL into Quadrant II of Grid 4 (each students decides how many units to move triangle JKL up and left).
Each student takes turns giving his/her partner the coordinate points so s/he can duplicate his/her partner's triangles in Grid 5.
Partners compare their triangles. (Grid 4 of one partner should duplicate Grid 5 of the other partner.)
Students draw and label triangle MNO in Quadrant III of Grid 6 (they choose the coordinate points).
Each student reflects (flips) triangle MNO across the x-axis into Quadrant II.
His/her partner checks to see that s/he has reflected triangle MNO correctly.
Pass out a " Rotating Triangles" handout and brad to each student.
Cut the paper on the dotted line, then cut out the two triangles.
Push the brad through the black triangle, then the gray triangle.
Next, push the brad (with the triangles on it) into the center point of the square and secure.
Instruct the students to rotate (turn) the black triangle 1/4 turn (90 degrees). Continue to give instructions for the students to rotate the black triangle 1/2 turn, then 270 degrees, etc. Give

directions in both degrees and fractions of a turn.
With a partner, have students take turns giving directions to their partner to rotate one of the triangles (have them give directions in both degrees and fractions of a turn).

Extensions

Students look for letters in the alphabet that look the same when reflected in a mirror. Try to find entire words that look the same, for example, "MOM" or "TOOT."
The Kuba people of the Congo (Zaire) region of Africa use slides and flips when making patterns on cloth. Examine some samples of Kuba cloth.
Tessellations (M.C. Escher)
The famous Renaissance artist, Leonardo DaVinci, often wrote words in mirror-image in his journals so that others could not read them. Extend this concept into an art activity.

Family Connections

Play with or discuss the popular "Transformer" toys. How do they change or transform?
Using an everyday object from home (such as a spoon), practice sliding, turning, and flipping it on a flat surface.
Play Simon Says and give instructions like "Simon says slide two steps forward," "Simon says turn around two and a half times," "Lie down on your back and flip over three times."

Assessment Plan

Evaluate students using the following rubric:	
4 Full Accomplishment	Student accurately graphs translations and reflections on the coordinate plane.
3 Substantial Accomplishment	Student graphs translations and reflections on the coordinate plane, but not always accurately.
2 Partial Accomplishment	Student has difficulty graphing translations and reflections on the coordinate plane.
1 Little Accomplishment	Student does not accurately graph translations and reflections on the coordinate plane.

Have each student write a paragraph telling how graphing a translation is different from graphing a reflection.
Have students draw and label a four quadrant grid. Then draw triangle ABC with A(-1,2); B(-3,4); C(-2,0). Translate it 3 units to the right and 1 unit down.
Have students draw and label a four quadrant grid. Then draw triangle DEF with D(-3,2); E(-2,4); F(-1,1). Reflect it across the y-axis.

Bibliography

Research Basis

Dickinson, D. (1996). *Learning Through Many Kinds of Intelligence*. Seattle: New Horizons for

Learning.
It is important to encourage children to explore and exercise all of their intelligences. Bodily/Kinesthetic Intelligence involves physical coordination and dexterity, expressing oneself or learning through physical activities. Logical/Mathematical Intelligence involves number and computing skills, recognizing patterns and order, and the ability to solve different kinds of problems through classifying and sequencing activities, and solving various kinds of puzzles.

Marzano, R. J., Pickering, D. J., & Pollock, J. E. (2001). *Classroom Instruction that Works: Research-Based Strategies for Increasing Student Achievement*. Alexandria: Association for Supervision and Curriculum Development.

It has been shown that explicitly engaging students in the creation of nonlinguistic representations stimulates and increases activity in the brain. When students elaborate on knowledge, they not only understand it in greater depth, but they can recall it much more easily.

Wahl, M. (1999). *Math for Humans: Teaching Math Through 8 Intelligences*. Seattle: New Horizons for Learning.

With new pressures on teachers and students to meet higher standards, this book offers tools that make concepts concrete and understandable. It has many practical and creative methods that take into consideration different learning styles and kinds of intelligences. Wahl has developed strategies that all teachers can use to help their students become successful in math.

Authors

Utah LessonPlans