Hands-On Strategies for Transformational Geometry

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CMC - South
October 25, 2014

Goals

- Build understanding of congruence and similarity through the use of translations, reflections, rotations, and dilations.

- Utilize hands-on tools and the mathematical practices to develop understanding and solve problems.

Timed-Round Robin

What do you know about Transformational Geometry?

What do you hope to learn?
What is different about CCSS Geometry?

- Challenges include attention to precision and language about transformations.
- Grade 8 students get hands on experience with rotations, reflections, translations, and dilations, observing their effects on two-dimensional figures on the coordinate plane. This prepares for work in high school on formulating precise definitions of these transformations.
- Congruence and Similarity is approached through transformations.

Gearing Up for the Common Core Standards in Mathematics, Standards

Grade 8 and High School Standards

<table>
<thead>
<tr>
<th>Standards</th>
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<tbody>
<tr>
<td>Grade 8 – 8.G.1</td>
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<tr>
<td>Understand congruence and similarity using physical models, transparencies, or geometry software.</td>
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<tr>
<td>1. Verify experimentally the properties of rotations, reflections, and translations:</td>
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<tr>
<td>a. Lines are taken to lines, and line segments to line segments of the same length.</td>
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<td>b. Angles are taken to angles of the same measure.</td>
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<td>c. Parallel lines are taken to parallel lines.</td>
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<td>High School – G.CO.2</td>
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<tr>
<td>Experiment with transformations in the plane</td>
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<tr>
<td>G.CO.2. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).</td>
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Transformations

- Use Patty Paper and Miras to explore the following Transformations:
  - Translations
  - Reflections
  - Rotations

- Be prepared to share your strategies and your observations.

Standards for Mathematical Practice

- What standards for mathematical practice did you use in this task?

- How would you need to structure it so that students engage in the standards for mathematical practice?

Mathematically proficient students:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning
**Standards - Congruence**

**Grade 8**
- Understand congruence and similarity using physical models, transparencies, or geometry software.
  - 8.G.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.
  - 8.G.3 - Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

**High School**
- Experiment with transformations in the plane.
  - G-CO.5 - Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
  - 8.G.2 - Understand congruence in terms of rigid motions. (Build on rigid motions as a familiar starting point for development of concept of geometric proof.)
  - 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 congruent figures, describe a sequence of rigid motions to decide if they are congruent.

**Dilations and Similarity**

**Grade 8**
- Understand congruence and similarity using physical models, transparencies, or geometry software.
  - 8.G.3 - Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.
  - 8.G.4 - Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

**High School – Math 2**
- Understand similarity in terms of similarity transformations.
  - G-SRT.1 - Verify experimentally the properties of dilations given by a center and a scale factor:
    - A dilation takes a line not passing through the center to a parallel line and leaves a line passing through the center unchanged.
    - The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
  - G-SRT.2 - Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

**Is it Dilated?**

- For each pair, explain why you think it is dilated or not.

http://www.corestandards.org/
Dilations Using Measurement

- Use blank paper and patty paper (or a protractor) to complete the following:
  - Person A: Problems 1 to 2.
  - Person B: Problems 3 to 4.
  - Person C: Problems 7 to 8.

Discuss:

Question 5

a. Does a dilation preserve lengths of sides and measures of angles?

b. Is a dilation an isometry? Use mathematics to justify your answer.

SBAC Item Specifications

Grade 8
Achievement Level Descriptors

Level 1: Students should be able to identify reflections, rotations, and translations and show the result of these rigid motions on figures.

Level 2: Students should be able to construct reflections and translations of figures in a coordinate plane and identify dilations and the results of dilations on figures.

Level 3: Students should be able to understand and describe the impact of a transformation on a figure and its component parts with or without coordinates. They should be able to use or describe a sequence of transformations to determine or exhibit the congruence of two figures. They should also be able to construct rotations and dilations of figures in a coordinate plane.

Level 4: Students should be able to describe a sequence that exhibits the similarity between two shapes and understand that the angle measures are unchanged.

Vocabulary

- Angle
- Transformation
- Translation
- Translate
- Rotation
- Rotate
- Reflection
- Reflect
- Dilation
- Dilate
- Line segment
- Similar
- Congruent
- Parallel
- Transversal
- Exterior angle
- Interior angle
- Angle-angle criterion
- Scale factor
- Adjacent angle
- Supplementary angles
- Complementary angles

Target-Specific Attributes

Rotations are only multiples of 90 degrees about the origin.
Reflections are only over the x- and y-axes.
Dilations are only with the origin as the center.
There are at most three transformations in a sequence of transformations.
Transformations are limited to the coordinate plane.
Sample Items

Try the Sample Items.

What are students expected to know and be able to do?

High School
Claim 3 – Communicating Reasoning

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Resources

- Common Core Connect
  - http://commoncore.tcoe.org
  - Search by Standard
  - Search by "Transformational Geometry"

E-mail
- Julie Joseph
  - jjoseph@ers.tcoe.org

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
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5 digit poll code for this session

Speaker was engaging and an effective presenter (0-3)
Other comments, suggestions, or feedback (words)

Speaker was well-prepared and knowledgeable (0-3)
Session matched title and description in program book (0-3)

Example: 45059 323 Great session!
Non-Example: 45059 3 2 3 Great session!
Non-Example: 45059-2-3 Great session!