# Unit 3: Transformations and Tessellations

## Geometry ACC

### Unit Goals – Stage 1

**Number of Days:** 14 days  
12/19/16-1/20/17  

**Unit Description:** Geometric transformations have stepped to the forefront in the Common Core authors' determination to make geometry accessible to every student. In this unit, students will employ transformational techniques (reflections, translations and rotations) to manipulate geometric figures while maintaining their size and shape. Similarity will be introduced as a product of dilation where the figure maintains the same shape, but now has a different size. Tessellations will be used to illustrate examples of real-world applications of transformations.

**Materials:** Straightedge, protractor, scissors, whiteboard, pen, eraser, glue stick, poster paper, Geometry software (ex.: Geogebra) (optional)

### Standards for Mathematical Practice

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

### Transfer Goals

**Students will be able to independently use their learning to…**

- Make sense of never-before-seen problems and persevere in solving them.
- Construct viable arguments and critique the reasoning of others.

### Making Meaning

**UNDERSTANDINGS**

**Students will understand that…**

- Symmetry is found everywhere around us.
- Reflections, rotations and translations are types of transformations.
- Transformations can be defined mathematically.
- A property is preserved under a transformation if the image of any figure having that property also has that property.
- Geometry is a dynamic study, even if it often appears to be static.

**ESSENTIAL QUESTIONS**

**Students will keep considering…**

- Where do we see symmetry around us?
- What are ways we can describe a sequence of transformations?
- Do all geometric figures tessellate?

### Acquisition

**KNOWLEDGE**

**Students will know…**

- The basic properties of transformations and symmetry.
- Properties of isometries (rigid transformations).
- Vocabulary: transformation (rigid and nonrigid); translation, translation vector, and composition; rotation; reflection, glide reflection and line of reflection; reflectional, rotational, point symmetry and line of symmetry; minimal path.
- The names of tiling methods and the method of numerically identifying them.
- Reflection and tessellation conjectures.
- Function notation used to describe transformations.
- Construction skills.

**SKILLS**

**Students will be skilled at and/or be able to…**

- Identify and create translations, rotations, and reflections of figures in the plane.
- Find a minimal path using reflection.
- Use vector notation.
- Discover isometries that result from the composition of other isometries.
- Apply concepts of reflectional, rotational, translational, and glide-reflectional symmetry.
- Classify and identify monohedral, regular, and semiregular tessellations.
- Explore tessellations with regular and nonregular polygons.
- Create Escher-type tessellations with translations, rotations, and reflections.
### Assessed Grade Level Standards

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<th>Standards for Mathematical Practice</th>
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<table>
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<th>Standards for Mathematical Content</th>
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<tbody>
<tr>
<td><strong>[s]</strong> G-CO.A</td>
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<td>G-CO.2</td>
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<td>G-CO.5</td>
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<tr>
<td><strong>[m]</strong> G-CO.B</td>
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<tr>
<td>G-CO.6</td>
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**[m]** = major clusters, **[s]** = supporting clusters, **[a]** = additional clusters
## Evidence of Learning – Stage 2

### Assessment Evidence

#### Unit Assessment

**Claim 1:** Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency. Concepts and skills that may be assessed in Claim 1:

- **G-CO.A** Experiment with transformations in the plane
  - Students will describe transformations in the plane as functions.
  - Students will draw a transformed figure when given a rotation, reflection, and/or translation.
  - Students will specify a series of transformations that carry a figure onto itself.

- **G-CO.B** Understand congruence in terms of rigid motions
  - Students will transform figures using geometric descriptions of rigid motions.
  - Students will predict the effect of a given rigid motion on a given figure.
  - Students will use the definition of congruence in terms of rigid motion to decide if two figures are congruent.

**Claim 2:** Students can solve a range of well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies. Standard clusters that may be assessed in Claim 2:

- **NONE**

**Claim 3:** The student can clearly and precisely construct viable arguments to support their own reasoning and critique the reasoning of others. Standard clusters that may be assessed in Claim 3:

- **G-CO.A**
- **G-CO.B**

**Claim 4:** The student can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems. Standard clusters that may be assessed in Claim 4:

- **NONE**

#### Other Evidence

**Formative Assessment Opportunities**

- Opening Tasks
- Informal teacher observations
- Checking for understanding using active participation strategies
- Exit slips/Summaries
- Modeling Lessons (SMP 4)
- Tasks
- Formative Assessment Lessons (FAL)
- Quizzes/Chapter Tests
- SBAC Interim Assessment Blocks

<table>
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<tr>
<th>Days</th>
<th>Learning Target</th>
<th>Expectations</th>
<th>Discovering Geometry (Activities and Lessons)</th>
<th>Curriculum Intranet</th>
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<tr>
<td>1 day</td>
<td>I will explore transforming an image by participating in the Opening Task.</td>
<td>The opening task, Explore Transformations, is a review of some of the techniques the students used in their discovery of many conjectures. It can, also, serve as a brief introduction to the ideas they will use as they learn to tessellate. In this opening task, the student will use a transformation technique, observe the changes made to the original image, and generalize about those changes. A possible follow-up activity to this task would be to have the students combine these transformations to create a work of art.</td>
<td></td>
<td>Conceptual Understanding: • Explore Transformations</td>
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</table>
| 3-4 days | I will transform figures in the plane by... | • Examining basic properties of transformations and symmetry.  
• Identifying and creating translations, rotations, and reflections of figures in the plane. (SMP 6)  
• Applying concepts of reflectional, rotational, and translational symmetry. (SMP 5)  
• Identifying symmetries of regular polygons.  
• Finding a minimal path using reflections. (SMP 5)  
• Identifying the result of reflecting a figure across two lines, parallel or intersecting.  
• Answering questions such as…  
  o What is the difference between rigid transformation and nonrigid transformation?  
  o What are the three types of rigid transformation and what would you use each of the three to achieve?  
  o If you are given two figures (the original and the image), but the line of reflection is missing, how can you locate that line of reflection?  
  o Describe how to solve for the minimal path from point A to line l to point B.  
  o Where would you use the Minimal Path conjecture in the real world?  
  o When do you use the word “transformation” versus the word “composition”?  
  o Is a composition of reflections always equivalent to a single reflection?  
  o Can you express a rotation as a set of reflections? | • Lesson 7-1  
• Lesson 7-2  
• Lesson 7-3 | Conceptual Understanding:  
• Illuminations: Flip-n-Slide: Exploring Transformations through Modeling and Computer Games Interactive Activity  
• MathVisionProject: Leaping Lizards Translate, Rotate, Reflect Task  
• MathVisionProject: Can You Get There From Here Task  
• MathVisionProject: Leap Year Transformation Task  
• MathVisionProject: Symmetries of Quadrilaterals Task  
• MathVisionProject: Symmetries of Regular Polygons Task  
Procedural Skills and Fluency:  
• Determine Coordinates for Transformation-Shooting Pool Interactive Tool  
• Illustrative Mathematics: Identifying Rotations Task |
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<td>2-3 days</td>
<td>I will check my understanding of transformations by participating in the FAL.</td>
<td><strong>FORMATIVE ASSESSMENT LESSON</strong></td>
<td>• Identifying monohedral, regular, and semiregular tessellations.</td>
<td>• MathVisionProject: Leap Frog Rotate Reflect Task</td>
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</tbody>
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| 4-6 days | (Optional) I will experiment with tessellations by… | • Identifying monohedral, regular, and semiregular tessellations.  
• Creating tessellations with regular and nonregular polygons.  
(SMP 5)  
• Creating Escher-type tessellations with and without rotations.  
(SMP 5)  
• How much does the area of the shape change as it is tesselated?  
• Answering questions such as…  
  o Do ALL polygons tessellate?  
  o Why do bees use regular hexagons to create the honey combs in their hives?  
  o What types of symmetry can a tessellation have?  
  o What do you need to take into consideration to tile a plane with different, nonregular shapes?  
  o Describe the process of creating tessellations?  
  o How much does the area of the shape change as it is rearranged? | • Lesson 7-4  
• Lesson 7-5  
• Lesson 7-6  
• Lesson 7-7 | • FAL: Representing and Combine Transformations |
| 2 days  | I will prepare for the unit assessment on transformations by… | • Incorporating the Standards for Mathematical Practice (SMPs) along with the content standards to review the unit. | • Transformation Review | • Symmetry and Tessellations Examples  
• Illuminations: Tessellation Creator Dynamic Tool  
• TedEd: The Complex Geometry of Islamic Design |
| 1-2 days |                                                                                 |                                                                                                 |                                                                                       | Unit Assessment (LBUSD Math Intranet, Assessment)                                      |