

# NAD Teacher Bulletin Unit Plan 2013

## Symmetry and Tessellations

Unit Author	
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Unit Overview	
Unit Plan Title:	Symmetry and Tessellations
Curriculum-Framing Questions	
Essential Question	How does the geometry of polygons relate to tessellations?
Unit Questions	<ul style="list-style-type: none"><li>• How does the geometry of polygons and relate to tessellations?</li><li>• What are the basic symmetries and how do they apply to tessellations?</li><li>• How are tessellations used in every day life?</li><li>• What geometric concepts are present in the designs of tessellations?</li><li>• Who was Escher, and how is his artwork related to tessellations?</li></ul>



<p>Content Questions</p>	<ol style="list-style-type: none"> <li>1. What are polygons?</li> <li>2. What shapes will tessellate?</li> <li>3. Why will certain shapes tessellate while others will not?</li> <li>4. What is symmetry?</li> <li>5. How many different tessellating patterns can we create using two or more regular polygons?</li> <li>6. Do tessellating designs have symmetry?</li> <li>7. What are transformations?</li> <li>8. How can we use transformations (slides/translations, flips/reflections, and turns/rotations) to create unique tessellations?</li> <li>9. Are all symmetries tessellations?</li> <li>10. Who is Escher and where can examples of his work be found?</li> <li>11. How can Escher-like art be created?</li> <li>12. What programs are available for tessellations online?</li> <li>13. Where are tessellations found in every day life?</li> <li>14. Where are tessellations found in the natural world?</li> </ol>
<p>Unit Summary:</p> <p>This unit begins with polygons, examines symmetry, experiments with tessellations, designs and bids a floor, and ends with the creation of Escher-like tessellation art. This is math for the creative artist. It is so much fun a person forgets that it IS math.</p>	



**Subject Area(s): Click box(es) of the subject(s) that your Unit targets**

<input type="checkbox"/> Business Education	<input type="checkbox"/> Drama	<input checked="" type="checkbox"/> Religion
<input type="checkbox"/> Engineering	<input type="checkbox"/> Foreign Language	<input type="checkbox"/> Technology
<input type="checkbox"/> Home Economics	<input type="checkbox"/> Industrial Technology	<input checked="" type="checkbox"/> Other: Art
<input type="checkbox"/> Language Arts	<input checked="" type="checkbox"/> Math	This unit also covers the use of tessellations in home furnishings and construction.
<input type="checkbox"/> Music	<input type="checkbox"/> Physical Education	
<input type="checkbox"/> Social Studies	<input checked="" type="checkbox"/> Science	

**Grade Level: Click box(es) of the grade level(s) that your Unit targets**

<input type="checkbox"/> K-2	<input type="checkbox"/> 3-5
<input type="checkbox"/> 6-8	<input type="checkbox"/> 9-12
<input checked="" type="checkbox"/> ESL	<input type="checkbox"/> Resource
<input checked="" type="checkbox"/> Gifted and Talented	<input checked="" type="checkbox"/> Other: K-12 All grades can use some or all of this unit.

**Targeted NAD Learning Strands:**

*Curriculum Guide: Mathematics, NAD 2003, Geometry Standard:*

"Instructional programs from prekindergarten through grade 12 should enable all students to:

- analyze characteristics and properties of two- and three- dimensional geometric shapes and develop mathematical arguments about geometric relationships;
- specify locations and describe spatial relationship using coordinate geometry and other representational systems;
- apply transformations and use symmetry to analyze mathematical situations;
- use visualization, spatial reasoning, and geometric modeling to solve problems."

*(Principles and Standards for School Mathematics, NCTM, 2000, p. 41)*

*Curriculum Guide: Fine Arts, NAD 2002*

National Standard 2: Elements of Design

National Standard 6: Art Connections With Other Disciplines

**Targeted State Frameworks/Content Standards/Benchmarks:**

*Curriculum Guide: Mathematics, NAD 2003, Geometry Standard*

Apply transformations and use symmetry to analyze mathematical situations.

- +Understand and represent translations, reflections, rotations, and dilations of objects in the plane by using sketches, coordinates, vectors, function notation, and matrices;



+Use various representations to help understand the effects of simple transformations and their compositions.

*Curriculum Guide: Fine Arts, NAD 2002*

**NS 2: (3) Shape**

- a. Explore shape in art
- b. Identify shape as an area enclosed by a line.
- c. Name and identify geometric shapes (triangle, square, rectangle, circle, oval).
- d. Arrange shapes to create a composition.
- e. Recognize shape as two-dimensional.
- f. Identify and use shape as being one element of design.

**NS 6: (1) Recognizes connections between art and other disciplines**

**(2) Create art that illustrates a concept from another discipline.**

## Procedures:

### Introducing the Unit

This is a very visual unit. A bulletin board of the works of Escher will pique interest in the lessons.

### Introducing Core Content

Each lesson should begin with visuals, both PowerPoints and handouts. Core content is taught through hands-on work by the students.

### Unit Schedule

This unit should not be forced into abbreviated lessons. Lower grade and special needs students can understand and apply a surprising amount of this material. However, do not force these students to the point of frustration. But do allow all students of any grade level to do the art projects.

Explorations should take as long as needed for students to understand and apply the concept. A student who is careful and meticulous should not be rushed.

Day 1 Identifying polygons

Day 2 The Symmetries

Day 3 The Symmetries continued

Day 4 Learning about Tessellations

Day 5 Who was M.C. Escher

Day 5 - 6 Your Flooring Company Makes A Bid

Day 7 - 8 Creating Your Own Tessellations

### Technology - Software: (Click boxes of all software needed.)

- |   |  |   |
|---|--|---|
| <input type="checkbox"/> Database/Spreadsheet   | <input type="checkbox"/> Image Processing                | <input type="checkbox"/> Web Page Development   |
| <input type="checkbox"/> Desktop Publishing     | <input checked="" type="checkbox"/> Internet Web Browser | <input checked="" type="checkbox"/> Word Processing   |
| <input type="checkbox"/> E-mail Software        | <input checked="" type="checkbox"/> Multimedia           | <input checked="" type="checkbox"/> Other: Ability to show movie clips and powerpoints. This can be done on a large screen computer or personal computer if a projector is not available. |
| <input type="checkbox"/> Encyclopedia on CD-ROM |  |   |

<p><b>Printed Materials:</b></p>	<p>Elements of the unit will need to be printed for use by students. It would also be nice to have a book of M.C. Escher's art, and some posters.</p> <p><u>Introduction to TESSELLATIONS</u>, by Dale Seymour and Jill Britton, Dale Seymour Publications, USA, 1989.</p> <p><u>M.C.Escher: The Graphic Work</u>, published by Barnes &amp; Noble, Inc.,USA, by arrangement with TASCHEN GmbH, 2007</p> <p><u>Symmetry and Tessellations Investigating Patterns</u>, Jill Britton, Dale Seymour Publications, USA, 2000</p>
<p><b>Supplies:</b></p>	<p>Your choice of colored pencils, crayons, markers or paints, construction paper, large block graph paper, scissors, large sheets of paper, pencils &amp; pens, protractor, compass, stick glue, pattern blocks (or paper pattern blocks).</p>

**Internet  
Resources:**

**Dynamic Paper**

<http://illuminations.nctm.org/ActivityDetail.aspx?ID=205>

Need a pentagonal pyramid that's six inches tall? Or a number line that goes from -18 to 32 by 5's? Or a set of pattern blocks where all shapes have one-inch sides? You can create all those things and more with the Dynamic Paper tool. Place the images you want, then export it as a PDF activity sheet for your students or as a JPEG image for use in other applications or on the web.

**Mirror Tool**

<http://illuminations.nctm.org/ActivityDetail.aspx?ID=24>

This tool is used to experiment with symmetry.

**Tessellations Creator**

<http://illuminations.nctm.org/ActivityDetail.aspx?ID=202>

This program will let you create and print out tessellations.

**M. C. Escher: The Official Website**

<http://www.mcescher.com/>

On this website you can find information about the use of M.C. Escher's work, a short biography, news, bibliography, links and some fun stuff like a Virtual Ride through some of his works.

**ORACLEThinkQuest**

<http://library.thinkquest.org/16661/>

This site has very clear and easy information about tessellations and M.C. Escher's art.

**MathSalamanders**

<http://www.math-salamanders.com/printable-geometry-worksheets.html>

<http://www.math-salamanders.com/shapes-clip-art.html>

Easy to use site with free downloadable and printable math sheets that are very simply made and often one concept. Great resource place.

**Illuminations**

<http://illuminations.nctm.org/>

This tool adds color and allows lots of intricate to scale tessellations to be made.

**Thinkfinity**

<http://www.thinkfinity.org/>

This is the VerizonFoundation's prestigious [Verizon Thinkfinity](#) website with just tons of amazing high quality lesson plans, games, summer activities, homework, and after school activities. Well worth checking out.

<b>Others:</b>	There are both illustrative and instructional PowerPoints and movie clips with this unit.
<b>Accommodations for Differentiated Instruction</b>	
Resource Student:	A good many resource students are great artists. They will respond to the concrete math and art principles shown in this unit.
Non-Native English Speaker:	Most of this unit can be hands-on demonstrated so that little translation is needed.
Gifted Student:	There is wide scope for the gifted math or art student to create stunning works of art.
<b>Student Assessment:</b>	This unit is meant to be exploratory and fun. Emphasis should be put on participation, experimentation and creation. <b>A portfolio of creations should be kept.</b>