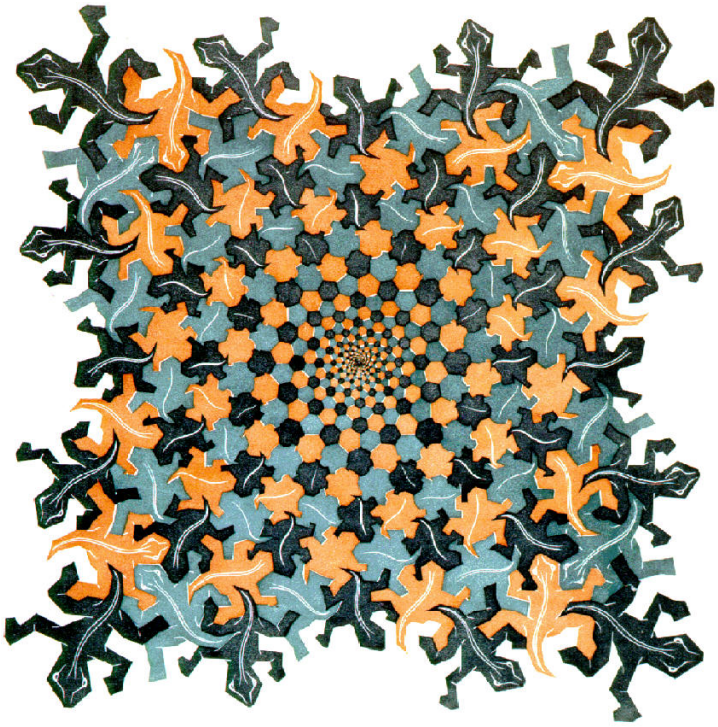
PROJECT DESCRIPTION

The Art of Dilation



Duration: 3 weeks
Grade 10 Math — Dr. Drew

I pray for the kids in the suburbs... I pray that one day, we'll all graduate from similarity.
— J. Merridew, *Fireworks Over Suburbia*

I decided that if I could paint that flower in a huge scale, you could not ignore its beauty.
— Georgia O'Keeffe, Artist (1887-1986)

OVERVIEW

In this project, *similarity* and the geometric transformation *dilation* (also known as *scaling*, and colloquially referred to as "zooming in" or "zooming out") are studied through modeling, exploration, and reasoning. Students will explore important ideas in geometry, and apply skills with functions and algebra. The primary context for this exploration is mathematical modeling and how geometry (specifically similarity and dilation) can be used to create scaled versions of pieces of art. Topics covered include:

Similarity and Congruence

- Further developing intuitive ideas about the meaning of "same shape" and reinforce last year's learning of the formal definitions of *similar* and *congruent*

- Discovering the special properties of triangles in connection with similarity, as well as other features of triangles as special polygons

Proportional Reasoning and the Algebra of Proportions

- Understanding the meaning of proportionality in connection with similarity
- Developing equations of proportionality from situations involving similar figures
- Understanding the role of proportionality in non-geometric situations
- Developing techniques for solving equations involving fractional expressions

Polygons and Angles

- Developing angle sum formulas for triangles and other polygons
- Discovering the properties of angles formed by a transversal across parallel lines
- Discovering the triangle inequality and investigating its extension to polygons

Logical Reasoning and Proof

- Working with the concept of *counterexample* in understanding the criteria for similarity

Experiments and Data Analysis

- Planning and carrying out controlled experiments
- Collecting and analyzing data
- Identifying key features in graphs of data

Mathematical Modeling

- Using a geometric diagram to represent a real-world situation
- Using scale drawings to solve problems
- Applying properties of similar triangles to real-world situations
- Exploring how models provide insight in a variety of situations

This exploration also forms the basis for a study of trigonometry in the second semester.

ENDURING UNDERSTANDING

Students will develop an intuitive understanding similarity and its relationship to the dilation transformation.
Students will develop a deep association between congruence/similarity and the real-world application of creating mathematical models.

ESSENTIAL QUESTIONS

- *How do we use mathematics to construct scale models?*
- *How do we make convincing arguments?*

STUDENT OBJECTIVES

Common Core State Standards for Mathematical Practice:

- #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.

Common Core State Standards

Geometry: Similarity, Right Triangles

Understand similarity in terms of similarity transformations

- Verify experimentally the properties of dilations given by a center and a scale factor (G-SRT-1)
- 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. (G-SRT-2)
- Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. (G-SRT-3)

Prove theorems involving similarity

- Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.* (G-SRT-4)
- Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. (G-SRT-5)

Geometry: Circles

Understand and apply theorems about circles

- Prove that all circles are similar (G-C-1)

EXECUTION

This first part of this project is exploratory-based and very loosely based on the IMP units "Shadows" and "Geometry by Design". Details of the actual activities can be found on my DP.

The second part of the project is exhibition-focused and requires students to document the creation of an art piece as a dilation transformation and exhibit that documentation as part of their "Cultural Connections" project. The art pieces being created vary by team:

- Classes A and B: In chemistry, students will be creating scale models of… The Benchmarks are:
    - …
- Classes C and D: In art, students are…The public art being created includes exhibiting the actual dilation from the original scale drawing; including project lines, center of dilation, the pre-image (the scale drawing) and the image (the final mural). The Benchmarks are:
    - Benchmark #1: Exhibition Proposal: A draft of an exhibition proposal, as a detailed dilation transformation (measurements included).
    - Benchmark #2: The dilation transformation, with special focus on the student's portion of the mural. Benchmark #2 must be exhibition-quality.
    - Benchmark #3: Exhibition!
    - Benchmark #4: Digital Portfolio Update

Details of these benchmarks will be posted on Edmodo and on my DP.
Benchmark due dates will be posted on Edmodo.