

Exploring Geometry and Art Through Tessellations

**TED
Design
Competition
Winner**

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This lesson won the 2023 AECT Teacher Education Division PK-12 Lesson Design Competition. It was not peer-reviewed.

OVERVIEW

In this lesson, elementary school students explore geometric shapes and tessellations using a Cricut Maker 3. During Part 1 of the activity, students review geometric concepts of regular versus irregular polygons and lines of symmetry. This includes using shapes cut by the Cricut machine to determine which regular polygons form a tessellation when put together. Then students answer reflection questions. During Part 2, there is a discussion about how the artist MC Escher used different types of symmetry (e.g., translations, rotations, and reflections) to modify irregular shapes to create tessellations. In Part 3, students are given materials to prototype their own tessellation using regular and irregular shapes and at least one type of symmetry transformation.

Topics: Art, Geometry, Tessellations

Time: Total is up to 3.5 hours: Part 1 (1 hour), Part 2 (.5 hour), and Part 3 (1-2 hours)

MATERIALS

- Part 1 reflection questions (described below)
- Cricut Maker 3 machine for student use
- Computer with Cricut Design Space application installed for students
- Cricut cutting mat (standard grip recommended)
- Cardstock paper (preferably five colors or more)
- Construction or printer paper
- Scissors
- [Irregular shape tessellation webpage](#) (Math & the Art of MC Escher, 2013)
- [MC Escher tessellations examples webpage](#) (Math & the Art of MC Escher, 2014)
- [Shapes Tessellations Movie](#) (JTILT, 2023)

CONTEXT-AT-A-GLANCE

This lesson was developed conceptually for a PK-12 lesson design competition.

Competition Parameters

The Teacher Education Division of the Association for Educational Communications and Technology provided live explorations of two Cricut Maker 3 machines during their annual convention in October 2023. Attendees were given three days to design original, hands-on, curricular materials based on the tool. Their instructions were to amplify or transform student learning in a PK-12 (or equivalent) setting and describe their idea in approximately 750 words.

Setting

A public elementary school in the United States.

Modality

Face-to-face instruction

Class Structure

Designed for a 4th grade mathematics classroom.

Technology Rationale

Using Cricut to cut shapes in Part 1 is helpful for teachers who do not have plastic shapes for math activities. This is more of a replacement than an amplification but is less expensive and easier to store. In Part 3, the Cricut Maker 3 allows students to create more precise tessellation designs. Cricut Design Space makes it simple to undo work and test designs while conserving paper. It also ensures that the design is cut the same way each time. With paper, it's hard to create precise replications of the tessellation to make sure that all pieces fit together without gaps. In sum, the Cricut Maker 3 increases precision and saves resources.

LEARNING OBJECTIVE:

Students will create tessellations using geometric concepts and examples of artwork by MC Escher.

LEARNING REPRESENTATION

Specific notes for the teacher are in italics.

PART 1: GEOMETRY REVIEW (1 HOUR)

Start the lesson by discussing key definitions and showing simple examples such as the tessellation (a pattern of shapes that fit together without any gaps), and regular vs. irregular polygons (including their angle measures and lines of symmetry).

Give small groups of 2-3 students a set of at least four Cricut cut-outs of these four regular shapes:

1. Triangles,
2. Squares,
3. Pentagons, and
4. Hexagons.

Watch the [Shapes Tessellation Movie](#) (JTILT, 2023) for examples of simple shapes and how they tessellate. As students explore the set of Cricut shapes, they should answer these reflection questions:

- Which of these regular shapes form a tessellation when you put them together?
- Which do not? Why?
 - *For the teacher: Pentagons do not tessellate.*
- What real-world examples can you think of for at least two of these regular shapes?
- *Ungraded (for students who finish early):* What other shapes would form a tessellation? Think of an example of where irregular polygons could fit together. Draw it out! Don't worry about getting it perfect. We just want you to start generating ideas for the next section of this lesson.

Part 2: Tessellation Discussion (0.5 hours)

Pull up a presentation showing how shapes that are not regular can tessellate (see Math & the Art of MC

Escher, 2013). Explain why all quadrilaterals tessellate because of how their angles add to 360 degrees when put together.

Review the student responses from the reflection questions. See if students thought of or drew any examples in Part 1. Transition to talking about MC Escher's mathematical work in creating art. Show examples of his work and analyze if they meet the definition of a tessellation.

Explain how Escher used three types of symmetry: translation, reflection, and rotation to create his tessellations (see Math & the Art of MC Escher, 2014, for examples and animated GIFs).

PART 3: CREATE A TESSELLATION (1-2 HOURS)

The purpose of Part 3 is for students to apply what they learned in Parts 1 and 2. Part 3 begins with students learning the Cricut Design Space. Demonstrate how to alter simple shapes and apply a translation, reflection, and rotation transformation using the Combine tool in Cricut Design Space.

Students are then tasked with creating an irregular shape that includes at least one of the three types of symmetry (e.g., translation, reflections, rotation) in their own design (see JTILT, 2023).

Give students paper and scissors to draw and test their tessellation ideas before printing their idea with the Cricut. Then students will take turns using the Cricut Design Space program to design and print their tessellation. The time for Part 3 will depend on the complexity of the designed shapes and the number of students in the class.

REFERENCES

JTILT. (2023, December 18). Shapes tessellation movie [Video]. *YouTube*.
<https://youtu.be/ZRvWtBk0PcY>

Math & the Art of MC Escher. (2013, August 20). *Tessellations by squares, rectangles and other polygons*. Retrieved December 4, 2023, from https://mathstat.slu.edu/escher/index.php/Tessellations_by_Squares_Rectangles_and_other_Polygons

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Tessellations by recognizable figures. Retrieved
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ABOUT THE AUTHOR

Alyssa Erickson received her master's in Instructional Psychology & Technology at Brigham Young University (BYU) in 2018. As a student, she worked as an instructional design assistant and taught undergraduate courses about using technology in the classroom. After graduating, Alyssa was a full-time instructional designer from 2018-2023, enjoying a variety of projects including workplace safety courses, sales enablement, customer product training, and secondary education courses. She now works as a production process manager at BYU, supporting the delivery of online courses to customers on time and within budget. Alyssa enjoys learning new things, like the accordion and different styles of international dance.

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