Geometry In My World
#3 - Tessellating Shapes

Overview
Students use Pattern Blocks to discover which polygons tessellate. They create their own tessellating design. Students review polygons and their attributes.

Principles and Standards for School Mathematics, National Council of Teachers of Mathematics, 2000.

Standard: Geometry *In Grades 3 through 5, all students should -*

Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships:

- identify, compare, and analyze attributes of two-dimensional geometric shapes and develop vocabulary to describe the attributes;
- investigate, describe, and reason about the results of subdividing, combining and transforming shapes;
- explore congruence and similarity;
- make and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions.

Apply transformations and use symmetry to analyze mathematical situations:

- predict and describe the results of sliding, flipping and turning two-dimensional shapes;
- describe a motion or a series of motions that will show that two shapes are congruent.

Standard: Reasoning and Proof *In Grades 3 through 5, all students should -*

- make and investigate mathematical conjectures.

Standard: Communication *In Grades 3 through 5, all students should -*

- use the language of mathematics to express mathematical ideas precisely.

California Academic Standards:
These are the California Academic Standards addressed in this program. Be sure to check your local or state standards to see how this fits your curriculum.

Grade 3: Measurement and Geometry

2.0 Students describe and compare the attributes of plane and solid geometric figures and use their understanding to show relationships and solve problems.

2.1 Identify, describe and classify polygons (including pentagons and hexagons).

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Grade 3: Mathematical Reasoning

1.0 Students make decisions about how to approach problems.

1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.

Grade 4: Mathematical Reasoning

3.0 Students move beyond a particular problem by generalizing to other situations.

3.3 Develop generalizations of the results obtained and apply them in other circumstances.

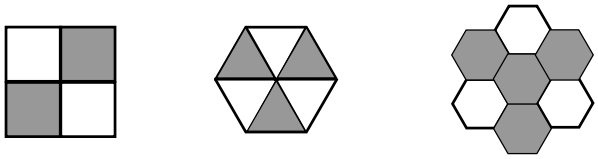
Teacher - to - Teacher

Teaching Tessellations

Exploring polygons that tessellate offer many opportunities to incorporate a variety of geometric concepts within a unit. Students review and identify two dimensional shapes, explore relationships among the shapes, measure angles, and apply transformations (slides, flips and turns). Similar figures, symmetry, and congruency can also be incorporated in a unit on tessellations.

The word **tessellation** comes from the Latin *tessella*, which was a small, square stone or tile used in ancient Roman mosaics. Tilings and mosaics are common synonyms for tessellations. A plane tessellation is a pattern made up of one or more shapes, completely covering a surface without any gaps or overlaps. All tessellations can be extended in the plane infinitely in every direction.

For shapes to tessellate, their angles, when arranged around a point, must have measures that add to exactly 360^0. When a tessellation uses only one shape, as in a honeycomb, it's called a **monohedral tiling.** All quadrilaterals will tessellate and, since a triangle is one half of a quadrilateral, all triangles will also tessellate. The only regular (all sides and angles equal) polygons that create monohedral tessellations are equilateral triangles, squares, and regular hexagons. These tessellations are called **regular tessellations.**



This is teacher background information. Students should be led to discover this concept through hands-on activities, teacher questioning, and student discussion.

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Pre-viewing Activity

Advanced Preparation

Duplicate TIS#3.1 onto tagboard, cut out shapes and put one set of shapes into each envelope. (one per group)

Materials

Pattern Blocks - one bucket per group

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SAS#3.1 - one per student
TIS#3.1 - one per group, on tagboard
TIS#3.2 - Journal Prompt

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White construction paper (8" x 8")
Crayons, colored pencils or markers
Index cards (5" x 7") - one per student
White construction paper (8"x8") - one per student
Newsprint or scratch paper - one per student
Envelopes - one per group
Student Journals

Program Viewing

Welcome	Introductions
Focus	Students explore polygons to discover which shapes tessellate. They then create a tessellation.
Activity #1	**Which Pattern Block Tessellates?**
DLI	Reviews polygons and their attributes, discusses tessellations, then introduces activity
	YOUR TIME
CT	Facilitates activity
S	Select a Pattern Blocks shape and check to see if that shape tessellates
Activity #2	**Which Polygons Tessellate?** (SAS#3.1 & TIS#3.1)
DLI	Discusses tessellations and introduces activity
	YOUR TIME
CT	Facilitates activity
S	Explore tessellating patterns and record results on SAS#3.1
Activity #3	**Creating a Tessellation**
DLI	Introduces activity
	YOUR TIME
CT	Facilitates activity
S	Sketch, plan and create a design on scratch paper
Journal Writing	Explain a tessellation to a friend. (TIS#3.2)

KEY	*DLI: Distance Learning Instructor*	*CT: Classroom Teacher*	*S: Students*

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Instructions for Program Viewing

Activity #1 **Which Pattern Blocks Tessellate?**

Description

There are two YOUR TIME segments for this activity. Students select a Pattern Block Shape and arrange it on a 5″ x 7″ card to discover which shapes tessellate. Students review names of the shapes and their attributes.

Materials

Pattern Blocks - one bucket per group
Index cards (5″ x 7″) - one per student

Lesson Implementation

The Distance Learning Instructor introduces the activity. The Classroom Teacher facilitates. Suggest that students select different blocks so that groups collect more information during ***YOUR TIME***. As students discover whether their shapes tessellate, encourage them to share their findings.

YOUR TIME

Students work in pairs, with groups of 6 to 8, sharing a bucket of Pattern Blocks. They select a shape different than the other pairs and see if their block will cover the surface of the 5″ x 7″ card without leaving gaps and without overlapping.

Activity #2 **Which Polygons Tessellate?** (SAS#3.1 & TIS#3.1)

Description

Students use polygon shapes to discover if all polygons tessellate. They trace the shapes, TIS#3.2, on newsprint to discover which shapes tessellate and record the polygon name on SAS#3.1.

Materials

SAS#3.1 - one per student
TIS#3.1 (from Pre-viewing Activity)

Lesson Implementation

The Distance Learning Instructor introduces the activity. The Classroom Teacher reviews attributes and names of polygons. After distributing envelopes to groups, the Classroom Teacher facilitates the lesson.

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YOUR TIME

Students work in groups. Each group member selects a shape, identifies the polygon, then traces it on newsprint to see if it tessellates. If students can prove to the group that their shape tessellates, they record a "yes" on that shape on SAS#3.1 and move on to explore another shape. Students write the polygon name under each shape.

Activity #3 Creating a Tessellation

Description

Students create a tessellating design using one polygon. They use color and transformations to make the design interesting.

Materials

Pattern Blocks or shapes from TIS#3.1
White construction paper (8" x 8") - one per student
Crayons, colored pencils, or markers
Newsprint or scratch paper - one per student

Lesson Implementation

The Distance Learning Instructor introduces the activity. The Classroom Teacher facilitates by asking students to describe or demonstrate how the shape tessellates.

YOUR TIME

Students select a polygon that tessellates (either a Pattern Blocks shape or a polygon from Activity #2) to create their tessellating design. They can apply transformations (flips, slides, rotations) to make their design interesting. This is an ongoing activity. Students may need to explore several ideas before finding the tessellating design pattern they want to make and color on the white construction paper.

Post-viewing Activities

Complete Tessellations

- Have students complete their tessellation designs
- Trim and mount on colored construction paper
- Have students tell about how they created their design

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Optional Post-viewing Activities

Regular Polygons

- *Pattern Blocks Activities B,* pages 61-66, (Creative Publication kit)
- *Geometry and Fractions with Pattern Blocks* (ETA kit)

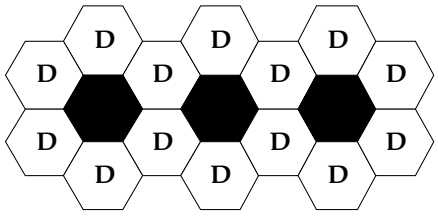
Geoboard Activities

- Use activities related to angles, triangles and quadrilaterals, see *Geoboard Collection, grades 4-6* (ETA kit)

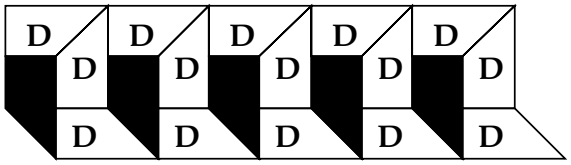
Create a Tessellating Tessellation

- Cut each of the completed student designs into a shape that will tessellate. Arrange the designs into a large class design. You may want to also include some of your basic shapes in solid colors.

Example 1: Hexagon



Example 2: Quadrilateral



D = Student Design

S = Solid Color

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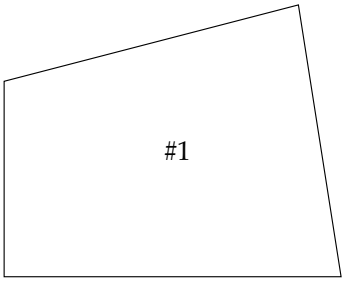
SAS#3.1 — Which Polygons Tessellate?

Name:_____ **Date:**_____

Instructions

Identify and write the name of each polygon on the line below each shape. If the shape tessellates, write “YES” on the shape.



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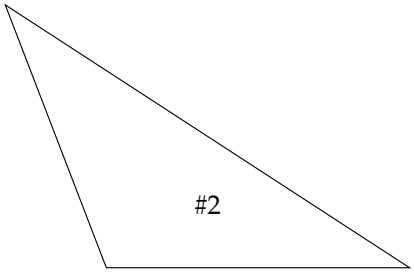

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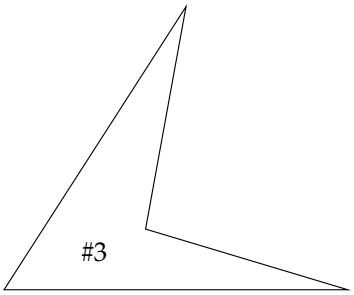

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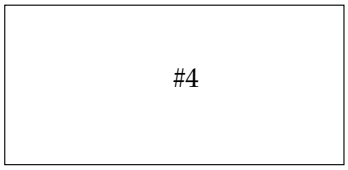

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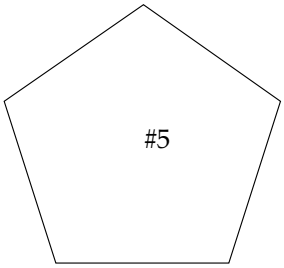

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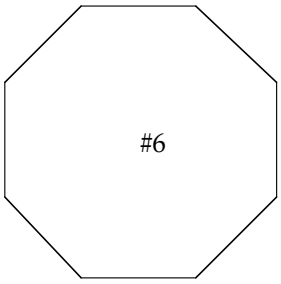

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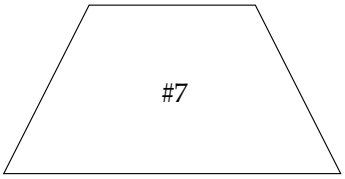

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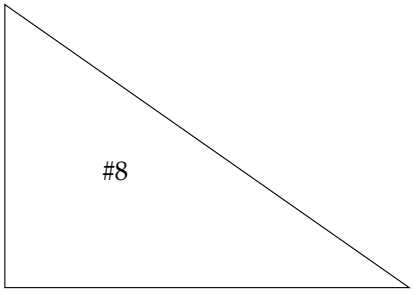

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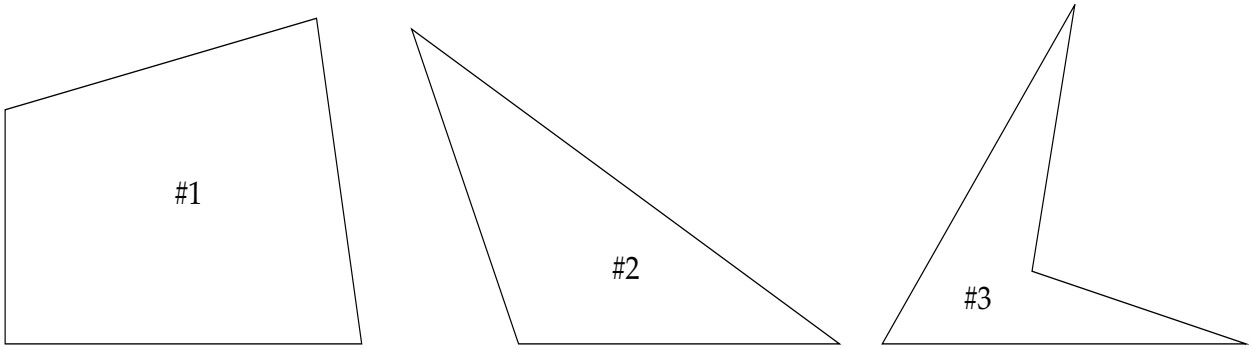
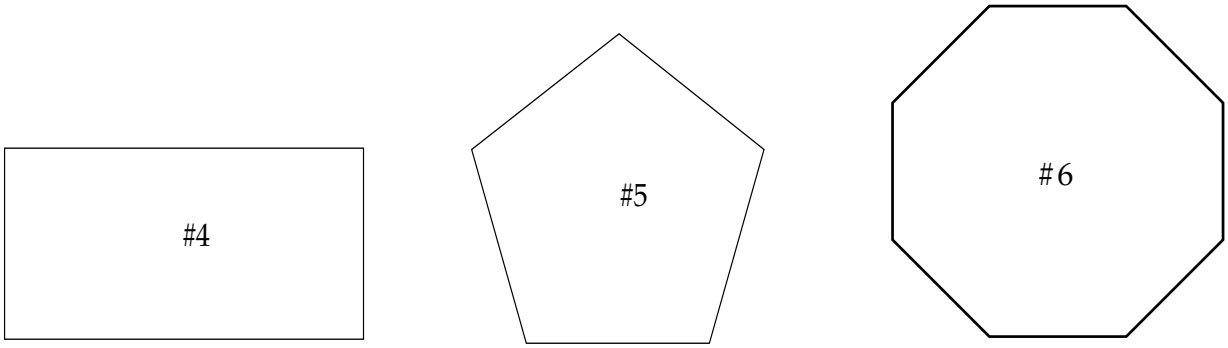
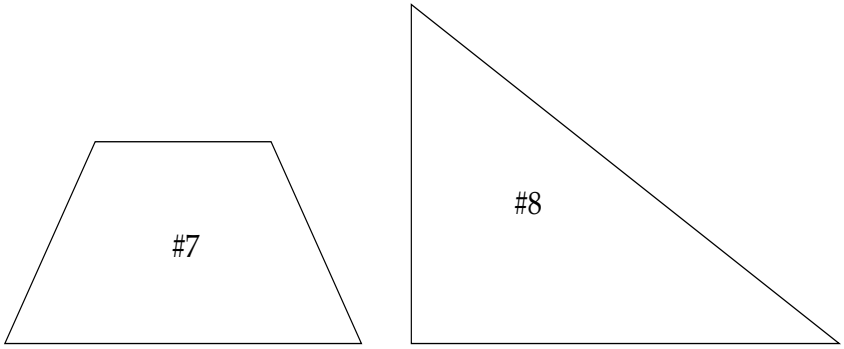
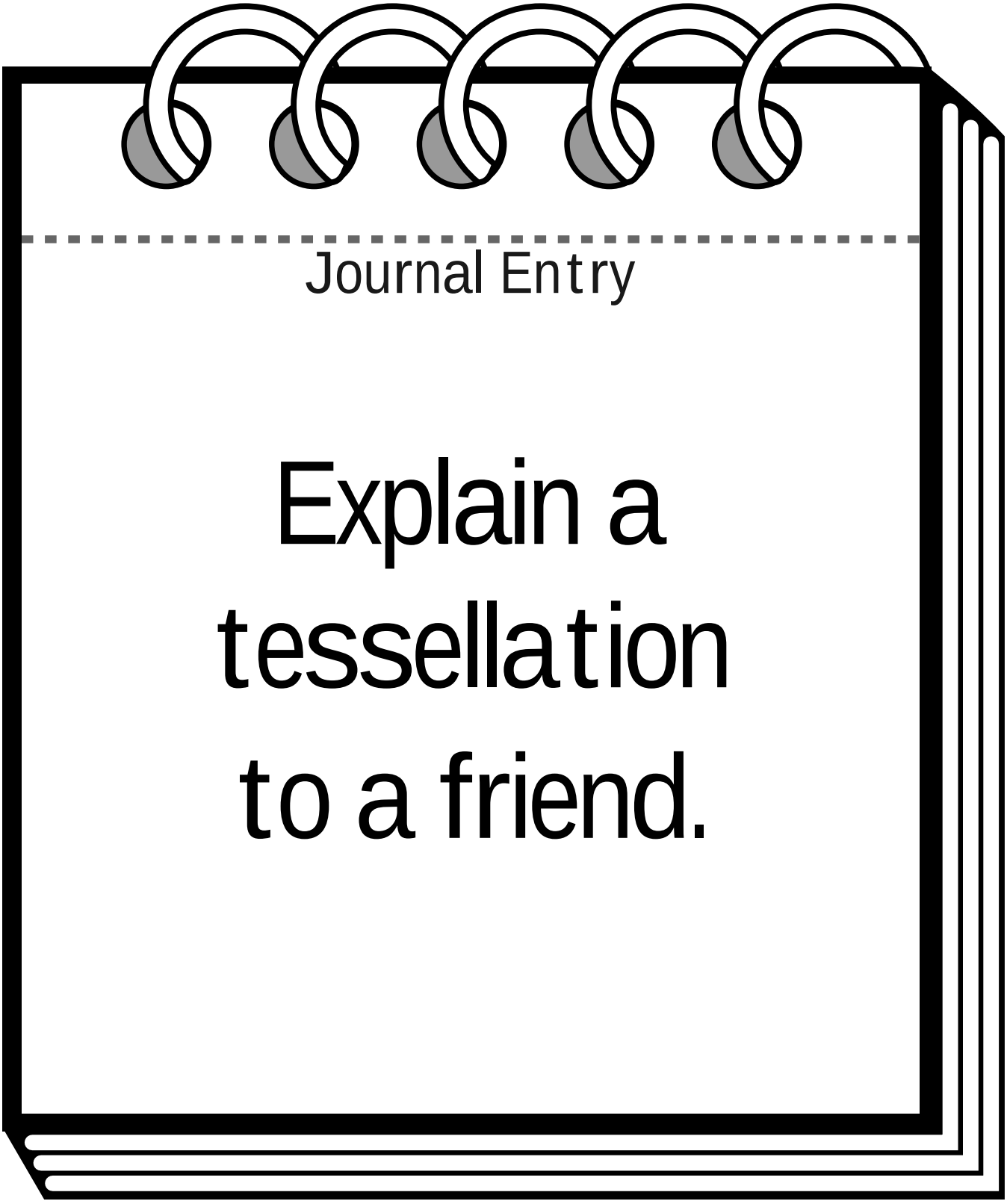
TIS#3.1 — Polygons









Journal Entry

Explain a tessellation to a friend.