

## **Title: All Wrapped Up in Tessellations**

### **Brief Overview:**

This learning unit involves four activities and a performance task. The students will learn how to use flips, slides, and turns to create a tessellation. At the end of the unit, the students will use what they know about tessellations to design wrapping paper that will be sold at their school.

### **Links to NCTM 2000 Standards:**

- **Standard 2: Patterns, Functions, and Algebra**  
Mathematics instructional programs should include attention to patterns, symbols, and models so that all students understand various types of patterns; and use symbolic forms to represent and analyze mathematical situations and structures. Students will use repeated patterns to construct tessellations and continue repeated patterns using slides, flips, and turns.
- **Standard 3: Geometry and Spatial Sense**  
Mathematics instructional programs should include attention to geometry and spatial sense so that all students analyze characteristics and properties of two-dimensional geometric objects; select and use different representational systems; recognize the usefulness of transformations and symmetry in analyzing mathematical situations; and use visualization and spatial reasoning to solve problems both within and outside of mathematics. Students will demonstrate their ability to describe and apply geometric relationships using two-dimensional objects, and they will use patterns and symmetry to identify and create tessellations.
- **Standard 6: Problem Solving**  
Mathematics instructional programs should focus on solving problems as part of understanding mathematics so that all students build new mathematical knowledge through their work with problems; develop a disposition to formulate, represent, abstract, and generalize in situations within and outside mathematics; apply a wide variety of strategies to solve problems and adapt the strategies to new situations; and monitor and reflect on their mathematical thinking in solving problems. Students will demonstrate their ability to solve problems in mathematics by making predictions about shapes that will tessellate, finding patterns in objects that will flip, slide, or turn, and applying skills to real world problems.
- **Standard 7: Reasoning and Proof**  
Mathematics instructional programs should focus on learning to reason and construct proofs as part of understanding mathematics so that all students recognize reasoning as essential and powerful parts of mathematics; make and investigate mathematical conjectures; and select and use various types of reasoning. Students will demonstrate their ability to reason mathematically, and they will make predictions, charts, and tessellations to test their thinking.
- **Standard 8: Communication**  
Mathematics instructional programs should use communication to foster an understanding of mathematics so that all students organize and consolidate their mathematical thinking to communicate with others; express mathematical ideas coherently and clearly to peers, teachers, and others; extend their mathematical knowledge by considering the thinking and strategies of others; and use the language of mathematics as a precise means of mathematical expression.

Students will demonstrate their ability to communicate mathematically, and they will read, write, and discuss mathematics using signs, symbols, and tessellation vocabulary.

• **Standard 10: Representation**

Mathematics instructional programs should emphasize mathematical representations to foster an understanding of mathematics so that all students create and use representations to organize, record, and communicate mathematical ideas; develop a repertoire of mathematical representations that can be used purposefully, flexibly, and appropriately; and use representations to model and interpret physical, social, and mathematical phenomena. Students will create tessellations that will serve as representations to organize, record, and communicate mathematical ideas and will develop a repertoire of mathematical representations that can be used purposefully, flexibly, and appropriately.

**Grade/Level:**

Third through fourth grades

**Duration/Length:**

Six days

**Prerequisite Knowledge:**

Students should have working knowledge of the following skills:

- Symmetry
- Geometrical shapes: hexagon, parallelogram, triangle, square, trapezoid

**Student Outcomes:**

Students will:

- identify and construct tessellations.
- use the moves: flips, slides (translations), and turns (rotations) to create a tessellation.
- write to inform.
- use knowledge of patterns to identify, create, and continue patterns.

**Materials/Resources/Printed Materials:**

- Concept Attainment cards (Teacher Resources #1 - 6)
- Crackers of various shapes (circles, square, triangle, gold fish shaped, “s” shaped, animal shaped) - optional
- Pattern blocks (Teacher Resource #7)
- Teacher Resource Sheets #1 - 10
- Student Resource Sheets #1 - 5
- Blank paper for students
- Tape
- Wallpaper, wrapping paper, colored construction paper, etc. (Optional)

## Development/Procedures:

### DAY 1

#### 1. **Concept Attainment: Characteristics of a tessellation**

Put a column for YES and a column for NO on the board. Put Teacher Resources #1-6 under the appropriate column (YES or NO) one at a time. Allow students time to compare the two columns to figure out the characteristics of a tessellation. Use the definition below to guide you.

YES: Teacher Resource Sheets 4, 5, 6

NO: Teacher Resource Sheets 1, 2, 3

**Tessellation: a tiling, made up of a repeated use of a shape. The repeated uses of shapes completely fills a plane without any gaps or overlaps.**

After completing concept attainment, discuss the characteristics of a tessellation.

2. Show students shapes that can and can not tessellate (Teacher Resources #7 and #8). Have students predict which shapes will tessellate. (Pre-cut shapes and back with construction paper or tag board.)

3. Pass out Does It Tessellate?? (Student Resource #1). Have students make predictions about which shapes will tessellate. Have students test predictions using square, round, and triangle crackers. Model for students the act of holding the shape and tracing it with a pencil before moving the shape. (Give students more a challenge by adding goldfish and animal shaped crackers.)

4. Have students complete the question at the bottom of the page and discuss.

5. Gather in meeting area and show students real world examples. (Bring in examples or take a walk around building to find examples - bricks on wall, floor tiles.)

HOMEWORK IDEA: Have students find real world examples of tessellations at home.

### DAY 2

1. Go over vocabulary for the day: TESSELLATIONS AND TRANSLATION (SLIDE): (See Teacher Resource #10)

Have students stand and act out the slide (translation) movement.

2. Use pattern blocks or Teacher Resource #7 to model making a tessellation with the slide movement. (On the overhead use real pattern blocks or on a chalkboard make models with Teacher Resource #7.) Remember to use vocabulary when modeling.

3. Have students choose a hexagon, square, or parallelogram from the pattern blocks. Have students create a tessellation using the slide movement only. (Remind students to trace each movement before moving the shape.)

4. Share final products and discuss the movement and the tessellation (remind students to use new vocabulary).

5. Give students journal question to glue in their journals (Student Resource #2). Discuss question. Have students write an answer and share. (Remind students to use their new vocabulary in their writing.)

HOMEWORK IDEA: Create your own design using the slide movement. Students can use Teacher Resource #7.

### DAY 3

1. Review vocabulary from yesterday (tessellation, slide) and have students act out movement. Introduce new vocabulary word: ROTATION (TURN): (See Teacher Resource #10) Have students stand up or lie on the floor to act out rotations. Students choose one point that stays on the floor (shoulder, feet, etc.). Students turn on that point.

2. Use pattern blocks or Teacher Resource #7 to model making a tessellation using the rotation (turn) movement. (On the overhead use real pattern blocks or on a chalkboard make models with Teacher Resource #7.) Remember to use vocabulary when modeling. Show students how to hold the figure at one point and rotate it.

3. Have students choose a pattern block from the basket and create a tessellation using the rotation (turn) movement only. (Students can color when finished.)

4. Share final products. Discuss the movement and the tessellation (remind students to use new vocabulary).

5. Hand out both pages of Student Resource #3 (*Geometric Design*) Read directions together and have students follow directions to make design. Discuss directions and author's strategies (The author did not include pictures. Pictures would make the directions easier to follow.) Have students answer reading question.

HOMEWORK IDEA: Have students create a tessellation using translations (slides) and rotations (turns).

### DAY 4

1. Warm-Up: Have the students tape two pattern block shapes together from the pattern block basket. Ask them to try to create a tessellation with translations (slides) or rotations (turns).

2. Discuss final products and target students who need extra help.

3. Review vocabulary from previous days (tessellations, translations, and rotations). Practice body movements that go along with vocabulary. Discuss new vocabulary: FLIPS: (See Teacher Resource #10.) (Have students open a book or journal to show how the cover "flips" on a line of symmetry. You could play Simon Says by calling out the commands "flips, slides, turns" and have students act out each.)

4. Model the flip movement with a triangle on the overhead or chalkboard. (Use pattern blocks on overhead or Teacher Resource #7 for board models.)

5. Have students choose two pattern blocks to tape together. Remind them that all shapes do not tessellate, and therefore, they may need to choose another set of shapes. Allow students to use paper, pattern blocks, markers, crayon, . . . to create a tessellation using the flip movement.
6. Have students complete Student Resource #4. Go over answers with students and have them discuss their answers using vocabulary.

### **DAYS 5-6**

1. Show students' tessellations in the "real world" (wall paper, quilts, wrapping paper, table cloth, curtains, floor/wall tiling, clothing, . . .). Discuss what makes each piece a tessellation and what movements the designer used.
2. Pass out performance task (Student Resource #5) and go over directions.
3. Students complete performance task. (After students have created design, you can pass out wrapping paper, wall paper, colored paper, etc. and have students glue paper down or color a tessellation. You may want to laminate the final product.)
4. Talk about other tessellations that the students have observed and why it is important to know about tessellations. Display the students' wrapping paper.

### **Performance Assessment:**

Assessment can be done throughout the unit by observing, scoring students' resource sheets, and journal questions. The final performance task can be evaluated using the rubric included in the packet (Teacher Resource #9).

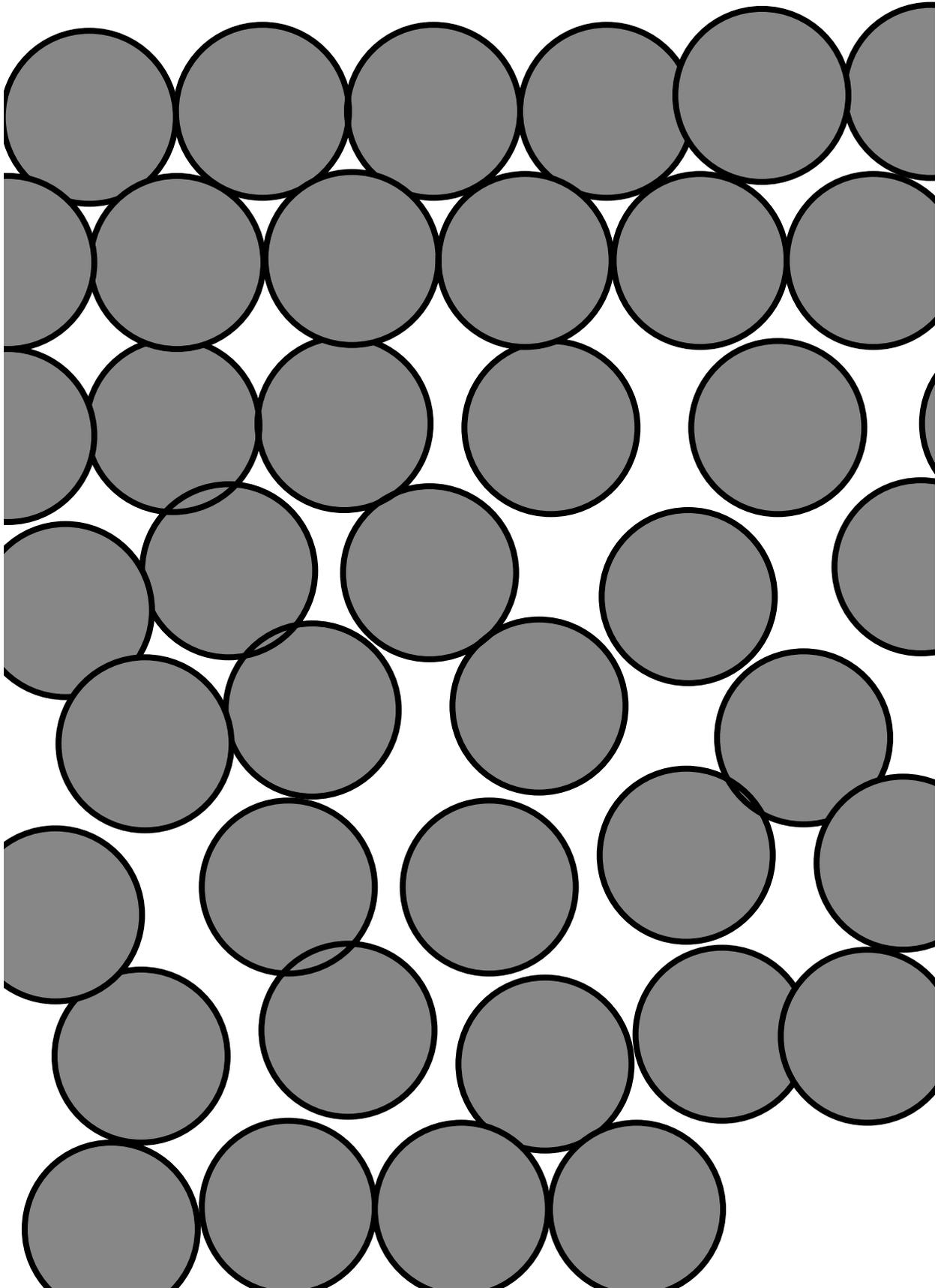
### **Extension/Follow Up:**

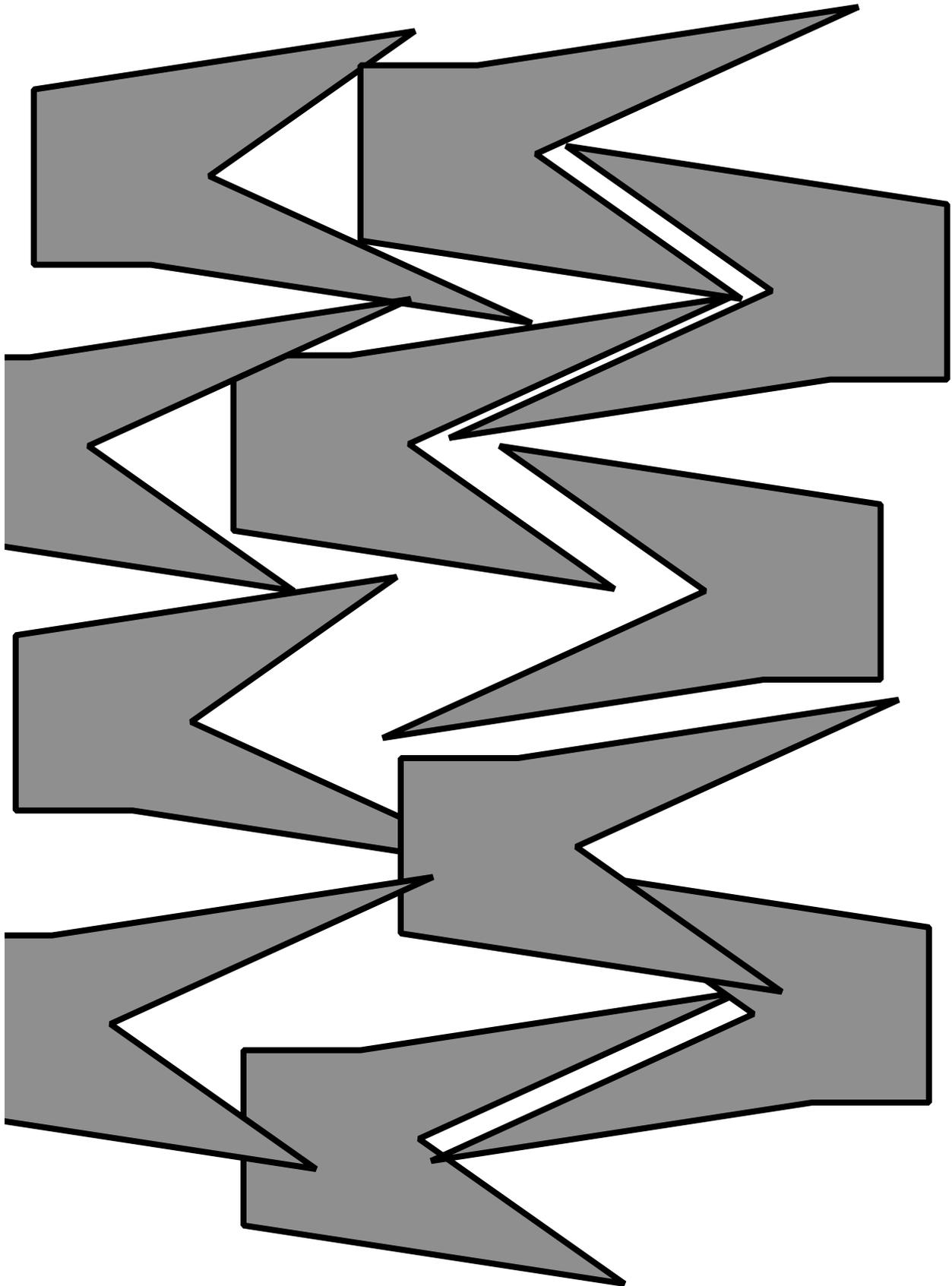
- Use activities in the Tessel Mania manual by MECC.
- Use the Tessel Mania computer program.
- Extend wrapping paper problem to include money or data collection.
- Have students suggest/create other products that could use tessellations.
- Have students vote on favorite gift wrap.
- Use 3-D objects to create tessellations.
- Have students create a new cracker that will tessellate. They can create a box for the cracker with information about how it tessellates on the back.
- Make greeting cards or pictures by creating a design using pattern blocks, using at least two shapes. Then cut each shape out of a different wallpaper sample. Glue them down to create a design.

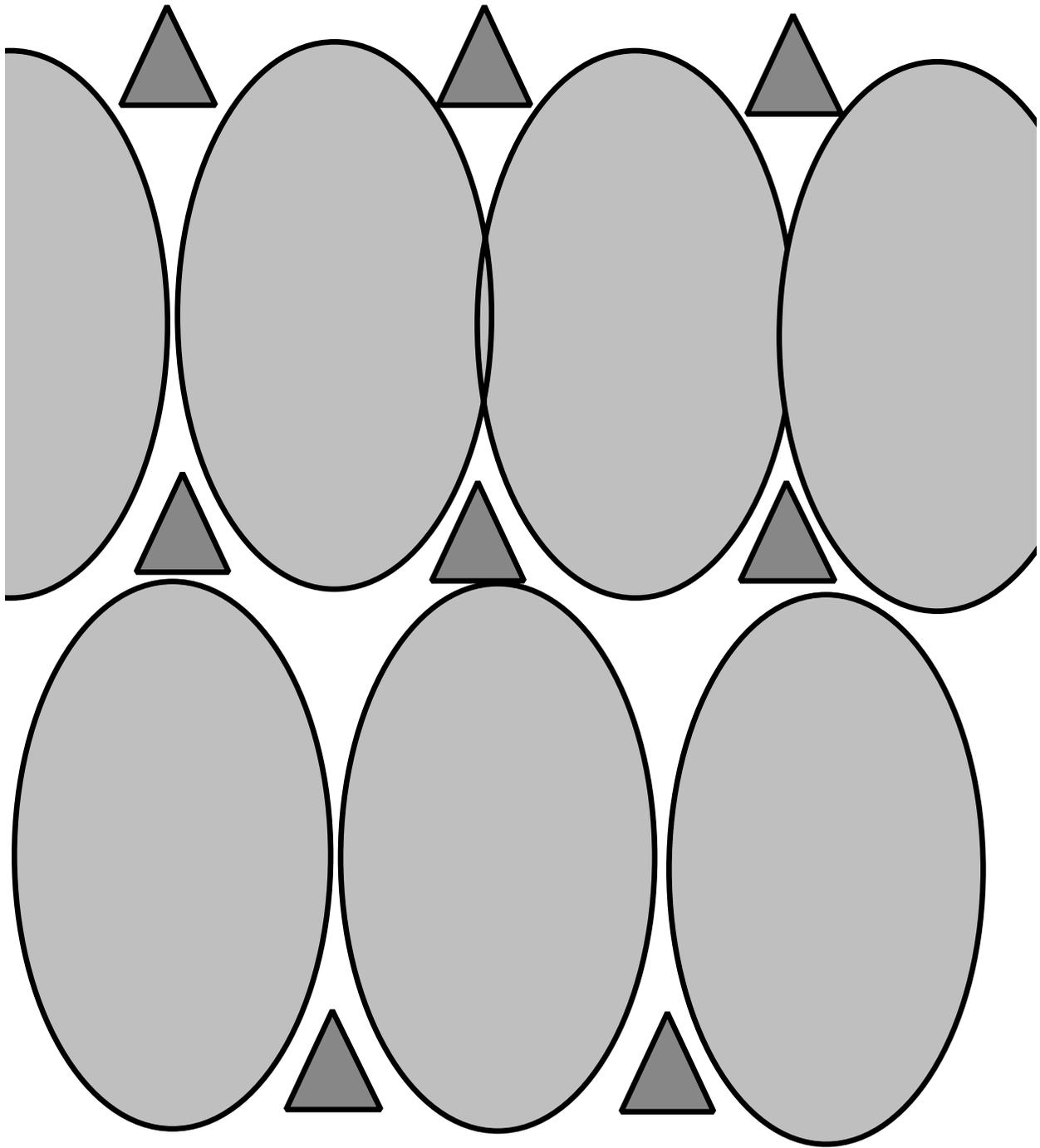
### **Authors:**

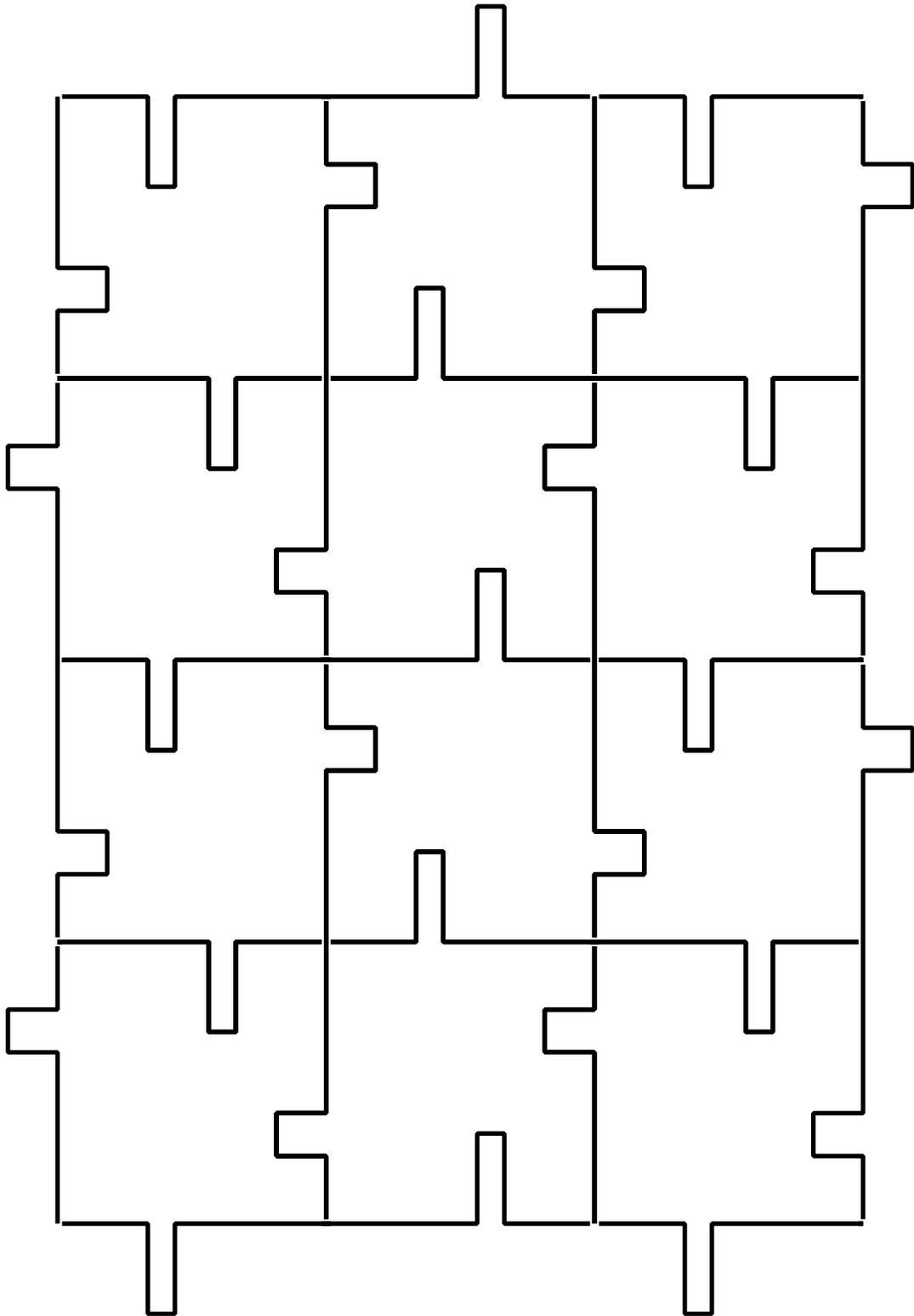
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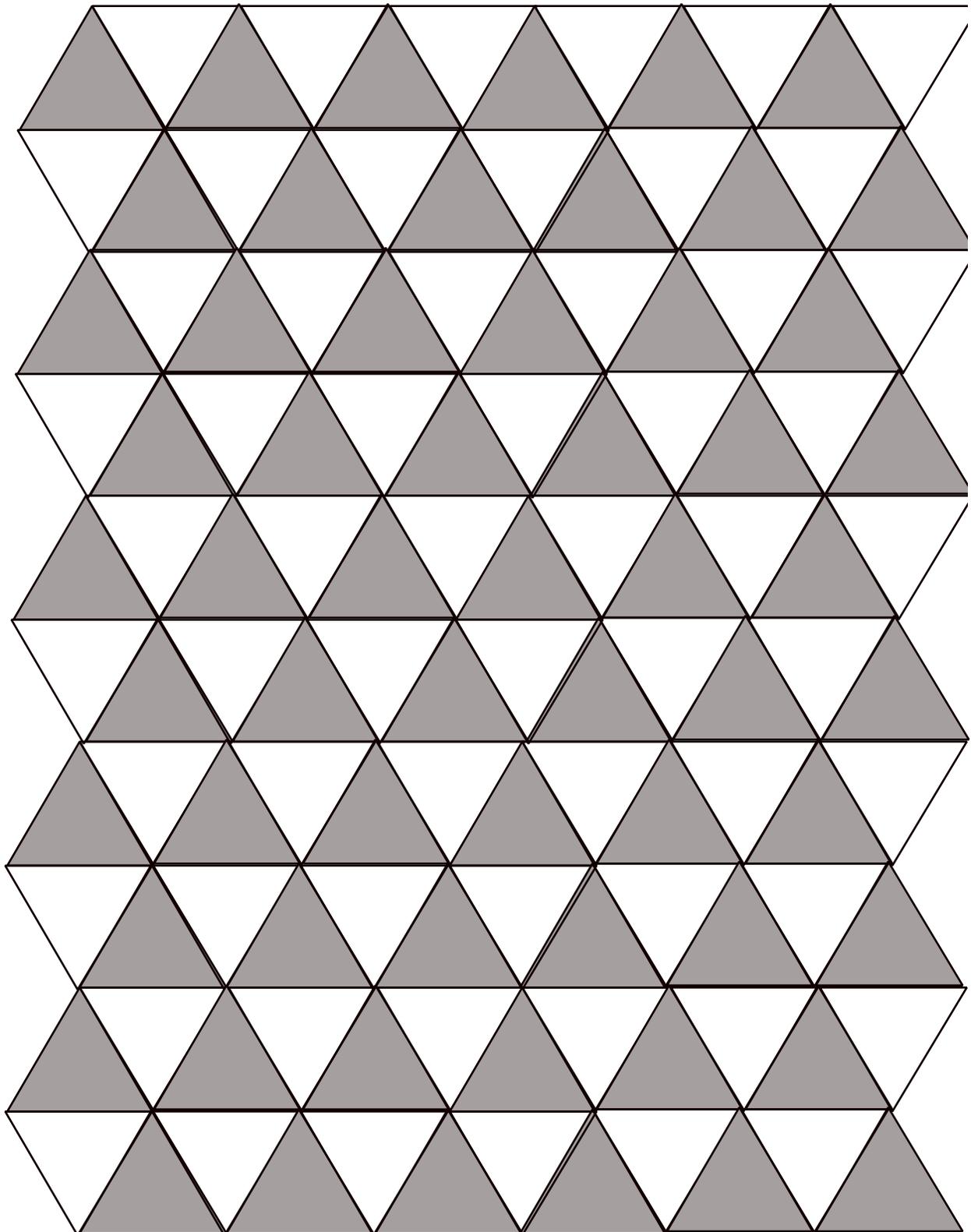
Melanie Yingling  
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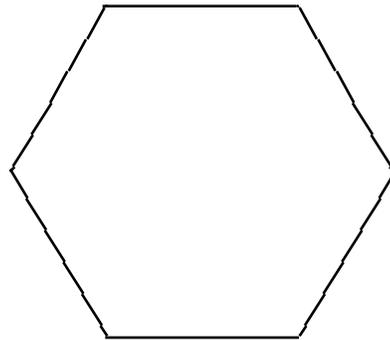
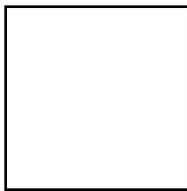
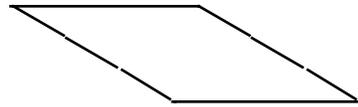
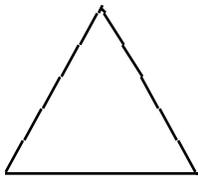
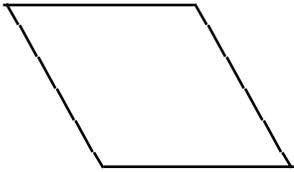




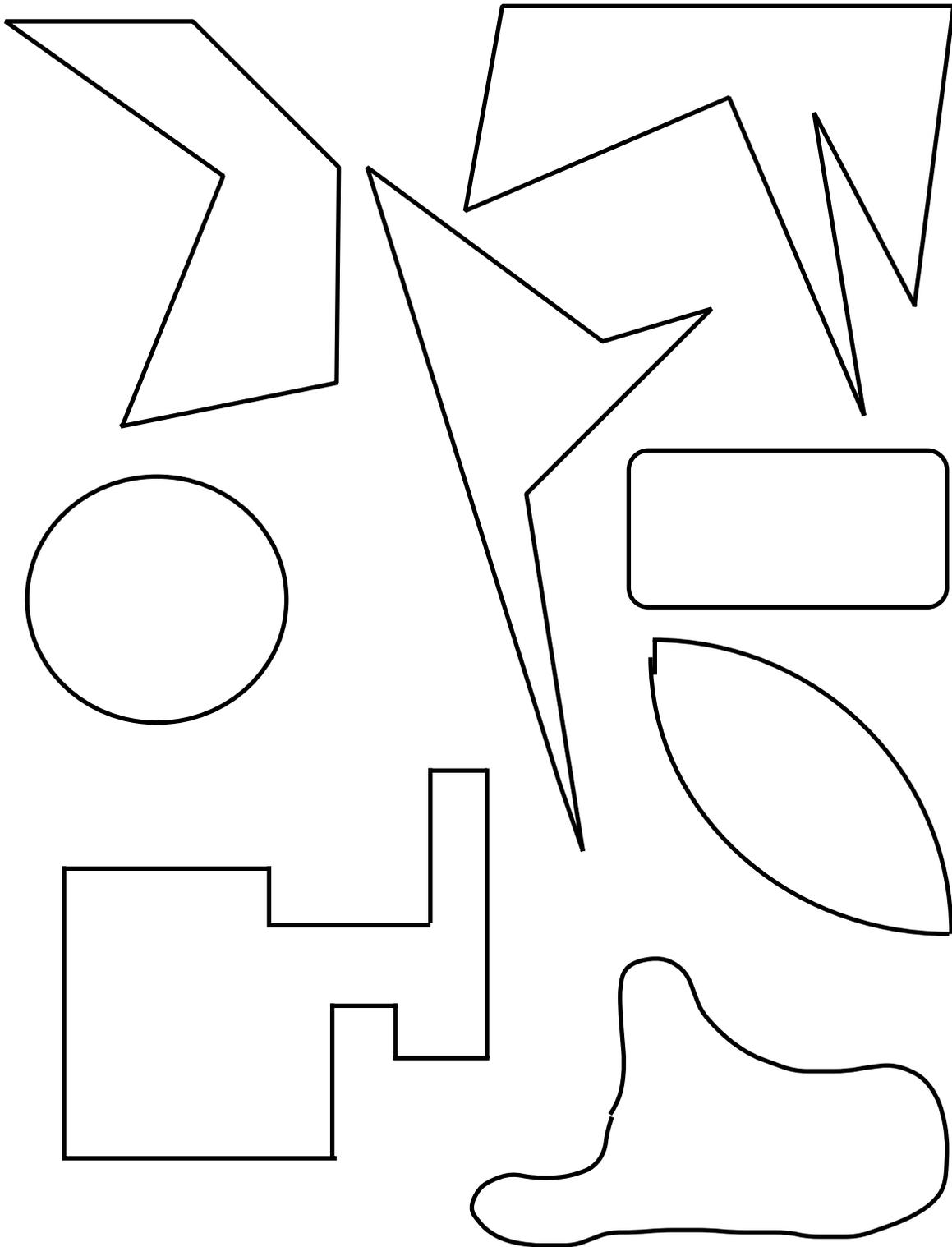




## Template for Pattern Blocks



## Objects That Do Not Tessellate

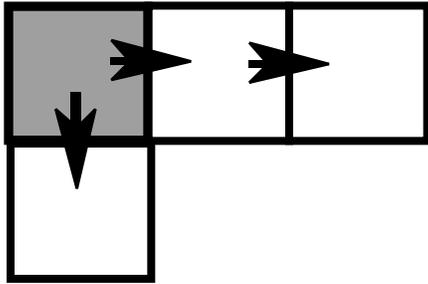


## All Wrapped Up in Tessellations Rubric

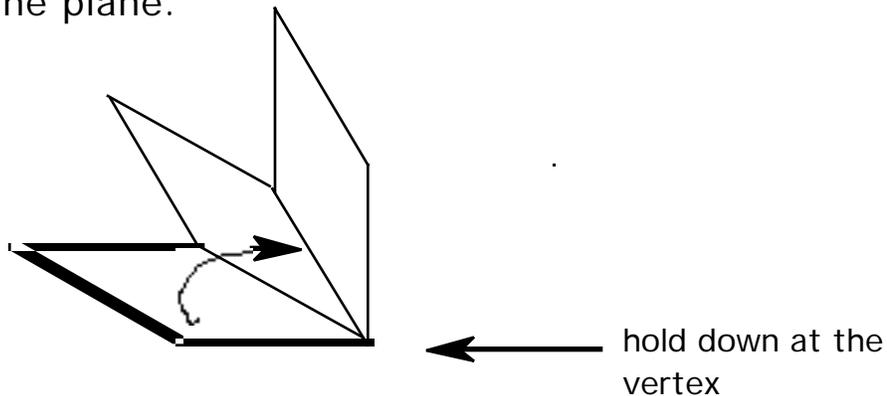
- 3
  - Explains the definition of tessellation
  - Describes the movement translation, rotation, or flip (description of movement and how they used it)
  - Uses geometry vocabulary
  
- 2
  - Includes definition of tessellation
  - Includes description of the movement translation, rotation, or flip (description of movement and how they used it is not clear and complete)
  - Uses geometry vocabulary
  
- 1
  - Demonstrates an understanding of tessellations  
OR movements (translation, rotation, or flip) but not both
  
- 0
  - Does not demonstrate an understanding of tessellations and movements (translation, rotation, or flip)

## How to Make a Tessellation Using Slides, Flips, and Turns

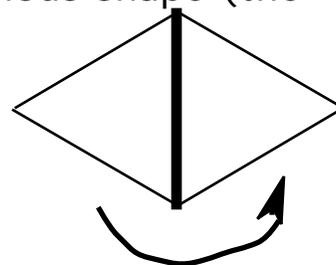
Slides (Translation)- Put the shape on the paper. Trace the shape. Slide the shape in any direction, but remember no overlaps or gaps. Continue until the plane is filled.



Turn (Rotation) - Place a shape on the paper and trace. Hold down one vertex and rotate the shape, but remember no gaps or overlaps. Once you make a complete rotation, you will also need to slide to fill the plane.



Flip - Place a shape on the paper and trace. You will actually pick up the shape, keeping one side touching the paper and flip the shape. You will now see the back of the shape (it may help to have students mark the front and back of the shape) and it should be symmetrical to the previous shape (the flip creates a line of symmetry).

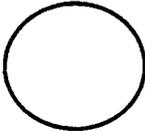




# Does It Tessellate??



1. In the prediction column, write yes if you think the shape will tessellate or no if you think the shape will not tessellate.
2. Use the manipulatives to test your prediction.
3. Complete the chart by testing other shapes.

Shape		Prediction (yes or no)	Results (yes or no)
name	picture		
square			
circle			
triangle			

Choose one shape that will tessellate. Explain how you know the shape will tessellate. Remember to use specific examples from your chart.

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## You're a Tessellation Sensation!!

You have just learned how to use slides to create a tessellation. The second-graders have seen some of the patterns we've created and are eager to learn more. Share your knowledge of how to use slides to create a beautiful tessellating pattern. Be sure to use numbers, pictures, and words.

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# Geometric Design

## Reading to Perform a Task

You will need :

a rhombus pattern

a pencil

crayons, colored pencils, or markers (yellow, red, purple, blue,  
and green)

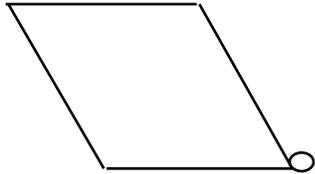
a ruler.

1. Color the small circle yellow.
2. Color the rhombus red.
3. Place a rhombus pattern block on top of the rhombus you colored red.
4. Keeping the **vertex** on the yellow dot, **rotate** the shape to the right. Do not overlap or leave spaces between the two shapes. Trace the shape, then color it purple.
5. Repeat 4 more times. Color the next one blue, then repeat the same three colors.
6. With your ruler draw a 3-inch line from the circle, towards the bottom of the page.
7. Place the pattern block on the last blue shape on your paper and **slide** it 2 inches down the line you drew, so that the **vertex** touches the line.
8. Trace the pattern block and color it green. **Slide** the block so that the opposite vertex touches the line. Trace it and color it green.
9. Complete the questions on the bottom of your handout.
10. If you have time, turn your paper to the back. Fold your paper in half. On one side design an original shape that uses translations (slides) and rotations. On the other half of your paper write directions for a friend to create your design. See if they can create your design!!

# Geometric Design

Reading to Perform a Task

Use the directions provided by your teacher to create a design.



What might be added or changed in the directions to help you or someone else follow them more easily? Be sure to provide specific examples and explain how they will help make the activity easier.

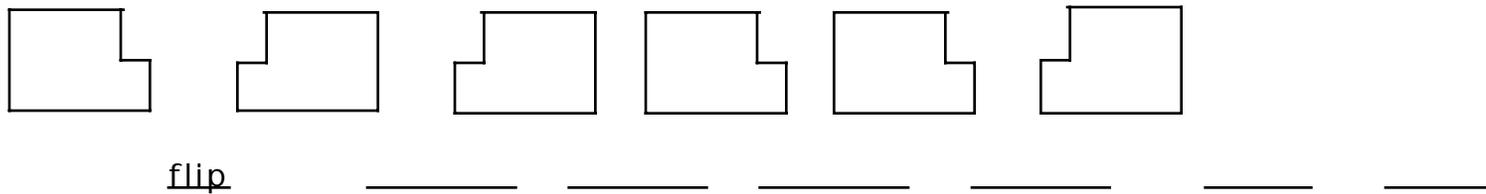
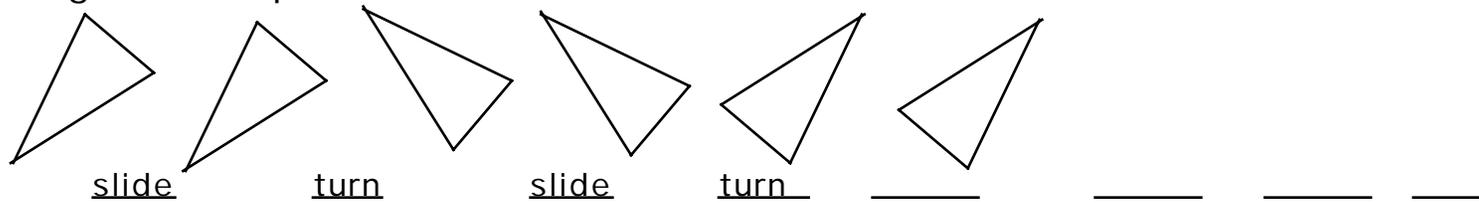
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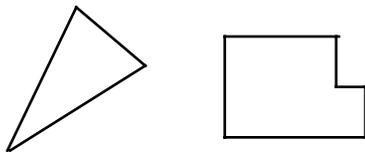
## Flipping, Sliding, and Turning for Patterns

Identify how the shape has moved. Write flip, slide, or turn in the space. Then draw the next shape in the pattern and identify the movement. On the back of this page or on a separate sheet, create your own pattern using slides, flips, and turns.



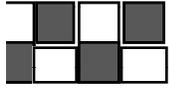

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The shapes below are provided for you to cut out if you would like them to check the movements.

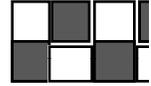


Name \_\_\_\_\_

Date \_\_\_\_\_



## All Wrapped Up in Tessellations



### Activity 1

#### Introduction

Your school has decided to sell gift wrap to raise money for the new school supplies. The school would like to have students make the wrapping paper to sell. Our class has been put in charge of designing the wrapping paper.

The PTA has seen the tessellations that your class has created and decided that the wrapping paper designs should be a tessellation.

A. Create a figure that will tessellate. Use the pattern blocks and tape that you have been given to make a figure by combining two different shapes. Draw your figure in the space below.

B. Work with your group or a partner to decide on one figure you will use to make your wrapping paper design. Remember to choose a figure that will tessellate.

C. Use the space below to check your decision. Make a tessellation using the figure you chose. Move your figure three times using the flip, rotation(slide), or rotation(turn) movement. Write the movement you used in your tessellation on the line under your design.

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D. Using the large paper, pencil, markers, and other materials that your teacher has given you, create an original page of wrapping paper. Before you begin, think about the characteristics of a tessellation. When you have created your design in pencil, you may use other materials to decorate your design. You may begin!

## Activity 2

Now that you have created your design, the PTA is almost ready to sell it. The PTA wants the wrapping paper not only to be used to wrap gifts, but also to teach others about tessellations. They have decided to include information about the designs in the gift wrap packages. Since most people have never made a tessellation, you will need to explain what a tessellation is and how you used the movement to create your design.

Write a paragraph to inform the consumer about your design. Since the wrapping paper will be bought by parents in your community, make sure that you explain your thinking clearly and that you check for capitalization, usage, punctuation, and spelling.

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