



Tessellations Project

Intro to Geometry



Maurits Cornelis Escher, born in Leeuwarden, Holland in 1898, created unique and fascinating works of art that explore and exhibit an array of mathematical ideas. Among his greatest admirers were mathematicians, who recognized in Escher's work an extraordinary visualization of mathematical principles. This was quite remarkable as Escher had no formal mathematics training beyond secondary school.

Tessellations, or regular divisions of the plane, are arrangements of closed shapes that completely cover the plane without overlapping and without leaving gaps. For shapes to fill the plane without overlaps or gaps, their angles, when arranged around a point, must have measures that add up to exactly 360° . Typically, the shapes making up a tessellation are polygons or similar regular shapes (like square tiles used on floors). Escher exploited these basic patterns in his tessellations, applying reflections, translations, and rotations to obtain a greater variety of patterns. He also "distorted" these shapes to form animals, birds, and other figures.

Project Objective: Students will create a tessellation that demonstrates their knowledge of the properties of geometric transformations, such as translations, rotations, and reflections.

Procedure:

Tessellation

Use one or more transformations to create a Tessellation on *8.5" x 11" paper (standard computer paper)*.

You will need to make a template to trace. There are complexity points for your tessellation. You get more points for attempting a more difficult tessellation. You may not simply take a polygon and slide, rotate, or reflect it over and over again to create your tessellation. You must create a template based on one of the methods in this packet.

**You can use the computer to create your template, but the tessellation must be drawn by hand.

Written Response

Type a 1-page response that specifically answers each of the questions below:

1. What is the idea/theme behind your tessellation?
2. What polygon(s) did you start with and how did you alter it?
3. What transformations did you use?
4. In your opinion, are tessellations math or pieces of art? Justify your answer.

5. Provide some examples of where tessellations are found in the world around us. For example, look for examples in nature, art, architecture, business, or advertising. Include two photos or a printout of two pictures to support your claim.

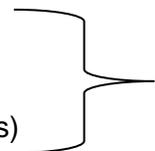
Your response needs to be typed and in complete sentences!

**You may work in pairs or individually for this project. For those students working in pairs, both students will receive the same grade. So, choose your partners carefully!

**Use the Project Planning Worksheet to generate ideas and help focus your project on a specific theme. Remember, you are creating an *original* piece of work.

Assessment: Tessellation

- Polygon(s) and transformations used
- Complexity and creativity
- Visual appeal (neatness and color)
- Follows directions (meets project requirements)



20 pts.

Written Response 20 pts.

The entire project will be worth **40 pts.**

TESSELLATION RUBRIC

CATEGORY	4	3	2	1
Organization	Tessellations are presented in an organized manner. Their construction is complete and accurate.	Tessellations are presented in a somewhat organized manner. Their construction is fairly complete.	Tessellations are organized, but not well constructed.	There is no organization to the tessellation.
Complexity of Design	Tessellation was created with non-polygon shapes that connect to create an intricate and complex pattern.	Tessellation was created with complex polygon shapes that connect to create an intricate and complex pattern.	Tessellation was created with simple shapes that connect to create a pattern	Tessellation is simple and pattern is not complex or interesting.
Completeness of Tessellation	All areas of the tessellation are covered by the complex pattern to completely fit together.	All areas of the tessellation are covered by the simple pattern with few or small holes in the pattern.	Most areas of the tessellation are covered by the simple pattern with some holes in the pattern.	There are major holes in the tessellation and it does not fit together.
Creativity	Tessellation uses unique design and patterns of unusual shapes to form a complex and interesting design.	Tessellation uses a mixture of polygons and interesting shapes to create a nice design.	Tessellation uses some shapes that fit together to form a simple pattern	There is no creativity to the design.
Follows Directions	Tessellation covers an 8.5"x11" sheet of paper completely with interesting display and presentation.	Tessellation covers an 8.5"x11" sheet of paper and has a complete presentation.	Tessellation mostly covers an 8.5"x11" sheet of paper and has no presentation	Tessellation does not cover the 8.5"x11" paper completely.

Maximum of 20 pts. earned here

WRITING GUIDELINES

- Each answer in your written response should be numbered to correspond with each question.
- Questions need to be clearly answered and they must be supported by sufficient detail.
- Response must contain use of mathematical terms, such as reflection, translation, rotation, etc.
- Response is neatly typed with few distracting errors, such as spelling and grammar.

Maximum of 20 pts. earned here

Tessellations Project → Planning Worksheet

Use one or more tessellations to create a Tessellation on 8.5" x 11" paper. You must create a template based on one of the methods below.

**You can use the computer to create your template, but the tessellation must be drawn by hand.

Consider the following when planning your tessellation:

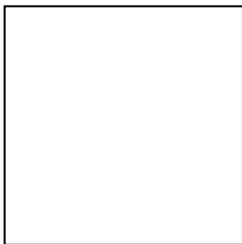
- Do you want to use one polygon or more than one?
- How complex do you want to make your original figure?
- Do you want to use one transformation or a combination to tessellate your figure?
- How are you going to use color to alter your tessellation and create more patterns?
- What is the idea or theme that you want to express in your piece?
- What is the title of your piece?

Translation Tessellation (Easy) Template

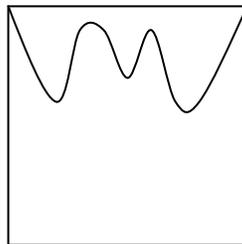
For simple translation tessellations, the starting polygon should have opposite sides that are parallel and congruent. Squares, hexagons, and parallelograms work best here.

Example:

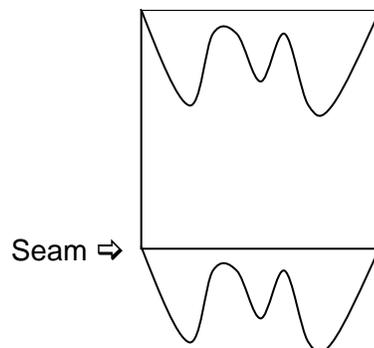
1. Start with a square.



2. Draw a design on one side of the square.



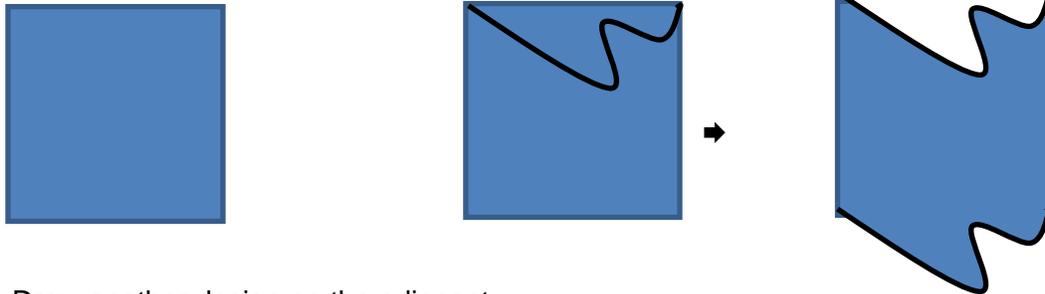
3. Cut the design piece out and translate (slide) it across to the opposite side of the square. Secure it there with tape—be careful not to overlap the piece or make a gap. It should fit perfectly at the seam.



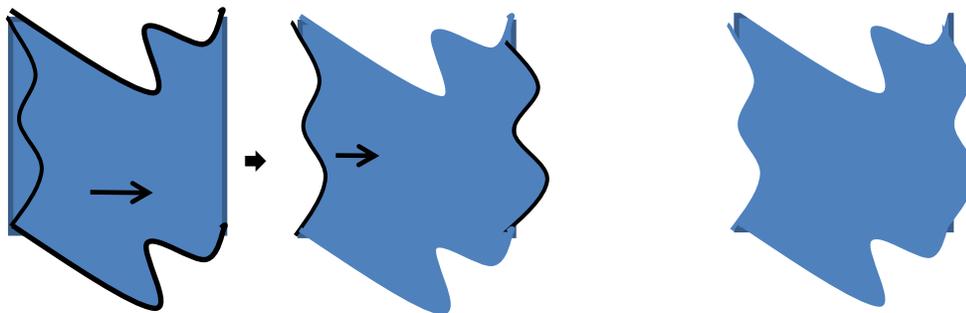
Translation Tessellation (Hard) Template

Example:

1. Start with a square.
2. Draw a design on one side of the square, translate (slide) it to the opposite side, and secure it with tape.



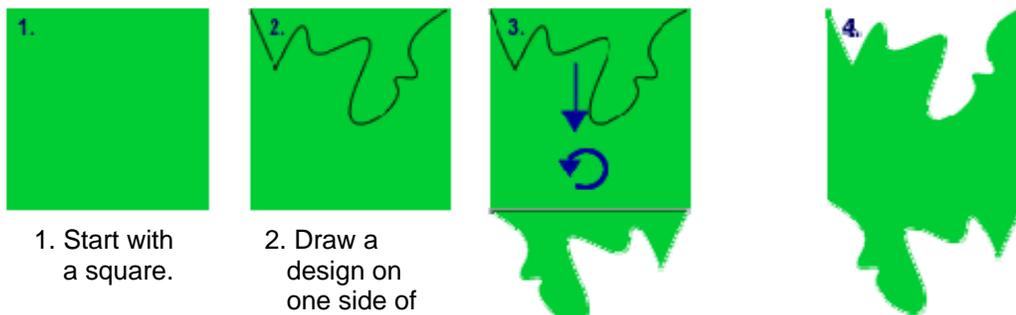
3. Draw another design on the adjacent side of the square and translate (slide) it to the opposite side. Secure it with tape.



Glide Reflection Tessellation Template

For glide reflection tessellations, the starting polygon should have opposite sides that are parallel and congruent. Squares, hexagons, and parallelograms work best here.

Example:



1. Start with a square.

2. Draw a design on one side of the square.

3. Cut the design piece out and translate (slide) it across to the opposite side of the square.

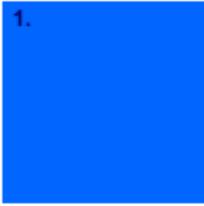
Reflect (flip) the cut piece on its vertical axis.

4. Secure the cutout piece with tape to the opposite side of the square to complete the pattern.

*This pattern needs to be rotated or reflected as it is traced.

Rotation Tessellation Template

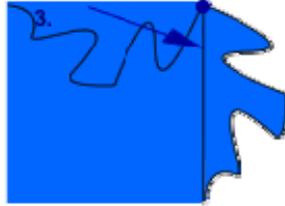
For rotation tessellations, the adjacent sides of the polygon must be congruent. Squares, equilateral triangles, regular hexagons, and rhombi work best here.



1. Start with a square.



2. Draw a design on one side of the square.



3. Cut the design piece out and rotate (turn) it on an end point until it lies evenly with an adjacent side of the square.



4. Secure the cutout piece to the adjacent side of the square to complete the pattern. This pattern (template) needs to be rotated as it is traced.

Examples of M.C. Escher's Work

