Creating Escher-Style Tessellations

Focus on...

After this lesson, you will be able to...

❑ create tessellations from combinations of regular and irregular polygons

❑ describe the tessellations in terms of the transformation used to create them

Materials

• ruler
• scissors
• glue stick
• cardboard or construction paper
• tape
• coloured pencils

In the previous sections, you created tessellating patterns using regular and irregular polygons. When Escher created his tessellations, he did so in a variety of ways. Look at the two Escher works. What is different about the tessellations?
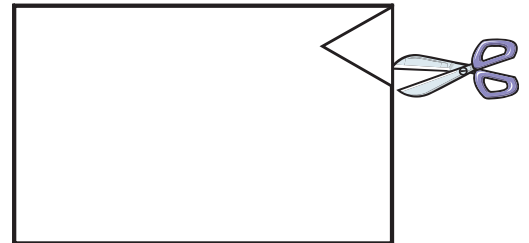
Explore the Math

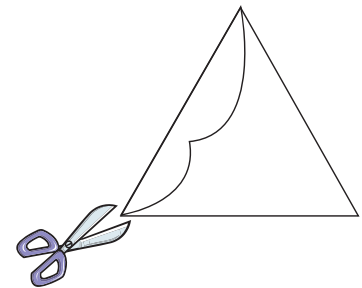### How do you make Escher-style tessellations?

1. Draw an equilateral triangle with 6-cm sides on a blank piece of paper. Cut out the triangle and glue it to a sheet of cardboard or construction paper. Cut out the triangle again.

2. Inside the triangle, draw a curve that connects two adjacent vertices. Cut along the curve to remove a piece from one side of the triangle.

3. Rotate the piece you removed 60° counterclockwise about the vertex at the top end of the curve. This rotation moves the piece to another side of the triangle. Tape the piece in place to complete your tile.
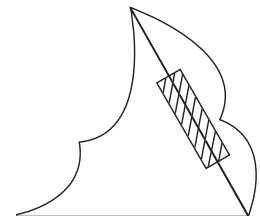
4. To tessellate the plane, draw around the tile on a piece of paper. Then, rotate and draw around the tile over and over until you have a design you like.
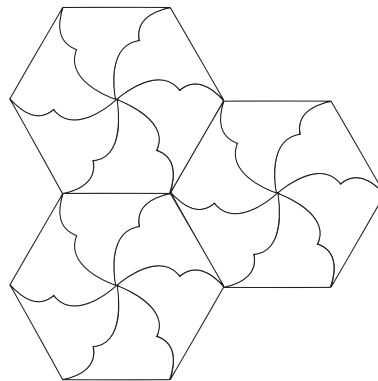
5. Add colour and designs to the tessellation to make a piece of art.
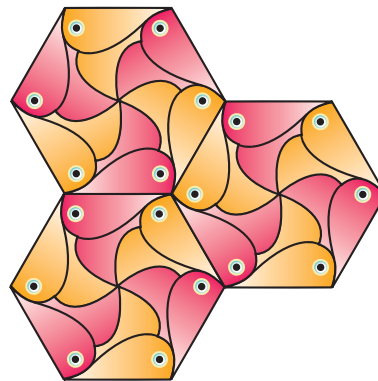
6. Repeat steps 1 through 5 using a parallelogram and translations to create another Escher-style drawing.

Reflect on Your Findings

7. You can use transformations to create Escher-style tessellations just as you did with regular and irregular polygons.
   a) Describe how to use rotations to create Escher-style tessellations.
   b) What do you notice about the sum of the angle measures at the vertices where the tessellating tiles meet?
   c) How does the area of the modified tile compare with the area of the original polygon? Explain.

Example: Identify the Transformation Used in a Tessellation

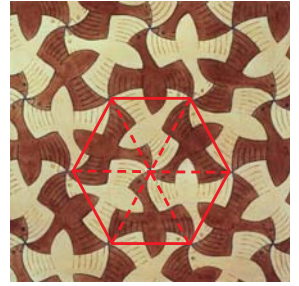What transformation was used to create each of the following tessellations?

Tessellation A

Tessellation B

Solution

Tessellation A is made up of triangles that have been rotated to form a hexagon. This tessellation is made using rotations.

Tessellation B is made up of figures that alternate gold to black and then repeat horizontally across the drawing. This tessellation is made using translations.

Show You Know

What transformation was used to create this tessellation? Explain your answer.


Key Ideas

- You can create Escher-style tessellations using the same methods you used to create tessellations from regular or irregular polygons:
  - Start with a regular or irregular polygon.
  - The area of the tessellating tile must remain unchanged—any portion of the tile that is cut out must be reattached to the tile so that it fits with the next tile of the same shape.
  - Make sure there are no overlaps or gaps in the pattern.
  - Make sure interior angles at vertices total exactly 360°.
  - Use transformations to tessellate the plane.

1. When creating a tile for an Escher-style tessellation, the original polygon is cut up. How do you know the area of the original polygon is maintained?

2. Rico believes that he can use this tile to create an Escher-style tessellation. Is he correct? Explain.

3. Tessellations must have no gaps or overlaps. What other two properties must be maintained when creating Escher-style tessellations?
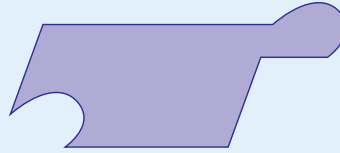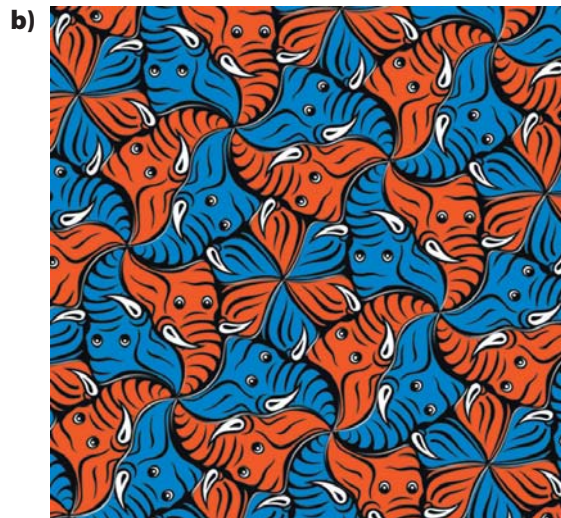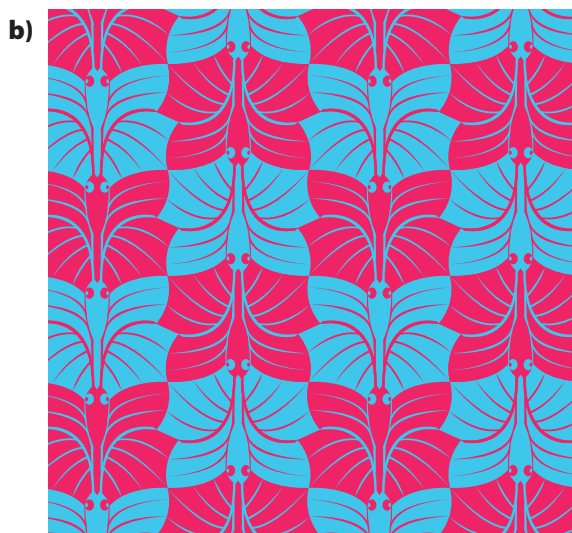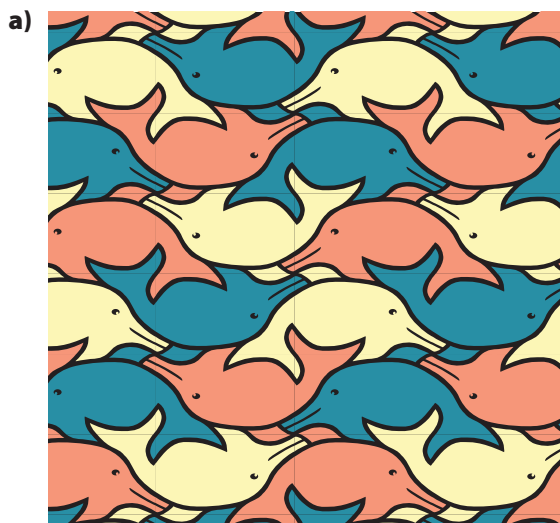
Check Your Understanding

Practise

For help with #4 to #7, refer to the Example on pages 462–463.

4. Identify the transformations used to create each tessellation.

a)

b)

5. Identify the original shape from which each tile was made for each tessellation in #4.

**6.** Identify the transformations used to create each tessellation.

a)

b)

7. Identify the original shape from which each tile was made for each tessellation in #6.

8. Create an Escher-style tessellation using a scalene triangle with translations.

9. Create an Escher-style tessellation using an equilateral triangle with rotations.

10. Create an Escher-style tessellation using squares with rotations and translations.

11. Escher also used impossible figures in his art, as shown.
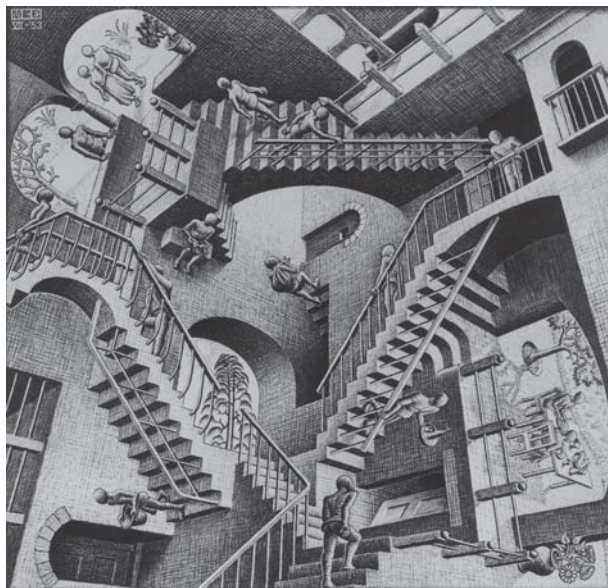
a) What impossible figures were used in the drawing?

b) Research other examples of Escher's art that include impossible figures.

MATH LINK

Use an Escher-style tessellation to create a design for a binder cover, wrapping paper, a border for writing paper, or a placemat.

WWW Web Link

To see examples of Escher's art, go to www.mathlinks8.ca and follow the links.