EXPLORING TESSELLATIONS

Background: What is a tessellation?

A *tessellation* is any pattern made of repeating shapes that covers a surface completely without overlapping or leaving any gaps. A checkerboard is a tessellation made of squares. The squares meet edge to edge with no gaps and no overlapping areas. The pattern of bricks on a wall is a tessellation made of rectangles.

Over 2,200 years ago, ancient Greeks were decorating their homes with tessellations, making elaborate mosaics from tiny, square tiles. Early Persian and Islamic artists also created spectacular tessellating designs. More recently, the Dutch artist M. C. Escher used tessellation to create enchanting patterns of interlocking creatures, such as birds and fish.

Making tessellations combines the creativity of an art project with the challenge of solving a puzzle.

Part One: Tessellating with One Shape

Grades 1–2, challenge for K. [15–30 minutes]

Materials:

- Pattern blocks (multiple sets)

  You can purchase these online, or download and print out paper patterns here: http://mason.gmu.edu/~mmankus/Handson/manipulatives.htm
- Index card 3" x 5"

Try This:

Step 1 Choose one pattern block shape. Do you think this shape will cover your card? Using only your shape, cover the index card, leaving no spaces in between. How many shapes did it take to cover the card? How many fit across? How many fit up-and-down?

Step 2 Check out other people's work—did their shapes cover the paper? It is possible to do this with every pattern block shape. The process is called tessellating.

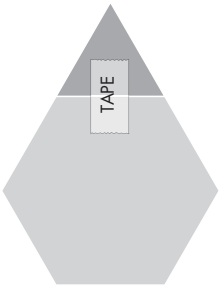
Part Two: Tessellating with Two Shapes

Grade 2, challenge for grade 1. [30 minutes]

Materials:

- Pattern blocks (multiple sets), excluding the orange squares and white rhombuses
- Triangle Grid Paper (included)
- Markers
- Plain paper
- Pencils
- Tape

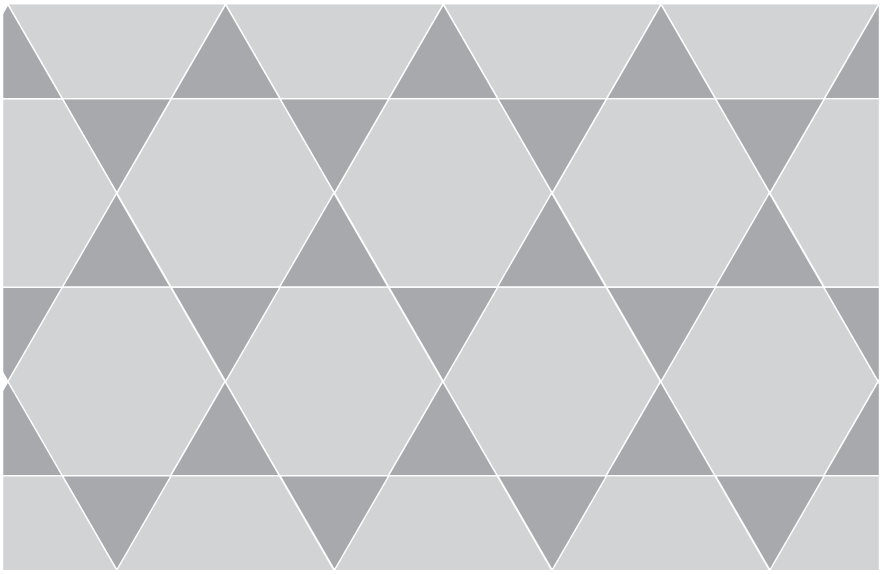
Try This:



Step 1 Now that you know that you can tessellate with any one of these shapes, try choosing two shapes. Put the two blocks together to make a unit, and use a small piece of tape to hold them together. How many sides does this new shape have?

Step 2 Describe out loud how you have arranged the two shapes. (For example: "The green triangle is above the yellow hexagon. One side of the triangle matches exactly with one side of the hexagon.") Now build 10 more of the same unit, taping each unit together.

Step 3 Can you tessellate space (cover the paper leaving no spaces in between) with this unit? If not, try making a new unit with two blocks.



Step 4 Look at other people's work as well. Were they able to tessellate space with their shapes? Describe out loud how you arranged the units to make a tessellation.

Step 5 If you placed your units side-by-side without turning or flipping them, you made a *translation tessellation*. If you had to turn your units to fit them together (like a pinwheel), you made a *rotation tessellation*. If you had to flip your units over to the other side, you made a *reflection tessellation*. You may have had to do one, two, or all three of these things to make your tessellation.

Step 6 You have made a repeating pattern, or *periodic tessellation*. How many ways can you arrange your two blocks into a unit to make periodic tessellations? Look at your classmates' work to see if they have tried anything that you haven't.

Step 7 Once you have made a tessellation that you like, you can preserve it by either tracing the shapes or drawing them freehand on the triangular grid paper.

Part Three: Tessellating Three-Dimensional (3D) Space

[20 minutes]

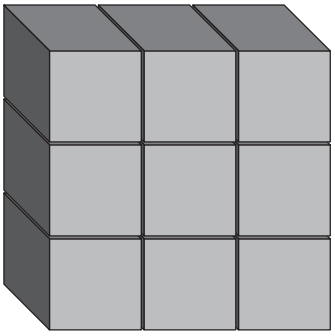
Materials:

- Cubes (sugar cubes, wooden blocks, or any cubes that are easy to obtain)
- Rectangular prisms (shoe boxes, toothpaste boxes, tissue boxes—as long as they are all the same size and shape)
- Cylinders (soda cans, paper towel tubes, soup cans, or any cylinders that are all the same size and shape)
- Spheres (marbles, tennis balls, or any spheres that are all the same size)
- Unsharpened pencils (If you rubber band a bunch of pencils together and look at them from the end, you will see a tessellating honeycomb pattern.)
- Any other groups of identical three-dimensional objects

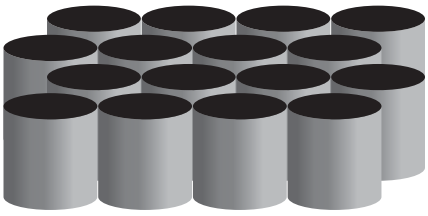
Try This:

Step 1 Explore tessellating with three-dimensional objects and notice the similarities to and differences from working with two-dimensional objects.

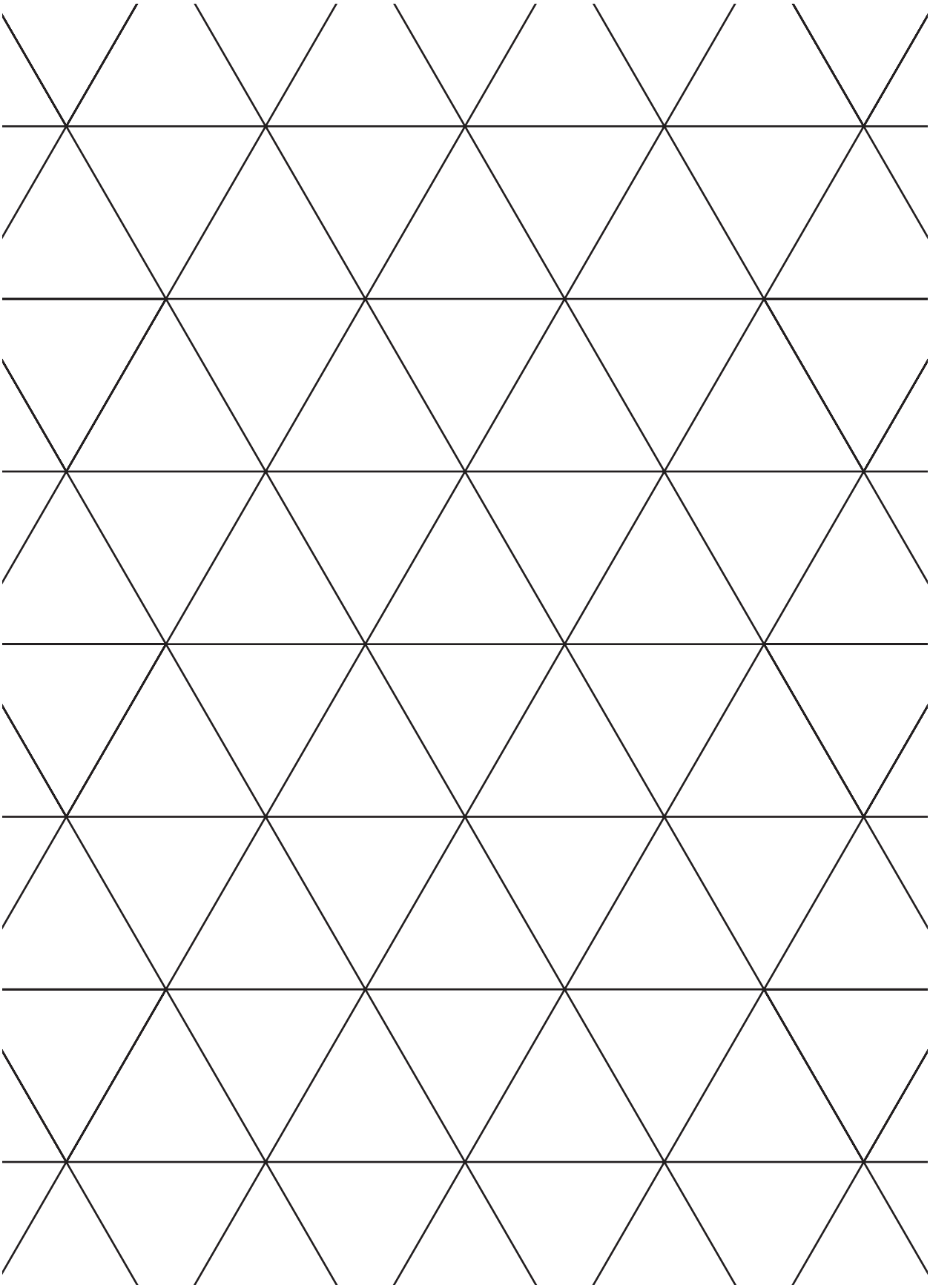
Step 2 Start with the cubes. Can you stack the cubes together to fill three-dimensional space without leaving any gaps? To test this out, see if there are any spaces between the cubes that you can stick your pencil into. If not, you have tessellated three-dimensional space.



Step 3 Now try each of the other shapes. Which ones tessellate space? Which ones do not?



Triangle Grid Paper



From the National Council of Teachers of Mathematics (NCTM)

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

- Recognize, name, build, draw, compare, and sort two- and three-dimensional shapes;
- Describe attributes and parts of two- and three-dimensional shapes;
- Investigate and predict the results of putting together and taking apart two- and three-dimensional shapes;
- Specify locations and describe spatial relationships using coordinate geometry and other representational systems;
- Describe, name, and interpret relative positions in space and apply ideas about relative position;
- Apply transformations and use symmetry to analyze mathematical situations;
- Recognize and apply slides, flips, and turns.