

Plethora of Polygons

MATERIALS

FOR STUDENT: (one per student unless otherwise noted)

- FloraCraft® Make It: Fun® Foam Blocks, cut from large Foam Block (see "FOR TEACHER") to 3" x 3" x 1/2" thick; and 1 1/2" x 1 1/2" x 1/2" thick, three pieces of each size.
- Copy paper, 3" x 3", three pieces or photocopied pattern
- Cardstock, white 3/4" x 12" strip
- Toothpicks, two
- Paintbrush, medium size
- Pencil
- Washable black felt tip marker
- Ruler
- Protractor
- Scissors
- Glue bottle (to trace around for a circle)
- Paper plate
- Paper towel
- Paint apron
- Plastic knife
- Plastic zip-sealed bag (to hold pieces), one per two students



FOR TEACHER:

- FloraCraft® Make It: Fun® Foam Block, 1/2" x 12" x 36" (can get thirty-two 3" pieces and sixty-four 1 1/2" pieces)
- Acrylic paint: Canyon Orange, Tangerine, Bright Yellow, Margarita, Irish Moss, and Blue Grass Green
- Water bucket
- Paintbrush, medium size
- Pencil
- Ruler
- Protractor
- Paper cutter
- Scissors
- Serrated knife
- Glue gun (for teacher only)
- Old newspapers or plastic tablecloth (optional)
- Cutting mat (or stack of newspapers)
- Plastic-lined garbage can
- Paper towels
- Sink (water)
- Wet wipes
- Drying area

TEACHER PREPARATION

Note: Read through all the instructions first and check out the TIPS! Plan to have the students work with a partner to figure out the shapes, to cut, and paint them. Together they will have one set of polygons. Decide how in depth you want to go – You can photocopy the pattern for the students to cut out, or you can give them paper squares and show them how to draw their own. They can use the protractor to figure out the degrees of the angles of each shape. (Divide 360 degrees by the number of sides and that will be the degree of each interior angle.) It is recommended that you make your samples first, before preparing the materials for the students, since this can help you decide.

[1] Use a ruler and pencil to measure and mark 1 1/2" squares for the first 12" at one end of the foam block. (This gives you sixty-four pieces, which is enough for twenty-one students to have three each.) For the remaining 24" length of the block, mark 3" squares. (This gives you 32 pieces, enough for ten students to have three each.) Adjust measurements as needed based on the number of students.

Then, on a cutting mat, use a serrated knife against the edge of a ruler to cut the foam block.

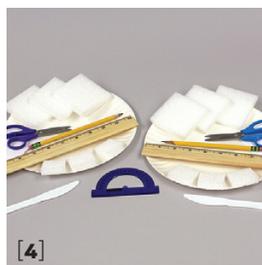
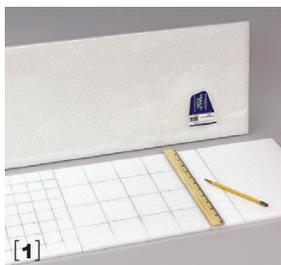
[2] If you want the students to draw their own polygons, use a paper cutter to cut three 3" squares of copy paper per student. If you plan to use the

polygons, photocopy enough for each pair of students. Vertically, cut apart the sheets to give one half to each student in the pair.

Also cut white cardstock into 3/4" x 12" long strips, one per student.

[3] Prepare painting materials. Have paint bottles, two paper plates with two paintbrushes and two paper towels ready to distribute to each pair of students.

[4] On another paper plate for each student, put three large and three small foam squares, a pencil, scissors, and plastic knife. If you're having students draw their own polygons, add a protractor and ruler. If not, add polygon patterns.



MATH

GRADE LEVEL
SECOND – THIRD

COMPLETION TIME

- 50 minute session (longer if shapes are drawn)
- 30 minute session



OBJECTIVES

Students learn:

- What polygons are and the names for the first six
- How a protractor works to measure degrees based on a 360-degree circle
- Optional: How to use a protractor

STANDARDS

- Develop an understanding of multiplication and division and their strategies
- Reason abstractly and quantitatively
- Use appropriate tools strategically and attend to precision
- Describe and analyze two-dimensional shapes; geometry - reason with shapes and their attributes

LESSON INTRODUCTION

- Define a polygon as a shape made from three or more sides. The names and number of sides for the ones they will be making are: Triangle 3, Quadrilateral (square) 4, Pentagon 5, Hexagon 6, Heptagon or Septagon 7 and Octagon 8.
- Optional: Explain that a circle contains 360 degrees. Show students how to use a protractor to measure angles and explain that they can draw a shape with any number of equal-length sides by knowing what the angles are. To do that, they need to divide 360 degrees by the number of sides. That number is the degree of each angle and can be calculated to draw any shape.



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INSTRUCTIONS

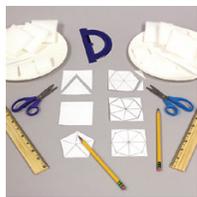
[1] If the students are not drawing their own polygons, have them cut out the polygon patterns using scissors.

If they are drawing their own, demonstrate the following on the board. Draw a large circle with a center point. From the point draw a straight line to the right until you touch the circle. Explain that there are 360 degrees in a circle. Show how placing the protractor on the line allows you to measure any number of degrees. From the line, find 120 degrees and mark it with another line. Move the protractor to that line and measure another 120 degrees. This will give you three lines. Explain that you can connect the points (vertices) where those lines cross the circle, to make an equal-sided (equilateral) triangle.

If students are ready for division, you can explain that 360 divided by 3 (sides or points) is 120, which is how you knew you needed 120 degrees. If not, you can give them the number of degrees needed for each side of each polygon: Triangle 120 degrees, Quadrilateral 90, Pentagon 72, Hexagon 60, Heptagon or Septagon 51.43 – round to 52, and Octagon 45.

Show several more examples with four, five and six sides. Also mention that they can make the polygon any size they want by measuring the same distance out from the center for each of the points (vertices) of the shape. Then they simply connect the vertices to make the sides for the shapes.

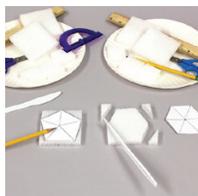
Have the students work together to draw one of each polygon on their 3" squares of paper. Ask them to show you their polygons before cutting them out. (Give them the hint that they should start by folding their papers into fourths to find the centers.)



[2] Have the students use pencils to trace their paper polygons onto the 3" pieces of foam. Then demonstrate and have them use the plastic knives to trim along the pencil lines.

Demonstrate and have the students compress and slightly round all the edges, by pressing the foam edge down onto the table

with even pressure, while rocking the foam back and forth to smooth. Caution them not to flatten the corners, however, or they will turn their shapes into circles.



[3] Distribute the glue bottles, explaining that they won't be gluing. Demonstrate and have the students center the bottle on a small foam square. Then use the plastic knife to trace around the bottle to trim off the foam corners. Have them compress and smooth the foam into a circle by rocking it back and forth, as well as rotating it and rolling it on the table. Collect the glue bottles.



[4] Have students put on their aprons. Distribute the painting paper plates and squeeze paint onto each. Note: Ask each pair of students to have one student paint the yellow, orange and red-orange polygons (in that order); and have the other student paint the yellow-green, green and blue-green polygons (in that order). By going from light to dark, they do not have to wash out their brushes between colors. Have students paint polygons.

While they paint, squeeze more paint onto their plates and distribute wet wipes as needed. When they are finished, collect the brushes and put them into the bucket of water (until after class when they can be washed out). Have the students move their plates to a drying area.

If possible, before the pieces are thoroughly dry, turn them over to release them from the paper plate. Then let them finish drying.



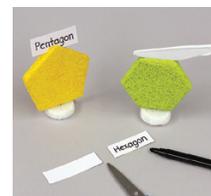
NEXT SESSION

[5] Distribute two: Pencils, black markers, plastic knives, scissors, cardstock strips and three toothpicks to each pair of students. Demonstrate and have the students pinch the top and bottom of one toothpick and carefully snap it in half, without releasing the pieces until they are separated. Demonstrate and have them insert one toothpick half into the center of one foam circle base. Then center and press a polygon shape onto it. Have them repeat with their other two polygons.



[6] Show students that some shapes will have a top that is a point, while others will have a straight edge. Show them how to hold the shape, bracing their wrists, and elbows against the table, and use the plastic knife to carefully saw a slit that goes about 1/4" down into the foam. Have the students cut the slits.

Then, have them use their pencil to write the name of that particular shape on one side and their name or initials on the back. Then ask them to trace over the polygon name with marker and use scissors to trim it to the right length. Have them insert it into the top of their foam shape. Distribute a zip-sealed plastic bag for each pair of students to store their polygons.



REFERENCES

The Usborne Illustrated Dictionary of Math by Tori Large
If You Were A Polygon by Marcie Aboff
Shape Up by David A. Adler
The Greedy Triangle by Marilyn Burns



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INSTRUCTIONS

MODIFICATIONS

To simplify project:

- Use the patterns and focus on the names of the shapes, skipping the explanation of the angles and their degrees.
- Have each student make one polygon instead of three.

To expand project:

- Ask students to find examples of the various polygons in their school or at home.
- Ask them to make additional polygons, with more sides: Nonagon 9, Decagon 10, Hendecagon 11, Dodecagon 12, Quindecagon 15 and Icosagon 20.
- Have them research and report back to the class information on: Equiangular, equilateral, convex and concave polygons.

For multiple ages:

- Younger and older students can work side-by-side, with the older students figuring out the angles and drawing the shapes, while the younger ones cut them out and trace them. Both can paint.

ADDITIONAL IDEAS

- The foam shapes are 3-D manipulatives like tessellations or like Osmo on an iPad.
- Let the students quiz each other on the names of the polygons by turning them around so that the labels can't be read.
- Instead of having students put the polygons on bases, combine everyone's polygons in a learning center, where students can arrange and rearrange them in various combinations.
- Cut 6" or 12" squares of foam to make jumbo polygons that can be displayed around the room or in a learning center.
- String them together with cord or wire to make hanging mobiles for the classroom.
- Invite students to make a video with an iPad, explaining how to use division to determine the degrees needed for making the various polygons.



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TIPS

- When you cut the foam, keep the serrated knife blade perpendicular to the table so that the foam edges are straight. Score lightly first and then press more firmly to cut deeper with several passes of the knife.
- Have extra paper plates, paper squares, paint and foam.
- Prepare the painting area, covering tables if needed. Allow for plenty of space for each student. Have a large, plastic-lined garbage can ready.
- Call attention to the protractor's numbers, such as where 0 is and that 0 is where all measuring should begin. Also point out that the extra set of numbers allows you to measure from either direction.
- Have paper towels and wipes ready to distribute to any messy fingers.

PATTERN

POLYGONS
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