Using Coffee Stirrers to Develop Reasoning about Geometric Shapes and their Attributes

Rice University School Mathematics Project
Houston, Texas
http://rusmp.rice.edu

Susan Troutman
tROUTMAN@RICE.EDU
Director of Secondary Programs

Carolyn L White
cLWHITE@RICE.EDU
Director of Elementary Programs
All students in grades 3-5 should be able to:

• identify, compare, and analyze attributes of two-and three-dimensional shapes
• develop vocabulary to describe the attributes
• classify two- and three-dimensional shapes according to their properties
• develop definitions of classes of shapes such as triangles and pyramids
• make and test conjectures about geometric properties and relationships
• develop logical arguments to justify conclusions

Level 0  Visual level
   Students judge shapes by the way they look.

Level 1  Descriptive level
   Students identify shapes according to properties.

Level 2  Informal Deduction level
   Students are able to see the interrelationships between figures.
Level 3  Formal Deduction level-Proofs
Students give reasons for steps in a proof. At this level, students are able to work with abstract statements about geometric properties and make conclusions based more on logic than intuition.

Level 4  Rigor
Students supply reasons for contradictions for a proof and rigorously compare different axiomatic systems.

Geometric Terms

Types of Angles

- Right
- Acute
- Obtuse
- Straight
- Reflex

Types of Lines

- Parallel
- Intersecting
- Perpendicular
Shapes in The Greedy Triangle

<table>
<thead>
<tr>
<th>Name of Shape</th>
<th>Number of Sides</th>
<th>Number of Angles</th>
<th>Number of Vertices</th>
<th>Real-world Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Let’s explore polygon concepts

• What is a polygon?
• Polygon Vocabulary
  o Regular
  o Sides vs Edges
Types of Triangles

Based on Side Lengths
• Equilateral
• Isosceles
• Scalene

Based on Angles
• Acute
• Right
• Obtuse
Use your coffee stirrers and chenille sticks to create different quadrilaterals.

- Square
- Rectangle
- Parallelogram
- Rhombus
- Kite
- Trapezoid
2-D Shapes Challenge

Build a:
1. Triangle with congruent sides
2. Rectangle with four congruent sides
3. Parallelogram with four congruent sides
4. Closed figure with five sides
5. Triangle with a right angle
6. Shapes that are congruent
7. Triangle with an angle whose measure is larger than the measure of a right angle
8. Quadrilateral with exactly one pair of parallel sides
9. Shape with six lines of symmetry
10. Shape with three lines of symmetry

Bonus:
• Build a shape with two diagonals
• Build a shape with nine diagonals
Right Trapezoids
Stick Figures

Cooperative Learning Activity from *Get It Together*
Solution to Stick Figures 1

In the figure, both the rectangle and the triangle are regular polygons.

Make the figure!
Let’s build three-dimensional shapes

- Cube
- Rectangular Prism
- Triangular Prism
- Square Pyramid
- Triangular Pyramid
## Attributes of 3-D Shapes

### Three Dimensional Figures

<table>
<thead>
<tr>
<th>Name of Figure</th>
<th>Number of Edges</th>
<th>Number of Faces</th>
<th>Number of Vertices</th>
<th>Conjecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cube</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangular Prism</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triangular Prism</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Square Pyramid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triangular Pyramid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
https://rusmp.rice.edu/resources/symbaloo


