Geometric Spaghetti

Topic

- Explore convex polygons

Objectives

Students will:

- Demonstrate an understanding of the characteristics of convex polygons
- Understand the necessary conditions for congruent triangles
- Learn through inquiry
- Work collaboratively to develop a general rule for the lengths of the sides of convex polygons

Timeline

- 10–20 minutes for students to generate a hypothesis and test it to form a rule

WICR Strategies

- Writing to Learn
  - Write a hypothesis
- Inquiry
  - Test a hypothesis
  - Develop a general rule based on a tested hypothesis
- Collaboration
  - Work in a small group to develop and test a hypothesis

NCTM Standards

Focal Point Grade 8

Geometry and Measurement: Analyzing two- and three-dimensional space and figures by using distance and angle

Algebra

Instructional programs from pre-kindergarten through grade 12 should enable all students to represent and analyze mathematical situations and structures using algebraic symbols.

Geometry

Instructional programs from pre-kindergarten through grade 12 should enable all students to analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.

Representation

Instructional programs from pre-kindergarten through grade 12 should enable all students to create and use representations to organize, record, and communicate mathematical ideas.

Rationale

Learning through inquiry is a critical skill. Students who interact with concepts will retain more for longer periods. In the *"Geometric Spaghetti"* activity students will be provided with the opportunity to generate hypotheses and quickly test them to form a general rule that will serve them well in their plane geometry courses.

Vertical Alignment

- This activity enables young students to discover the characteristics of polygons in a non-threatening way. The activity can be used when polygons are first introduced in the middle level and also used as students understanding of general rules of polygons and three-dimensional shapes expands in later math classes.

Materials/Preparation

- Paper
- Pencil
- Uncooked spaghetti

Instructions

- Divide the class into triads.
- Ask students to predict the number of pieces into which a piece of spaghetti will break if held at each end and bent.
  - *Note:* Physicists have reasoned that in nearly all cases the spaghetti will break into more than two pieces. (Many a sleepless night has gone into proving this mathematically.)
- Ask students to write their hypotheses.
- Survey the class for their ideas and then do the experiment.
- Ask students whose spaghetti broke into more than two pieces to use the pieces that they have to construct a convex polygon if possible.
- Ask the students who were unable to construct a convex polygon to display their pieces of spaghetti on an overhead/visual presenter for the class to see.
- Ask students to develop a rule that would explain why some students were able to construct the convex polygon and others were not.
- Ask the student groups to write a general rule for an n-sided polygon.
- Ask students to test their rule with a variety of lengths of spaghetti.
- Ask students to form triangles with three equal length sides of a given length of 10cm.
- Ask students to compare their triangles with those of other members in their group or with other groups.
- Ask students to construct triangles with side lengths of 10cm, 8cm and 15cm and then compare their triangles with those of other members in their group or other groups.

- Ask students to speculate why the all the triangles in the room are congruent.
- Ask students to speculate about how much must be known about two triangles to ensure that they are congruent.
- Divide the class into five groups and ask them to investigate the five remaining possible combinations of triangle sides and angles. (SAS, SSA, ASA, AAS and AAA)
- Ask each group to present a counterexample of why their combination does not work or a justification as to why it does.

Higher-Level Questions

Level Two

- What is the general rule for n-gons?
- What are the necessary conditions for congruent triangles?

Level Three

- Does the general rule for n-gons apply for concave polygons?
- Are there any generalizations that might be drawn for three-dimensional objects?
- Compare the characteristics of the congruent triangles and non-congruent triangles when using SSA.

Formative Assessment

- Were students able to work together to construct a general rule for an n-gon?
- Were students able to write and test a hypothesis?
- Were students able to apply their rule to a variety of polygons?
- Did students develop accurate triangle conjectures?