

# Geometry In My World

## #6 - Properties of Polyhedrons

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### Overview

Students explore the properties of three-dimensional figures (polyhedrons). They begin to identify attributes of polyhedrons and connect them to their two-dimensional jackets. Surface area is introduced and discussed.

### ***Principles and Standards for School Mathematics, National Council of Teachers of Mathematics, 2000.***

#### **Standard: Geometry** *In Grades 3 through 5, all students should -*

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

- identify, compare, and analyze attributes of two- and three-dimensional shapes and develop vocabulary to describe the attributes;
- classify two- and three-dimensional shapes according to their properties and develop definitions of classes of shapes such as triangles and pyramids;
- investigate, describe, and reason about the results of subdividing, combining, and transforming shapes;
- explore congruence and similarity;
- make and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions.

Use visualization, spatial reasoning, and geometric modeling to solve problems:

- create and describe mental images of objects, patterns, and paths;
- identify and build a three-dimensional object from two-dimensional representations of that object.

#### **Standard: Measurement** *In Grades 3 through 5, all students should -*

Apply appropriate techniques, tools, and formulas to determine measurements:

- develop strategies to determine the surface areas and volumes of rectangular solids.

#### **Standard: Problem Solving** *In Grades 3 through 5, all students should -*

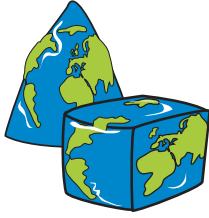
- build new mathematical knowledge through problem solving.

#### **Standard: Reasoning and Proof** *In Grades 3 through 5, all students should -*

- make and investigate mathematical conjectures.

#### **Standard: Communication** *In Grades 3 through 5, all students should -*

- communicate their mathematical thinking coherently and clearly to peers, teachers, and others;
- use the language of mathematics to express mathematical ideas precisely.



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### California Academic Standards:

These are the California Academic Standards addressed in this program. Be sure to check your local or state standards to see how this fits your curriculum.

#### Grade 3: Measurement & Geometry

- 1.0 *Students choose and use appropriate units and measurement tools to quantify the properties of objects:*
  - 1.2 Estimate or determine the area and volume of solid figures by covering them with squares or by counting the number of cubes that would fill them.
- 2.0 *Students describe and compare the attributes of plane and solid geometric figures and use their understanding to show relationships and solve problems:*
  - 2.1 Identify, describe and classify polygons (including pentagons and hexagons).
  - 2.5 Identify, describe, and classify common three-dimensional geometric objects (e.g., cube, rectangular solid, sphere, prism, pyramid, cone, cylinder).
  - 2.6 Identify common solid objects that are the components needed to make a more complex solid object.

#### Grade 3: Mathematical Reasoning

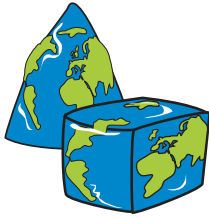
- 3.0 *Students move beyond a particular problem by generalizing to other situations:*
  - 3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.

#### Grade 4: Measurement & Geometry

- 3.0 *Students demonstrate an understanding of plane and solid geometric objects and use this knowledge to show relationships and solve problems:*
  - 3.3 Identify congruent figures.
  - 3.6 Visualize, describe and make models of geometric solids (e.g., prisms, pyramids, etc.) in terms of the number and shape of faces, edges and vertices; interpret two-dimensional representations of three-dimensional objects; and draw patterns (of faces) for a solid that, when cut and folded, will make a model of the solid.
  - 3.8 Know the definition of different quadrilaterals (e.g., rhombus, square, rectangle, parallelogram, trapezoid).

#### Grade 4: Mathematical Reasoning

- 3.0 *Students move beyond a particular problem by generalizing to other situations:*
  - 3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.



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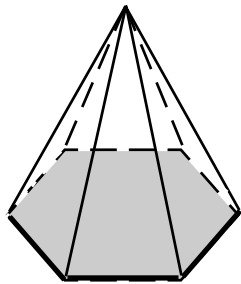
### Teacher-to-Teacher

### Geoblocks Background Information

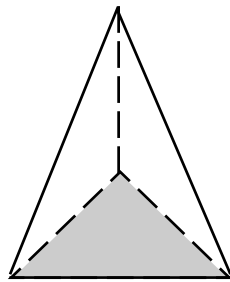
The tub of geoblocks contains three-dimensional figures called **polyhedrons**. The faces of a polyhedron are **polygons**. These geoblock polyhedrons are either pyramids or prisms.

Each flat surface is called a **face**. An **edge** is a line or line segments where two faces intersect. The point where three or more intersect is called a **vertex** (*pl.* vertices)

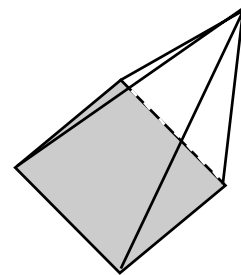
**Pyramids** have triangular faces that all meet at a common vertex. The base can be any polygon. *A pyramid takes its name from the base polygon.*



**Hexagonal Pyramid**

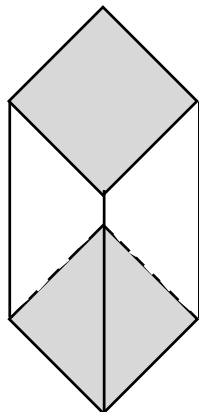


**Triangular Pyramid**

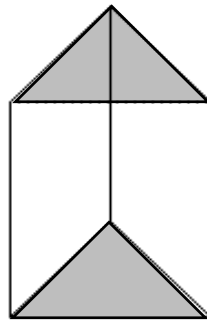


**Rectangular Pyramid**

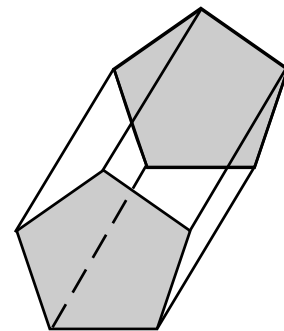
**Prisms** have at least two parallel and congruent faces. *They take their names from those faces.*



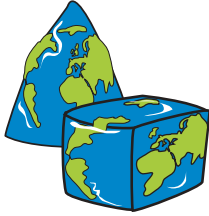
**Rectangular Prism**



**Triangular Prism**



**Pentagonal Prism**



# Geometry In My World

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### Materials

- Geoblocks - one tub per group
- .....
- SAS#6.1 - one per student pair
- SAS#6.2 - one per student pair
- TIS#6.1, #6.2 and #6.3 - transparencies of SAS#6.1
- TIS#6.4 - Journal Prompt
- .....
- Scissors- one per student
- Tape- one per student pair
- Student Journals

### Pre-viewing Activity

Review geometric terms with students.

Congruent - Same shape, size, and measurements.

Polygon - A closed geometric shape made up of line segments.

Quadrilateral- A polygon made up of exactly four line segments.

Parallelogram - A quadrilateral with two pairs of parallel sides

Rectangle - A quadrilateral with 4 - 90° angles and opposite sides are congruent

Square - A rectangle that has 4 congruent sides

Trapezoid - A quadrilateral with one pair of parallel sides

Reflective symmetry - When a figure/design has one line of symmetry. Also called bilateral symmetry. This heart has one line of symmetry.

Rotational symmetry - When a figure/design can be traced and rotated less than a complete cycle and can be made to fit exactly onto the original. This design has rotational symmetry.

Similar - Figures that have the same shape, but are **not** congruent. The corresponding angles are congruent and the corresponding sides are proportional.

Triangle - A polygon that is made up of exactly three line segments.

Acute - Triangle with all angle measures less than 90°

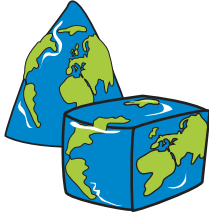
Equilateral - Triangle with all sides congruent

Isosceles - Triangle with at least two congruent sides

Obtuse - Triangle with one angle measure greater than 90°

Right - Triangle with one angle measure equal to 90°

Scalene - Triangle with no congruent sides



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### Program Viewing

<b>Welcome</b>	Introduction
<b>Focus</b>	Students describe attributes of geometric solids.
<b>Activity #1</b>	<b>Polygon Puzzles</b> (SAS#6.1 & TIS#6.1, 6.2, 6.3)
<b>DLI</b>	Discusses attributes of polygons and introduces activity <i>YOUR TIME</i>
<b>CT</b>	Facilitates activity
<b>S</b>	Solve puzzle #1 <i>YOUR TIME</i>
<b>S</b>	Students solve puzzles #2 and #3
<b>Activity #2</b>	<b>Describing Geoblocks</b>
<b>DLI</b>	Discusses geometric solids and introduces activity <i>YOUR TIME</i>
<b>CT</b>	Facilitates activity
<b>S</b>	Describe a geoblock to their partner
<b>Activity #3</b>	<b>Where can we find polyhedrons?</b>
<b>DLI</b>	Introduces the video field trip
<b>CT</b>	Facilitates activity
<b>S</b>	Identify polyhedrons during the video field trip
<b>Activity #4</b>	<b>Which jacket fits?</b> (SAS#6.2)
<b>DLI</b>	Introduces activity <i>YOUR TIME</i>
<b>CT</b>	Facilitates activity
<b>S</b>	Predict which jacket fits a block then verify
<b>Journal Writing</b>	Describe how it would look if you were inside a pyramid. (TIS#6.4)

<b>KEY</b>	<i>DLI: Distance Learning Instructor</i>	<i>CT: Classroom Teacher</i>	<i>S: Students</i>
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### Instructions for Program Viewing

#### **Activity #1 Polygon Puzzles** (SAS#6.1 & TIS#6.1, 6.2, 6.3)

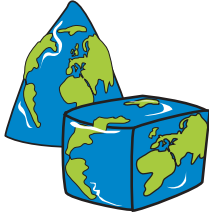
**Description** There are two *YOUR TIME* segments for this activity. Students review geometric terms as they solve puzzles.

**Materials** SAS#6.1 - one per student pair  
TIS#6.1, 6.2, 6.3 - transparencies

**Lesson Implementation** The Distance Learning Instructor discusses attributes of polygons and introduces the puzzle activity. The Classroom Teacher asks students to justify their answers.



***YOUR TIME*** Students read and discuss clues to solve puzzle #1.



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### *YOUR TIME*

Students read and discuss clues to solve puzzles #2 & #3.

### **Activity #2 Describing Geoblocks**

**Description** Students select geoblocks and describe their block to a partner in terms of number and names of faces, congruent faces and number of vertices and edges.

**Materials** Geoblocks - one tub per group

### **Lesson Implementation**

The Distance Learning Instructor attributes of geometric solids and introduces activity. Classroom Teacher encourages students to use mathematical terminology to describe their geoblocks.



### *YOUR TIME*

Students work with partners, taking turns selecting a geoblock and describing the block in detail.

### **Activity #3 Where can we find polyhedrons?**

**Description** Students take a video field trip across the nation to identify polyhedrons.

### **Lesson Implementation**

The Distance Learning Instructor introduces the video field trip. The Classroom Teacher makes sure students are identifying polyhedrons.

### **Activity #4 Which jacket fits? (SAS#6.2)**

**Description** Students predict which geoblock each jacket will cover.

**Materials** SAS#6.2 - one per student group  
Scissors - one pair per student group  
Tape - one pair per student group

### **Lesson Implementation**

The Distance Learning Instructor explains and demonstrates the activity. The Classroom Teacher encourages students to discuss and test their predictions.

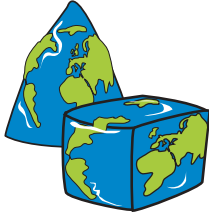


### *YOUR TIME*

Students predict which geoblock each jacket will cover. They test their predictions using the jacket to make a polyhedron and compare it to the geoblock.

## **Post-viewing Activity**

- Select a polyhedron and allow the class 20 yes-no questions to guess the polyhedron.



# Geometry In My World

## #6 - Properties of Polyhedrons

### SAS#6.1 - Polygon Puzzles

Name: \_\_\_\_\_

Date: \_\_\_\_\_

#### PUZZLE #1

Begin with the number of sides in a triangle.  
Multiply by the number of line segments in a quadrilateral.  
Add the number of sides in a rectangle.  
Subtract the number of sides in a pentagon.  
Multiply the number of parallel sides in a trapezoid.

**ANSWER TO PUZZLE #1** \_\_\_\_\_

#### PUZZLE #2

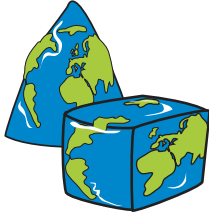
Begin with the number of sides in an octagon.  
Multiply by the number of sides in a hexagon.  
Divide by the number of right angles in a square.  
Multiply by the number of sides in a triangle.  
Subtract the number of angles in a hexagon.

**ANSWER TO PUZZLE #2** \_\_\_\_\_

#### PUZZLE #3

Begin with the number of sides in a hexagon.  
Add the number of sides in an octagon.  
Subtract the number of parallel sides in a trapezoid.  
Divide by the number of angles in a triangle.  
Multiply by the number of sides in a quadrilateral.  
Subtract the number of right angles in a right triangle.  
Divide by the number of line segments in a pentagon.

**ANSWER TO PUZZLE #3** \_\_\_\_\_

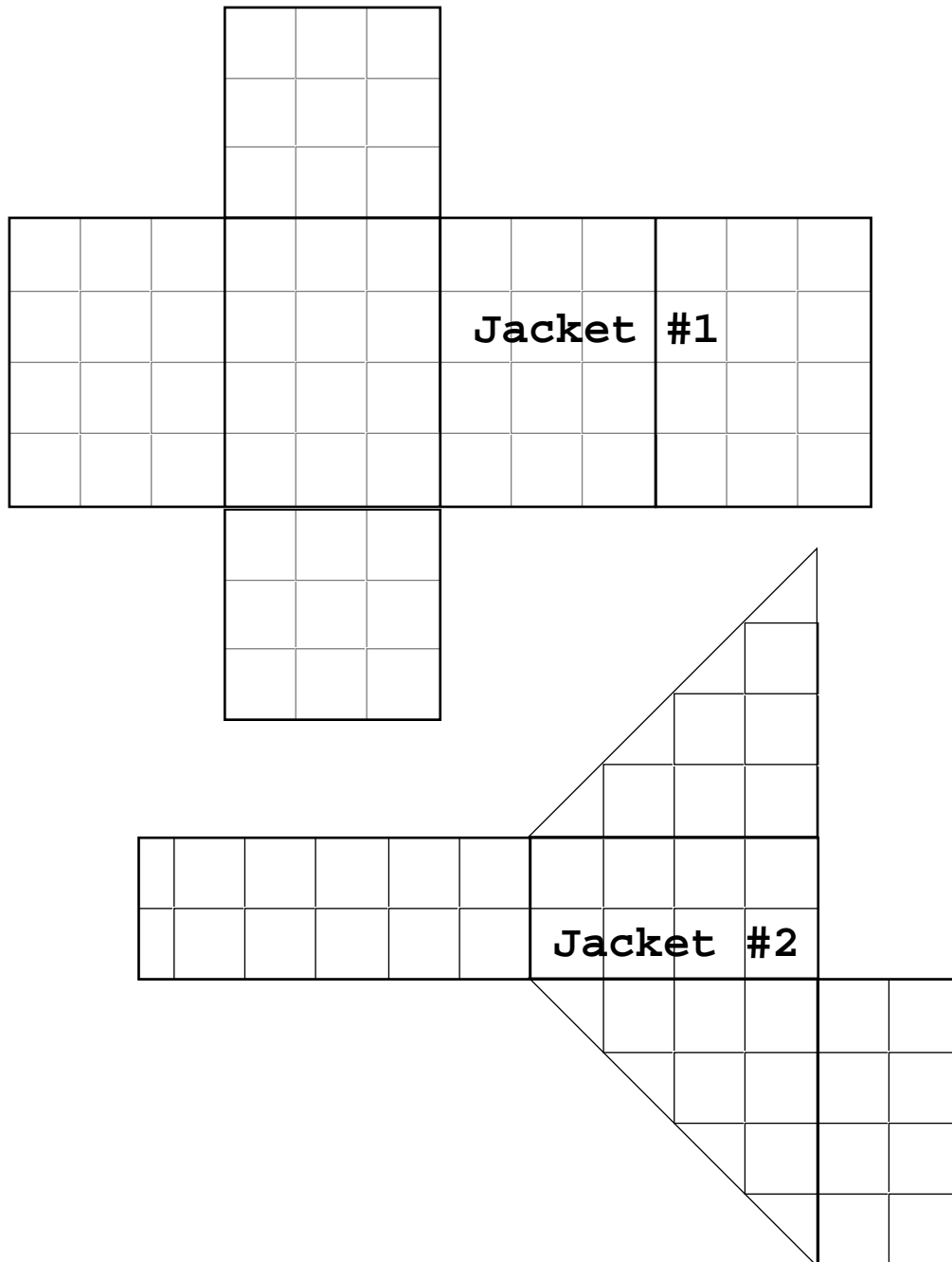


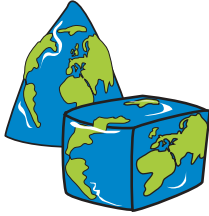
# Geometry In My World

## #6 - Properties of Polyhedrons

### SAS#6.2 - Geoblock Jackets

Predict which geoblock polyhedron each jacket matches. Discuss your predictions with your partner. Cut out the jackets and tape them to make your own geoblock.



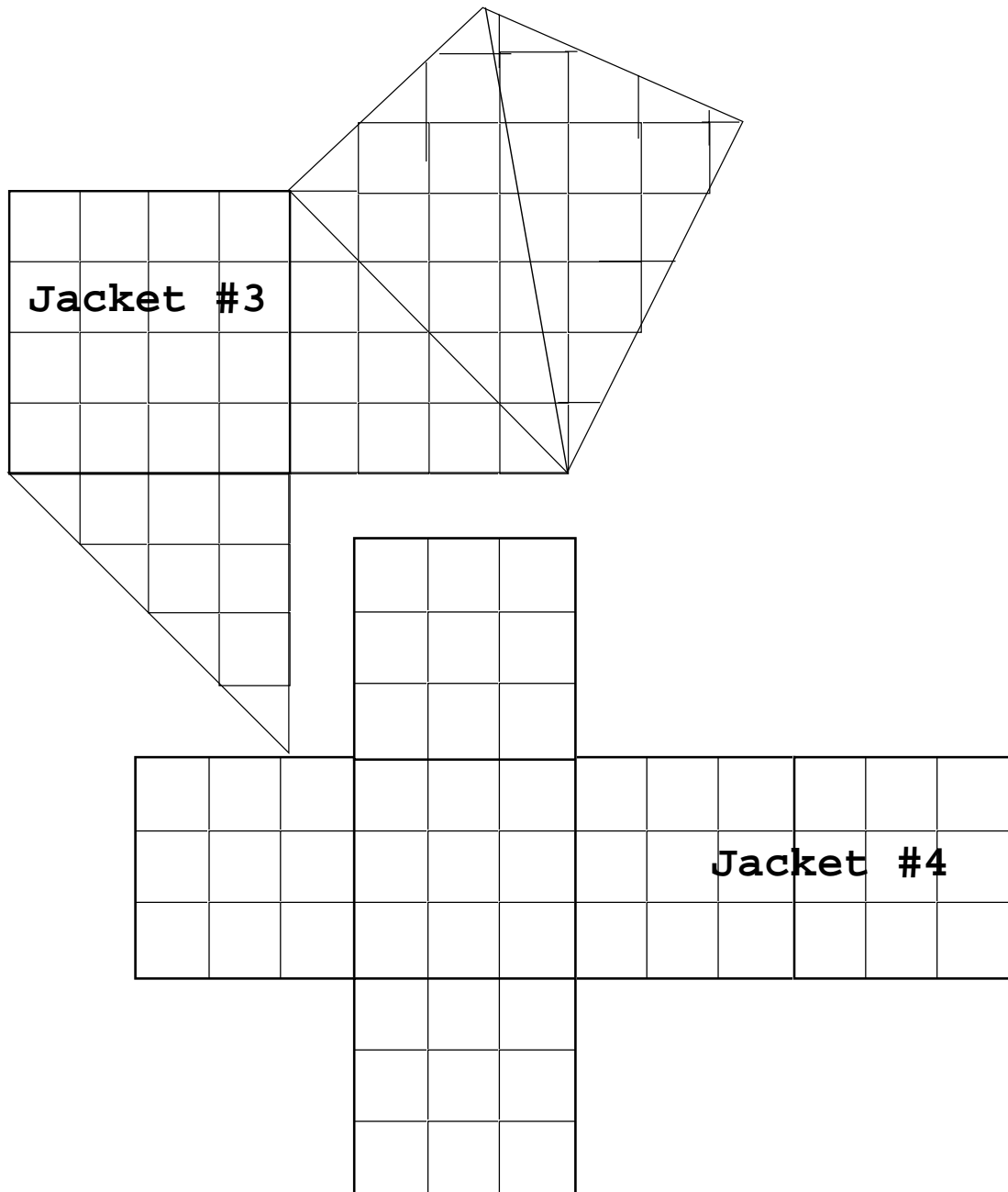


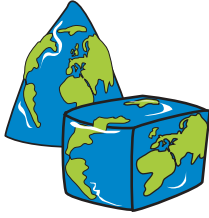
# Geometry In My World

## #6 - Properties of Polyhedrons

### SAS#6.2 - Geoblock Jackets (Cont'd.)

Predict which geoblock polyhedron each jacket matches. Discuss your predictions with your partner. Cut out the jackets and tape them to make your own geoblock.





# Geometry In My World

## #6 - Properties of Polyhedrons

### TIS#6.1 - Puzzle #1

## PUZZLE #1

Begin with the number of sides in a triangle.

Multiply by the number of line segments in a quadrilateral.

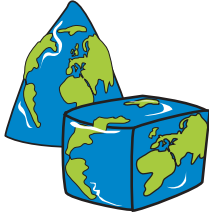
Add the number of sides in a rectangle.

Subtract the number of sides in a pentagon.

Multiply the number of parallel sides in a trapezoid.

**ANSWER:** \_\_\_\_\_





# Geometry In My World

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TIS#6.2 - Puzzle #2

### PUZZLE #2

Begin with the number of sides in an octagon.

Multiply by the number of sides in a hexagon.

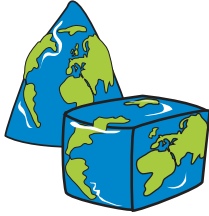
Divide by the number of right angles in a square.

Multiply by the number of sides in a triangle.

Subtract the number of angles in a hexagon.

**ANSWER:** \_\_\_\_\_





# Geometry In My World

## #6 - Properties of Polyhedrons

TIS#6.3 - Puzzle #3

### PUZZLE #3

Begin with the number of sides in a hexagon.

Add the number of sides in an octagon.

Subtract the number of parallel sides in a trapezoid.

Divide by the number of angles in a triangle.

Multiply by the number of sides in a quadrilateral.

Subtract the number of right angles in a right triangle.

Divide by the number of line segments in a pentagon.

**ANSWER:** \_\_\_\_\_



