Math Content by Strand

Geometry

Kindergarten

Geometry work builds on students' experiences interacting with and observing shapes in their environment and daily lives. Students develop a deeper understanding of the two-dimensional (2-D) and three-dimensional (3-D) world in which they live by identifying, describing, and comparing shapes, as well as composing and decomposing shapes.

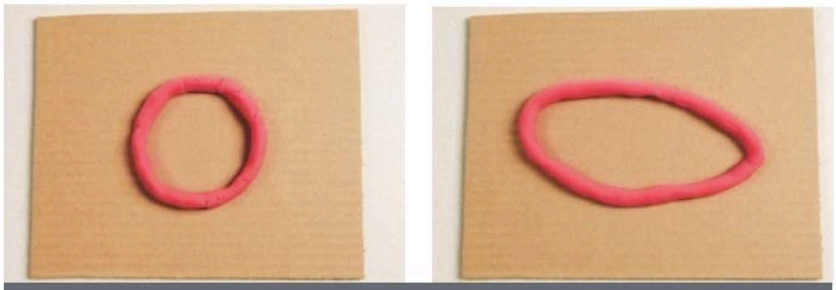
Students are encouraged to use their own words to describe shapes and to associate them with familiar objects as they learn the names used to identify them. They may describe a circle as being "round like a ball," or a rectangular prism as being "tall like a building." They describe 2-D shapes with words such as "flat" and think of 3-D shapes as "ones you can hold in your hand."

Students explore the idea that shapes can be combined to make other shapes. For example, they investigate the different combinations of pattern block shapes that can be combined to make a hexagon and compose a replica of a rectangular prism from smaller 3-D shapes.

[Ways to make a hexagon]

[One way to make a rectangular prism]

Students deepen their understanding of the attributes of 2-D and 3-D shapes and how different shapes relate to each other as they construct shapes with materials like clay and geoboards. Constructing shapes requires students to form and use mental images of the shapes and to think about the attributes of particular shapes.



When comparing shapes, students often use informal language to describe mathematical attributes. For example, "The oval and circle are both round, but the oval is longer;" and " The oval is stretched out like an egg, but is not as round as the circle."

As students are exposed to many different examples of shapes, and as they make and build various shapes, they develop and deepen their understanding of how certain attributes define a shape, and they can identify shapes regardless of size or orientation.

Working with geometric shapes and materials also provides many opportunities for students to practice and use words and phrases that describe the relative position of an object, such as *above, below, besides, in front of, behind, or next to.*

MAIN MATH IDEAS

- Describing, identifying, and comparing 2-D shapes
- Composing and decomposing 2-D shapes
- Describing, identifying, and comparing 3-D shapes
- Composing and decomposing 3-D shapes

BENCHMARKS

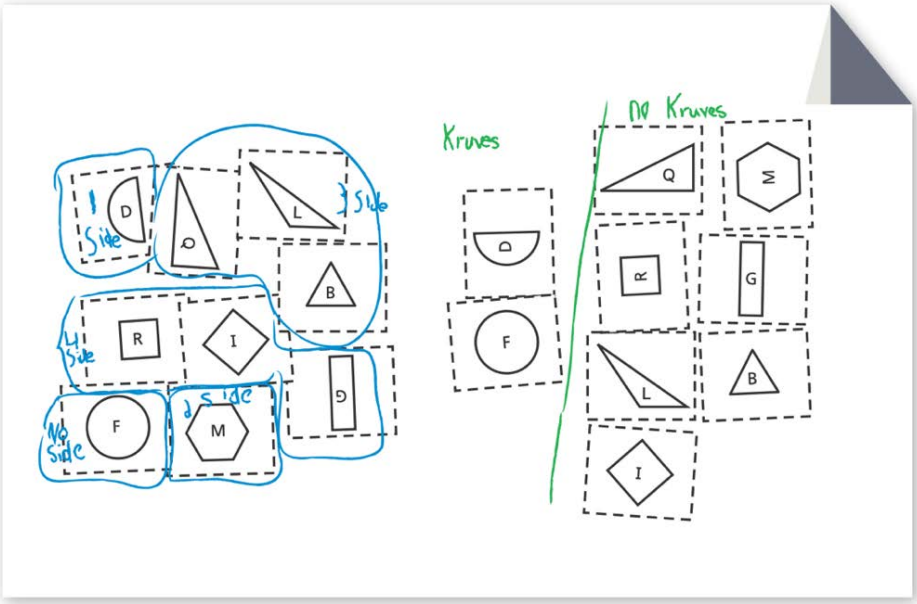
- Identify and describe the overall size, shape, and features of familiar 2-D shapes. (Unit 3)
- Make 2-D shapes. (Unit 3)
- Combine shapes to make 2-D shapes. (Unit 3)
- Identify and describe the overall size, shape, and features of familiar 3-D shapes. (Unit 5)
- Make 3-D shapes. (Unit 5)
- Combine shapes to make 3-D shapes. (Unit 5)
- Understand words that describe relative position. (Unit 5)

Grade 1

The geometry work focuses on careful observation, description, and comparison of two-dimensional (2-D) and three-dimensional (3-D) geometric shapes.

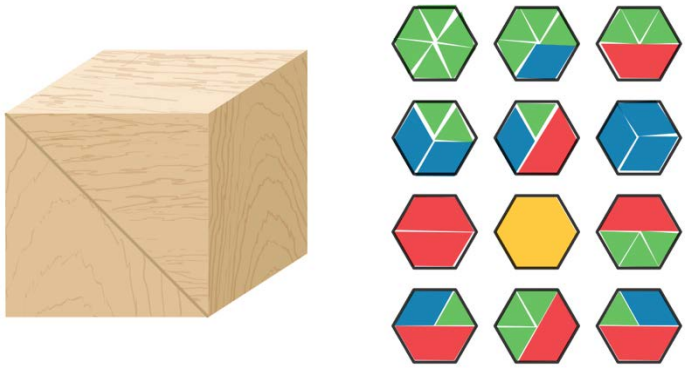
Students become more competent at determining which attributes of shapes are, or are not, important as they describe, build, and draw 2-D and 3-D shapes; as they sort and compare them; and as they think about questions such as, "What makes a triangle a triangle?" and "How is a cylinder different from a cone?"

In order to sort 2-D shapes into groups that "go together," students must look for similar and different attributes among a collection of shapes. While their categories may not always be conventional, explaining why certain shapes are grouped together helps students develop vocabulary for naming and describing the defining attributes of shapes.



[Deshawn sorted by number of sides, and Paula used curves and no curves as her categories.]

Composing and decomposing 2-D and 3-D shapes helps students learn about geometric relationships and structure. While working with GeoBlocks, students notice that they can "put together" two triangular prisms to build a cube or, with pattern blocks, that they can use two trapezoids to make a hexagon.



[Students explore ways to make composite shapes with GeoBlocks and pattern blocks.]

Work with 2-D and 3-D shapes is connected as students look carefully at two of the defining attributes of 3-D shapes—the number and shapes of faces. As students describe the 2-D faces of 3-D prisms in the GeoBlock set, they notice that some faces are square while others are (non-square) rectangles or triangles. Similarly, as they match blocks to the outlines of faces or to drawings of blocks made by other students, they are considering specific attributes, as well as developing a visual image of the 3-D shape as a whole. In doing so, they deepen their understanding of both 3-D and 2-D shapes.

[A student makes a 2-D sketch of a 3-D GeoBlock.]

As students have a variety of experiences working with geometric shapes from various perspectives, they deepen their understanding of specific shapes and their defining attributes.

MAIN MATH IDEAS

- Describing, identifying, and comparing attributes of 2-D shapes
- Composing and decomposing 2-D shapes
- Describing, identifying, and comparing attributes of 3-D shapes
- Composing and decomposing 3-D shapes
- Relating 2-D and 3-D shapes

BENCHMARKS

- Compose and decompose shapes in different ways. (Unit 2)
- Build and draw familiar 2-D shapes. (Unit 2)

- Use geometric language to describe and identify important attributes and use those attributes to sort familiar 2-D shapes. (Unit 2)
- Use geometric language to describe and identify defining attributes of familiar 3-D shapes. (Unit 8)
- Compose 3-D shapes. (Unit 8)
- Match a 2-D representation of a 3-D shape to the outline of one of its faces. (Unit 8)

Grade 2

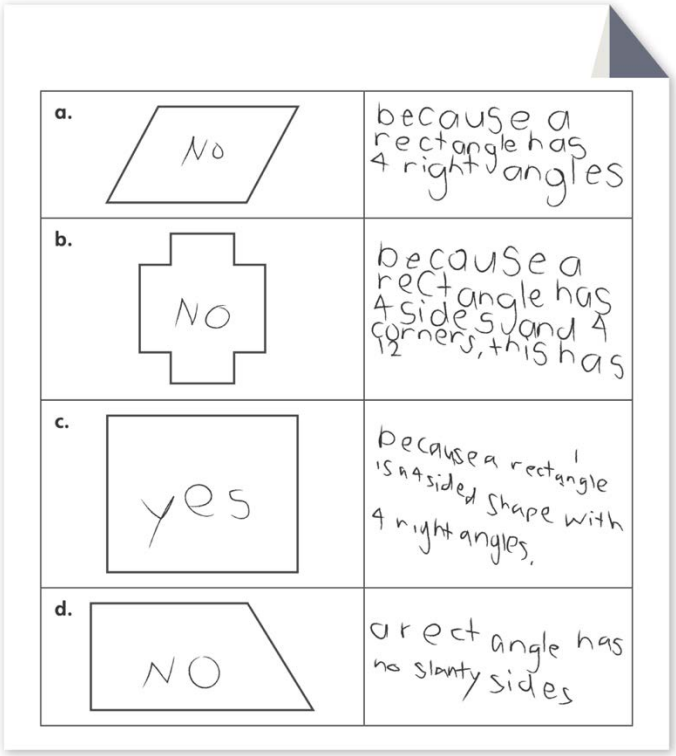
Students observe and describe the defining attributes of two-dimensional (2-D) and three-dimensional (3-D) shapes. These attributes include, for 2-D shapes, number and lengths of sides, and number of angles and vertices, and for 3-D shapes, the number, and shape(s) of faces. As students sort, compare, construct, and draw 2-D shapes and 3-D objects, they develop visual images and geometric language for describing them.

Describing GeoBlocks

General Features	Geometric Features
Some look like real objects: a box, a ramp	Faces are square
Made of wood	Has 6 faces (sides)
Smooth	Cube
	3-D shape
	Has vertices (corners, points)
	Faces are flat
	Rectangular Prism: 6 faces: 2 square faces, 4 rectangles
	Triangular Prism: 5 faces: 2 triangles, 3 rectangles

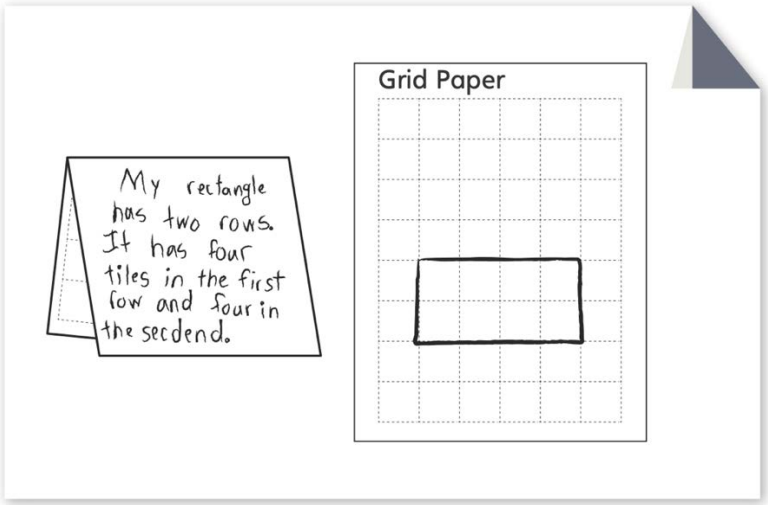
[Students identify the geometric features of GeoBlocks.]

As part of this work, students consider the defining attributes of polygons, with a particular focus on quadrilaterals. They explore the properties of rectangles and squares, and they look particularly at the defining attributes of relative side lengths (e.g., Are all four sides of equal length?) and the type of angles as they consider questions such as, "What makes a rectangle a rectangle?"



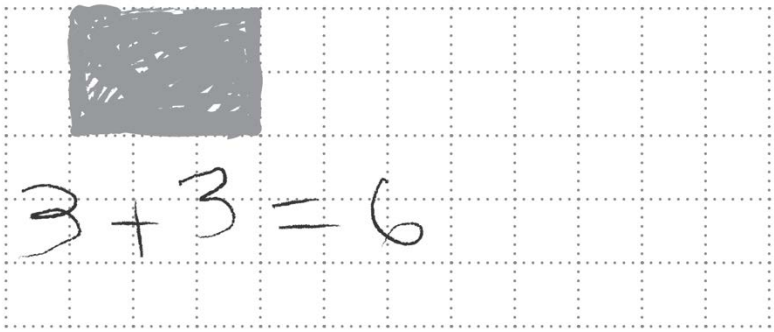
[A student explains why shapes are (or are not) rectangles.]

Students work with rectangles from two perspectives: as 4-sided shapes with 4 right angles and as arrays made of equal rows and columns of squares. Students investigate the structure of arrays as they partition rectangles into rows and columns and as they compose rectangles with square tiles.



[Students build and describe rectangles in terms of the number of columns and rows.]

The study of arrays supports students' work with number and operations. As students make and describe rectangular arrays, they use various counting strategies to determine the total number of squares in an array and use an equation to represent this total as the sum of equal addends. This work with equal groups contributes to laying the foundation for multiplication.



[As students play *Double Arrays,* they practice the doubles facts and learn about the structure of an array.]

MAIN MATH IDEAS

- Describing, identifying, and comparing attributes of 2-D and 3-D shapes
- Visualizing the structure of arrays
- Visualizing equal groups in the structure of arrays

BENCHMARKS

- Identify defining attributes of 2-D and 3-D shapes (number and shape of faces, number and length of sides, number of angles and vertices) and draw shapes with those attributes. (Unit 2)
- Make a rectangle out of same size squares and specify the number of rows and the number of squares in each row. (Unit 2)
- Write an addition equation to express the total number of objects in a rectangular array. (Unit 7)

Grade 3

Students study the attributes of 2-D shapes and how these attributes determine their classification. For example, a polygon is classified as a triangle, or a quadrilateral based on the number of its sides.

Number of sides	Name of polygon	Examples
3	triangle	
4	quadrilateral	

Students also work with the idea that shapes in different categories may share attributes. Students compare the attributes of quadrilaterals, rectangles, rhombuses, and squares and identify examples and non-examples of these different shapes. Students learn that a given shape may fall into more than one category.

All Quadrilaterals

- Have 4 straight sides
- Are closed shapes
- Have 4 angles
- Have 4 vertices

All Squares

- Have 4 straight sides
- Have 4 equal sides
- Have 4 right angles
- Have 4 vertices
- Are quadrilaterals
- Are rectangles

All Rectangles

- Have 4 straight sides
- Have 4 right angles
- Have 4 vertices
- Have opposite sides that are equal
- Are quadrilaterals

All Rhombuses

- Have 4 straight sides
- Have 4 angles
- Have 4 vertices
- Have 4 equal sides

MAIN MATH IDEA

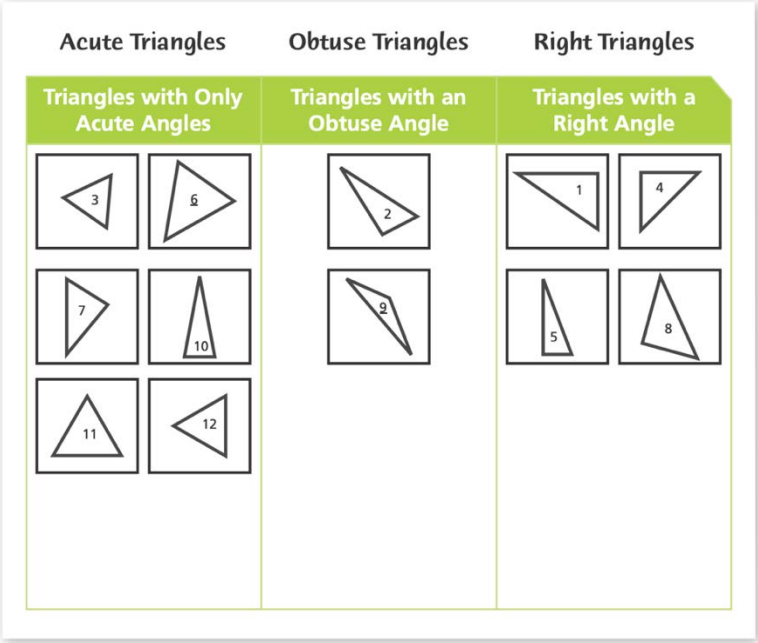
- Describing and classifying 2-D figures

BENCHMARKS

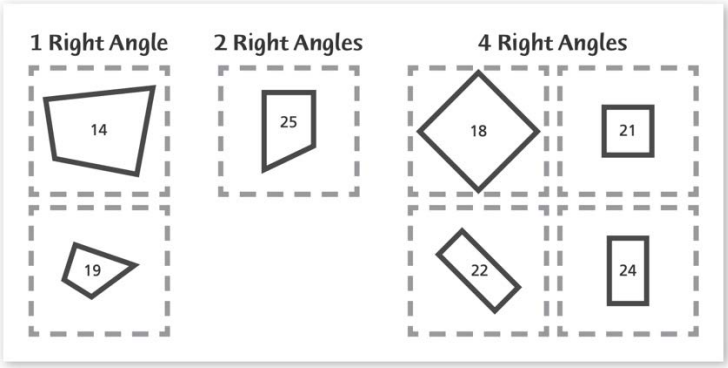
- Categorize quadrilaterals, including squares, rhombuses, and rectangles, based on their attributes. (Unit 4)

Grade 4

Students define polygons as closed shapes with straight sides and become familiar with a polygon's components—line segments, points, vertices, and angles. They study different attributes and consider how those attributes determine classifications. Polygons can be classified by their number of sides: triangles have 3 sides, quadrilaterals have 4 sides, pentagons have 5 sides, and so on. Triangles can be classified by the size of their angles (acute, obtuse, or right).

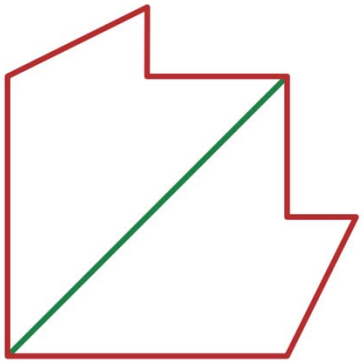


Students classify quadrilaterals by such features as the relative length of sides (rhombuses have four equal sides), the number of pairs of parallel sides (parallelograms have two pairs of parallel sides and trapezoids have one pair), and the number of pairs of perpendicular sides (the number of right angles.)



Students' work with these geometric shapes is essential for work they do in measurement—finding angle size through reasoning and learning to use a protractor—and in finding perimeter and area of rectangles. See the **Measurement** section for more information.

In their work with polygons, students learn about mirror symmetry. They identify lines of symmetry and use lines of symmetry to help them determine the area of shapes.



MAIN MATH IDEAS

- Describing and classifying 2-dimensional figures
- Identifying mirror symmetry in shapes

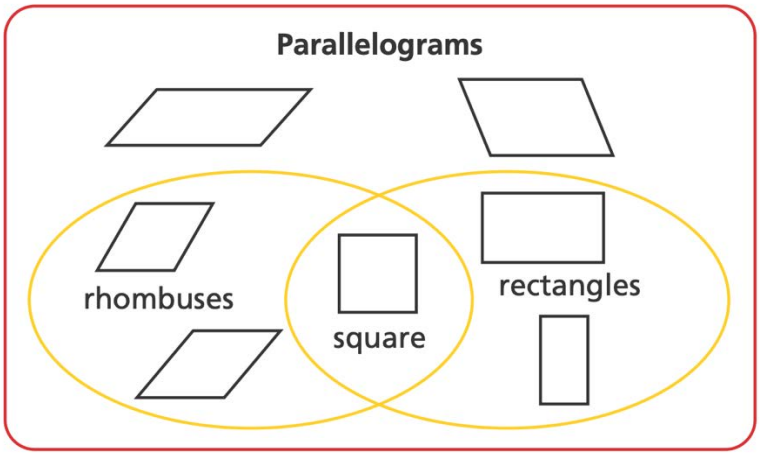
BENCHMARKS

- Draw and identify lines and angles, including parallel and perpendicular lines, and classify polygons by properties of their sides and angles. (Unit 4)
- Identify lines of symmetry in polygons. (Unit 4)

Grade 5

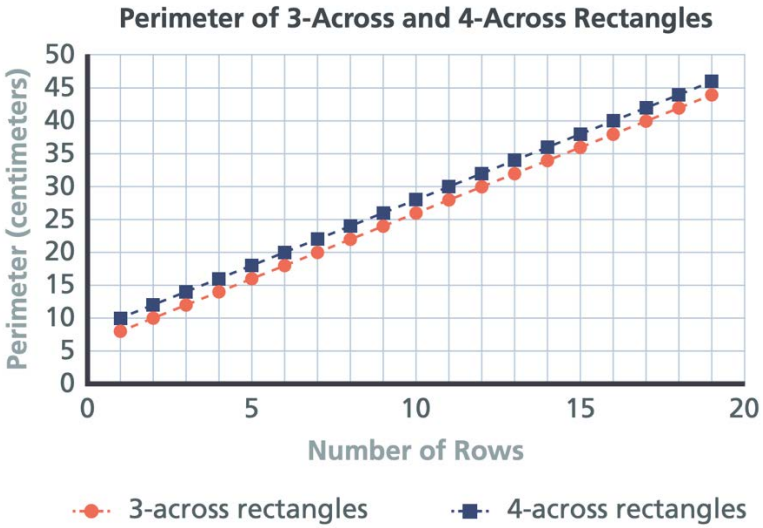
Students sort shapes based on attributes such as number of sides, relative lengths of sides, and sizes of angles. By finding shapes that share certain attributes, students determine and name properties and categories of triangles and quadrilaterals.

Students learn that some triangles or quadrilaterals fit more than one category as they consider problems and questions such as: Draw a rectangle. Is what you drew a parallelogram? Are all squares rectangles? Are all rectangles parallelograms? Can a scalene triangle also be a right triangle? Students make representations of the relationships among the different types of quadrilaterals, and see that not only can a figure belong to multiple categories, but that categories are subcategories of other categories. For example, squares are a subcategory of rectangles, which are a subcategory of parallelograms, which are a subcategory of quadrilaterals. The categories of rhombuses and rectangles overlap, but neither is a subcategory of the other.



In Unit 5, students use coordinate graphs to represent the correspondence between two quantities. Students learn that the two values represented by a point on a coordinate grid can be shown as an ordered pair—and that the order of the numbers matter: the first number is the value of the x-coordinate (the horizontal axis), and the second number is the value of the y-coordinate (the vertical axis).

Students plot ordered pairs as points on a grid using their x- and y- coordinates. See the **Analyzing Patterns and Rules** section for more information on how students use coordinate graphs, tables, and symbolic notation to solve mathematical and real-world problems.



MAIN MATH IDEAS

- Classifying two-dimensional figures
- Finding perimeter and area of related rectangles
- Modeling situations with mathematics: graphs, ordered pairs, tables, and symbolic notation

BENCHMARKS

- Use tables to record ordered pairs and construct coordinate graphs to represent the relationship between x-coordinates and y-coordinates. (Unit 5)
- Classify polygons by their attributes and know that some quadrilaterals can be classified in more than one way. (Unit 8)
- Identify and explain numerical patterns when comparing perimeters or areas of related rectangles. (Unit 8)