

Geometry

Michigan's Mathematics Grade Level Content Expectations in Geometry are categorized into four domains:

- Geometric shape and properties, and mathematical arguments (GS)
- Location and spatial relationships (LO)
- Spatial reasoning and geometric modeling (SR)
- Transformation and Symmetry (TR)

In the early grades the expectations in this strand focus heavily on recognizing, creating, describing, and comparing the basic two-dimensional and three-dimensional geometric shapes. Numeric and geometric patterns are examined, and describing location and modeling objects begins. In upper elementary grades, description of shapes and their properties is refined, the relationships among shapes are considered and analysis of symmetry and motion begins. In the middle school years the expectations emphasize special angle, line, and plane relationships, and work with congruence and similarity. Understanding of the Pythagorean Theorem is developed and applied. Combining this background with understanding of the related Measurement expectations (in gray text) for perimeter, area, and volume, students at the end of eighth grade are expected to have the tools they need to understand and model geometric situations, solve common real world problems involving geometry, and justify geometric arguments.

NUMBER & OPERATIONS

ALGEBRA

MEASUREMENT

GEOMETRY

DATA & PROBABILITY

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Professional organization whose members have contributed to the development of Michigan's K-8 Grade Level Content Expectations through their work on committees:



Michigan Council of Teachers of Mathematics



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Geometric Shapes, Properties, and Mathematical Arguments

Geometric Shapes, Properties, and Mathematical Arguments								
K	1	2	3	4	5	6	7	8
<p>G.GS.00.01 Relate familiar three-dimensional objects inside and outside the classroom to their geometric name, e.g., ball/sphere, box/cube, soup can/cylinder, ice cream cone/cone, refrigerator/prism.</p> <p>G.GS.00.02 Identify, sort, and classify objects by attribute and identify objects that do not belong in a particular group.</p> <p>G.GS.00.03 Create, describe, and extend simple geometric patterns.</p>	<p>G.GS.01.01 Create common two-dimensional and three-dimensional shapes, and describe their physical geometric attributes, such as color and shape.</p>	<p>GS.02.01 Identify, describe, and compare familiar two-dimensional and three-dimensional shapes, such as triangles, rectangles, squares, circles, semi-circles, spheres, rectangular prisms.</p> <p>G.GS.02.02 Explore and predict the results of putting together and taking apart two-dimensional and three-dimensional shapes.</p>	<p>G.GS.03.04 Identify, describe, compare, and classify two-dimensional shapes, e.g., parallelogram, trapezoid, circle, rectangle, square, and rhombus, based on their component parts (angles, sides, vertices, line segments) and on the number of sides and vertices.</p> <p>G.GS.03.03 Identify parallel faces of rectangular prisms in familiar shapes and in the classroom.</p> <p>G.GS.03.06 Identify, describe, build, and classify familiar three-dimensional solids, e.g., cube, rectangular prism, sphere, pyramid, cone, based on their component parts (faces, surfaces, bases, edges, vertices).</p>	<p>G.GS.04.02 Identify basic geometric shapes, including isosceles, equilateral, and right triangles, and use their properties to solve problems.</p>		<p>G.GS.06.02 Understand that for polygons, congruence means corresponding sides and angles have equal measures.</p>		
	<p>M.UN.01.01 Measure the lengths of objects in non-standard units, e.g., pencil lengths, shoe lengths, to the nearest whole unit.</p> <p>M.UN.01.02 Compare measured lengths using the words shorter, shortest, longer, longest, taller, tallest, etc.</p>	<p>M.UN.02.01 Measure lengths in meters, centimeters, inches, feet, and yards approximating to the nearest whole unit and using abbreviations: cm, m, in, ft, yd.</p> <p>M.TE.02.11 Determine perimeters of rectangles and triangles by adding lengths of sides, recognizing the meaning of perimeter.</p> <p>G.GS.02.04 Distinguish between curves and straight lines and between curved surfaces and flat surfaces.</p>	<p>M.UN.03.07 Distinguish between units of length and area and choose a unit appropriate in the context.</p> <p>M.UN.03.05 Know the definition of area and perimeter and calculate the perimeter of a square and rectangle given whole number side lengths.</p> <p>G.GS.03.01 Identify points, line segments, lines, and distance.</p> <p>G.GS.03.02 Identify perpendicular lines and parallel lines in familiar shapes and in the classroom.</p>	<p>M.TE.04.04 Measure surface area of cubes and rectangular prisms by covering and counting area of the faces.</p> <p>M.TE.04.10 Identify right angles and compare angles to right angles.</p> <p>G.GS.04.01 Identify and draw perpendicular, parallel, and intersecting lines using a ruler and a tool or object with a square (90°) corner.</p>	<p>G.GS.05.04 Find unknown angles in problems involving angles on a straight line, angles surrounding a point, and vertical angles.</p> <p>G.GS.05.02 Measure angles with a protractor and classify them as acute, right, obtuse, or straight.</p> <p>G.GS.05.03 Identify and name angles on a straight line and vertical angles.</p> <p>G.GS.05.05 Know that angles on a straight line add up to 180° and angles surrounding a point add up to 360°; justify informally by “surrounding” a point with angles.</p>	<p>G.GS.06.01 Understand and apply basic properties of lines, angles, and triangles, including:</p> <ul style="list-style-type: none"> • triangle inequality • relationships of vertical angles, complementary angles, supplementary angles • congruence of corresponding and alternate interior angles when parallel lines are cut by a transversal, and that such congruences imply parallel lines • locate interior and exterior angles of any triangle, and use the property that an exterior angle of a triangle is equal to the sum of the remote (opposite) interior angles • know that the sum of the exterior angles of a convex polygon is 360°. 		<p>G.GS.08.01 Understand at least one proof of the Pythagorean Theorem; use the Pythagorean Theorem and its converse to solve applied problems including perimeter, area, and volume problems.</p>
					<p>G.GS.05.07 Find unknown angles and sides using the properties of: triangles, including right, isosceles, equilateral; parallelograms, including rectangles and rhombuses; and trapezoids.</p> <p>G.GS.05.06 Understand why the sum of the interior angles of a triangle is 180° and the sum of the interior angles of a quadrilateral is 360°, and use these properties to solve problems.</p>			

* revised expectations in italics



Geometric Shapes, Properties, and Mathematical Arguments

Geometric Shapes, Properties, and Mathematical Arguments continued								
K	I	2	3	4	5	6	7	8
			<p>M.TE.03.09 Estimate the perimeter of a square and rectangle in inches and centimeters; estimate the area of a square and rectangle in square inches and square centimeters.</p> <p>M.PS.03.13 Solve contextual problems about perimeters of rectangles and areas of rectangular regions.</p>	<p>M.TE.04.06 Know and understand the formulas for perimeter and area of a square, and a rectangle; calculate the perimeters and areas of these shapes and combinations of these shapes using the formulas.</p> <p>M.TE.04.07 Find one dimension of a rectangle given the other dimension and its perimeter or area.</p> <p>M.TE.04.08 Find the side of a square given its perimeter or area.</p> <p>M.PS.04.09 Solve contextual problems about perimeter and area of squares and rectangles in compound shapes.</p> <p>M.PS.04.11 Solve contextual problems about surface area.</p>	<p>M.TE.05.06 Understand and know how to use the area formula of a triangle: $A = \frac{1}{2}bh$ (where b is length of the base and h is the height), and represent using models and manipulatives.</p> <p>M.TE.05.07 Understand and know how to use the area formula for a parallelogram: $A = bh$, and represent using models and manipulatives.</p> <p>M.TE.05.10 Solve applied problems about the volumes of rectangular prisms using multiplication and division and using the appropriate units.</p> <p>M.PS.05.05 Represent relationships between areas of rectangles, triangles, and parallelograms using models.</p>	<p>M.TE.06.03 Compute the volume and surface area of cubes and rectangular prisms given the lengths of their sides, using formulas.</p>		

Location and Spatial Relationships

Location and Spatial Relationships								
	<p>LO.01.02 Describe relative position of objects on a plane and in space, using words such as above, below, behind, in front of.</p>	<p>G.LO.02.07 Find and name locations using simple coordinate systems such as maps and first quadrant grids.</p> <p>M.TE.02.04 Find the area of a rectangle with whole number side lengths by covering with unit squares and counting, or by using a grid of unit squares; write the area as a product.</p>						<p>G.LO.08.02 Find the distance between two points on the coordinate plane using the distance formula; recognize that the distance formula is an application of the Pythagorean Theorem.</p>

Spatial Reasoning and Geometric Modeling

Spatial Reasoning and Geometric Modeling								
<p>G.SR.01.03 Create and describe patterns, such as repeating patterns and growing patterns using number, shape, and size.</p> <p>G.SR.01.04 Distinguish between repeating and growing patterns.</p> <p>G.SR.01.05 Predict the next element in a simple repeating pattern.</p> <p>G.SR.01.06 Describe ways to get to the next element in simple repeating patterns.</p>	<p>G.SR.02.05 Classify familiar plane and solid objects, e.g., square, rectangle, rhombus, cube, pyramid, prism, cone, cylinder, and sphere, by common attributes such as shape, size, color, roundness, or number of corners and explain which attributes are being used for classification.</p>	<p>G.SR.03.05 Compose and decompose triangles and rectangles to form other familiar two-dimensional shapes, e.g., form a rectangle using two congruent right triangles, or decompose a parallelogram into a rectangle and two right triangles.</p> <p>G.SR.03.07 Represent front, top, and side views of solids built with cubes.</p> <p>M.UN.03.06 Use square units in calculating area by covering the region and counting the number of square units.</p>	<p>G.SR.04.03 Identify and count the faces, edges, and vertices of basic three-dimensional geometric solids including cubes, rectangular prisms, and pyramids; describe the shape of their faces.</p>		<p>M.TE.05.08 Build solids with unit cubes and state their volumes.</p>	<p>G.SR.06.05 Use paper folding to perform basic geometric constructions of perpendicular lines, midpoints of line segments and angle bisectors; justify informally.</p>	<p>G.SR.07.01 Use a ruler and other tools to draw squares, rectangles, triangles, and parallelograms with specified dimensions.</p> <p>G.SR.07.02 Use compass and straightedge to perform basic geometric constructions: the perpendicular bisector of a segment, an equilateral triangle, and the bisector of an angle; understand informal justifications.</p>	<p>G.SR.08.08 Sketch a variety of two-dimensional representations of three-dimensional solids including orthogonal views (top, front, and side), picture views (projective or isometric), and nets; use such two-dimensional representations to help solve problems.</p> <p>G.SR.08.03 Understand the definition of a circle; know and use the formulas for circumference and area of a circle to solve problems.</p> <p>G.SR.08.04 Find area and perimeter of complex figures by subdividing them into basic shapes (quadrilaterals, triangles, circles).</p> <p>G.SR.08.05 Solve applied problems involving areas of triangles, quadrilaterals, and circles.</p> <p>G.SR.08.06 Know the volume formulas for generalized cylinders ((area of base) x height), generalized cones and pyramids ($\frac{1}{3}$ (area of base) x height), and spheres ($\frac{4}{3} \pi$ (radius)³) and apply them to solve problems.</p> <p>G.SR.08.07 Understand the concept of surface area and find the surface area of prisms, cones, spheres, pyramids, and cylinders.</p>

* revised expectations in italics



Transformation and Symmetry

Transformation and Symmetry								
K	I	2	3	4	5	6	7	8
		<p>G.TR.02.06 Recognize that shapes that have been slid, turned, or flipped are the same shape, e.g., a square rotated 45° is still a square.</p>		<p>G.TR.04.04 Recognize plane figures that have line symmetry.</p> <p>G.TR.04.05 Recognize rigid motion transformations (flips, slides, turns) of a two-dimensional object.</p>	<p>G.TR.05.01 Associate an angle with a certain amount of turning; know that angles are measured in degrees; understand that 90°, 180°, 270°, and 360° are associated respectively, with $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and full turns.</p>	<p>G.TR.06.03 Understand the basic rigid motions in the plane (reflections, rotations, translations), relate these to congruence, and apply them to solve problems.</p> <p>G.TR.06.04 Understand and use simple compositions of basic rigid transformations, e.g., a translation followed by a reflection.</p>	<p>G.TR.07.03 Understand that in similar polygons, corresponding angles are congruent and the ratios of corresponding sides are equal; understand the concepts of similar figures and scale factor.</p> <p>G.TR.07.04 Solve problems about similar figures and scale drawings.</p> <p>G.TR.07.05 Show that two triangles are similar using the criteria: corresponding angles are congruent (AAA similarity); the ratios of two pairs of corresponding sides are equal and the included angles are congruent (SAS similarity); ratios of all pairs of corresponding sides are equal (SSS similarity); use these criteria to solve problems and to justify arguments.</p> <p>G.TR.07.06 Understand and use the fact that when two triangles are similar with scale factor of r, their areas are related by a factor of r^2.</p>	<p>G.TR.08.09 Understand the definition of a dilation from a point in the plane and relate it to the definition of similar polygons.</p> <p>G.TR.08.10 Understand and use reflective and rotational symmetries of two-dimensional shapes and relate them to transformations to solve problems.</p>