Geometry and Spatial Sense

Grades K-2

Ohio Benchmarks Grades K-2	Grade-Level Indicators Kindergarten	Grade-Level Indicators Grade 1	Grade-Level Indicators Grade 2
A. Describe and create plane figures: circle, rectangle, square, triangle, hexagon, trapezoid, parallelogram and rhombus, and identify them in the environment.		2. Create new shapes by combining or cutting apart existing shapes. 3. Identify the shapes of the faces of three-dimensional objects.	1. Identify, describe, compare, and sort three-dimensional objects (i.e., cubes, spheres, prisms, cones, cylinders and pyramids) according to the shape of the faces or the numbers of faces, edges, or vertices. 2. Predict what new shapes will be formed by combining or cutting apart existing shapes.
B. Describe solid objects: cube, rectangular prism, sphere, cylinder, cone and pyramid, and identify them in the environment.		3. Identify the shapes of the faces of three-dimensional objects.	1. Identify, describe, compare, and sort three-dimensional objects (i.e., cubes, spheres, prisms, cones, cylinders and pyramids) according to the shape of the faces or the numbers of faces, edges, or vertices.

Geometry and Spatial Sense
Grades K-2

Ohio Benchmarks Grades K-2	Grade-Level Indicators Kindergarten	Grade-Level Indicators Grade 1	Grade-Level Indicators Grade 2
C. Sort and compare two-dimensional figures and three-dimensional objects according to their characteristics and properties.	1. Identify and sort two-dimensional shapes and three-dimensional objects. For example: a. Identify and describe two-dimensional figures and three-dimensional objects from the environment using the child's own vocabulary. b. Sort shapes and objects into groups based on student-defined categories. c. Select all shapes or objects of one type from a group. d. Build two-dimensional figures using paper shapes or tangrams; build simple three-dimensional objects using blocks.	1. Identify, compare, and sort two-dimensional shapes; i.e., square, circle, ellipse, triangle, rectangle, rhombus, trapezoid, parallelogram, pentagon, and hexagon. For example: a. Recognize and identify triangles and rhombuses independent of position, shape or size; b. Describe two-dimensional shapes using attributes such as number of sides and number of vertices (corners, or angles).	1. Identify, describe, compare, and sort three-dimensional objects (i.e., cubes, spheres, prisms, cones, cylinders and pyramids) according to the shape of the faces or the numbers of faces, edges, or vertices.

Geometry and Spatial Sense
Grades K-2

Ohio Benchmarks Grades K-2	Grade-Level Indicators Kindergarten	Grade-Level Indicators Grade 1	Grade-Level Indicators Grade 2
D. Identify, explain and model (superposition, copying) the concept of shapes being congruent and similar.		5. Copy figures and draw simple two-dimensional shapes from memory.	4. Identify and determine whether two-dimensional shapes are congruent (same shape and size) or similar (same shape different size) by copying or using superposition (lay one thing on top of another).
E. Recognize two- and three-dimensional objects from different positions.		5. Copy figures and draw simple two-dimensional shapes from memory.	3. Recognize two-dimensional shapes and three-dimensional objects from different positions.

Geometry and Spatial Sense
Grades K-2

Ohio Benchmarks Grades K-2	Grade-Level Indicators Kindergarten	Grade-Level Indicators Grade 1	Grade-Level Indicators Grade 2
F. Describe location, using comparative (before, after), directional (above, below), and positional (first, last) words.	2. Name and demonstrate the relative position of objects as follows: a. place objects over, under, inside, outside, on, beside, between, above, below, on top of, upside-down, behind, in back of, in front of; b. describe placement of objects with terms such as on, inside, outside, above, below, over, under, beside, between, in front of, behind.	4. Extend the use of location words to include distance (near, far, close to) and directional words (left, right).	
G. Identify and draw figures with line symmetry.		5. Copy figures and draw simple two-dimensional shapes from memory.	5. Create and identify two-dimensional figures with line symmetry; e.g., what letter shapes, logos, polygons are symmetrical?

K-2 | 3-4 | 5-7 | 8-10 | 11-12 | Back

Geometry and Spatial Sense
Grades 3-4

Ohio Benchmarks Grades 3-4	Grade-Level Indicators Grade 3	Grade-Level Indicators Grade 4
A. Provide rationale for groupings and comparisons of two-dimensional figures and three-dimensional objects.	1. Analyze and describe properties of two-dimensional shapes and three-dimensional objects using terms such as vertex, edge, angle, side and face.	3. Identify similarities and differences of quadrilaterals; e.g., squares, rectangles, parallelograms and trapezoids. 4. Identify and define triangles based on angle measures (equiangular, right, acute and obtuse triangles) and side lengths (isosceles, equilateral and scalene triangles).
B. Describe and identify points, lines and planes in the environment.		5. Describe points, lines and planes, and identify models in the environment.
C. Describe and identify intersecting, parallel and perpendicular lines or segments in the environment.		1. Identify, describe and model intersecting, parallel and perpendicular lines and line segments; e.g., use straws or other material to model lines.

Geometry and Spatial Sense
Grades 3-4

Ohio Benchmarks Grades 3-4	Grade-Level Indicators Grade 3	Grade-Level Indicators Grade 4
D. Identify and draw right, obtuse, acute and straight angles.	2. Identify and describe the relative size of angles with respect to right angles as follows: a. Use physical models, like straws, to make different sized angles by opening and closing the sides, not by changing the side lengths. b. Identify, classify and draw right, acute, obtuse and straight angles.	
E. Use attributes to describe, classify and sketch plane figures and build solid objects.	1. Analyze and describe properties of two-dimensional shapes and three-dimensional objects using terms such as vertex, edge, angle, side and face. 5. Build a three-dimensional model of an object composed of cubes; e.g., construct a model based on an illustration or actual object.	2. Describe, classify, compare and model two- and three-dimensional objects using their attributes.

Geometry and Spatial Sense
Grades 3-4

Ohio Benchmarks Grades 3-4	Grade-Level Indicators Grade 3	Grade-Level Indicators Grade 4
F. Develop definitions of classes of shapes.		3. Identify similarities and differences of quadrilaterals; e.g., squares, rectangles, parallelograms and trapezoids. 4. Identify and define triangles based on angle measures (equiangular, right, acute and obtuse triangles) and side lengths (isosceles, equilateral and scalene triangles).
G. Find and name locations in coordinate systems.	3. Find and name locations on a labeled grid or coordinate system; e.g., a map or graph.	6. Specify locations and plot ordered pairs on a coordinate plane, using first quadrant points.
H. Identify and describe line and rotational symmetry in two-dimensional shapes and designs.	4. Draw lines of symmetry to verify symmetrical two-dimensional shapes.	
I. Describe, identify and model reflections, rotations and translations, using physical materials.		7. Identify, describe and use reflections (flips), rotations (turns), and translations (slides) in solving geometric problems; e.g., use transformations to determine if 2 shapes are congruent.

Geometry and Spatial Sense
Grades 3-4

Ohio Benchmarks Grades 3-4	Grade-Level Indicators Grade 3	Grade-Level Indicators Grade 4
J. Describe a motion or series of transformations that show two shapes are congruent.		7. Identify, describe and use reflections (flips), rotations (turns), and translations (slides) in solving geometric problems; e.g., use transformations to determine if 2 shapes are congruent.
		Note: There are instances when a grade-level indicator for one standard is linked to a benchmark for a different standard. See correlations for ***Number, Number Sense and Operations*** *(page 17) and* ***Measurement*** *(page 13) for indicator 8.*

K-2 | 3-4 | 5-7 | 8-10 | 11-12 | Back

Geometry and Spatial Sense
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
A. Identify and label angle parts and the regions defined within the plane where the angle resides.	2. Use standard language to describe line, segment, ray, angle, skew, parallel and perpendicular. 3. Label vertex, rays, interior and exterior for an angle.		
B. Draw circles, and identify and determine the relationships among the radius, diameter, center and circumference.	1. Draw circles, and identify and determine relationships among the radius, diameter, center and circumference; e.g., radius is half the diameter, the ratio of the circumference of a circle to its diameter is an approximation of π.		
C. Specify locations and plot ordered pairs on a coordinate plane.	6. Extend understanding of coordinate system to include points whose *x* or *y* values may be negative numbers.		

Geometry and Spatial Sense
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
D. Identify, describe and classify types of line pairs, angles, two-dimensional figures and three-dimensional objects using their properties.	2. Use standard language to describe line, segment, ray, angle, skew, parallel and perpendicular. 5. Use physical models to determine the sum of the interior angles of triangles and quadrilaterals. 7. Understand that the measure of an angle is determined by the degree of rotation of an angle side rather than the length of either side.	1. Classify and describe two-dimensional and three-dimensional geometric figures and objects by using their properties; e.g., interior angle measures, perpendicular/parallel sides, congruent angles/sides. 2. Use standard language to define geometric vocabulary: vertex, face, altitude, diagonal, isosceles, equilateral, acute, obtuse, etc. 4. Identify and define relationships between planes; i.e., parallel, perpendicular and intersecting.	2. Determine sufficient (not necessarily minimal) properties that define a specific two-dimensional figure or three-dimensional object. For example: a. Determine when one set of figures is a subset of another; e.g., all squares are rectangles. b. Develop a set of properties that eliminates all but the desired figure; e.g., only squares are quadrilaterals with all sides congruent and all angles congruent.

Geometry and Spatial Sense
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
E. Use proportions to express relationships among corresponding parts of similar figures.			1. Use proportional reasoning to describe and express relationships between parts and attributes of similar and congruent figures. 6. Determine and use scale factors for similar figures to solve problems using proportional reasoning.
F. Describe and use the concepts of congruence, similarity and symmetry to solve problems.	4. Describe and use properties of congruent figures to solve problems.	6. Draw similar figures that model proportional relationships; e.g., model similar figures with a 1 to 2 relationship by sketching two of the same figure, one with corresponding sides twice the length of the other.	4. Determine necessary conditions for congruence of triangles. 7. Identify the line and rotation symmetries of two-dimensional figures to solve problems.

Geometry and Spatial Sense
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
G. Describe and use properties of triangles to solve problems involving angle measures and side lengths of right triangles.	5. Use physical models to determine the sum of the interior angles of triangles and quadrilaterals.	3. Use multiple classification criteria to classify triangles; e.g., right scalene triangle.	3. Use and demonstrate understanding of the properties of triangles. For example: a. Use Pythagorean Theorem to solve problems involving right triangles. b. Use triangle angle sum relationships to solve problems. 5. Apply properties of congruent or similar triangles to solve problems involving missing lengths and angle measures. *Note: There are instances when a grade-level indicator for one standard is linked to a benchmark for a different standard. See also correlation for **Patterns, Functions and Algebra** (page 12) for indicator 3.*

Geometry and Spatial Sense
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
H. Predict and describe results (size, position, orientation) of transformations of two-dimensional figures.		5. Predict and describe sizes, positions and orientations of two-dimensional shapes after transformations such as reflections, rotations, translations and dilations.	8. Perform translations, reflections, rotations and dilations of two-dimensional figures using a variety of methods (paper folding, tracing, graph paper).
I. Identify and draw three-dimensional objects from different views (top, side, front and perspective).	8. Predict what three-dimensional object will result from folding a two-dimensional net, then confirm the prediction by folding the net.	7. Build three-dimensional objects built with cubes and sketch the two-dimensional representations of each side; i.e., projection sets.	9. Draw representations of three-dimensional geometric objects from different views.

Geometry and Spatial Sense
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
J. Apply properties of equality and proportionality to solve problems involving congruent or similar figures; e.g., create a scale drawing.	4. Describe and use properties of congruent figures to solve problems.	6. Draw similar figures that model proportional relationships; e.g., model similar figures with a 1 to 2 relationship by sketching two of the same figure, one with corresponding sides twice the length of the other.	1. Use proportional reasoning to describe and express relationships between parts and attributes of similar and congruent figures. 6. Determine and use scale factors for similar figures to solve problems using proportional reasoning.

K-2 | 3-4 | 5-7 | 8-10 | 11-12 | Back

Geometry and Spatial Sense
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
A. Formally define geometric figures.			1. Formally define and explain key aspects of geometric figures, including: a. interior and exterior angles of polygons; b. segments related to triangles (median, altitude, midsegment); c. points of concurrency related to triangles (centroid, incenter, orthocenter, and circumcenter); d. circles (radius, diameter, chord, circumference, major arc, minor arc, sector, segment, inscribed angle). 2. Recognize and explain the necessity for certain terms to remain undefined, such as point, line and plane. 6. Identify the reflection and rotation symmetries of two- and three-dimensional figures. 10. Solve problems involving chords, radii, and arcs within the same circle.

Geometry and Spatial Sense
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
B. Describe and apply the properties of similar and congruent figures; and justify conjectures involving similarity and congruence.	1. Make and test conjectures about characteristics and properties (e.g., sides, angles, symmetry) of two-dimensional figures and three-dimensional objects. 3. Use proportions in several forms to solve problems involving similar figures (part-to-part, part-to-whole, corresponding sides between figures).		
C. Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines, and parallel lines.	2. Recognize the angles formed and the relationship between the angles when two lines intersect and when parallel lines are cut by a transversal.		10. Solve problems involving chords, radii, and arcs within the same circle.

Geometry and Spatial Sense
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
D. Use coordinate geometry to represent and examine the properties of geometric figures.	1. Make and test conjectures about characteristics and properties (e.g., sides, angles, symmetry) of two-dimensional figures and three-dimensional objects. 4. Represent and analyze shapes using coordinate geometry; e.g., given three vertices and the type of quadrilateral, find the coordinates of the fourth vertex.		

Geometry and Spatial Sense
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
E. Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology.	6. Draw nets for a variety of prisms, pyramids, cylinders and cones.		4. Construct right triangles, equilateral triangles, parallelograms, trapezoids, rectangles, rhombuses, squares and kites, using compass and straightedge or dynamic geometry software. 5. Construct congruent or similar figures using tools, such as compass, straightedge, and protractor or dynamic geometry software. 7. Perform reflections and rotations using compass and straightedge constructions and dynamic geometry software.

Geometry and Spatial Sense
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
F. Represent and model transformations in a coordinate plane and describe the results.	5. Draw the results of translations, reflections, rotations and dilations of objects in the coordinate plane, and determine properties that remain fixed; e.g., lengths of sides remain the same under translations.		8. Derive coordinate rules for translations, reflections and rotations of geometric figures in the coordinate plane. 9. Show and describe the results of combinations of translations, reflections and rotations (compositions); e.g., perform compositions and specify the result of a composition as the outcome of a single motion, when applicable.
G. Prove or disprove conjectures and solve problems involving two- and three-dimensional objects represented within a coordinate system.		3. Analyze two-dimensional figures in a coordinate plane; e.g., use slope and distance formulas to show that a quadrilateral is a parallelogram.	*Note: This benchmark is also supported with indicators from benchmark F and benchmark H.*

Geometry and Spatial Sense
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
H. Establish the validity of conjectures about geometric objects, their properties and relationships by counter-example, inductive and deductive reasoning, and critiquing arguments made by others.	1. Make and test conjectures about characteristics and properties (e.g., sides, angles, symmetry) of two-dimensional figures and three-dimensional objects.		3. Make, test and establish the validity of conjectures about geometric properties and relationships using counterexample, inductive and deductive reasoning, and paragraph or two-column proof, including: a. prove the Pythagorean Theorem; b. prove theorems involving triangle similarity and congruence; c. prove theorems involving properties of lines, angles, triangles and quadrilaterals; d. test a conjecture using basic constructions made with a compass and straightedge or technology. 10. Solve problems involving chords, radii, and arcs within the same circle.

Geometry and Spatial Sense
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
I. Use right triangle trigonometric relationships to determine lengths and angle measures.		1. Define the basic trigonometric ratios in right triangles: sine, cosine and tangent. 2. Apply proportions and right triangle trigonometric ratios to solve problems involving missing lengths and angle sizes in similar figures.	

K-2 | 3-4 | 5-7 | 8-10 | 11-12 | Back

Geometry and Spatial Sense
Grades 11-12

Ohio Benchmarks Grades 11-12	Grade-Level Indicators Grade 11	Grade-Level Indicators Grade 12
A. Use trigonometric relationships to verify determine solutions in problem situations.	4. Use trigonometric relationships to determine lengths and angle measures; i.e., Law of Sines and Law of Cosines.	2. Derive and apply the basic trigonometric identities; i.e., angle addition, angle subtraction, and double angle.
B. Represent transformations within a coordinate system using vectors and matrices.	1. Use polar coordinates to specify locations on a plane. 2. Represent translations using vectors. 3. Describe multiplication of a vector and a scalar graphically and algebraically, and apply to problem situations.	1. Use matrices to represent translations, reflections, rotations, dilations and their compositions.

Geometry and Spatial Sense
Grades 11-12

Ohio Benchmarks Grades 11-12	Grade-Level Indicators Grade 11	Grade-Level Indicators Grade 12
Note: This is an extension of the following benchmarks in grades 8-10 for more complex figures. A. Formally define geometric figures. D. Use coordinate geometry to represent and examine the properties of geometric figures. E. Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology.	5. Identify, sketch and classify the cross sections of three-dimensional objects.	
Note: This is an extension of benchmark H in grades 11-12 in Mathematical Processes. H. Use formal mathematical language and notation to represent ideas, to demonstrate relationships within and among representation systems, and to formulate generalizations.		3. Relate graphical and algebraic representations of lines, simple curves and conic sections.

Geometry and Spatial Sense
Grades 11-12

Ohio Benchmarks Grades 11-12	Grade-Level Indicators Grade 11	Grade-Level Indicators Grade 12
Note: This is closely related to benchmark H in grades 11-12 in Mathematical Processes. H. Use formal mathematical language and notation to represent ideas, to demonstrate relationships within and among representation systems, and to formulate generalizations.		4. Recognize and compare specific shapes and properties in multiple geometries; e.g., plane, spherical and hyperbolic.

K-2 | 3-4 | 5-7 | 8-10 | 11-12 | Back