Measurement Standard
Grades K-2

Ohio Benchmarks Grades K-2	Grade-Level Indicators Kindergarten	Grade-Level Indicators Grade 1	Grade-Level Indicators Grade 2
A. Explain the need for standard units of measure.		1. Recognize and explain the need for fixed units and tools for measuring length and weight; i.e., rulers and balance scales.	
B. Select appropriate units for length, weight, volume (capacity) and time, using: • objects; i.e., non-standard units; • U.S. customary units: inch, foot, yard, ounce, pound, cup, quart, gallon, minute, hour, day, week and year; • metric units: centimeter, meter, gram and liter.	1. Identify units of time (day, week, month, year) and compare calendar elements; e.g., weeks are longer than days. 2. Compare and order objects of different lengths, areas, weights and capacities; and use relative terms, such as longer, shorter, bigger, smaller, heavier, lighter, more and less.		1. Identify and select appropriate units of measure for: a. length – centimeters, meters, inches, feet, or yards; b. volume (capacity) – liters, cups, pints, or quarts; c. weight – grams, ounces, or pounds; d. time – hours, half-hours, quarter-hours, or minutes and time designations a.m. or p.m.

Measurement Standard
Grades K-2

Ohio Benchmarks Grades K-2	Grade-Level Indicators Kindergarten	Grade-Level Indicators Grade 1	Grade-Level Indicators Grade 2
C. Develop common referents for units of measure for length, weight, volume (capacity) and time to make comparisons and estimates.	1. Identify units of time (day, week, month, year) and compare calendar elements; e.g., weeks are longer than days. 2. Compare and order objects of different lengths, areas, weights and capacities; and use relative terms, such as longer, shorter, bigger, smaller, heavier, lighter, more and less. 4. Order events based on time. For example: a. activities that take a long or short time; b. review what we do first, next, last; c. recall what we did or plan to do yesterday, today, tomorrow.	2. Tell time to the hour and half hour on digital and analog (dial) timepieces. 3. Order a sequence of events with respect to time; e.g., summer, fall, winter and spring; morning, afternoon and night.	2. Establish personal or common referents for units of measure to make estimates and comparisons; e.g., the width of a finger is a centimeter, a large bottle of soda pop is 2 liters, a small paper clip weighs about one gram. 4. Tell time to the nearest minute interval on digital and to the nearest 5 minute interval on analog (dial) timepieces.

Measurement Standard
Grades K-2

Ohio Benchmarks Grades K-2	Grade-Level Indicators Kindergarten	Grade-Level Indicators Grade 1	Grade-Level Indicators Grade 2
D. Apply measurement techniques to measure length, weight and volume (capacity).	3. Measure length and volume (capacity) using uniform objects in the environment. For example, find: a. how many paper clips long is a pencil; b. how many small containers it takes to fill one big container using sand, rice, beans.	4. Estimate and measure weight using non-standard units; e.g., blocks of uniform size. 5. Estimate and measure lengths using non-standard and standard units; i.e., centimeters, inches and feet.	5. Estimate and measure the length and weight of common objects, using metric and U.S. customary units, accurate to the nearest unit. 6. Select and use appropriate measurement tools; e.g., a ruler to draw a segment 3 inches long, a measuring cup to place 2 cups of rice in a bowl, a scale to weigh 50 grams of candy.

Measurement Standard
Grades K-2

Ohio Benchmarks Grades K-2	Grade-Level Indicators Kindergarten	Grade-Level Indicators Grade 1	Grade-Level Indicators Grade 2
E. Recognize that using different units of measurement will yield different numbers for the same measurement.			3. Describe and compare the relationships among units of measure, such as centimeters and meters; inches, feet and yards; cups, pints and quarts; ounces and pounds; and hours, half-hours, and quarter-hours; e.g., how many inches in a foot? 7. Make and test predictions about measurements, using different units to measure the same length or volume.

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Measurement Standard
Grades 3-4

Ohio Benchmarks Grades 3-4	Grade-Level Indicators Grade 3	Grade-Level Indicators Grade 4
A. Select appropriate units for perimeter, area, weight, volume (capacity), time and temperature using: • objects of uniform size; • U.S. customary units; e.g., mile, square inch, cubic inch, second degree Fahrenheit, and other units as appropriate; • metric units; e.g., millimeter, kilometer, square centimeter, kilogram, cubic centimeter, degree Celsius, and other units as appropriate.	1. Identify and select appropriate units for measuring: a. length – miles, kilometers and other units of measure as appropriate. b. volume (capacity) – gallons; c. weight – ounces, pounds, grams, or kilograms; d. temperature – degrees (Fahrenheit or Celsius). 4. Read thermometers in both Fahrenheit and Celsius scales.	3. Identify and select appropriate units to measure: a. perimeter – string or links (inches or centimeters). b. area – tiles (square inches or square centimeters). c. Volume – cubes (cubic inches or cubic centimeters).
B. Know that the number of units is inversely related to the size of the unit for any item being measured.		1. Relate the number of units to the size of the units used to measure an object; e.g., compare the number of cups to fill a pitcher to the number of quarts to fill the same pitcher.

Measurement Standard
Grades 3-4

Ohio Benchmarks Grades 3-4	Grade-Level Indicators Grade 3	Grade-Level Indicators Grade 4
C. Develop common referents for units of measure for length, weight, volume (capacity) and time to make comparisons and estimates.	2. Establish personal or common referents to include additional units; e.g., a gallon container of milk; a postage stamp is about a square inch. 5. Estimate and measure length, weight and volume (capacity), using metric and U.S. customary units, accurate to the nearest $\frac{1}{2}$ or $\frac{1}{4}$ unit as appropriate.	2. Demonstrate and describe perimeter as surrounding and area as covering a two-dimensional shape, and volume as filling a three-dimensional object.

Measurement Standard
Grades 3-4

Ohio Benchmarks Grades 3-4	Grade-Level Indicators Grade 3	Grade-Level Indicators Grade 4
D. Identify appropriate tools and apply counting techniques for measuring side lengths, perimeter, and area of squares, rectangles, and simple irregular two-dimensional shapes, volume of rectangular prisms, and time and temperature.	4. Read thermometers in both Fahrenheit and Celsius scales. 6. Use appropriate measurement tools and techniques to construct a figure or approximate an amount of specified length, weight or volume (capacity); e.g., construct a rectangle with length $2\frac{1}{2}$ inches and width 3 inches, fill a measuring cup to the $\frac{3}{4}$ cup mark. 7. Make estimates for perimeter, area and volume using links, tiles, cubes and other models.	4. Develop and use strategies to find perimeter using string or links, area using tiles or a grid, and volume using cubes; e.g., count squares to find area of regular or irregular shapes on a grid, layer cubes in a box to find its volume.
E. Tell time to the nearest minute.	3. Tell time to the nearest minute and find elapsed time using a calendar or a clock.	

Measurement Standard
Grades 3-4

Ohio Benchmarks Grades 3-4	Grade-Level Indicators Grade 3	Grade-Level Indicators Grade 4
		Note: There are instances where a grade-level indicator is linked to a benchmark for a grade band that does not include the grade level of the indicator. See Grade 5 (page 9) for indicator 5 and Grade 5 (page 12) for indicator 6.

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Measurement
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
A. Select appropriate units to measure angles, circumference, surface area, mass and volume, using: • U.S. customary units; e.g., degrees, square feet, pounds, and other units as appropriate; • Metric units; e.g., square meters, kilograms and other units as appropriate.	1. Identify and select appropriate units to measure angles; i.e., degrees.		1. Select appropriate units for measuring derived measurements; e.g., miles per hour, revolutions per minute.
B. Convert units of length, area, volume, mass and time within the same measurement system.	5. *Make simple unit conversions within a measurement system; e.g., inches to feet, kilograms to grams, quarts to gallons.* **(Grade 4)** 5. Make conversions within the same measurement system while performing computations.		2. Convert units of area and volume within the same measurement system using proportional reasoning and a reference table when appropriate; e.g., square feet to square yards, cubic meters to cubic centimeters.

Measurement
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
C. Identify appropriate tools and apply appropriate techniques for measuring angles, perimeter or circumference and area of triangles, quadrilaterals, circles, and composite shapes, and surface area and volume of prisms and cylinders.	6. Use strategies to develop formulas for determining perimeter and area of triangles, rectangles and parallelograms, and volume of rectangular prisms. 7. Use benchmark angles (e.g.; 45º, 90º, 120º) to estimate the measure of angles, and use a tool to measure and draw angles.	2. Use strategies to develop formulas for finding circumference and area of circles, and to determine the area of sectors; e.g., $\frac{1}{2}$ circle, $\frac{2}{3}$ circle, $\frac{1}{3}$ circle, $\frac{1}{4}$ circle. 3. Estimate perimeter or circumference and area for circles, triangles and quadrilaterals, and surface area and volume for prisms and cylinders by: a. estimating lengths using string or links, areas using tiles or grid, and volumes using cubes; b. measuring attributes (diameter, side lengths, or heights) and using established formulas for circles, triangles, rectangles, parallelograms and rectangular prisms.	6. Use strategies to develop formulas for finding area of trapezoids and volume of cylinders and prisms. 7. Develop strategies to find the area of composite shapes using the areas of triangles, parallelograms, circles and sectors.

Measurement
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
		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 2.*	*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 6.*
D. Select a tool and measure accurately to a specified level of precision.			3. Estimate a measurement to a greater degree of precision than the tool provides.
E. Use problem solving techniques and technology as needed to solve problems involving length, weight, perimeter, area, volume, time and temperature.	6. *Write, solve and verify solutions to multi-step problems involving measurement.* **(Grade 4)** 2. Identify paths between points on a grid or coordinate plane and compare the lengths of the paths; e.g., shortest path, paths of equal length.	4. Determine which measure (perimeter, area, surface area, volume) matches the context for a problem situation; e.g., perimeter is the context for fencing a garden, surface area is the context for painting a room.	4. Solve problems involving proportional relationships and scale factors; e.g., scale models that require unit conversions within the same measurement system.

Measurement
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
F. Analyze and explain what happens to area and perimeter or surface area and volume when the dimensions of an object are changed.	3. Demonstrate and describe the differences between covering the faces (surface area) and filling the interior (volume) of three-dimensional objects. 4. Demonstrate understanding of the differences among linear units, square units and cubic units.	1. Understand and describe the difference between surface area and volume. 6. Describe what happens to the perimeter and area of a two-dimensional shape when the measurements of the shape are changed; e.g. length of sides are doubled.	9. Describe what happens to the surface area and volume of a three-dimensional object when the measurements of the object are changed; e.g., length of sides are doubled.

Measurement
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
G. Understand and demonstrate the independence of perimeter and area for two-dimensional shapes and of surface area and volume for three-dimensional shapes.	8. *Use geometric models to solve problems in other areas of mathematics, such as number (multiplication/division) and measurement (area, perimeter, border).* ***Geometry and Spatial Sense (Grade 4)*** 3. Demonstrate and describe the differences between covering the faces (surface area) and filling the interior (volume) of three-dimensional objects. 4. Demonstrate understanding of the differences among linear units, square units and cubic units.	1. Understand and describe the difference between surface area and volume. 5. Understand the difference between perimeter and area, and demonstrate that two shapes may have the same perimeter, but different areas or may have the same area, but different perimeters.	8. Understand the difference between surface area and volume, and demonstrate that two objects may have the same surface area, but different volumes or they may have the same volume, but different surface areas.

Measurement
Grades 5-7

Ohio Benchmarks Grades 5-7	Grade-Level Indicators Grade 5	Grade-Level Indicators Grade 6	Grade-Level Indicators Grade 7
	Note: There are instances when a grade-level indicator for one standard is linked to a benchmark for a different standard. See correlation for ***Patterns, Functions and Algebra*** *(page 12) for indicator 6.*		*Note: There are instances where a grade-level indicator is linked to a benchmark for a grade band that does not include the grade level of the indicator. See Grade 8 (page 15) for indicator 5.*

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Measurement
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
A. Solve increasingly complex non-routine measurement problems and check for reasonableness of results.	5. *Analyze problem situations involving measurement concepts, select appropriate strategies, and use an organized approach to solve narrative and increasingly complex problems.* **(Grade 7)** 6. Solve and determine the reasonableness of the results for problems involving rates and derived measurements, such as velocity and density, using formulas, models and graphs.		

Measurement
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
B. Use formulas to find surface area and volume for specified three-dimensional objects accurate to a specified level of precision.	3. Use appropriate levels of precision when calculating with measurements. 4. Derive formulas for surface area and volume and justify them using geometric models and common materials. For example, find: a. the surface area of a cylinder as a function of its height and radius; b. that the volume of a pyramid (or cone) is one-third of the volume of a prism (or cylinder) with the same base area and height.		

Measurement
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
C. Apply indirect measurement techniques, tools and formulas, as appropriate, to find perimeter, circumference and area of circles, triangles, quadrilaterals and composite shapes and to find volume of prisms, cylinders, and pyramids.	5. Determine surface area for pyramids by analyzing their parts. 9. Demonstrate understanding of the concepts of perimeter, circumference and area by using established formula for triangles, quadrilaterals, and circles to determine the surface area and volume of prisms, pyramids, cylinders, spheres and cones. (Note: Only volume should be calculated for spheres and cones.)		

Measurement
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 proportional reasoning and apply indirect measurement techniques, including right triangle trigonometry and properties of similar triangles, to solve problems involving measurements and rates.	1. Compare and order the relative size of common U.S. customary units and metric units; e.g., mile and kilometer, gallon and liter, pound and kilogram. 2. Use proportional relationships and formulas to convert units from one measurement system to another; e.g., degrees Fahrenheit to degrees Celsius. 7. Apply proportional reasoning to solve problems involving indirect measurements or rates.	1. Convert rates within the same measurement system; e.g., miles per hour to feet per second; kilometers per hour to meters per second. 2. Use unit analysis to check computations involving measurement. 3. Use the ratio of lengths in similar two-dimensional figures or three-dimensional objects to calculate the ratio of their areas or volumes respectively.	5. Determine the measures of central and inscribed angles and their associated major and minor arcs.

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Measurement
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 proportional reasoning and apply indirect measurement techniques, including right triangle trigonometry and properties of similar triangles, to solve problems involving measurements and rates.		4. Use scale drawings and right triangle trigonometry to solve problems that include unknown distances and angle measures. 5. Solve problems involving unit conversion for situations involving distances, areas, volumes and rates within the same measurement system.	

Measurement
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
E. Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.	3. Use appropriate levels of precision when calculating with measurements. 8. Find the sum of the interior and exterior angles of regular convex polygons with and without measuring the angles with a protractor. 10. Use conventional formulas to find the surface area and volume of prisms, pyramids and cylinders and the volume of spheres and cones to a specified level of precision.		
F. Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.	6. Solve and determine the reasonableness of the results for problems involving rates and derived measurements, such as velocity and density, using formulas, models and graphs.		

Measurement
Grades 8-10

Ohio Benchmarks Grades 8-10	Grade-Level Indicators Grade 8	Grade-Level Indicators Grade 9	Grade-Level Indicators Grade 10
			Note: There are instances where a grade-level indicator is linked to a benchmark for a grade band that does not include the grade level of the indicator. See Grade 11 (page 22) for indicators 1,2,3,4.

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Measurement
Grades 11-12

Ohio Benchmarks Grades 11-12	Grade-Level Indicators Grade 11	Grade-Level Indicators Grade 12
A. Explain differences among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations.	1. *Explain how a small error in measurement may lead to a large error in calculated results.* **(Grade 10)** 2. *Calculate relative error.* **(Grade 10)** 3. *Explain the difference between absolute error and relative error in measurement.* **(Grade 10)** 4. *Give examples of how the same absolute error can be problematic in one situation but not in another; e.g., compare "accurate to the nearest foot" when measuring the height of a person versus when measuring the height of a mountain.* **(Grade 10)** 1. Determine the number of significant digits in a measurement.	

Measurement
Grades 11-12

Ohio Benchmarks Grades 11-12	Grade-Level Indicators Grade 11	Grade-Level Indicators Grade 12
B. Apply various measurement scales to describe phenomena and solve problems.	2. Use radian and degree angle measures to solve problems and perform conversions as needed.	
C. Estimate and compute areas and volume in increasingly complex problem situations.	3. Derive a formula for the surface area of a cone as a function of its slant height and the circumference of its base. 4. Calculate distances, areas, surface areas and volumes of composite three-dimensional objects to a specified number of significant digits.	3. Apply informal concepts of successive approximation, upper and lower bounds, and limits in measurement situations; e.g., measurement of some quantities, such as volume of a cone, can be determined by sequences of increasingly accurate approximations.
D. Solve problem situations involving derived measurements; e.g., density, acceleration.	5. Solve real-world problems involving area, surface area, volume and density to a specified degree of precision.	1. Solve problems involving derived measurements; e.g., acceleration and pressure. 2. Use radian measures in the solution of problems involving angular velocity and acceleration.

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