Ohio Tutorials are designed specifically for the Ohio Learning Standards to prepare students for the Ohio State Tests and end-of-course exams.

Math Tutorials offer targeted instruction, practice and review designed to develop computational fluency, deepen conceptual understanding, and apply mathematical practices. They automatically identify and address learning gaps down to elementary-level content, using adaptive remediation to bring students to grade-level no matter where they start. Students engage with the content in an interactive, feedback-rich environment as they progress through standards-aligned modules. By constantly honing the ability to apply their knowledge in abstract and real world scenarios, students build the depth of knowledge and higher order skills required to demonstrate their mastery when put to the test.

In each module, the Learn It and Try It make complex ideas accessible to students through focused content, modeled logic and process, multi-modal representations, and personalized feedback as students reason through increasingly challenging problems. The Review It offers a high impact summary of key concepts and relates those concepts to students' lives. The Test It assesses students' mastery of the module's concepts, providing granular performance data to students and teachers after each attempt. To help students focus on the content most relevant to them, unit-level pretests and posttests can quickly identify where students are strong and where they're still learning.

1. POINTS, LINES, AND ANGLES

- **POINTS, RAYS, LINE SEGMENTS, LINES, AND FIGURES**
  - **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*

- **PARALLEL AND PERPENDICULAR LINES**
  - **OH.Math.HSG.GPE.5** *Justify the slope criteria for parallel and perpendicular lines, and use them to solve geometric problems, e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point.*
  - **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*

- **PARALLEL LINES AND ANGLE RELATIONSHIPS**
  - **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
  - **OH.Math.HSG.CO.9** *Prove and apply theorems about lines and angles.*

- **PERPENDICULAR BISECTOR AND ANGLE BISECTOR THEOREMS**
  - **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
  - **OH.Math.HSG.CO.9** *Prove and apply theorems about lines and angles.*
  - **OH.Math.HSG.CO.10** *Prove and apply theorems about triangles.*

2. COORDINATE GEOMETRY

- **SLOPE-INTERCEPT FORM OF A LINEAR EQUATION**
  - **OH.Math.HSS.ID.7** *Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.*
  - **OH.Math.HSF.IF.1** *Understand that a function from one set (called the domain) to another set (called the range) assigns to*

each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$.

- **OH.Math.HSF.LE.2** *Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).*
- **OH.Math.HSF.IF.7a** *Graph linear functions and indicate intercepts.*
- **OH.Math.HSA.REI.10** *Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).*
- **OH.Math.HSA.CED.2a** *Focus on applying linear and simple exponential expressions.*
- **OH.Math.HSG.GPE.5** *Justify the slope criteria for parallel and perpendicular lines, and use them to solve geometric problems, e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point.*
- **OH.Math.HSF.IF.6** *Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*
- **OH.Math.HSF.IF.9a** *Focus on linear and exponential functions.*
- **OH.Math.HSF.IF.9b** *Focus on linear, quadratic, and exponential functions.*

LENGTH AND THE DISTANCE FORMULA

- **OH.Math.HSG.GPE.6** *Find the point on a directed line segment between two given points that partitions the segment in a given ratio.*
- **OH.Math.HSG.GPE.7** *Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*
- **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*
- **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*

MIDPOINT FORMULA ON THE COORDINATE PLANE

- **OH.Math.HSG.GPE.6** *Find the point on a directed line segment between two given points that partitions the segment in a given ratio.*
- **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*
- **OH.Math.HSG.GPE.7** *Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*

CONJECTURES IN COORDINATE GEOMETRY

- **OH.Math.HSG.CO.2** *Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not, e.g., translation versus horizontal stretch.*
- **OH.Math.HSG.CO.9** *Prove and apply theorems about lines and angles.*
- **OH.Math.HSG.CO.10** *Prove and apply theorems about triangles.*
- **OH.Math.HSG.CO.11** *Prove and apply theorems about parallelograms.*
- **OH.Math.HSG.GPE.4** *Use coordinates to prove simple geometric theorems algebraically and to verify geometric relationships algebraically, including properties of special triangles, quadrilaterals, and circles.*

3. PERIMETER, AREA, AND TRANSFORMATIONS ON THE COORDINATE PLANE

PERIMETER ON THE COORDINATE PLANE

- **OH.Math.HSG.GPE.7** *Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*
- **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*
- **OH.Math.HSG.GPE.4** *Use coordinates to prove simple geometric theorems algebraically and to verify geometric relationships algebraically, including properties of special triangles, quadrilaterals, and circles.*

AREA ON THE COORDINATE PLANE

- **OH.Math.HSG.GPE.7** *Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*
- **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*

- **TRANSFORMATIONS ON THE COORDINATE PLANE**
  - **OH.Math.HSG.CO.2** *Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not, e.g., translation versus horizontal stretch.*
  - **OH.Math.HSG.CO.6** *Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.*
  - **OH.Math.HSG.CO.5** *Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using items such as graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.*
  - **OH.Math.HSG.SRT.2** *Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.*
  - **OH.Math.HSG.SRT.1a** *A dilation takes a line not passing through the center of the dilation to a parallel line and leaves a line passing through the center unchanged.*
  - **OH.Math.HSG.CO.4** *Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.*
  - **OH.Math.HSG.CO.3a** *Identify figures that have line symmetry; draw and use lines of symmetry to analyze properties of shapes.*
  - **OH.Math.HSG.SRT.1b** *The dilation of a line segment is longer or shorter in the ratio given by the scale factor.*

- **DILATIONS, TRANSLATIONS, ROTATIONS, AND REFLECTIONS**
  - **OH.Math.HSG.CO.2** *Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not, e.g., translation versus horizontal stretch.*
  - **OH.Math.HSG.CO.6** *Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.*
  - **OH.Math.HSG.CO.4** *Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.*
  - **OH.Math.HSG.CO.5** *Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using items such as graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.*
  - **OH.Math.HSG.CO.3b** *Identify figures that have rotational symmetry; determine the angle of rotation, and use rotational symmetry to analyze properties of shapes.*
  - **OH.Math.HSG.SRT.2** *Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.*
  - **OH.Math.HSG.SRT.1a** *A dilation takes a line not passing through the center of the dilation to a parallel line and leaves a line passing through the center unchanged.*
  - **OH.Math.HSG.SRT.1b** *The dilation of a line segment is longer or shorter in the ratio given by the scale factor.*

4. CONGRUENCE AND SIMILARITY

- **TRIANGLES AND CONGRUENCE TRANSFORMATIONS**
  - **OH.Math.HSG.CO.6** *Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.*
  - **OH.Math.HSG.CO.7** *Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.*
  - **OH.Math.HSG.CO.8** *Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.*

- **OH.Math.HSG.CO.10** *Prove and apply theorems about triangles.*
- **OH.Math.HSG.SRT.5** *Use congruence and similarity criteria for triangles to solve problems and to justify relationships in geometric figures that can be decomposed into triangles.*

- **TRIANGLES AND SIMILARITY TRANSFORMATIONS**
  - **OH.Math.HSG.CO.10** *Prove and apply theorems about triangles.*
  - **OH.Math.HSG.SRT.2** *Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.*
  - **OH.Math.HSG.SRT.4** *Prove and apply theorems about triangles.*
  - **OH.Math.HSG.SRT.5** *Use congruence and similarity criteria for triangles to solve problems and to justify relationships in geometric figures that can be decomposed into triangles.*
  - **OH.Math.HSG.SRT.3** *Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.*

- **CONGRUENCE OF OTHER POLYGONS**
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*
  - **OH.Math.HSG.CO.6** *Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.*
  - **OH.Math.HSG.CO.5** *Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using items such as graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.*
  - **OH.Math.HSG.CO.3a** *Identify figures that have line symmetry; draw and use lines of symmetry to analyze properties of shapes.*
  - **OH.Math.HSG.CO.2** *Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not, e.g., translation versus horizontal stretch.*
  - **OH.Math.HSG.GPE.4** *Use coordinates to prove simple geometric theorems algebraically and to verify geometric relationships algebraically, including properties of special triangles, quadrilaterals, and circles.*
  - **OH.Math.HSG.CO.3b** *Identify figures that have rotational symmetry; determine the angle of rotation, and use rotational symmetry to analyze properties of shapes.*

- **SIMILARITY OF OTHER POLYGONS**
  - **OH.Math.HSG.SRT.2** *Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.*

5. TRIANGLES

- **TRIANGLE ANGLE THEOREMS**
  - **OH.Math.HSG.CO.10** *Prove and apply theorems about triangles.*

- **TRIANGLE BISECTORS**
  - **OH.Math.HSG.CO.9** *Prove and apply theorems about lines and angles.*
  - **OH.Math.HSG.CO.10** *Prove and apply theorems about triangles.*
  - **OH.Math.HSG.CO.12** *Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).*
  - **OH.Math.HSG.SRT.4** *Prove and apply theorems about triangles.*
  - **OH.Math.HSG.SRT.5** *Use congruence and similarity criteria for triangles to solve problems and to justify relationships in geometric figures that can be decomposed into triangles.*
  - **OH.Math.HSG.C.3** *Construct the inscribed and circumscribed circles of a triangle; prove and apply the property that opposite angles are supplementary for a quadrilateral inscribed in a circle.*

- **MEDIANS AND ALTITUDES OF TRIANGLES**
  - **OH.Math.HSG.CO.10** *Prove and apply theorems about triangles.*

6. QUADRILATERALS AND CONSTRUCTIONS

- **PARALLELOGRAMS AND RECTANGLES**
  - **OH.Math.HSG.CO.11** *Prove and apply theorems about parallelograms.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*

- **SQUARES AND RHOMBI**
  - **OH.Math.HSG.CO.11** *Prove and apply theorems about parallelograms.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*

- **CONSTRUCTIONS**
  - **OH.Math.HSG.CO.12** *Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).*
  - **OH.Math.HSG.CO.13** *Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.*
  - **OH.Math.HSG.CO.14** *Classify two-dimensional figures in a hierarchy based on properties.*
  - **OH.Math.HSG.C.4** *Construct a tangent line from a point outside a given circle to the circle.*

7. TRIANGLES AND TRIGONOMETRY

- **PYTHAGOREAN THEOREM**
  - **OH.Math.HSG.SRT.8a** *Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems if one of the two acute angles and a side length is given.*
  - **OH.Math.HSG.SRT.8b** *Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*
  - **OH.Math.HSG.SRT.4** *Prove and apply theorems about triangles.*
  - **OH.Math.HSG.SRT.5** *Use congruence and similarity criteria for triangles to solve problems and to justify relationships in geometric figures that can be decomposed into triangles.*
  - **OH.Math.HSG.CO.10** *Prove and apply theorems about triangles.*

- **TRIGONOMETRIC RATIOS**
  - **OH.Math.HSF.TF.3** *Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4, and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π – x, π + x, and 2π – x in terms of their values for x, where x is any real number.*
  - **OH.Math.HSG.SRT.6** *Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.*
  - **OH.Math.HSG.SRT.8a** *Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems if one of the two acute angles and a side length is given.*
  - **OH.Math.HSG.SRT.8b** *Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*
  - **OH.Math.HSG.SRT.7** *Explain and use the relationship between the sine and cosine of complementary angles.*
  - **OH.Math.HSG.SRT.5** *Use congruence and similarity criteria for triangles to solve problems and to justify relationships in geometric figures that can be decomposed into triangles.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*

- **LAWS OF SINE AND COSINE**
  - **OH.Math.HSG.SRT.9** *Derive the formula $A = ½ ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a*

vertex perpendicular to the opposite side.

- **OH.Math.HSG.SRT.8a** *Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems if one of the two acute angles and a side length is given.*
- **OH.Math.HSG.SRT.8b** *Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*
- **OH.Math.HSG.SRT.10** *Explain proofs of the Laws of Sines and Cosines and use the Laws to solve problems.*
- **OH.Math.HSG.SRT.11** *Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles, e.g., surveying problems, resultant forces.*

RADIANS AND THE UNIT CIRCLE

- **OH.Math.HSG.C.6** *Derive formulas that relate degrees and radians, and convert between the two.*
- **OH.Math.HSF.TF.1** *Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.*
- **OH.Math.HSF.TF.2** *Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.*
- **OH.Math.HSG.C.5a** *Apply similarity to relate the length of an arc intercepted by a central angle to the radius. Use the relationship to solve problems.*
- **OH.Math.HSF.TF.3** *Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4, and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π – x, π + x, and 2π – x in terms of their values for x, where x is any real number.*
- **OH.Math.HSF.TF.4** *Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.*
- **OH.Math.HSG.SRT.8a** *Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems if one of the two acute angles and a side length is given.*

8. CIRCLES

CIRCLE BASICS

- **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
- **OH.Math.HSG.C.2** *Identify and describe relationships among angles, radii, chords, tangents, and arcs and use them to solve problems.*

CENTRAL ANGLES, INSCRIBED ANGLES, AND CHORDS

- **OH.Math.HSG.C.2** *Identify and describe relationships among angles, radii, chords, tangents, and arcs and use them to solve problems.*
- **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
- **OH.Math.HSG.CO.9** *Prove and apply theorems about lines and angles.*
- **OH.Math.HSG.C.3** *Construct the inscribed and circumscribed circles of a triangle; prove and apply the property that opposite angles are supplementary for a quadrilateral inscribed in a circle.*
- **OH.Math.HSG.C.5a** *Apply similarity to relate the length of an arc intercepted by a central angle to the radius. Use the relationship to solve problems.*

SECANTS, ANGLES, AND INTERCEPTED ARCS

- **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
- **OH.Math.HSG.CO.9** *Prove and apply theorems about lines and angles.*
- **OH.Math.HSG.C.2** *Identify and describe relationships among angles, radii, chords, tangents, and arcs and use them to solve problems.*

TANGENTS, ANGLES, AND INTERCEPTED ARCS

- **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
- **OH.Math.HSG.C.2** *Identify and describe relationships among angles, radii, chords, tangents, and arcs and use them to solve problems.*

- **OH.Math.HSG.CO.9** *Prove and apply theorems about lines and angles.*

9. PROPERTIES OF CIRCLES

- **CONGRUENT AND SIMILAR CIRCLES**
  - **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
  - **OH.Math.HSG.C.1** *Prove that all circles are similar using transformational arguments.*
  - **OH.Math.HSG.CO.6** *Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.*
  - **OH.Math.HSG.CO.4** *Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.*
  - **OH.Math.HSG.SRT.2** *Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.*
  - **OH.Math.HSG.GPE.4** *Use coordinates to prove simple geometric theorems algebraically and to verify geometric relationships algebraically, including properties of special triangles, quadrilaterals, and circles.*

- **CIRCUMFERENCE AND ARC LENGTH**
  - **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
  - **OH.Math.HSG.GPE.4** *Use coordinates to prove simple geometric theorems algebraically and to verify geometric relationships algebraically, including properties of special triangles, quadrilaterals, and circles.*
  - **OH.Math.HSG.GMD.1** *Give an informal argument for the formulas for the circumference of a circle, area of a circle, and volume of a cylinder, pyramid, and cone.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*

- **AREA OF CIRCLES AND SECTORS**
  - **OH.Math.HSG.GMD.1** *Give an informal argument for the formulas for the circumference of a circle, area of a circle, and volume of a cylinder, pyramid, and cone.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*
  - **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
  - **OH.Math.HSG.C.5b** *Derive the formula for the area of a sector, and use it to solve problems.*

10. CONIC SECTIONS

- **CIRCLES**
  - **OH.Math.HSG.CO.1** *Know precise definitions of ray, angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and arc length.*
  - **OH.Math.HSG.GPE.1** *Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.*

- **PARABOLAS**
  - **OH.Math.HSG.GMD.4** *Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.*
  - **OH.Math.HSG.GPE.2** *Derive the equation of a parabola given a focus and directrix.*
  - **OH.Math.HSA.CED.2b** *Focus on applying simple quadratic expressions.*
  - **OH.Math.HSA.CED.2c** *Extend to include more complicated function situations with the option to graph with technology.*

11. SURFACE AREA

- **SURFACE AREA AND VOLUME OF SPHERES**
  - **OH.Math.HSG.GMD.2** *Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.*
  - **OH.Math.HSG.GMD.3** *Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*
  - **OH.Math.HSG.GMD.4** *Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*

- **SURFACE AREA OF COMPOSITE SOLIDS**
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*

- **SURFACE AREA OF SIMILAR SOLIDS**
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*

12. VOLUME

- **RELATING TWO-DIMENSIONAL FIGURES TO THREE-DIMENSIONAL SOLIDS**
  - **OH.Math.HSG.GMD.4** *Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.*
  - **OH.Math.HSG.CO.14** *Classify two-dimensional figures in a hierarchy based on properties.*

- **VOLUME OF PRISMS AND PYRAMIDS**
  - **OH.Math.HSG.GMD.2** *Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.*
  - **OH.Math.HSG.GMD.1** *Give an informal argument for the formulas for the circumference of a circle, area of a circle, and volume of a cylinder, pyramid, and cone.*
  - **OH.Math.HSG.GMD.3** *Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*
  - **OH.Math.HSG.GMD.4** *Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.*

- **VOLUME OF CYLINDERS AND CONES**
  - **OH.Math.HSG.GMD.1** *Give an informal argument for the formulas for the circumference of a circle, area of a circle, and volume of a cylinder, pyramid, and cone.*
  - **OH.Math.HSG.GMD.2** *Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.*
  - **OH.Math.HSG.GMD.3** *Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*
  - **OH.Math.HSG.GMD.4** *Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.*

- **MODELING SITUATIONS WITH GEOMETRY**
  - **OH.Math.HSG.MG.2** *Apply concepts of density based on area and volume in modeling situations, e.g., persons per square mile, BTUs per cubic foot.*
  - **OH.Math.HSG.MG.3** *Apply geometric methods to solve design problems, e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios.*

13. VOLUME OF SIMILAR AND COMPOSITE SHAPES

- **VOLUME OF COMPOSITE SOLIDS**
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*
  - **OH.Math.HSG.GMD.3** *Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*
  - **OH.Math.HSG.GMD.2** *Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.*

- **VOLUME OF SIMILAR SOLIDS**
  - **OH.Math.HSG.GMD.3** *Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*
  - **OH.Math.HSG.MG.1** *Use geometric shapes, their measures, and their properties to describe objects, e.g., modeling a tree trunk or a human torso as a cylinder.*
  - **OH.Math.HSG.GMD.5** *Understand how and when changes to the measures of a figure (lengths or angles) result in similar and non-similar figures.*
  - **OH.Math.HSG.GMD.6** *When figures are similar, understand and apply the fact that when a figure is scaled by a factor of , the effect on lengths, areas, and volumes is that they are multiplied by k, k^2, and k^3, respectively.*

14. BASIC PROBABILITY CONCEPTS

- **INTRODUCTION TO PROBABILITY**
  - **OH.Math.HSS.CP.2** *Understand that two events A and B are independent if and only if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.*
  - **OH.Math.HSS.CP.8** *Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)·P(B|A) = P(B)·P(A|B), and interpret the answer in terms of the model.*
  - **OH.Math.HSS.CP.1** *Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").*
  - **OH.Math.HSS.CP.5** *Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.*
  - **OH.Math.HSS.CP.7** *Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.*

- **COMBINATIONS AND PERMUTATIONS**
  - **OH.Math.HSS.CP.9** *Use permutations and combinations to compute probabilities of compound events and solve problems.*

15. ADVANCED PROBABILITY CONCEPTS

- **CONDITIONAL PROBABILITY**
  - **OH.Math.HSS.CP.3** *Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.*
  - **OH.Math.HSS.CP.5** *Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.*
  - **OH.Math.HSS.CP.6** *Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.*
  - **OH.Math.HSS.CP.2** *Understand that two events A and B are independent if and only if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.*
  - **OH.Math.HSS.ID.5** *Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.*
  - **OH.Math.HSS.CP.4** *Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.*
  - **OH.Math.HSS.CP.1** *Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").*

- **GEOMETRIC PROBABILITIES**
  - **OH.Math.HSG.MG.3** *Apply geometric methods to solve design problems, e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios.*
  - **OH.Math.HSG.C.5b** *Derive the formula for the area of a sector, and use it to solve problems.*
  - **OH.Math.HSS.MD.7** *Analyze decisions and strategies using probability concepts, e.g., product testing, medical testing, pulling a hockey goalie at the end of a game.*
  - **OH.Math.HSS.CP.1** *Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").*
  - **OH.Math.HSS.CP.7** *Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.*

- **ANALYZING DECISIONS IN PROBABILITY**
  - **OH.Math.HSS.MD.6** *Use probabilities to make fair decisions, e.g., drawing by lots, using a random number generator.*
  - **OH.Math.HSS.MD.7** *Analyze decisions and strategies using probability concepts, e.g., product testing, medical testing, pulling a hockey goalie at the end of a game.*