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Geometry

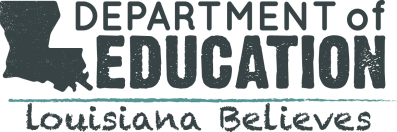
**Louisiana Student Standards: Companion Document for Teachers**

This document is designed to assist educators in interpreting and implementing Louisiana’s new mathematics standards. It contains descriptions of each high school Geometry standard to answer questions about the standard’s meaning and how it applies to student knowledge and performance. To ensure that descriptions are helpful and meaningful to teachers, this document also provides examples indicating how students might meet the requirements of a standard. Examples are samples only and should not be considered an exhaustive list.

This companion document is considered a “living” document as we believe that teachers and other educators will find ways to improve the document as they use it. Please send feedback to [LouisianaStandards@la.gov](mailto:LouisianaStandards@la.gov) so that we may use your input when updating this guide.

Additional information on the Louisiana Student Standards for Mathematics, including how to read the standards’ codes, a listing of standards for each grade or course, and links to additional resources, is available at

<http://www.louisianabelieves.com/resources/library/k-12-math-year-long-planning>.



**Standards for Mathematical Practices**

The Louisiana Standards for Mathematical Practice are expected to be integrated into every mathematics lesson for all students in grades K-12. Below are a few examples of how these practices may be integrated into tasks that high school students complete.

| Louisiana Standards for Mathematical Practice (MP) for High School | | | |
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| **Louisiana Standard** | | **Explanations and Examples** | |
| **HS.MP.1.** Make sense of problems and persevere in solving them. | | High school students start to examine problems by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. By high school, students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. They check their answers to problems using different methods and continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches. | |
| **HS.MP.2.** Reason abstractly and quantitatively. | | High school students seek to make sense of quantities and their relationships in problem situations. They abstract a given situation and represent it symbolically, manipulate the representing symbols, and pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Students use quantitative reasoning to create coherent representations of the problem at hand; consider the units involved; attend to the meaning of quantities, not just how to compute them; and know and flexibly use different properties of operations and objects. | |
| **HS.MP.3.** Construct viable arguments and critique the reasoning of others. | | High school students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. High school students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. High school students learn to determine domains, to which an argument applies, listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments. | |
| **HS.MP.4. Model with mathematics.** | | High school students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. High school students make assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose. | |
| **HS.MP.5.** Use appropriate tools strategically. | | High school students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. High school students should be sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. They are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts. | |
| **HS.MP.6.** Attend to precision. | | High school students try to communicate precisely to others by using clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, specify units of measure, and label axes to clarify the correspondence between quantities in a problem. They calculate accurately and efficiently, expressing numerical answers with a degree of precision appropriate for the problem context. By the time they reach high school they have learned to examine claims and make explicit use of definitions. | |
| **HS.MP.7.** Look for and make use of structure. | | By high school, students look closely to discern a pattern or structure. In the expression *x*2 + 9*x* + 14, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see  5 – 3(*x* – *y*)2 as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers *x* and *y*. High school students use these patterns to create equivalent expressions, factor and solve equations, and compose functions, and transform figures. | |
| **HS.MP.8.** Look for and express regularity in repeated reasoning. | | High school students notice if calculations are repeated, and look both for general methods and for shortcuts. Noticing the regularity in the way terms cancel when expanding (*x* – 1)(*x* + 1), (*x* – 1)(*x*2 + *x* + 1), and (*x* – 1)(*x*3 + *x*2 + *x* + 1) might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, derive formulas or make generalizations, high school students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results. | |

**Modeling Standards**

Modeling is best interpreted not as a collection of isolated topics but rather in relation to other standards. Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by a star symbol (★).

**What is Modeling?**

Modeling links classroom mathematics and statistics to everyday life, work, and decision-making. Modeling is the process of choosing and using appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions. Quantities and their relationships in physical, economic, public policy, social, and everyday situations can be modeled using mathematical and statistical methods. When making mathematical models, technology is valuable for varying assumptions, exploring consequences, and comparing predictions with data.

A model can be very simple, such as writing total cost as a product of unit price and number bought, or using a geometric shape to describe a physical object like a coin. Even such simple models involve making choices. It is up to us whether to model a coin as a three-dimensional cylinder, or whether a two-dimensional disk works well enough for our purposes. Other situations—modeling a delivery route, a production schedule, or a comparison of loan amortizations—need more elaborate models that use other tools from the mathematical sciences. Real-world situations are not organized and labeled for analysis; formulating tractable models, representing such models, and analyzing them is appropriately a creative process. Like every such process, this depends on acquired expertise as well as creativity.

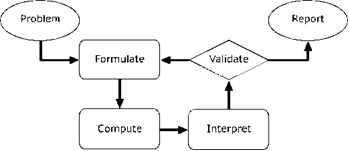
Some examples of such situations might include:

* Estimate how much water and food is needed for emergency relief in a devastated city of 3 million people, and how it might be distributed.
* Plan a table tennis tournament for 7 players at a club with 4 tables, where each player plays against each other player.
* Design the layout of the stalls in a school fair so as to raise as much money as possible.
* Analyze the stopping distance for a car.
* Model a savings account balance, bacterial colony growth, or investment growth.
* Engage in critical path analysis, e.g., applied to turnaround of an aircraft at an airport.
* Analyze the risk in situations such as extreme sports, pandemics, and terrorism.
* Relate population statistics to individual predictions.

In situations like these, the models devised depend on a number of factors: How precise an answer do we want or need? What aspects of the situation do we most need to understand, control, or optimize? What resources of time and tools do we have? The range of models that we can create and analyze is also constrained by the limitations of our mathematical, statistical, and technical skills, and our ability to recognize significant variables and relationships among them. Diagrams of various kinds, spreadsheets and other technology, and algebra are powerful tools for understanding and solving problems drawn from different types of real-world situations.

One of the insights provided by mathematical modeling is that essentially the same mathematical or statistical structure can sometimes model seemingly different situations. Models can also shed light on the mathematical structures themselves, for example, as when a model of bacterial growth makes more vivid the explosive growth of the exponential function.

The basic modeling cycle is summarized in the diagram. It involves (1) identifying variables in the situation and selecting those that represent essential features, (2) formulating a model by creating and selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the variables, (3) analyzing and performing operations on these relationships to draw conclusions, (4) interpreting the results of the mathematics in terms of the original situation, (5) validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable, (6) reporting on the conclusions and the reasoning behind them. Choices, assumptions, and approximations are present throughout this cycle.



In descriptive modeling, a model simply describes the phenomena or summarizes them in a compact form. Graphs of observations are a familiar descriptive model—for example, graphs of global temperature and atmospheric CO2 over time.

Analytic modeling seeks to explain data on the basis of deeper theoretical ideas, albeit with parameters which are empirically based; for example, exponential growth of bacterial colonies (until cut-off mechanisms such as pollution or starvation intervene) follows from a constant reproduction rate. Functions are an important tool for analyzing such problems.

Graphing utilities, spreadsheets, computer algebra systems, and dynamic geometry software are powerful tools that can be used to model purely mathematical phenomena (e.g., the behavior of polynomials) as well as physical phenomena.

| Geometry: Congruence (G-CO) **Experiment with transformations in the plane.** | | |
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| **Louisiana Standard** | **Explanations and Examples** | |
| **GM: G-CO.A.1.** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. | Students recognize the importance of having precise definitions and use the vocabulary to accurately describe figures and relationships among figures. Students define angles, circles, perpendicular lines, parallel lines, and line segments precisely using the undefined terms.  **Example:**   * Draw an example of each of the following and justify how it meets the definition of the term.   1. Angle   2. Circle   3. Perpendicular lines   4. Parallel lines   5. Line segment * Defining Parallel Lines: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/1/tasks/1543> * Defining Perpendicular lines: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/1/tasks/1544> | |
| **GM: G-CO.A.2.** Represent transformations in the plane using, e.g., transparencies, tracing paper, or 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). | | Students describe and compare function transformations on a set of points as inputs to produce another set of points as outputs and is an extension of the work started in Grade 8. They distinguish between transformations that are rigid (preserve distance and angle measure: reflections, rotations, translations, or combinations of these) and those that are not (dilations or rigid motions followed by dilations). Transformations produce congruent figures while dilations produce similar figures.  **Examples:**   * A plane figure is translated 3 units right and 2 units down. The translated figure is then dilated with a scale factor of 4, centered at the origin.  1. Draw a plane figure and represent the described transformation of the figure in the plane. 2. Explain how the transformation is a function with inputs and outputs. 3. Determine if the relationship between the pre-image and the image after a series of transformations. Provide evidence to support your answer.   Transform with vertices , and using the function rule and describe the transformation as completely as possible. |
| **GM: G-CO.A.2.** *continued* | | * Dilations and Distances: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/2/tasks/1546> * Horizontal Stretch of the Plane: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/2/tasks/1924> * Complete the rule for the transformation below: and determine if the transformations preserve distance and angle. Provide justification for your answer.      * Dilations and Distances: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/2/tasks/1546> * Horizontal Stretch of the Plane: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/2/tasks/1924> |
| **GM: G-CO.A.3.** Given a rectangle, parallelogram, trapezoid, or regular polygons, describe the rotations and reflections that carry it onto itself. | Students describe and illustrate how a rectangle, parallelogram, isosceles trapezoid or regular polygon are mapped onto themselves using transformations. Students determine the number of lines of reflection symmetry and the degree of rotational symmetry of any regular polygon.  **Example:**   * For each of the following shapes, describe the rotations and reflections that carry it onto itself. * Symmetries of rectangles: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/3/tasks/1469> * Origami regular octagon: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/3/tasks/1487> | | |
| **GM: G-CO.A.4.** Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. | Students develop the definition of each transformation in regards to the characteristics between pre-image and image points.   * For a *translation*: connecting any point on the pre-image to its corresponding point on the translated image, and connecting a second point on the pre-image to its corresponding point on the translated image, the two segments are equal in length, translate in the same direction, and are parallel. * For a *reflection*: connecting any point on the pre-image to its corresponding point on the reflected image, the line of reflection is a perpendicular bisector of the line segment. * For a *rotation*: connecting the center of rotation to any point on the pre-image and to its corresponding point on the rotated image, the line segments are equal in length and the measure of the angle formed is the angle of rotation.   **Example:**   * Is quadrilateral A’B’C’D’ a reflection of quadrilateral ABCD across the given line? Justify your reasoning.      * Identifying Translations: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/4/tasks/1912> * Identifying Rotations: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/4/tasks/1913> | | |
| **GM: G-CO.A.5.** Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another. | Students transform a geometric figure given a rotation, reflection, or translation. They create sequences of transformations that map a geometric figure onto itself and another geometric figure. Students predict and verify the sequence of transformations (a composition) that will map a figure onto another.  **Example:**   * Reflected Triangles: <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/5/tasks/31> * Showing a triange congruence: a particular case   <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/5/tasks/1547>   * Showing a triange congruence: the general case   <https://www.illustrativemathematics.org/content-standards/HSG/CO/A/5/tasks/1549>   * **Part 1**   Draw the shaded triangle after:   1. It has been translated −7 units horizontally and +1 units vertically. Label your answer A. 2. It has been reflected over the *x-*axis. Label your answer B. 3. It has been rotated 90° clockwise about the origin. Label your answer C. 4. It has been reflected over the line *y* = *x*. Label your answer D.   **Part 2**  Describe fully the single transformation that:   1. Takes the shaded triangle onto the triangle labeled F. 2. Takes the shaded triangle onto the triangle labeled E. | | |

| Geometry: Congruence (G-CO) **Understand congruence in terms of rigid motions.** | |
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| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-CO.B.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. | Students use descriptions of rigid motion and transformed geometric figures to predict the effects rigid motion has on figures in the coordinate plane. Students recognize rigid transformations preserve size and shape or distance and angle and develop the definition of congruent. Students determine if two figures are congruent by determining if rigid motions will turn one figure into the other.  **Examples**:   * Consider parallelogram ABCD with coordinates A(2,-2), B(4,4), C(12,4) and D(10,-2). Perform the following transformations. Make predictions about how the lengths, perimeter, area and angle measures will change under each transformation.  1. A reflection over the x-axis. 2. A rotation of 270° counter-clockwise about the origin. 3. A dilation of scale factor 3 about the origin. 4. A translation to the right 5 and down 3.   Verify your predictions. Compare and contrast which transformations preserved the size and/or shape with those that did not preserve size and/or shape. Generalize, how could you determine if a transformation maintains congruency from the pre-image to the image?   * Determine if the figures below are congruent. If so, tell what rigid motions were used.      * Building a tile by reflecting hexagons:   <https://www.illustrativemathematics.org/content-standards/HSG/CO/B/6/tasks/1338> |

| **GM: G-CO.B.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. | A rigid motion is a transformation of points in space consisting of a sequence of one or more translations, reflections, and/or rotations. Rigid motions are assumed to *preserve distances and angle measures*. Two triangles are said to be congruent if one can be exactly superimposed on the other by a rigid motion, and the congruence theorems specify the conditions under which this can occur.    Students identify corresponding sides and corresponding angles of congruent triangles. Explain that in a pair of congruent triangles, corresponding sides are congruent (distance is preserved) and corresponding angles are congruent (angles measure is preserved). They demonstrate that when distance is preserved (corresponding sides are congruent) and angle measure is preserved (corresponding angles are congruent) the triangles must also be congruent.  **Example:**   * Properties of Congruent Triangles: <http://www.illustrativemathematics.org/illustrations/1637> |
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| **GM: G-CO.B.8.** Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. | Students list the sufficient conditions to prove triangles are congruent: ASA, SAS, and SSS. They map a triangle with one of the sufficient conditions (e.g., SSS) onto the original triangle and show that corresponding sides and corresponding angles are congruent.  **Examples:**   * Why Does SAS Work?: <http://www.illustrativemathematics.org/illustrations/109> * Why Does ASA Work?: <http://www.illustrativemathematics.org/illustrations/339> * Why Does SSS Work?: <http://www.illustrativemathematics.org/illustrations/110> * Josh is told that two triangles Δ𝐴𝐵𝐶 and Δ𝐷𝐸𝐹 share two sets of congruent sides and one set of congruent angles: is congruent to , is congruent to , and is congruent to . He is asked if these two triangles must be congruent. Josh draws the two triangles below and says, “They are definitely congruent because two pairs of sides are congruent and the angle between them is congruent!”  1. Explain Josh’s reasoning using one of the triangle congruence criteria: ASA, SSS, SAS. 2. Given two triangles Δ𝐴𝐵𝐶 and Δ𝐷𝐸𝐹, what is an example of three congruent parts that will not guarentee the two triangles are congruent. |
| Geometry: Congruence (G-CO) **Prove geometric theorems.** | |
| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-CO.C.9.** Prove and apply theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment’s endpoints.* | Encourage multiple ways of writing proofs, such as *narrative paragraphs*, using *flow diagrams*, and *two-column format.* Students should be encouraged to focus on the validity of the underlying reasoning while exploring a variety of formats for expressing that reasoning. Geometry is visual and should be taught in ways that leverage this aspect. Sketching, drawing and constructing figures and relationships between and within geometric objects should be central to any geometric study and certainly to proof. The use of dynamic geometry software, such as GeoGebra, can be important tools for helping students conceptually understand important geometric concepts. GeoGebra is a free app for tablets, phones and desktops. Click [here](http://www.geogebra.org/download) to download GeoGebra.  **Examples:**   * Tangent Lines and the Radius of a Circle:   <https://www.illustrativemathematics.org/content-standards/HSG/CO/C/9/tasks/963>   * Congruent angles made by parallel lines and a transverse:   <https://www.illustrativemathematics.org/content-standards/HSG/CO/C/9/tasks/1922>   * Points equidistant from two points in a the plane:   <https://www.illustrativemathematics.org/content-standards/HSG/CO/C/9/tasks/967> |
| **GM: G-CO.C.10.** Prove and apply theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.* | Encourage multiple ways of writing proofs, such as *narrative paragraphs*, using *flow diagrams*, and *two-column format.* Students should be encouraged to focus on the validity of the underlying reasoning while exploring a variety of formats for expressing that reasoning. Geometry is visual and should be taught in ways that leverage this aspect. Sketching, drawing and constructing figures and relationships between and within geometric objects should be central to any geometric study and certainly to proof. The use of dynamic geometry software can be important tools for helping students conceptually understand important geometric concepts.  **Examples of Theorems and Applications:**   * <https://www.illustrativemathematics.org/HSG-CO.C.10> |
| **GM: G-CO.C.11.** Prove and apply theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.* | Encourage multiple ways of writing proofs, such as *narrative paragraphs*, using *flow diagrams*, and *two-column format.* Students should be encouraged to focus on the validity of the underlying reasoning while exploring a variety of formats for expressing that reasoning. Geometry is visual and should be taught in ways that leverage this aspect. Sketching, drawing and constructing figures and relationships between and within geometric objects should be central to any geometric study and certainly to proof. The use of dynamic geometry software, such as GeoGebra, can be important tools for helping students conceptually understand important geometric concepts. GeoGebra is a free app for tablets, phones and desktops. Click [here](http://www.geogebra.org/download) to download GeoGebra.    **Examples:**   * Congruence of parallelograms: <https://www.illustrativemathematics.org/content-standards/HSG/CO/C/11/tasks/1517> * Is this a parallelogram: <https://www.illustrativemathematics.org/content-standards/HSG/CO/C/11/tasks/1321> * Midpoints of the sides of a parallelogram:   <https://www.illustrativemathematics.org/content-standards/HSG/CO/C/11/tasks/35>   * Parallelograms and Translations:   <https://www.illustrativemathematics.org/content-standards/HSG/CO/C/11/tasks/1511> |
| **GM: G-CO.D.12.** Make formal geometric constructions with a variety of tools and methods, e.g., compass and straightedge, string, reflective devices, paper folding, or dynamic geometric software. *Examples:* *copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.* | Free resources for this standard include:   * Java Applets and Other Interactive Material: David Little, Penn State University:   <http://www.personal.psu.edu/dpl14/java/geometry/> (requires newer version of Java)   * Animated Geometric Constructions (compass/straight edge):   <http://www.mathsisfun.com/geometry/constructions.html> |
| **GM: G-CO.D.13.** Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. | In high school, students perform formal geometry constructions using a variety of tools. Students utilize proofs to justify validity of their constructions.  **Students complete three specific constructions:**   * Equilateral triangle inscribed in a circle: <https://www.youtube.com/watch?v=C6FiPa-aQ-Y> * Square inscribed In a circle: <https://www.youtube.com/watch?v=2gNfltBkbkI> * Regular hexagon inscribed in a circle: <https://www.youtube.com/watch?v=mjjs-xs6FVQ> |

| Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT) **Understand similarity in terms of similarity transformations.** | |
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| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-SRT.A.1.** Verify experimentally the properties of dilations given by a center and a scale factor:   1. 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. 2. The dilation of a line segment is longer or shorter in the ratio given by the scale factor. | Students should understand that a dilation is a transformation that moves each point along the ray through the point emanating from a fixed center, and multiplies distances from the center by a common scale factor.  Students perform a dilation with a given center and scale factor on a figure in the coordinate plane.  **Example:**   * Given with , and apply the rule   Students verify that when a side passes through the center of dilation, the side and its image lie on the same line and the remaining corresponding sides of the pre-image and images are parallel.  **Example:**   * Using and its image from the previous example, connect the corresponding pre-image and image points. Describe how the corresponding sides are related. Determine the center of dilation.   Students verify that a side length of the image is equal to the scale factor multiplied by the corresponding side length of the pre-image.  **Examples:**   * Calculate the side length of each side of the triangle. How do the side lengths compare? How do the perimeters compare? * Suppose we apply a dilation with a factor of 2, centered at the point P to the figure below.  1. In the picture, locate the images A’, B’, and C’ of the points A, B, C under this dilation. 2. Based on you picture in part a., what do you think happens to the line *l* when we perform the dilation? 3. Based on your picture in part a., what appears to be the relationship between the distance of A’B’ and the distance of AB? 4. Prove your observations in part c.  * Given two similar figures that are related by dilation, determine the center of dilation and scale factor. |
| **GM: G-SRT.A.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. | Students use the idea of dilation transformations to develop the definition of similarity. They understand that a similarity transformation is a rigid motion followed by a dilation. Students demonstrate that in a pair of similar triangles, corresponding angles are congruent (angle measure is preserved) and corresponding sides are proportional. They determine that two figures are similar by verifying that angle measure is preserved and corresponding sides are proportional.  **Example:**   * In the picture to the right, line segments *AD* and *BC* intersect at *X*. Line segments *AB* and *CD* are drawn, forming two triangles Δ*AXB* and Δ*CXD*.   In each part a-d below, some additional *assumptions* about the picture are given. For each assumption:   1. Determine whether the given assumptions are enough to prove that the two triangles are similar. If so, what is the correct correspondence of vertices. If not, explain why not. 2. If the two triangles must be similar, prove this result by describing a sequence of similarity transformations that maps one variable to the other.    1. The lengths of *AX* and *AD* satisfy the equation . 3. The lengths *AX*, *BX*, *CX*, and *DX* satisfy the equation 4. Lines *AB* and *CD* are parallel. 5. ∠ *XAB* is congruent to angle ∠*XCD*. |

| Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT) **Understand similarity in terms of similarity transformations.** | |
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| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-SRT.A.3.** Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. | Students can use the theorem that the angle sum of a triangle is 180° and verify that the AA criterion is equivalent to the AAA criterion.  Given two triangles for which AA holds, students use rigid motions to map a vertex of one triangle onto the corresponding vertex of the other in such a way that their corresponding sides are in line. Then show that dilation will complete the mapping of one triangle onto the other.  **Examples:**   * Given that is a dilation of with scale factor *k*, use properties of dilations to show that the AA criterion is sufficient to prove similarity.      * Similar Triangles: <https://www.illustrativemathematics.org/content-standards/HSG/SRT/A/3/tasks/1422> |
| Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT) **Prove theorems involving similarity.** | |
| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-SRT.B.4.** Prove and apply theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity; SAS similarity criteria, SSS similarity criteria, ASA similarity.* | Use AA, SAS, and SSS similarity theorems to prove triangles are similar. Use triangle similarity to prove other theorems about triangles.  **Examples:**   * How does the Pythagorean Theorem support the case for triangle similarity? * View the video below and create a visual proving the Pythagorean Theorem using similarity. <http://www.youtube.com/watch?v=LrS5_l-gk94> * Prove that if two triangles are similar, then the ratio of corresponding altitudes is equal to the ratio of corresponding sides. |
| **GM: G-SRT.B.5.** Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. | The similarity postulates include SSS, SAS, and AA. The congruence postulates include SSS, SAS, ASA, AAS, and H-L. Students apply triangle congruence and triangle similarity to solve problem situations (e.g., indirect measurement, missing side(s)/angle measure(s), side splitting).  **Example:**   * Calculate the distance across the river, *AB*.      * In the diagram, quadrilateral *PQRS* is a parallelogram, *SQ* is a diagonal, and *SQ* || *XY*.   a. Prove that .  b. Prove that . |

| Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT) **Define trigonometric ratios and solve problems involving right triangles.** | |
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| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-SRT.C.6.** Understand that by similarity, side ratios in right triangles, including special right triangles (30-60-90 and 45-45-90) are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. | Students establish that the side ratios of a right triangle are equivalent to the corresponding side ratios of similar right triangles and are a function of the acute angle(s).  **Examples:**   * Find the sine, cosine, and tangent of *x*. * Explain why the sine of *x* is the same regardless of which triangle is used to find it in the figure to the right. |
| **GM: G-SRT.C.7.** Explain and use the relationship between the sine and cosine of complementary angles. | Students can explain why the sine of an acute angle in a right triangle is the cosine of complementary angle in the same right triangle. Students use the relationship to solve problems.  **Examples:**   * Using the diagram at the right, provide an argument justifying why . * Complete the following statement:   If , then   * Given: Angle *F* and angle *G* are complementary. As the measure of angle *F* varies from a value of *x* to a value of *y*, increases by 0.2. How does change as *F* varies from to ? |
| **GM: G-SRT.C.8.** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. **★** | This is a modeling standard which means students choose and use appropriate mathematics to analyze situations. Thus, contextual situations that require students to determine the correct mathematical model and use the model to solve problems are essential.  **Examples:**   * Find the height of a tree to the nearest tenth if the angle of elevation of the sun is 28° and the shadow of the tree  is 50 ft.      * A new house is 32 feet wide. The rafters will rise at a 36° angle and meet above the centerline of the house. Each rafter also needs to overhang the side of the house by 2 feet. How long should the carpenter make each rafter? |

| Geometry: Circles (GM: G-C) **Understand and apply theorems about circles.** | |
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| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-C.A.1.** Prove that all circles are similar. | Students use the fact that the ratio of diameter to circumference is the same for all circles; prove that all circles are similar. Students use any two circles in a plane and show that they are related by dilation.  **Example:**   * Show that the two given circles are similar by stating the necessary transformations from C to D.   C: center at with a radius of 5  D: center at with a radius of 10 |
| **GM: G-C.A.2.** Identify and describe relationships among inscribed angles, radii, and chords, including the following: *the relationship that exists between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; and a radius of a circle is perpendicular to the tangent where the radius intersects the circle.* | Students can:   * Identify central angles, inscribed angles, circumscribed angles, diameters, radii, chords, and tangents. * Describe the relationship between a central angle and the arc it intercepts. * Describe the relationship between an inscribed angle and the arc it intercepts. * Describe the relationship between a circumscribed angle and the arcs it intercepts. * Recognize that an inscribed angle whose sides intersect the endpoints of the diameter of a circle is a right angle. * Recognize that the radius of a circle is perpendicular to the tangent where the radius intersects the circle.     **Example:**   * Given the circle to the right with radius of 10 and chord length of 12, find the distance from the chord to the center of the circle. * Right Triangles Inscribed by Circles I:   <https://www.illustrativemathematics.org/content-standards/HSG/C/A/2/tasks/1091>   * Right Triangles Inscribed by Circles II   <https://www.illustrativemathematics.org/content-standards/HSG/C/A/2/tasks/1093> |
| **GM: G-C.A.3.** Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. | Students construct the inscribed circle whose center is the point of intersection of the angle bisectors (the center).  http://jwilson.coe.uga.edu/EMAT6680Fa09/Osibodu/Assign4/Incenter.png  Students construct the circumscribed circle whose center is the point of intersection of the perpendicular bisectors of each side of the triangle (the circumcenter).  http://jwilson.coe.uga.edu/emat6680/dunbar/assignment4/circumcenter.gif  Students prove properties of angles for a quadrilateral inscribed in a circle.  **Example:**   * Given the inscribed quadrilateral to the right, prove that m∠ *B* is supplementary to m∠*D*. |

| Geometry: Circles (GM: G-C) **Find arc lengths and areas of sectors of circles.** | |
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| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-C.B.5.** Use similarity to determine that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. | All circles are similar (G-C.A.1). Sectors with the same central angle have arc lengths that are proportional to the radius. The radian measure of the angle is the constant of proportionality.  ***Example:***   * Find the area of the sectors. What general formula can you develop based on this information? * Find the area of a sector with an arc length of 40 cm and a radius of 12 cm. |
| Geometry: Expressing Geometric Properties with Equations (G-GPE) **Translate between the geometric description and the equation for a conic section.** | |
| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-GPE.A.1.** Derive the equation of a circleof given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation. | Students define a circle as the set of points whose distance from a fixed point is constant. Given a point on the circle and the fixed point, they identify that the difference in the *x*-coordinates represents the horizontal distance and the difference in the  *y*-coordinates represents the vertical distance. Students apply the Pythagorean Theorem to calculate the distance between the two points. Generalizing this process, students derive the equation of a circle. Students connect the derivation of the equation of a circle to the distance formula.  **Example:**   * Write the equation of a circle that is centered at with a radius of 5 units. * Write an equation for a circle given that the endpoints of the diameter are and |

| Geometry: Expressing Geometric Properties with Equations (G-GPE) **Use coordinates to prove simple geometric theorems algebraically.** | |
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| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-GPE.B.4.** Use coordinates to prove simple geometric theorems algebraically*. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2* | Students determine the slope of a line and the length of a line segment using a variety of methods including counting intervals and using formulas. Students have prior experience with the slope formula. Students need to develop the distance formula as an application of the Pythagorean Theorem. Students use the concepts of slope and distance to prove that a figure in the coordinate system is a special geometric shape. Students recognize the length of the line segment is the same as the distance between the end points.  **Examples:**   * The coordinates for the vertices of quadrilateral MNPQ are , , , and .  1. Classify quadrilateral *MNPQ*. 2. Identify the properties used to determine your classification 3. Use slope and length to provide supporting evidence of the properties  * Use slope and distance formulas to verify the polygon formed by connecting the points is a parallelogram. * If quadrilateral *ABCD* is a rectangle, where , , and is unknown:  1. Find the coordinates of the fourth vertex. 2. Verify that *ABCD* is a rectangle by providing evidence related to the sides and angles. |
| **GM: G-GPE.B.5.** Prove 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). | Students use the formula for the slope of a line to determine whether two lines are parallel or perpendicular. Two lines are parallel if they have the same slope and two lines are perpendicular if their slopes are opposite reciprocals of each other. In other words, the product of the slopes of lines that are perpendicular is . Additionally, students find the equations of lines that are parallel or perpendicular given certain criteria.  **Examples:**   * Suppose a line *k* in a coordinate plane has slope .  1. What is the slope of a line parallel to *k*? Why must this be the case? 2. What is the slope of a line perpendicular to *k*? Why does this seem reasonable?  * Two points , determines a line, .  1. What is the equation of the line AB? 2. What is the equation of the line perpendicular to . passing through the point ? |
| **GM: G-GPE.B.6.** Find the point on a directed line segment between two given points that partitions the segment in a given ratio. | Understanding the process to find the point on a directed line segment requires students to:   * Interpret the ratio *a*:*b* as *part*:*part* and recognize that there are parts. Thus a point is from the starting endpoint. * Describe the difference between a directed line segment AB and directed line segment BA. The first starts at *A* and goes to *B* while the latter starts at *B* and goes to *A*. * Calculate the vertical change and horizontal change (in regards to the direction of the line segment   Thus the point is located at .  **Example:**   * Given and ,  1. Find the point that divides the line segment *AB* two-thirds of the way from *A* to *B*. 2. Find the midpoint of line segment *AB*.  * Given directed line segment with and find point *P* that partitions the segment into a ratio of 1:3. * Scaling a Triangle in the Coordinate Plane:   <https://www.illustrativemathematics.org/content-standards/HSG/GPE/B/6/tasks/1867> |
| **GM: G-GPE.B.7**. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. **★** | This is a modeling standard which means students choose and use appropriate mathematics to analyze situations. Thus, contextual situations that require students to determine the correct mathematical model and use the model to solve problems are essential. This standard provides practice with the distance formula and its connection with the Pythagorean Theorem. Studetnts use the coordinates of the vertices of a polygon graphed in the coordinate plane and the distance formula to compute the perimeter and to find lengths necessary to compute the area.  **Examples**:   * Calculate the area of triangle *ABC* with altitude *CD*, given and . * Find the perimeter and area of a rectangle with vertices at . Round your answer to the nearest hundredth. |

| Geometry: Geometric Measurement and Dimension (G-GMD) **Explain volume formulas and use them to solve problems.** | |
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| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-GMD.A.1.** Give an informal argument, e.g., dissection arguments, Cavalieri’s principle, or informal limit arguments*,* for the formulas for the circumference of a circle; area of a circle; volume of a cylinder, pyramid, and cone. | **Circumference of a circle:**  Students begin with the measure of the diameter of the circle or the radius of the circle. They can use string or pipe cleaner to represent the measurement. Next, students measure the distance around the circle using the measure of the diameter. They discover that there are 3 diameters around the circumference with a small gap remaining. Through discussion, students conjecture that the circumference is the length of the diameter times. Therefore, the circumference can be written as . When measuring the circle using the radius, students discover there are 6 radii around the circumference with a small gap remaining. Students conjecture that the circumference is the length of the radius 2 times. Therefore, the circumference of the circle can also be expressed using .  **Area of a circle:**  Students may use dissection arguments for the area of a circle. Dissect portions of the circle like pieces of a pie and arrange the pieces into a figure resembling a parallelogram as indicated below. Reason that the base is half of the circumference and the height is the radius. Students use the formula for the area of a parallelogram to derive the area of the circle.  []':Users:jmaynor:Desktop:Screen shot 2011-09-07 at 4.18.58 PM.png |
| **GM: G-GMD.A.1.** *continued* | **Volume of a cylinder:**  Students develop the formula for the volume of a cylinder based on the area of a circle stacked over and over again until the cylinder has the given height. Therefore the formula for the volume of a cylinder is . This approach is similar to Cavalieri’s principle. In Cavalieri’s principle, the cross-sections of the cylinder are circles of equal area, which stack to a specific height.    **Volume of a pyramid or cone:**  For pyramids and cones, the factor will need some explanation. An informal demonstration can be done using a volume relationship set of plastic shapes that permit one to pour liquid or sand from one shape into another. Another way to do this for pyramids is with Geoblocks. The set includes three pyramids with equal bases and altitudes that will stack to form a cube. An algebraic approach involves the formula for the sum of squares (). After the coefficient has been justified for the formula of the volume of the pyramid (), one can argue that it must also apply to the formula of the volume of the cone by considering a cone to be a pyramid that has a base with infinitely many sides. |
| **GM: G-GMD.A.3.** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. **★** | http://m.everythingmaths.co.za/grade-11/07-measurement/pspictures/fb889069dc33794d62c0150641c28d47.pngThis is a modeling standard which means students choose and use appropriate mathematics to analyze situations. Thus, contextual situations that require students to determine the correct mathematical model and use the model to solve problems are essential.  **Example:**   * The Southern African Large Telescope (SALT) is housed in a cylindrical building with a domed roof in the shape of a hemisphere. The height of the building wall is 17 m and the diameter is 26 m. To program the ventilation system for heat, air conditioning, and dehumidifying, the engineers need the amount of space in the building. What is the volume, in cubic meters, of space in the building? |
| Geometry: Geometric Measurement and Dimension (G-GMD) **Visualize relationships between two-dimensional and three dimensional objects.** | |
| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-GMD.B.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. | Students identify shapes of two-dimensional cross-sections of three-dimensional objects. The Cross Section Flyer at <http://www.shodor.org/interactivate/activities/CrossSectionFlyer/> can be used to allow students to predict and verify the cross section of different three-dimensional objects.  **Example:**   * Identify two-dimensional cross sections of a rectangular prism.   Students identify three-dimensional objects generated by rotations of two-dimensional objects. The 3D Transmographer at <http://www.shodor.org/interactivate/activities/3DTransmographer/> can be used to allow students to predict and verify three-dimensional objects generated by rotations of two-dimensional objects.  **Example:**   * Identify the object generated when the following object is rotated about the indicated line. |

| Geometry: Modeling with Geometry ★ (G-MG) **Apply geometric concepts in modeling situations.** | |
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| **Louisiana Standard** | **Explanations and Examples** |
| **GM: G-MG.A.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). **★** | Students recognize situations that require relating two- and three- dimensional objects**.** They estimate measures (circumference, area, perimeter, volume) of real-world objects using comparable geometric shapes or three-dimensional objects. Students apply the properties of geometric figures to comparable real-world objects (e.g., The spokes of a wheel of a bicycle are equal lengths because they represent the radii of a circle).  **Example:**   * Describe each of the following as a simple geometric shape or combination of shapes. Illustrate with a sketch and label dimensions important to describing the shape.  1. Soup can label 2. A bale of hay 3. Paperclip 4. Strawberry |
| **GM: G-MG.A.2**. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). **★** | **Example:**   * An antique waterbed has the following dimensions 72 in. x 84 in. x 9.5in. It takes 240.7 gallons of water to fill it, which would weigh 2071 pounds. What is the weight of a cubic foot of water? * Wichita, Kansas has 344,234 people within 165.9 square miles. What is Wichita’s population density? |
| **GM: G-MG.A.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). **★** | **Examples:**   * You are the manager of a packing company responsible for manufacturing identical rectangular boxes from rectangular sheet of cardboard, each sheet having the same dimensions (18” X 24”). To save money, you want to manufacture boxes that will have the maximum possible volume. Determine the maximum volume possible. * The Bolero Chocolate Company makes square prisms to package their famous chocolate almond balls. The package holds 5 of the chocolate almond balls that are 1.5” in diameter. They are considering changing packaging to a triangular prism. What would be the difference in material cost if the cardboard used is currently purchased at $1.25 per square foot? (Consider both the top and bottom of the box.) |

| Statistics and Probability: Conditional Probability and the Rules of Probability ★ (S-CP) **Understand independence and conditional probability and use them to interpret data.** | |
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| **Louisiana Standard** | **Explanations and Examples** |
| **GM: S-CP.A.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”). **★** | Intersection: The **intersection** of two sets *A* and *B* is the set of elements that are common to both set *A* **and** set *B*. It is denoted by *A* ∩ *B* and is read ‘*A* intersection *B.*’   * *A* ∩ *B* in the diagram is {1, 5} * this means: BOTH/AND     Union: The **union** of two sets *A* and *B* is the set of elements, which are in *A* **or** in *B* **or** in both. It is denoted by *A* ∪ *B* and is read ‘*A* union *B.*’   * *A* ∪ *B* in the diagram is {1, 2, 3, 4, 5, 7} * this means: EITHER/OR/ANY * *could* be both   Complement: The **complement** of the set *A* ∪ *B* is the set of elements that are members of the universal set U but are not in *A* ∪ *B*. It is denoted by (*A* ∪ *B*)’  (*A* ∪ *B* )’ in the diagram is {8}. |
| **GM: S-CP.A.1.** *continued* | Students define a sample space and events within the sample space. The sample space is the set of all possible outcomes of an experiment. Students describe sample spaces using a variety of different representations.  **Example:**   * Describe the sample space for rolling two number cubes. *Note: This may be modeled well with a 6x6 table with the rows labeled for the first event and the columns labeled for the second event.* * Describe the sample space for picking a colored marble from a bag with red and black marbles. *Note: This may be modeled with set notation.* * Andrea is shopping for a new cellphone. She is either going to contract with Company A (60% chance) or with Company B (40% chance). She must choose between phone Q (25% chance) or phone R (75% chance). Describe the sample space. *Note: This may be modeled well with an area model.* * The 4 aces are removed from a deck of cards. A coin is tossed and one of the aces is chosen. Describe the sample space. *Note: This may be modeled well with a tree diagram.*   Students establish events as subsets of a sample space. An event is a subset of a sample space.  **Examples:**   * Describe the event of rolling two number cubes and getting evens. * Describe the event of pulling two marbles from a bag of red/black marbles. * Describe the event that the summing of two rolled number cubes is larger than 7 and even, and contrast it with the event that the sum is larger than 7 or even. |
| **GM: S-CP.A.2.** Understand that two events *A* and *B* are independent 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. **★** | Students calculate the probability of events.  **Examples:**   * When rolling two number cubes:  1. What is the probability of rolling a sum that is greater than 7? 2. What is the probability of rolling a sum that is odd? 3. Are the events, rolling a sum greater than 7, and rolling a sum that is odd, independent? Justify your response.  * You are picking a number out of a hat, which contains the numbers 1 through 100. What are the following events and their probabilities?  1. The number has a single digit 2. The number has two digits 3. The number is a multiple of 4 4. The number is not a multiple of 4 5. The sum of the number’s digits is 5   Students understand that two events A and B are independent when the probability that one event occurs in no way affects the probability of the other event occurring. In other words, the probability of A is the same even of event B has occurred. If events are independent then the  **Example:**   * Determine if the events are independent or not. Explain your reasoning.  1. Flipping a coin and getting heads and rolling a number cube and getting a 4 2. When rolling a pair of number cubes consider the events: getting a sum of 7 and getting doubles   From a standard deck of cards consider the events: draw a diamond and draw an ace |

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| **GM: S-CP.A.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*. **★** | Students understand conditional probability as the probability of A occurring given B has occurred.  **Example:**   * What is the probability that the sum of two rolled number cubes is 6 given that you rolled doubles?  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  | **Curfew** | |  | |  |  | **Yes** | **No** | **Total** | | **Chores** | **Yes** | 51 | 24 | 75 | | **No** | 30 | 12 | 42 | |  | **Total** | 81 | 36 | 117 |  * Each student in the junior class was asked if they had to complete chores at home and if they had a curfew. The table represents the data.  1. What is the probability that a student who has chores also has a curfew? 2. What is the probability that a student who has a curfew also has chores? 3. Are the two events have chores and have a curfew independent? Explain.  * There are two identical bottles. A bottle is selected at random and a single ball is drawn. Use the tree diagram at the right to determine each of the following:  1. ) |
| **GM: S-CP.A.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*. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.* **★** | Students:   * Determine when a two-way frequency table is an appropriate display for a set of data. * Collect data from a random sample. * Construct a two-way frequency table for the data using the appropriate categories for each variable. * Calculate probabilities from the table. * Use probabilities from the table to evaluate independence of two variables.   **Example:**     * The Venn diagram to the right shows the data collected at a sandwich shop for the last six months with respect to the type of bread people ordered (sourdough or wheat) and whether or not they got cheese on their sandwich. Use the diagram to construct a two-way frequency table and then answer the following questions.  1. *P* (sourdough) 2. *P* (cheese | wheat) 3. *P* (without cheese or sourdough) 4. Are the events “sourdough” and “with cheese” independent events? Justify your reasoning.      * Complete the two-way frequency table at the right and develop three conditional statements regarding the data. Determine if there are any set of events that are independent. Justify your conclusion. * Collect data from a random sample of students in your high school on their favorite subject among math, science, history, and English. Estimate the probability that a randomly selected 10th grade student from your school will favor science. Do the same for other subjects and compare the results. |
| **GM: S-CP.A.5.** Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.* **★** | **Examples:**   * Felix is a good chess player and a good math student. Do you think that the events “being a good chess player” and “being a good math student” are independent or dependent? Justify your answer. * Juanita assigned a letter for each side of a coin: H for heads and T for tails. She flipped the coin 10 times and got the following results: T, H, T, T, H, H, H, H, H, H. Dave thinks that the next flip is going to result in tails because there have been so many heads in a row. Do you agree? Explain why or why not. * At your high school the probability that a student takes a Business class and Spanish is 0.062. The probability that a student takes a Business class is 0.43. What is the probability that a student takes Spanish given that the student is taking a Business class? |
| Statistics and Probability: Conditional Probability and the Rules of Probability ★( S-CP) **Use the rules of probability to compute probabilities of compound events in a uniform probability model.** | |
| **Louisiana Standard** | **Explanations and Examples** |
| **GM: S-CP.B.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. **★** | The sample space of an experiment can be modeled with a Venn diagram such as:    So, the  **Example:**   * Peter has a bag of marbles. In the bag are 4 white marbles, 2 blue marbles, and 6 green marbles. Peter randomly draws one marble, sets it aside, and then randomly draws another marble. What is the probability of Peter drawing out two green marbles? *Note: Students must recognize that this a conditional probability P(green | green).* * A teacher gave her class two quizzes. 30% of the class passed both quizzes and 60% of the class passed the first quiz. What percent of those who passed the first quiz also passed the second quiz? * If a balanced tetrahedron with faces 1, 2, 3, 4 is rolled twice, what is the probability that the sum is prime (A) of those that show a 3 on at least one roll (B)? |
| **GM: S-CP.B.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. **★** | Students understand that the . Students may recognize that if two events *A* and *B* are mutually exclusive, also called *disjoint***,** the rule can be simplified to since for mutually exclusive events .  **Examples:**   * In a math class of 32 students, 18 boys and 14 are girls. On a unit test, 5 boys and 7 girls made an A grade. If a student is chosen at random from the class, what is the probability of choosing a girl or an A student? * Coffee at Mom’s Diner: <https://www.illustrativemathematics.org/content-standards/HSS/CP/B/7/tasks/1024> * Rain and Lightning: <https://www.illustrativemathematics.org/content-standards/HSS/CP/B/7/tasks/1112> * The Addition Rule: <https://www.illustrativemathematics.org/content-standards/HSS/CP/B/7/tasks/1885> |