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SUGGESTED

**INSTRUCTIONAL**

**PLANNING GUIDE**

*for the Mississippi College- and Career-Readiness Standards*

**q Mathematics**

|  |
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| **Geometry** |

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**INTRODUCTION**

The unprecedented, nationwide school closures in the spring of 2020 due to the COVID-19 pandemic have created a shift in how districts plan for school re-entry. Instead of the traditional brick-and-mortar planning, administrators are now identifying models that will support a variety of instructional delivery scenarios as they plan for school reopening. The traditional methods of planning and delivery are nearly impossible to implement as a stand-alone model; instead, innovative educators are developing and identifying strategies and resources to support a variety of distance learning scenarios as part of their plans. When using new models of delivery, it is important to recognize that the traditional approach to remediation—providing work better suited for earlier grades—may be insufficient. Instead, the conventional approach to remediation will likely compound the problem educators are trying to correct. According to a 2018 study, [The Opportunity Myth[[1]](#footnote-2)](https://tntp.org/assets/documents/TNTP_The-Opportunity-Myth_Web.pdf), the approach of “meeting students where they are”, while often well-intended, only widens the achievement gap. Instead of remediation, teachers and administrators are encouraged to look toward acceleration methods to support student growth and close the gaps.

**PURPOSE**

The purpose of the *Suggested Mississippi College- and Career-Readiness Standards Instructional Planning Guides* is to provide a *SUGGESTED* guide to assist teachers in planning rigorous, coherent lessons that focus on the critical content of each grade level. Providing curriculum guidance through intentional standard grouping and consideration for the time needed to address different objectives, should encourage consistent instruction that fully aligns to the Mississippi College- and Career-Readiness Standards. The use of this guide can also foster collaborative planning across schools and districts throughout the state.

**DEVELOPMENT**

The following planning and subsequent grouping of standards were determined through a collaborative process among state-level content specialists. By connecting standards through common conceptual understandings and relationships, the expectation is that conceptual connections will promote a cohesive process and avoid the teaching of standards in isolation. Additionally, it promotes a deeper understanding and a more authentic acquisition of mathematical knowledge and skills. The Standards for Mathematical Practices (SMPs) presented are those suggested to be highlighted within the respective standard; however, this does not exclude the inclusion of other SMPs. The standards determined as “**priority**” have been bolded and are standards identified as critical to the mastery of other standards. A standard’s “**priority**” status does *NOT* have a direct correlation with test item frequency. Additionally, some standards may appear multiple times throughout the course with a portion of the standard highlighted to depict that only that portion of the standard is to be taught within that unit.

**RESOURCES FOR CONSIDERATION**

The resources listed below may be referenced to support classroom teachers in the development of lesson plans and instruction at the local level. This list is not meant to be exhaustive, rather it represents consultative resources that align with the Units/Themes provided in the Instructional Planning Guides. Educators are encouraged to use these resources in addition to those curriculum materials that meet the needs of the students they serve.

| High-Quality Instructional Materials (HQIM) | Instruction and Planning Resources | Standards for Mathematical Practices (SMPs) | AssessmentResources | Professional Development |
| --- | --- | --- | --- | --- |
| * [MS HQIM Defined](https://mdek12.org/HQIM)
* [MS Adopted HQIM (Textbooks)](https://www.mdek12.org/caravan2019)
* [Illustrative Mathematics Geometry Curriculum](https://curriculum.illustrativemathematics.org/HS/teachers/2/index.html)
* [Big Ideas Easy Access Student Edition](https://bim.easyaccessmaterials.com/index.php?level=11.00)
* [Carnegie Learning Geometry Course Pacing](https://cdn.carnegielearning.com/assets/mathiax-pdfs/Geo_TIG_SS_TEXT.pdf)
* [Great Minds Teacher Resource Pack K-12](https://eurekamath.greatminds.org/teacher-resource-pack)
* [Great Minds Alignment to MSCCRS](https://greatminds.org/resources/products/mississippi-standards-alignment-study)
* [Kendall Hunt-Illustrative Mathematics Curriculum](https://im.kendallhunt.com/)
 | * [Achieve the Core Coherence Map-HS Math-Geometry](https://achievethecore.org/coherence-map/HS/G)
* [Standards Dependency and Flow View](http://jeffbaumes.github.io/standards/)
* *Scaffolding Instruction for ELLs*
* [Achieve the Core CCR Shifts in Mathematics](https://achievethecore.org/page/900/college-and-career-ready-shifts-in-mathematics)
* [Standards Progressions for Mathematics Progression Documents](http://ime.math.arizona.edu/progressions/)
* [Teacher Desmos](https://teacher.desmos.com/)
* [SFUSD Manipulatives List](http://www.sfusdmath.org/manipulatives.html)
* [Printable Manipulatives](https://www.mathematicalpractices.com/mp1e/content/printable-manipulatives/)
* [Achieve the Core Instructional Practice Guide HS](https://achievethecore.org/content/upload/Instructional%20Practice%20Guide_Math_HS.pdf)
* [Equip Exemplar Unit - Geometry](https://www.mdek12.org/sites/default/files/documents/OAE/OEER/Exemplar%20Units/math/Algebra-I-Exemplar-Unit-FINAL.pdf)
* [Mississippi CCRS Exemplar Lesson Plans](https://mdek12.org/ESE/math/lesson-plans)
* [CPM Core Connections Geometry Resources](https://cpm.org/ccg-additional-resources)
* [CPM Geometry Connections Additional Resources](https://cpm.org/gc-additional-resources)
* [Big Ideas Skills Review Handbook HS](https://bim.easyaccessmaterials.com/protected/content/srh/hs/)
* [HCPSS Family Mathematics Support Center-Geometry](http://hcpssfamilymath.weebly.com/geometry-gt.html)
* [MS CCRS Scaffolding Documents](https://mdek12.org/ese/ccr)
* [Access for All Guidance](https://mdek12.org/sites/default/files/documents/OAE/OAE/2019-access-for-all-guide.pdf)
* [MDE Family Guides for Student Success](https://mdek12.org/OAE/OEER/FamilyGuidesEnglish)\*

(Alternative Language: [Spanish](https://mdek12.org/OAE/OEER/FamilyGuidesSpanish))*\*This resource can be used for standards reinforcement of previous grades.* | * [Illustrative Mathematics Understanding the Standards for Mathematical Practices (SMPs)](http://tasks.illustrativemathematics.org/practice-standards/)
* [Inside Mathematics Mathematical Practice Standards](https://www.insidemathematics.org/common-core-resources/mathematical-practice-standards)
* [Inside Mathematics Mentors of Mathematical Practice](https://www.insidemathematics.org/common-core-resources/mentors-of-mathematical-practice)
 | * [Desmos Geometry Tool](https://www.desmos.com/geometry)
* [Desmos Graphing Calculato](https://www.desmos.com/calculator)r
* [MDE Desmos Calculator Support](https://www.mdek12.org/ese/Desmos-Calculator-Support)
* [Inside Mathematics Performance Tasks 2-HS](https://www.insidemathematics.org/performance-assessment-tasks)
* [Illustrative Mathematics Grade HS Tasks](http://tasks.illustrativemathematics.org/HS)
* [MARS Mathematics Assessment Project (6-HS)](https://www.map.mathshell.org/lessons.php?unit=9300&collection=8&redir=1)
* [Goalbook Pathways Grade HS](https://goalbookapp.com/pathways/?ref=topic#!/browse-topics/math/9-12)
* [Khan Academy HS Geometry](https://www.khanacademy.org/math/geometry)
 | * [MDE Professional Development Resources](https://www.mdek12.org/OPD/home)
* [MARS Prototype Professional Development Modules](https://www.map.mathshell.org/pd.php)
* [NCTM Professional Development Resources](https://www.nctm.org/Conferences-and-Professional-Development/Professional-Development-Resources/)
* [Inside Mathematics Classroom Videos](https://www.insidemathematics.org/classroom-videos)
* [NCTM Math Forum](https://www.nctm.org/tmf/mathed/mathed.research.new.html)
* [Great Minds (Eureka) Webinars](https://eurekamath.greatminds.org/webinar-library)
* [Using Manipulatives in the Classroom](https://www.teachervision.com/professional-development/using-manipulatives)
* [Learn Desmos](https://learn.desmos.com/)
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| Applets, Demos, Interactives, and Virtual Manipulatives |
| * [CPM Tiles](https://technology.cpm.org/general/tiles/)
* [Didax Virtual Manipulatives](https://www.didax.com/math/virtual-manipulatives.html)
* [Didax Free Activity Guides for Virtual Manipulatives](https://www.didax.com/virtual-manipulatives-activities)
* [GeoGebra Virtual Manipulatives](https://www.geogebra.org/m/NPDu3rCm)
* [Geometry Playground](https://www.maa.org/press/periodicals/loci/resources/geometry-playground)
* [Houghton Mifflin and Harcourt iTools](https://www-k6.thinkcentral.com/content/hsp/math/hspmath/na/common/itools_int_9780547584997_/main.html)
* [Interactive Mathematics Applications](https://www.intmath.com/help/interactive-math-applications.php)
* [Interactivate Tools](http://www.shodor.org/interactivate/tools/)
* [Key Curriculum Geometers Sketchpad](https://www.keycurriculum.com/training)
* [Mathed Applets](https://www.mathed.page/applets.html)
* [Mathies Learning Tools](https://www.mathies.ca/learningTools.php#gsc.tab=0)
* [Mathigon Polypad](https://mathigon.org/polypad)
* [Math Playground Math Manipulatives](https://www.mathplayground.com/math_manipulatives.html)
* [Mathsbot Manipulatives](https://mathsbot.com/manipulativeMenu)
* [McGraw Hill (Glencoe) Virtual Manipulatives](http://www.glencoe.com/sites/common_assets/mathematics/ebook_assets/vmf/VMF-Interface.html)
* [National Library of Virtual Manipulatives](http://nlvm.usu.edu/en/nav/vlibrary.html)
* [NCTM Illuminations Interactives](https://illuminations.nctm.org/)
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| **TERM 1****UNIT OF STUDY**(REAL-WORLD APPLICATION)**q** | **MS CCR STANDARDSq** | **STANDARDS FOR MATHEMATICAL PRACTICE (SMPs)q** | CORE ACADEMIC **VOCABULARY TERMSq** |
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| **Unit 1: Experiment with Plane Transformations** -An extension on the 7th and 8th grade concepts of transformational geometry, lines, angles, and triangles. (At the High School level, Geometry lays the foundation for career trades, advance mathematics, and sciences in relation to fields such as art, graphic design, architecture, robotics, engineering, physics, geography, and astrology.)[(Geometry in Real Life-Sciencing)](https://sciencing.com/geometry-used-real-life-8698204.html)[(Geometry in Real Life-Sutori)](https://www.sutori.com/story/geometry-in-real-life--SM69DTYX9yuUt7oNGARtEXxi) | G-CO.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. | * **SMP 4** Model with Mathematics.
* **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
 | AngleCircleCircular ArcDistance LineLine SegmentParallel Line Perpendicular Line Point |
|  | G-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). | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
 | Functions Input Non-Rigid MotionOutput Plane Rigid MotionTransformation |
|  | G-CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 6** Attend to precision.
 | ParallelogramQuadrilateralRectangle ReflectionRegular Polygon RotationRotational SymmetryTrapezoidTriangle |
|  | G-CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. | * **SMP 4** Model with Mathematics.
* **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
 | Non-Rigid MotionReflectionRigid MotionRotationTranslation |
|  | G-CO.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. | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 4** Model with Mathematics.
 | Non-Rigid MotionReflection Rigid Motion Rotation TransformationTranslation |
| **Unit 2: Congruence in Rigid Motions** (In previous grades, students were asked to draw triangles based on given measurements. They also have prior experience with rigid motions: translations, reflections, and rotations and have used these to develop notions about what it means for two objects to be congruent. In this unit, students establish triangle congruence criteria, based on analysis of rigid motions and formal constructions. They apply reasoning to complete geometric constructions and explain why they work.) | G-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. | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 5** Use appropriate tools strategically.
* **SMP 7** Look for and make use of structure.
 | CongruenceCongruentNon-Rigid MotionRigid MotionTransform |
|  | G-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. | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 5** Use appropriate tools strategically.
* **SMP 7** Look for and make use of structure.
 | CongruenceCongruentCorrespondCorresponding PairNon-Rigid MotionRigid Motion |
|  | G-CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 5** Use appropriate tools strategically.
* **SMP 7** Look for and make use of structure.
 | Angle-Side-Angle (ASA)CongruenceCongruentNon-Rigid MotionRigid MotionSide-Angle-Side (SAS)Side-Side-Side (SSS) |
| **Unit 3: Proving Geometric Theorems** (Students use triangle congruence as a familiar foundation for the development of forma proof. Students prove theorems and solve problems about triangles, quadrilaterals, and other polygons. Students can use their knowledge of forming geometric proofs to advanced mathematics and careers in legal studies and policies.)  | **G-CO.9 Prove 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.*** | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
 | Adjacent AnglesAlternate Exterior Angle Alternate Interior AngleAngleCongruentCorresponding AnglesEndpointsEquidistantLineLine SegmentPerpendicular Bisector TheoremTransversal Vertical Angles |
|  | **G-CO.10 Prove 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.*** | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
 | Base Angle Exterior Angle TheoremInterior Angle TheoremIsosceles Triangle TheoremMedians Triangle Midsection Triangle Sum Theorem |
|  | **G-CO.11 Prove 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.*** | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 5** Use appropriate tools strategically.
 | BisectCongruentConverse DiagonalOpposite angles ParallelogramsTheorem |
| **Unit 4: Geometric Constructions**(Geometric constructions are used in the arts and architecture. Architects use mathematics for several reasons. Apart from the mathematics needed when engineering buildings, architects use geometry: to define the spatial form of a building i.e. to create the design of the building its shape, height, structure basically the construction blueprint.) | G-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.). *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.* | * **SMP 4** Model with Mathematics.
* **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
 | Angle Compass Geometric ConstructionsLine Line Segment Perpendicular BisectorPerpendicular LinesPoint Segment |
|  | G-CO.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. | * **SMP 4** Model with Mathematics.
* **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
 | Circle Equilateral TriangleHexagonInscribe Square |

| **TERM 2****UNIT OF STUDY**(REAL-WORLD APPLICATION)**q** | **MS CCR STANDARDSq** | **STANDARDS FOR MATHEMATICAL PRACTICE (SMPs)q** | CORE ACADEMIC **VOCABULARY TERMSq** |
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| **Unit 5: Similarity Transformations**(Knowledge of geometric concepts and shapes can be used to create works of art with unique designs and in careers such as architecture and design.)  | G-SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor:G-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.G-SRT.1b the dilation of a line segment is longer or shorter in the ratio given by the scale factor. | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 6** Attend to precision.
 | DilationRatio Scale Factor SimilarSimilar Figures |
|  | G-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. | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 4** Model with Mathematics.
 | Angles Corresponding Pairs DilationProportional Sides SimilarSimilar FiguresSimilarity TransformationsTriangles |
|  | G-SRT.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. | * **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
 | Angle-Angle (AA) CriterionDilationSimilarSimilar FiguresSimilarity Transformations |
| **Unit 6: Similarity Theorems**(Students apply previous experiences with dilations and proportional reasoning to build a formal understanding of similarity. Using the criteria for similarity of triangles, students will solve problems using similarity and understand right triangle trigonometry by applying similarity in right triangles, paying close attention to the Pythagorean theorem and special right triangles. Students can use their knowledge of similarity theorems in triangles in the field of engineering, arts, and advanced mathematics courses.) | G-SRT.4 Prove 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.* | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
 | Parallel LineProportional Pythagorean TheoremTriangle Triangle Similarity |
|  | G-SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 7** Look for and make use of structure.
 | Angle-Angle (AA) CongruentDilationPythagorean TheoremSimilarSimilar Figures  |
| **Unit 7: Trigonometric Ratios and Right Triangles**(The definitions of sine, cosine, and tangent for acute angles are founded on right triangles and similarity, and, with the Pythagorean Theorem, are fundamental in many real-world and theoretical situations. The Pythagorean Theorem is generalized to non-right triangles by the Law of Cosines. Together, the Laws of Sines and Cosines embody the triangle congruence criteria for the cases where three pieces of information suffice to completely solve a triangle.) | G-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. | * **SMP 2** Reason abstractly and quantitatively.
* **SMP 6** Attend to precision.
 | Acute Angle Adjacent CosineHypotenuse Opposite Right Triangle Side Ratio SineTangentTrigonometric Ratio |
|  | G-SRT.7 Explain and use the relationship between the sine and cosine of complementary angles. | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 4** Model with Mathematics.
 | Complementary AnglesCosineSineTrigonometric Ratio |
|  | G-SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. \* | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 4** Model with Mathematics.
 | CosinePythagorean Theorem Right Triangle SineTangentTrigonometric Ratio |
| **Unit 8: Modeling Geometric Concepts: Trigonometric Ratios for Acute Angles** (An understanding of the attributes and relationships of geometric objects can be applied in diverse contexts— interpreting a schematic drawing, estimating the amount of wood needed to frame a sloping roof, rendering computer graphics, or designing a sewing pattern for the most efficient use of material.) | G-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). \* | * **SMP 2** Reason abstractly and quantitatively.
* **SMP 4** Model with Mathematics.
* **SMP 7** Look for and make use of structure.
 | AttributeThree-Dimensional Two-Dimensional |
|  | G-MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). \* | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 4** Model with Mathematics.
* **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
* **SMP 8** Look for and express regularity in repeated reasoning.
 | Area DensityVolume |
|  | G-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). \* | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 4** Model with Mathematics.
* **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
* **SMP 8** Look for and express regularity in repeated reasoning.
 | Constraints MaximizeMinimizeOptimize |

| **TERM 3****UNIT OF STUDY**(REAL-WORLD APPLICATION)**q** | **MS CCR STANDARDSq** | **STANDARDS FOR MATHEMATICAL PRACTICE (SMPs)q** | CORE ACADEMIC **VOCABULARY TERMSq** |
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| **Unit 9: Circumference, Area, and Volume Formulas and Problem Solving**(In advanced mathematics, students can use their problem-solving skills in Calculus to assist in making informal limit arguments.)  | G-GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri’s principle, and informal limit arguments.* | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
 | Area of A Circle Cavalieri’s Principle CircumferenceDissect Volume of A Cone Volume of A CylinderVolume of A Pyramid |
|  | G-GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. \* | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 4** Model with Mathematics.
* **SMP 7** Look for and make use of structure.
 | Volume of a Cone Volume of a CylinderVolume of a PyramidVolume of a Sphere |
| **Unit 10: Relationship Between 2-and 3-Dimensional Objects**(Students apply their knowledge of two-dimensional shapes to consider the shapes of cross sections and the result of rotating a two-dimensional object about a line. Geometry concepts like this one are applied in the fields of robotics, computer, and video games. These game engines depict a 3-D world using a 2-D map.) | G-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. | * **SMP 2** Reason abstractly and quantitatively.
* **SMP 4** Model with Mathematics.
* **SMP 7** Look for and make use of structure.
 | Cross Section Rotation Three-DimensionalTwo-Dimensional  |
| **Unit 11: Modeling Geometric Concepts: Relating 2-and 3-D Objects, Volume, and Trigonometry of Triangles**(Students’ experience with two-dimensional and three-dimensional objects is extended to include informal explanations of circumference, area, and volume formulas. Geometry can be used to model two- and three-dimensional objects to create different illusions in art, structures in architecture and understand advanced mathematics in high school.) | G-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). \* | * **SMP 2** Reason abstractly and quantitatively.
* **SMP 4** Model with Mathematics.
* **SMP 7** Look for and make use of structure.
 | AttributeThree-Dimensional Two-Dimensional |
| **Unit 12: Proving Geometric Theorems Algebraically with Coordinates** (Building on their work with the Pythagorean theorem in 8th grade to find distances, students use a rectangular coordinate system to verify geometric relationships, including properties of special triangles and quadrilaterals and slopes of parallel and perpendicular lines.Analytic geometry connects algebra and geometry, resulting in methods of analysis and problem solving. This correspondence between numerical coordinates and geometric points allows methods from algebra to be applied to geometry and vice versa.) | G-GPE.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). | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 7** Look for and make use of structure.
* **SMP 8** Look for and express regularity in repeated reasoning.
 | Parallel LinePerpendicular LineSlope |
|  | G-GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio. | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 8** Look for and express regularity in repeated reasoning.
 | EndpointLine Segment MidpointRatio |
|  | G-GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. \* | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 4** Model with Mathematics.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
 | Areas of Rectangles Areas of Triangles CoordinatesDistance Formula Perimeter of Polygons |
|  | G-GPE.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 (1, $√$3) origin and containing the point (0, 2). | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 4** Model with Mathematics.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
 | CoordinatesProof Theorems |

| **TERM 4****UNIT OF STUDY**(REAL-WORLD APPLICATION)**q** | **MS CCR STANDARDSq** | **STANDARDS FOR MATHEMATICAL PRACTICE (SMPs)q** | CORE ACADEMIC **VOCABULARY TERMSq** |
| --- | --- | --- | --- |
| **Unit 13: Circle Theorems**(In this unit, students prove basic theorems about circlessuch as a tangent line is perpendicular to a radius, inscribed angle theorem, and theorems about chords, secants, and tangents dealing with segment length and angle measures. In the Cartesian coordinate system, students use the distance formula to write the equation of a circle when given the radius and the coordinates of its center.Students study relationships among segments on chords, secants, and tangents as an application of similarity.) | G-C.1 Prove that all circles are similar. | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 4** Model with Mathematics.
* **SMP 5** Use appropriate tools strategically.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
* **SMP 8** Look for and express regularity in repeated reasoning.
 | CircleProof SimilarTheorem |
|  | G-C.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle. | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 5** Use appropriate tools strategically.
 | Angles Central Angles ChordCircumscribed Diameter Inscribed AnglesIntersect Perpendicular RadiiRadius of a Circle Right AngleScribe Tangent |
|  | G-C.3 Construct the inscribed and circumscribed circles of a triangle and prove properties of angles for a quadrilateral inscribed in a circle. | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 4** Model with Mathematics.
* **SMP 5** Use appropriate tools strategically.
 | ChordCircumscribeInscribeRadiiScribeTangent |
|  | G-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. | * **SMP 2** Reason abstractly and quantitatively.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 7** Look for and make use of structure.
* **SMP 8** Look for and express regularity in repeated reasoning.
 | CenterDiameterEquation of A CircleRadiusPythagorean Theorem |
| **Unit 14: Arc Lengths and Area of Sectors** (Sectors are important for designing and building Freeway exits, when they use a “Clover Leaf” style Interchanges.) | G-C.5 Derive using similarity the fact 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. | * **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 5** Use appropriate tools strategically.
* **SMP 7** Look for and make use of structure.
 | ArcArc Length AngleArea of a Sector Intercept Proportional Radian Measure RadiusSimilarity |
| **Unit 15: Geometric Description vs. Conic Section Equation**(Conic sections are used in bridge designing.) | G.PEI.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. | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
 | Center Complete the Equation of a Circle Pythagorean Radius Square Theorem |
| **Unit 16: Proving Geometric Theorems Algebraically with Coordinates: Simple Proofs Involving Circles**(Geometry is used in the field of astronomy, to map the positions of stars and planets on the celestial sphere and describe the relationship between movements of celestial bodies.) | G-GPE.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 (1, $√$3) origin and containing the point (0, 2). | * **SMP 1** Make sense of problems and persevere in solving them.
* **SMP 2** Reason abstractly and quantitatively.
* **SMP 3** Construct viable arguments and critique the reasoning of others.
* **SMP 4** Model with Mathematics.
* **SMP 6** Attend to precision.
* **SMP 7** Look for and make use of structure.
* **SMP 8** Look for and express regularity in repeated reasoning
 | CoordinatesDisprove Origin Proof ProveRectangle Theorems |
| **Unit 17: Modeling Geometric Concepts: Circles**(Dynamic geometry environments provide students with experimental and modeling tools that allow them to investigate geometric phenomena in much the same way as computer algebra systems allow them to experiment with algebraic phenomena.) | G-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). \* | * **SMP 2** Reason abstractly and quantitatively.
* **SMP 4** Model with Mathematics.
* **SMP 7** Look for and make use of structure.
 | AttributeThree-Dimensional Two-Dimensional |

 ***\* Modeling Standards***

1. *https://tntp.org/assets/documents/TNTP\_The-Opportunity-Myth\_Web.pdf* [↑](#footnote-ref-2)