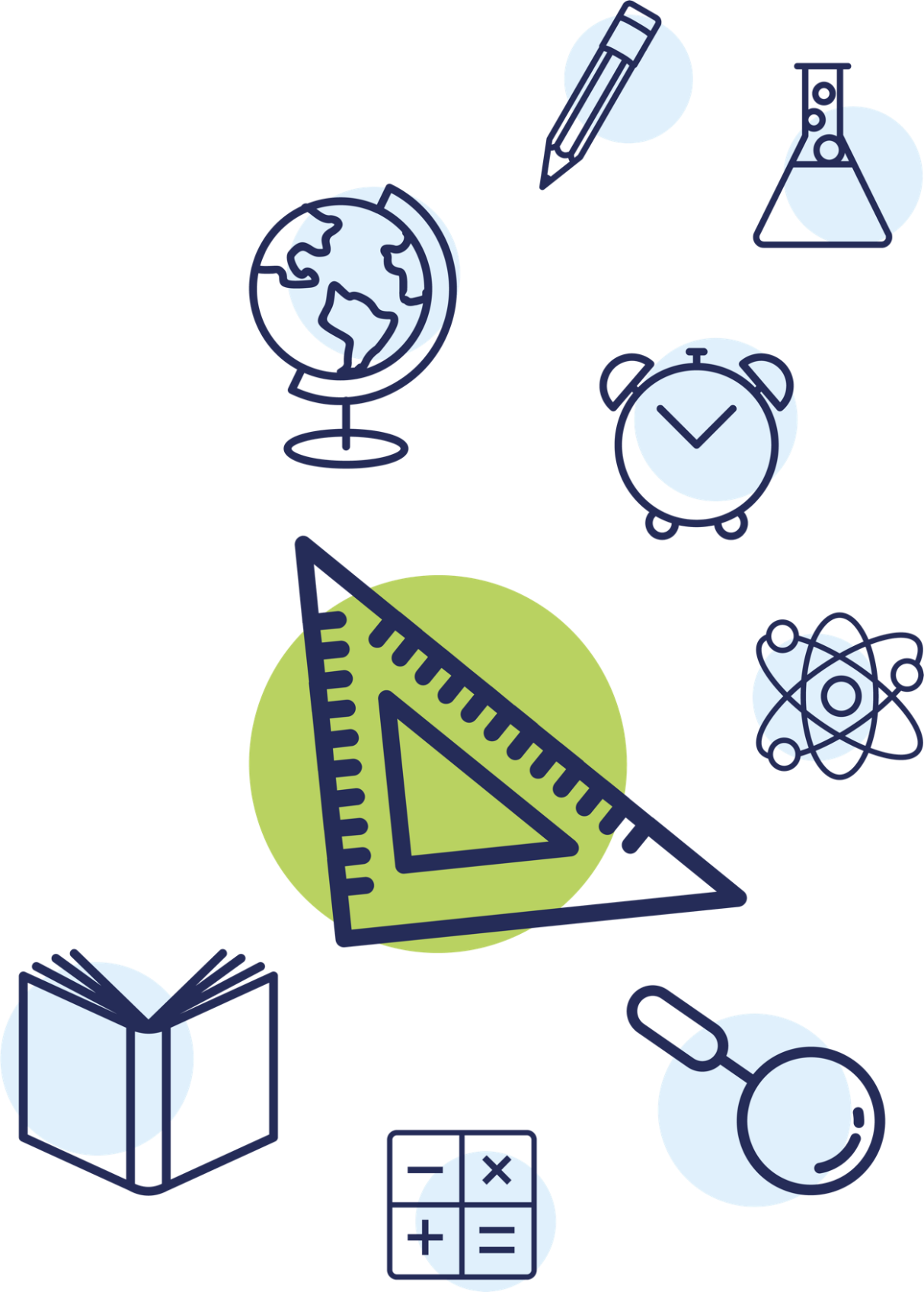
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SUGGESTED

**INSTRUCTIONAL**

**PLANNING GUIDE**

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

**q Mathematics**

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| **Algebra I** |

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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 ***Algebra I Suggested Mississippi College- and Career-Readiness Standards Instructional Planning Guide*** is to provide *SUGGESTED* guidance for teachers in planning rigorous, coherent lessons that focus on the critical content in the MS CCRS Algebra I course. Providing curriculum guidance through intentional standards 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 Unit; 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 MAAP assessment item frequency. Additionally, because some standards may appear multiple times throughout the Algebra I course, a portion of the standard has been highlighted to depict that only that part of the standard is to be taught within the respective Unit.

Included throughout the ***Algebra I******Suggested Instructional Planning Guide*** are practical tips that teachers **may** consider during the teaching and learning process. Each “**TEACHER TIP**” is denoted in red font; and, while these tips are **NOT** exhaustive in nature, they do represent tested and proven pedagogical strategies that encourage mathematical discourse, critical thinking, depth of knowledge, and writing in the classroom. The overall goal of the “**TEACHER TIP**” is to ensure all learning styles are met, that all students experience success, and to maximize students’ conceptual understanding within the given Unit. As teachers progress through the Unit, they are **encouraged** to add additional strategies to meet the needs of individual students and to align with their individual teaching style.

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**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 provided in this Instructional Planning Guide. Educators are encouraged to use these resources in addition to those curriculum materials that meet the needs of the students they serve.

|  |  |  |  |  |  |
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| High-Quality Instructional Materials (HQIM) | Instruction and  Planning Resources | | Standards for Mathematical Practices (SMPs) | Assessment  Resources | Professional  Development |
| * [MS HQIM Defined](https://mdek12.org/HQIM) * [MS Adopted HQIM (Textbooks)](https://mdek12.org/caravan2019) * [Algebra Nation](https://www.algebranation.com/ms/)*\** * [Great Minds Lessons-on-the Go](https://gm.greatminds.org/en-us/knowledgeonthego) * [Great Minds (Eureka Math) Teacher Resource Pack](https://eurekamath.greatminds.org/teacher-resource-pack) * [Great Minds Alignment to MSCCRS](https://greatminds.org/resources/products/mississippi-standards-alignment-study)   \* Year-to-year, state funded online platform for Algebra I teachers and students with digital and consumable resources. Account access set-up at the local level. | * [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) * [Achieve the Core Coherence Map-HS Math](https://achievethecore.org/coherence-map/HS) * [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) * [Illustrative Mathematics Algebra I Scope and Sequence](https://curriculum.illustrativemathematics.org/HS/students/1/index.html) * [Standards Progressions for Mathematics Progression Documents](http://ime.math.arizona.edu/progressions/) * [MS Exemplar Units & Lessons](https://mdek12.org/MEUL) * [MDE Developed Exemplar Lesson Plans](https://mdek12.org/ESE/math/lesson-plans) * [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) | | * [MS MAAP Program](https://mdek12.org/OSA/MAAP) * [MS MAAP-A Program](https://mdek12.org/OSA/SP/MAAP-A) * [MS MAAP Mathematics Resources](https://districtaccess.mde.k12.ms.us/studentassessment/Public%20Access/Forms/AllItems.aspx?RootFolder=%2Fstudentassessment%2FPublic%20Access%2FStatewide%5FAssessment%5FPrograms%2FMAAP%2DMississippi%20Academic%20Assessment%20Program%2FMath%5FGuidance) * [Desmos Graphing Calculator](https://www.desmos.com/calculator) * [Desmos](https://www.mdek12.org/ese/Desmos-Calculator-Support) Calculator Support * [Inside Mathematics Performance Tasks 2-HS](https://www.insidemathematics.org/performance-assessment-tasks) * [Illustrative Mathematics Grade 8 Tasks](http://tasks.illustrativemathematics.org/content-standards/8) * [MARS Mathematics Assessment Project (6-HS)](https://www.map.mathshell.org/index.php) | * [MDE Professional Development Resources](https://www.mdek12.org/OPD/home) * [SchoolKit and IM Video Lessons](http://schoolkitgroup.com/video-algebra/) * [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/mathforum/) * [Great Minds (Eureka) Webinars](https://eurekamath.greatminds.org/webinar-library) * [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/) |

| **TERM 1**  **UNIT OF STUDY**  (REAL-WORLD APPLICATION) **q** | **MS CCR**  **STANDARDS**  **q** | **STANDARDS FOR MATHEMATICAL  PRACTICE (SMPs) q** | CORE ACADEMIC **VOCABULARY TERMS q** |
| --- | --- | --- | --- |
| **Unit 1: The Importance of the Modeling Cycle** (Mini-lesson)  (As students begin to work with advanced math and apply it to the world around them, it is important they understand the meaning of their mathematical answer in the given context. When there is a misalignment between the response and the provided context, engage students in a reflective process that requires them to start over.)  TEACHER TIP: Throughout this course, the Modeling Cycle should be an embedded part of the teaching and learning process. This will further develop students’ mathematical reasoning, discourse, justifications, and problem-solving skills. | Reference the [MS CCRS for Mathematics](https://districtaccess.mde.k12.ms.us/curriculumandInstruction/Mathematics%20Resources/MS%20CCSSM%20Framework%20Documents/2016-MS-CCRS-Math.pdf), pages 89 and 90, for a complete description of the Modeling Cycle. | * **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 6** Attend to precision. | Compute  Formulate  Interpret  Model  Modeling  Problem  Report  Validate  For additional understanding related to the Modeling Cycle and Mathematical Modeling visit the link [here](http://www.corestandards.org/Math/Content/HSM/). |
| **Unit 2: Understanding Simple Expressions**  (In order for students to experience success in solving equations and graphing functions later in the course, they must have a solid understanding of expressions and the role each part of the expression plays. Expressions are all around us from a simple cooking recipe to complex computer software systems.) | | **A-SSE.1: Interpret expressions that represent a quantity in terms of its context.\***  **A-SSE.1a: Interpret parts of an**  **expression, such as terms, factors, and**  **coefficients.\***  A-APR.1: Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. (#SEE NOTE BELOW)  N-RN.3: Explain why the sum or product of two rational numbers is rational; the sum of a rational number and an irrational number is irrational; and the product of a nonzero rational number and an irrational number is irrational.  (#Unit 15 in this Instructional Planning Guide is dedicated solely to Polynomials.) | * **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. | Coefficient  Expression  Factor  Irrational Number  Polynomial  Rational Number  Term |
| **Unit 3: Measuring and Reporting**  (In real world problems, the answers are usually quantities, or numbers with units –which involve some type of measurement. In their work with measurement concepts in Grades K-8, students primarily measured common attributes such as length, area, and volume. Students will build on this foundation during this course as they encounter a wider variety of units while modeling.) | | **N-Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.**  N-Q.2: Define appropriate quantities for the purpose of descriptive modeling.\*  N-Q.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.\* | * **SMP 1** Make sense of problems and persevere in solving them. * **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. | Measurement  Model  Unit |
| **Unit 4: One Variable Equations**  (We use equations every day of our life without even knowing it. From the moment we wake up to our alarm and “calculate” the number of times we can hit the “SNOOZE” button to the amount of money we can spend each day. We often do this math mentally; but being able to do so helps us identify an unknown quantity.) | | **A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters**.  A-REI.1: Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.  A-CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. \*  A-CED.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.\** | * **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. | Coefficient  Equality  Equation  Linear Equation  Solution  Variable |
| **Unit 5: Formulas**  (Students will encounter many situations in their life where they will need to use a formula – which is basically a factual equation that models the relationship between two or more variables for a particular pattern, phenomena, shape, or situation. This skill will serve them well in advanced courses like Geometry.)  TEACHER TIP: Familiarize students with the formulas included on the current [MAAP Reference Sheet](https://districtaccess.mde.k12.ms.us/studentassessment/Public%20Access/Forms/AllItems.aspx?RootFolder=%2Fstudentassessment%2FPublic%20Access%2FStatewide%5FAssessment%5FPrograms%2FMAAP%2DMississippi%20Academic%20Assessment%20Program%2FMath%5FGuidance), commonly used formulas, and formulas that were introduced in previous grades. | | **A-CED.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations*. For example, rearrange Ohm’s law, V = IR, to highlight resistance, R*.\***  N-Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays**.** | * **SMP 1** Make sense of problems and persevere in solving them. * **SMP 4** Model with Mathematics. * **SMP 5** Use appropriate tools strategically. * **SMP 6** Attend to precision. | Formula  Quantity  Solution  Variable |
| **Unit 6: One Variable Inequalities**  (Inequalities in one variable are very useful whenever there is a possible range on the acceptable minimum or maximum value. Mastery in solving and graphing linear equalities will facilitate the skills required to master this Unit.)  TEACHER TIP: Refer to the middle grades standard **6.EE.8** to reinforce graphing of one-variable inequalities. | | **A-REI.3: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.**  A-CED.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. \*  A-CED.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*\* | * **SMP 1** Make sense of problems and persevere in solving them. * **SMP 4** Model with Mathematics. * **SMP 5** Use appropriate tools strategically. * **SMP 6** Attend to precision. | Inequality  Inequality Symbols  Number Line |
| **Unit 7: Finding the *nth* Term**  (Before students can master arithmetic sequences, they must be able to add and subtract negative numbers. This skill is critical when evaluating increasing or decreasing number patterns without having to write each number in the sequence out.)  TEACHER TIP: Introduce the formulas for arithmetic and geometric sequences early AND use them consistently during this Unit.  TEACHER TIP: As you progress through the Unit, consider using a highlighter to help students focus on which variable is of interest when using the formulas. | | **F-IF.3: Recognize that sequences are functions whose domain is a subset of the integers.**  **F-LE.2: Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).\***  F-BF.1: Write a function that describes a relationship between two quantities.\*  F-BF.1a: Determine an explicit  expression or steps for calculation  from a context. | * **SMP 1** Make sense of problems and persevere in solving them. * **SMP 6** Attend to precision. * **SMP 7** Look for and make use of structure. * **SMP 8** Look for and express regularity in repeated reasoning. | Arithmetic Sequence  Common Difference  Common Ratio  Infinite Sequence  Geometric Sequence  Finite Sequence  *n*th term |
| **Unit 8: The Concept of a Function**  (Functions help us determine a set of expected outputs/inputs when a permissible set of inputs/outputs are given. For example, the efficiency of a car in terms of mpg is a function. If a car “gets” approximately 20 mpg, and 10 gallons of gasoline are put into the car, students can estimate that the car will travel about 200 miles before it runs out of gas.)  TEACHER TIP: It is important to use a variety of letters and labeling notations when teaching functions aside from the traditional *f(x)=* and *y*= notations. This will help students prepare for upper level math courses and the ACT.  TEACHER TIP: Ensure students understand the difference between a function and a relation presented in a variety of forms (e.g., in words, pictures/diagrams, graphically, etc.)  TEACHER TIP: You may want to consider beginning this Unit referencing “input” and “output” as these are the terms used in the MS CCRS Grade 8 course. This will provide a great scaffold as you introduce the vocabulary terms and concepts associated with “domain” and “range”. Although functions are formally introduced in Grade 8, students do not use the actual *f(x)* notation until this course, MS CCRS Algebra I. | | **F-IF.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f(x)* denotes the output of *f* corresponding to the input x*.* The graph of *f* is the graph of the equation *y = f(x).***  **F-IF.2: Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.**  **F-LE.2: Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).\***  N-Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays**.** | * **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. | Domain  Function  Function Notation  Input  Ordered Pair  Output  Range  Relation |
| **Unit 9: Functions Have a Life of Their Own**  (As students begin to master functions, they will begin to see their application and utility every day. From understanding their monthly cell phone bill to the amount of money needed to take an Uber/taxi across town.)  TEACHER TIP: This is a larger Unit, be sure to spend sufficient time on each concept.  TEACHER TIP: Be sure students are introduced to the different forms of a linear function; and, have ample opportunities to convert between them.  TEACHER TIP: Provide opportunities where students are able to master the graphing functions on the [acceptable and recommended calculators](https://districtaccess.mde.k12.ms.us/studentassessment/Public%20Access/Forms/AllItems.aspx?RootFolder=%2Fstudentassessment%2FPublic%20Access%2FStatewide%5FAssessment%5FPrograms%2FMAAP%2DMississippi%20Academic%20Assessment%20Program%2FMath%5FGuidance) for classroom and testing use.  TEACHER TIP: Develop learning experiences that require students to graph by hand on graph paper without the Coordinate Plane pre-printed. Encourage, where appropriate, extending the graph of linear functions using a straightedge. This will lay the foundation for the S-ID standards presented in Unit 20 in Term 4.  TEACHER TIP: Provide real-world graphing opportunities that require students to label their axes based on the given context (i.e., by deciding what variables should be used).  TEACHER TIP: During instruction, be sure to include familiar symbols when calculating slope and rate of change (e.g., Δ and *m*).  TEACHER TIP: Consider using the graphing calculator to deepen understanding of the content standard A.REI.10. The TRACE function allows students to visually identify that given a particular *x-*value for the domain, the range is seen directly on the graph. Students can repeat this process to “understand” that a function consists of points (“solutions”).  This TEACHER TIP can be combined with the calculator tips provided in Units 8 and 9 of this Instructional Planning Guide. | | **A-REI.10: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).**  F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes*. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*\*  F-IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.\*  **F-IF.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\***  **F-IF.7a: Graph functions (linear**  **and quadratic) and show**  **intercepts, maxima, and minima.**  A-CED.2: Create equations in two variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.\*  F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.\*  F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*\*  N-Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays**.** | * **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. | Coordinate Plane  Function  Domain  Range  Slope  Slope-Intercept Form  Standard Form  Rate of Change  X-intercept / Zero  Y-intercept |
| **Unit 10: When the Change is Constant**  (Students should be able to examine a set of ordered pairs, a table, a graph, or a word problem to determine if the information presented has a constant rate of change that can be modeled by a linear function. For example, when determining their wages for an afterschool job based on an hourly rate.)  TEACHER TIP: While teaching the concepts and vocabulary for rate of change and slope, try to limit simplifying them to just “rise over run.” Encourage mathematical understanding by speaking in terms of the ordered pairs, graph, data set, etc. This will further support student understanding in advanced courses like Calculus. | | **F-IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.\***  F-LE.1: Distinguish between situations that can be modeled with linear functions and with exponential functions.\*  F-LE.1a: Prove that linear  functions grow by equal  differences over equal intervals  and that exponential functions  grow by equal factors over equal  intervals.  F-LE.1b: Recognize situations in  which one quantity changes at a  constant rate per unit interval  relative to another.  F-LE.2: Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).\*  F-LE.5: Interpret the parameters in a linear or exponential function in terms of a context.\* | * **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. | Average Rate of Change  Equal Intervals  Slope  Rate of Change |

| **TERM 2**  **UNIT OF STUDY**  (REAL-WORLD APPLICATION) **q** | **MS CCR**  **STANDARDS q** | **STANDARDS FOR MATHEMATICAL  PRACTICE (SMPs) q** | CORE ACADEMIC **VOCABULARY TERMS q** |
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| **Unit 11: Inequalities in Two Variables**  (Being able to see the (seemingly) infinite number of solutions for a real-life situation is a great skill for students to master. Inequalities are used more often than equations in real life, from budgeting and managing inventory to shipping, and daily calorie consumption.)  TEACHER TIP: During instruction, be sure students master the “shading” feature on the calculator.  TEACHER TIP: Develop several learning experiences that require students to graph by hand on graph paper.  TEACHER TIP: When teaching students how to graph by hand, effective **modeling** of “test points” is very important when determining the appropriate region to shade. Justify this algebraically and graphically in your demonstrations. Encourage advanced students to use “test points” other than the ordered pair (0,0).  TEACHER TIP: In the case of real-world problems, require students to justify algebraically AND graphically why a possible/viable solution works; and why a non-solution does not. | **A-CED.3: Represent constraints by** equations or **inequalities,** and by systems of equations and/or inequalities, **and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*\***  **A-REI.12: Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.** | * **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. * **SMP 6** Attend to precision. * **SMP 7** Look for and make use of structure. | Boundary Line  Constraint(s)  Half-Plane  Inequality  Inequality Symbols  Strict Inequality  “Test Point”  Viable |
| **Unit 12: Systems of Equations and Inequalities**  (Systems of equations and inequalities help business owners every day. Systems of linear inequalities, in particular, help business owners solve problems where there are multiple constraints to consider for different variables. This skill is especially useful when trying to figure out how to maximize something (e.g. profit) or identify where losses might occur.)  TEACHER TIP: This is a larger Unit, be sure to spend sufficient time on each concept.  TEACHER TIP: Include AND model all techniques listed in the standards A-REI.5, A-REI.6, and A-REI.11 during instruction.  TEACHER TIP: With respect to standards A-REI.5, A-REI.6, and A-REI.11, incorporate writing prompts that require students to examine WHY a particular solution is not possible given their knowledge of Quadrant attributes. This skill will support reasoning and test-taking strategies needed on the ACT and other assessments. | **A-REI.6: Solve systems of linear equations algebraically, exactly, and graphically while focusing on pairs of linear equations in two variables.**  **A-REI.11** **Explain why the x-coordinates of the points where the graphs of the equations *y = f(x)* and *y = g(x)* intersect are the solutions of the equation *f(x) = g(x)*; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where *f(x)* and/or *g(x)* are linear**, quadratic, absolute value, and exponential **functions**.\*  A-CED.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*\*  A-REI.5: Given a system of two equations in two variables, show and explain why the sum of equivalent forms of the equations produces the same solution as the original system.  **A-REI. 12: Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.** | * **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. | Boundary Line(s)  Feasibility Region Inequality  Inequality Symbols  Intersection  Linear Programming#  Point of Intersection  Solution  X-Coordinate  #NOTE: Utilize this concept/vocabulary when students are prepared for it. |
| **Unit 13:** **Exponential Functions**  (Exponential functions are widely used functions in real-world applications. They are used in modeling decay, compound interest, estimating time of death, investments, and population growth. Mastering the skills associated with exponential functions is a valuable tool that students will need in advanced coursework.)  TEACHER TIP: This is a larger Unit, be sure to spend sufficient time on each concept and to include several writing activities throughout.  TEACHER TIP: Interval notation is very important when describing the domain and range for exponential functions. Include this skill when students are ready.  TEACHER TIP: Consider introducing this Unit with a writing activity by showing the graphs for the parent functions (i.e., exponential growth and decay, where *b > 1, b ≠ 0; and where 0 < b < 1)*. Be sure the graphs are large enough for students to make assumptions about the end behavior as the graph approaches the x-axis. This writing activity should simply ask students to make observations/assumptions about each graph with respect to domain, range, end behavior, intercepts, etc. Students have enough background knowledge about graphing and the Coordinate Plane to make sound observations about each graph. Finally require them to compare and contrast the graphs.  An instructional goal should be to build in systematic ways throughout the Unit to validate (or refute) each observation students made during this introductory writing activity. (NOTE: if large, printed graphs are not available, an alternative is to use the graphing calculator and the TRACE feature or to examine the TABLE feature.) | **F-LE.1: Distinguish between situations that can be modeled with linear functions and with exponential functions.\***  F-LE.1a: Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.  F-LE.1c: Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.  **F-LE.2: Construct** linear and **exponential functions**, including arithmetic and geometric sequences, **given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).\***  F-IF.4:For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.\*  F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*\*  F-IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.\*  A-CED.1**: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.\***  A-CED.2: Create equations in two variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.\*  A-SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.\*  A-SSE.3c: Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15t can be rewritten as [1.151/12]12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.* | * **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. | Asymptote  Base  Domain  Exponent  Exponential Decay  Exponential Function  Exponential Growth  Growth Factor  Interval Notation  Parent Function  Range |
| **Unit 14: Compare, Graph and Translate Linear and Exponential Functions**  (As students encounter advanced functions, it is important for them to begin identifying functions by their behavior and patterns. In this Unit, students begin to compare two functions, see the impact of moving a graph, and how altering the coefficient or constant of the function rule modifies the graph’s behavior. These skills are used in real life especially in business when predicting how different situations/ “variables” might impact certain aspects of a business.)  TEACHER TIP: When students are graphing different functions by hand, it is important that they utilize different colors (highlighters, markers, pencils) to label and graph each function. This practice can also be used when creating a table of values for each function. This will help students in need of additional support distinguish each function clearly.  TEACHER TIP: Be sure students have mastered the different graphing styles on the calculator (i.e., traditional, thick, dotted, etc.). This skill will help your visual learners distinguish each graph efficiently and make it easier for them to make mathematical comparisons between them. | F-IF.9: **Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say***  ***which has the larger maximum.***  F-LE.1: Distinguish between situations that can be modeled with linear functions and with exponential functions.\*  **F-LE.1a: Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals**.  F-LE.1b: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.  F-LE.2: Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).\*  F-LE.5: Interpret the parameters in a linear or exponential function in terms of a context.\*  F-BF.3: **Identify the effect on the graph of replacing *f(x)* by *f(x) + k, k f(x), f(kx),* and *f(x + k)* for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.***  A-REI. 11: Explain why the *x*-coordinates of the points where the graphs of the equations *y* = *f*(*x*) and *y* = *g*(*x*) intersect are the solutions of the equation *f(x) = g(x)*; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or *g(x)* are linear, quadratic, absolute value, and exponential functions.\*  N-Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays**.** | * **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. | Domain  Exponential Function  Intersection (Point of)  Interval  Linear Function  Parent Graph  Range  Translate |

| **TERM 3**  **UNIT OF STUDY**  (REAL-WORLD APPLICATION) **q** | **MS CCR**  **STANDARDS q** | **STANDARDS FOR MATHEMATICAL  PRACTICE (SMPs) q** | CORE ACADEMIC **VOCABULARY TERMS q** |
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| **Unit 15**: **Polynomials**  (Polynomials are a very important “language” in mathematics. All polynomials, with a degree higher than 0, are modeled by a particular curve when graphed on the Coordinate Plane; and these curves share important information about the polynomial function. Polynomials are used in roller coaster designs, business projections, traffic control models, and medical research.)  TEACHER TIP: Some students may benefit from using a table array when performing arithmetic on polynomials – especially when adding and subtracting. This will help them identify like parts across the polynomial set. Encourage them to write each polynomial in decreasing order prior to “filling” the table array in and to write the operation in words above the table array.  TEACHER TIP: When teaching factoring, consider the order in which you do this. For example, you may want to try teaching it in this order: factoring polynomials by grouping, factoring trinomials when a≠1, factoring trinomials when a=1, and then other “special” polynomial cases. (NOTE: practice this with other colleagues first to see if this order works for you.) | **A-APR.1: Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.**  A-SSE.1: Interpret expressions that represent a quantity in terms of its context.\*  A-SSE.1a: Interpret parts of an  expression, such as terms, factors, and  coefficients.  A-SSE.1b: Interpret complicated  expressions by viewing one or more of  their parts as a single entity*. For*  *example, interpret P(1+r)n as the*  *product of P and a factor not depending*  *on P.*  A-SSE.2: Use the structure of an expression to identify ways to rewrite it. *For example, see x4 – y4 as (x2)2 – (y2)2 thus recognizing it as a difference of squares that can be factored as (x2 – y2) (x2 + y2).*  A-SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.\*  A-SSE.3a: Factor a quadratic expression to reveal the zeros of the function it defines. | * **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. | Binomial  Coefficient  Degree/Power  Factor  Monomial  Order of a Polynomial  Polynomial  Quadratic  Trinomial |
| **Unit 16: Solving Quadratic Equations**  (Quadratic models are used in many areas of life, such as when the military launches a missile, when objects are thrown from one person to the other, when car manufacturers design the braking system on a car, when product developers want to identify the life expectancy of a product, the development of sound systems, and even the popular game “Angry Birds”. Each of these examples rely on the concepts associated with solving a quadratic equation. Being able to solve a quadratic equation can reveal characteristics about the model and impact of certain “variables” on the functions behavior.)    TEACHER TIP: Completing the square tends to be one of the most challenging methods for students when solving quadratic equations. To help students master this concept, consider writing the process out in complete sentences in the margins as you complete each step.  TEACHER TIP: Once students master each of the techniques outlined in the standards A-REI.4a and A-REI.4b, provide quick-check activities where a series of quadratic equations are listed in a variety of forms and students identify *which* technique they should use to solve each equation quickly – and why. Encourage them to “debate” their reasoning with their classmates.  TEACHER TIP: Use the TRACE function on the calculator to help students “discover” why the solution is referred to as “a zero”. | **A-REI.4: Solve quadratic equations in one variable.**  **A-REI.4a: Use the method of completing the square to transform any quadratic equation in *x* into an equation of the form (*x* – *p*)2 = *q* that has the same solutions. Derive the quadratic formula from this form.**  **A-REI.4b: Solve quadratic equations by inspection (e.g., for *x*2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions.**  **A-APR.3: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial (limit to 1st- and 2nd- degree polynomials).** | * **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. | Coefficient  Complex Number  Complete the Square  Discriminant  *ί*  Imaginary Number  Perfect Square Trinomial  Quadratic  Quadratic Formula  Root  Solution  X-intercept  Zero(s) |
| **Unit 17: Quadratic Functions and Their Graphs**  (Quadratics are arguably the most common and recognizable polynomial type. They can see the function behavior of quadratics when a basketball player shoots a basketball, in the architectural designs on a bridge, on the popular video games they play, and in the logo of a popular fast-food restaurant.)  TEACHER TIP: Develop students’ conceptual understanding and the connection that exists between each part of the Quadratic Formula AND key attributes of the graph.  For example, reference the Quadratic Formula learned in the previous Unit and demonstrate to students how they can identify the equation for the axis of symmetry AND the value of the  *x*-coordinate of the vertex based on the values of *a* and *b*, and subsequent calculation of -  Also, for example, how the value of the discriminant (i.e., <0, >0, or =0) provides clues about the location of the x-intercept (if any) AND the number of solutions that exist for a quadratic function.  Leading whole class discussions about these types of connections will assist students as they prepare for the ACT and other assessments.  TEACHER TIP: Be sure students have mastered the different graphing styles on the calculator (i.e. traditional, thick, dotted, etc.). This skill will help your visual learners distinguish each graph efficiently and make it easier for them to make mathematical comparisons between them.  TEACHER TIP: Because linear functions were introduced in depth in Units 8 and 9 of this Instructional Planning Guide, it is appropriate for students to spend a few days on the skills discussed in the standard A-REI.11 prior to ending this Unit. During that time, be sure students are mastering the calculator AND the subsequent vocabulary for each function type. | **A-SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.\***  **A-SSE.3a: Factor a quadratic expression to reveal the zeros of the function it defines.**  **A-SSE.3b: Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.**  **A-APR.3: Identify zeros of polynomials when suitable factorizations are available and use the zeros to construct a rough graph of the function defined by the polynomial (limit to 1st- and 2nd- degree polynomials).**  F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*\*  F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*\*  F-IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.\*  F-IF.7: **Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\***  **F-IF.7a: Graph functions (linear**  **and quadratic) and show**  **intercepts, maxima, and minima.**  F-IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.  F-IF.8a: Use the process of factoring and  completing the square in a quadratic  function to show zeros, extreme values,  and symmetry of the graph, and interpret  these in terms of a context.  F-IF.9: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*  A-CED.1: Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*\*  A-CED.2: Create equations in two variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.\*  F-BF.3:Identify the effect on the graph of replacing *f*(*x*) by *f*(*x*) + *k*, *k f*(*x*), *f*(*kx*), and *f*(*x* + *k*) for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*  A-REI.11*:* Explain why the *x*-coordinates of the points where the graphs of the equations *y* = *f*(*x*) and *y* = *g*(*x*) intersect are the solutions of the equation *f*(*x*) = *g*(*x*); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where *f*(*x*) and/or *g*(*x*) are linear, quadratic, absolute value, and exponential functions.\* | * **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. | Axis of Symmetry  Coefficient  Complex Number  Discriminant  *ί*  Imaginary Number  Maximum  Minimum  Periodicity  Quadratic  Root  Solution  Vertex  X-intercept  Zero(s) |

| **TERM 4**  **UNIT OF STUDY**  (REAL-WORLD APPLICATION) **q** | **MS CCR**  **STANDARDS q** | **STANDARDS FOR MATHEMATICAL  PRACTICE (SMPs) q** | CORE ACADEMIC **VOCABULARY TERMS q** |
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| **Unit 18:** **Other Special Functions**  (The remaining functions presented in the MS CCRS Algebra I course include simple rational, piecewise, even and odd, square root, and absolute value functions. While these functions are not as widely used as linear or quadratic functions, they do serve their purpose in many areas of everyday life.)  TEACHER TIP: Interval notation and Set Notation are very important when describing the domain and range for these special functions. Include these skills consistently throughout this Unit.  TEACHER TIP: Have students discuss how the Absolute Value Function is a special type of Piecewise Function.  TEACHER TIP: Have students develop a “**Function Family ‘Folio**”. This is simply a student-created portfolio project that includes, at the minimum, the information provided in the bulleted list below for all the functions they have learned in the MS CCRS Algebra I course. This information can be computer generated, cut out from printed materials, or hand drawn using graphing and construction paper. This is a student product can be displayed around the classroom and they can carry with them into the MS CCRS Algebra II course. Teachers are encouraged to add to this list based on additional skills they may have taught during this Unit and throughout the year.   * Function Name * Key Vocabulary * Standard Form of the Function Rule * Other Forms of the Function Rule (if applicable) * Graph of the Parent Function * Attributes of the Parent Function * Calculator Tools * Samples of the Parent Function in the Real World (These are usually photographs from printed materials. Or, students can take a picture of them in the world around them using their phone, and print them out.)   (NOTE: An alternative to this entire project could be a student-developed and presented PPT. This would be a great alternative for those students that are on a hybrid or distant learning schedule this school year.) | **A-CED.1: Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*\***  **F-IF.7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\***  **F-IF.7b: Graph square root and**  **piecewise-defined functions,**  **including absolute value functions.**  **F-BF.3: Identify the effect on the graph of replacing *f*(*x*) by *f*(*x*) + *k*, *k f*(*x*), *f*(*kx*), and *f*(*x* + *k*) for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.***  F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*\*  F-IF.5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*\*  F-IF.6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.\*  F-IF.9: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*  A-REI.11: Explain why the *x*-coordinates of the points where the graphs of the equations *y* = *f*(*x*) and *y* = *g*(*x*) intersect are the solutions of the equation *f*(*x*) = *g*(*x*); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where *f*(*x*) and/or *g*(*x*) are linear, quadratic, absolute value, and exponential functions.\* | * **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. | Absolute Value  Additive Inverse  Asymptote  Axis of Symmetry  Base  Exclusive  Horizontal Asymptote  Inclusive  Interval Notation  One-to-One  Piece-Wise Function  Periodicity  Power  Rational Function  Set Notation  Square Root Function |
| **Unit 19: Represent and Describe Data**  (Developing your students’ skills related to representing and describing data will help lay the foundation for them to become informed readers and consumers as they begin to watch the news, analyze the truthfulness of studies performed, and evaluate statistical graphs.)  TEACHER TIP: When teaching skewness, try to work with distributions that are centered around the mean, median, and mode (“normal distribution”) first. Then add extreme values to your data set that are either above or below the mean. Require students to calculate the measures of central tendency and standard deviation by hand; and have them describe – in writing – the effect of those outliers/extreme values on the data set, distribution, and measures.  Extend their understanding by including real world data.  TEACHER TIP: Expose students to both horizontal and vertical box (and whisker) plots. Examples should include cases where the axis requires estimation skills.  TEACHER TIP: When, and if students are ready, teach the Empirical Rule. For students in need of intervention, be sure to use colored pencils/crayons when describing each area under the curve with respect to the percentage of data points that lie within ±1, ±2, and ±3 deviations of the mean.  TEACHER TIP: Allow students to compare the measures of center and spread for two or more data sets presented in DIFFERENT forms (i.e., present one data set in graphical form and present the other data set in a numerical form that requires some calculations on the student’s part). | **S-ID.1: Represent and analyze data with plots on the real number line (dot plots, histograms, and box plots).\***  **S-ID.2: Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.\***  **S-ID.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).\***  N-Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays**.** | * **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. | Box (and Whisker) Plot  Dot Plot  Empirical Rule#  First Quartile (Q1)  Histogram  Inter-Quartile Range  Left Skewed  Maximum  Mean /Average  Measures of Central  Tendency and Spread  Median  Minimum  Mode  Outlier  Range  Right Skewed  Scatterplot  Standard Deviation  Symmetric  Third Quartile (Q3)  #NOTE: Utilize this concept/vocabulary when students are prepared for it. |
| **Unit 20: Scatterplots and Linear Fits**  (Being able to make logical predictions based on whether or not a relationship exists between two variables is a valuable skill for high school students to have as they grow into young adulthood and make decisions.)  TEACHER TIP: Provide real world examples where relationships appear to be causal or correlated.  TEACHER TIP: When examining data sets that appear to have a linear relationship, MODEL extending the function line in both directions using a straightedge. Provide ample opportunities for students to make predications within AND outside of the given data set – while practicing this for both variables.  TEACHER TIP: Demonstrate and provide sufficient practice using the STAT, CALC, LIST, EVALUATE, WINDOW, and GRAPHING functions on the calculator.  TEACHER TIP: Lead rich discussions between students on the value of “*r*” to determine whether or not the function is the best fit for the data set. | S-ID.5: Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.\*  **S-ID.6: Represent data on two quantitative variables on a scatter plot and describe how the variables are related.\***  **S-ID.6a: Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.***  **S-ID.6b: Informally assess the fit of a function by plotting and analyzing residuals.**  **S-ID.6c: Fit a linear function for a**  **scatter plot that suggests a linear**  **association.**  S-ID.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.\*  **S-ID.8: Compute (using technology) and interpret the correlation coefficient of a linear fit.\***  S-ID.9: Distinguish between correlation and causation.\* | * **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. | Causation  Correlation  Correlation Coefficient  Exponential Regression  Extrapolate  Line of Best Fit  Linear Regression  Predict  Quadratic Regression  Scatterplot |

**\* *Modeling Standards***

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