

CTECS Mathematics Department

Algebra 2 Curriculum



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Vision of the Graduate

The Vision of a Graduate (VoG) at the Connecticut Technical Education and Career System (CTECS) embodies our commitment to preparing students for success in Connecticut’s workforce.

Developed in collaboration with students, parents, staff, and employers, the VoG ensures that CTECS students are not only job-ready but also equipped to lead, innovate, and adapt in a dynamic world.

As educators, we are dedicated to developing these qualities by providing a comprehensive education that empowers our students to achieve their fullest potential and make meaningful contributions to society.

Connecticut Technical Education and Career System
Vision of a Graduate
A CTECS Graduate is...



- | | |
|---|--|
|  A Problem Solver |  Work Ready |
|  Respectful |  Skilled Socially |
|  A Critical Thinker |  An Effective Communicator |

A Problem Solver

Work Ready

Problem solvers tackle challenges by identifying root causes of issues, brainstorming solutions, implementing effective strategies, and demonstrating adaptability.

- Engage students with open-ended, creative thinking tasks that require both conventional and innovative solutions.
- Facilitate group discussions and collaborative projects.
- Use real-world scenarios and hands-on activities.
- Highlight the importance of effort, persistence, and continuous learning.
- Provide regular feedback and encourage reflection.

To be work-ready includes a combination of technical expertise, soft skills, and personal qualities that ensure a graduate can effectively contribute to the workplace from day one.

- Set high standards for punctuality, responsibility, professionalism, and task completion.
- Use project-based learning and collaborative assignments.
- Emphasize clear written and verbal communication.
- Offer practical exercises like mock interviews and resume workshops.
- Integrate technology and teach digital literacy.

Respectful

Graduates who embody respectfulness emphasize the importance of treating others with dignity, valuing diversity, and fostering an inclusive and positive environment, both personally and professionally.

- Demonstrate personal, interpersonal, and professional skills.
- Show respect for diversity.
- Model respect through active listening and empathy.
- Set clear expectations for respectful interactions.
- Promote collaboration and group discussions.
- Celebrate respectful behavior.
- Address disrespect promptly and constructively.

A Critical Thinker

Skilled Socially

Graduates who are skilled socially are equipped to navigate social environments, build relationships, and contribute positively to their communities and workplaces.

- Show awareness of global responsibility to others and the environment.
- Participate in community involvement.
- Design cooperative group projects and team activities
- Set expectations for respect and give regular feedback.
- Facilitate discussions on inclusivity, kindness, and respect.
- Model positive interactions and recognize strong social skills.

An Effective Communicator

Critical thinkers approach problems systematically by analyzing, evaluating, and synthesizing information to make well-informed decisions and contribute to innovative solutions.

- Encourage critical thinking individually and collaboratively.
- Design lessons that challenge assumptions and explore diverse viewpoints.
- Use open-ended questions, rigorous activities, and cross-curricular projects.
- Integrate project-based learning and real-world problem-solving.
- Offer reflective opportunities like journaling and discussions.
- Cultivate an environment that values curiosity and inquiry.

Effective communicators convey ideas, information, and emotions accurately and persuasively, fostering understanding and collaboration.

- Communicate effectively using oral, written, visual, artistic, and technical modes.
- Include group discussions, presentations, and peer reviews.
- Promote active listening and thoughtful responses.
- Offer clear guidelines and constructive feedback.
- Stress clear, respectful, and purposeful communication.

CTECS Instructional Model

CTECS uses the Marzano Compendium to guide research-based instructional strategies that differentiate learning and promote access, engagement, and success for all students. Teachers apply these strategies to support diverse learners (including multilingual learners, students with disabilities, and students with varied academic or technical backgrounds) through scaffolds, modeling, guided practice, and multiple ways to participate and show understanding. This approach ensures every student can work toward proficiency in the Priority Standards and the competencies outlined in the CTECS Vision of a Graduate.

Feedback	Content	Context
<p>Providing and Communicating Clear Learning Goals</p> <ol style="list-style-type: none"> 1. Providing scales and rubrics 2. Tracking student progress 3. Celebrating success <p>Using Assessments</p> <ol style="list-style-type: none"> 4. Using informal assessments of the whole class 5. Using formal assessments of individual students 	<p>Conducting Direct Instruction Lessons</p> <ol style="list-style-type: none"> 6. Chunking content 7. Processing content 8. Recording and representing content <p>Conducting Practicing and Deepening Lessons</p> <ol style="list-style-type: none"> 9. Using structured practice sessions 10. Examining similarities and differences 11. Examining errors in reasoning <p>Conducting Knowledge Application Lessons</p> <ol style="list-style-type: none"> 12. Engaging students in cognitively complex tasks 13. Providing resources and guidance 14. Generating and defending claims <p>Using Strategies That Appear in All Types of Lessons</p> <ol style="list-style-type: none"> 15. Previewing strategies 16. Highlighting critical information 17. Reviewing content 18. Revising knowledge 19. Reflecting on learning 20. Assigning purposeful homework 21. Elaborating on information 22. Organizing students to interact 	<p>Using Engagement Strategies</p> <ol style="list-style-type: none"> 23. Noticing and reacting when students are not engaged 24. Increasing response rates 25. Using physical movement 26. Maintaining a lively pace 27. Demonstrating intensity and enthusiasm 28. Presenting unusual information 29. Using friendly controversy 30. Using academic games 31. Providing opportunities for students to talk about themselves 32. Motivating and inspiring students <p>Implementing Rules and Procedures</p> <ol style="list-style-type: none"> 33. Establishing rules and procedures 34. Organizing the physical layout of the classroom 35. Demonstrating withitness 36. Acknowledging adherence to rules and procedures 37. Acknowledging lack of adherence to rules and procedures <p>Building Relationships</p> <ol style="list-style-type: none"> 38. Using verbal and nonverbal behaviors that indicate affection for students 39. Understanding students' backgrounds and interests 40. Displaying objectivity and control <p>Communicating High Expectations</p> <ol style="list-style-type: none"> 41. Demonstrating value and respect for reluctant learners 42. Asking in-depth questions of reluctant learners 43. Probing incorrect answers with reluctant learners

Curriculum Introduction

The provided document details a comprehensive Algebra 2 curriculum structured around the Ainsworth Curriculum Model, which translates academic standards into specific actionable skills and concepts. Spanning eight distinct units over 160 instructional days, the course covers topics ranging from linear systems and polynomials to quadratic, radical, and exponential functions. Each unit is designed with a three-phase instructional framework—Launch, Exploration, and Practice—to ensure students move from initial patterns to independent mastery. Beyond mathematical procedures, the guide emphasizes academic vocabulary and language objectives, requiring students to justify their solutions through oral "Math Talks" and written

reflections. Ultimately, the curriculum aims to build a deep understanding of how mathematical modeling and function transformations are applied to solve complex, real-world problems.

Course Map

This course map for Algebra 2 is structured according to the Ainsworth Curriculum Model, which "unwraps" standards into specific concepts and skills across 160 instructional days. The curriculum is divided into four quarters, each containing two units that focus on advanced functions, transformations, and real-world modeling.

Quarter 1: Relations, Functions, and Systems (39 Days)

Unit	Duration	Priority Standards	Big Idea
Unit 1: Functions & Relations	19 Days	HSA.CED.A.3, HSF.BF. B.3, HSF.IF.A.1, HSF.IF.B.4, HSF.IF.C.7.C	Functions are special relations where each input has exactly one output; complex phenomena are modeled by applying transformations to "parent" functions.
Unit 2: Equations, Inequalities & Functions	20 Days	HSA.CED.A.1, HSA.REI.A.1, HSA.REI.C.6, HSA.REI. D.11, HSF.IF.B.6	Graphing systems of equations and inequalities represents real-world constraints and identifies viable solutions.

Quarter 2: Polynomials and Quadratics (42 Days)

Unit	Duration	Priority Standards	Big Idea
Unit 3: Polynomials	15 Days	HSA.APR.A.1, HSA.SSE.A.1.A, HSA.SSE.A.2, HSA.APR.C.5	Polynomials form a system analogous to integers, closed under addition, subtraction, and multiplication.
Unit 4: Quadratic Functions	27 Days*	HSA.REI.B.4, HSN.CN.A.2, HSF.IF.C.7.A, HSA.SSE.B.3.b	Quadratics determine extrema (maximums/minimums) to maximize outcomes; they can be solved using multiple algebraic and graphical methods.

*Includes 4 days for Midterm Review and Exam.

Quarter 3: Polynomial Functions and Equations (34 Days)

Unit	Duration	Priority Standards	Big Idea
Unit 5: Polynomial Functions	17 Days	HSF.IF.B.4, HSF.IF.C.7.C, HSA.APR.D.6, HSA.APR.C.5	Degree and leading coefficients determine end behavior; long division by $(x-a)$ identifies factors where the remainder is $P(a)$.
Unit 6: Polynomial Equations	17 Days	HSA.APR.B.2, HSA.APR.B.3, HSN.CN.C.9, HSA.REI.D.11	Every polynomial of degree n has exactly n roots in the complex number system (Fundamental Theorem of Algebra).

Quarter 4: Radical and Exponential Functions (45 Days)

Unit	Duration	Priority Standards	Big Idea
Unit 7: Radical Functions	22 Days	HSA.REI.A.2, HSF.BF.B.4.A, HSF.IF.C.7.B, HSA.SSE.A.2	Radicals follow the same rules as rational exponents; solving these equations requires checking for extraneous solutions.
Unit 8: Exponential Functions	23 Days*	HSF.IF.C.7.E, HSA.SSE.B.4, HSA.REI.D.11, HSA.CED.A.1	Exponential growth eventually overtakes polynomial growth; these functions are essential for modeling population and investments.

**Includes 4 days for Final Review and Exam.*

Instructional Approach

Throughout all units, students engage in a **three-phase learning plan**: **Launch** (exploring patterns and Math Talks), **Exploration** (direct instruction and workstations), and **Practice/Reflection** (independent work and evidence-based writing).

Vertical Alignment

An Algebra 2 curriculum that is vertically aligned builds directly on students' prior learning from Algebra 1 and Geometry while preparing them for advanced courses such

as Precalculus and Statistics. It ensures a coherent progression of skills, where This alignment also promotes consistency in mathematical practices such as problem-solving, reasoning, and communication. Students strengthen both conceptual understanding and procedural fluency while applying mathematics to real-world contexts. Overall, a vertically aligned Algebra 2 curriculum supports a smooth transition across grade levels, reinforces foundational skills, and prepares students for success in higher-level mathematics and future career pathways

Students deepen their understanding of functions, equations, and algebraic reasoning. Concepts expand from linear relationships to include quadratic, polynomial, rational, logarithmic, and trigonometric functions, with an emphasis on connecting multiple representations—graphical, numerical, algebraic, and verbal.

Vocabulary

Vocabulary in the Algebra 2 curriculum is fundamentally categorized into concepts (nouns) that students must know and academic terms that facilitate the description of complex mathematical relationships. This structured language approach allows students to orally describe and compare function features, such as domain, range, and transformations, during collaborative routines like "Math Talks". By utilizing specialized terms such as one-to-one, onto, and discrete vs. continuous, students transition from a basic understanding to the formal notation required for advanced mathematical modeling.

The importance of this vocabulary extends to constructing viable arguments and providing evidence-based writing throughout the instructional framework. Students use academic vocabulary to justify each step of solving equations and to orally defend mathematical choices, such as identifying restricted domains or explaining why a value is zero. Furthermore, the curriculum emphasizes increased repetition and daily reviews of academic terms to ensure students can perform high-level tasks, such as using argumentative reflection to explain why exponential growth eventually overtakes polynomial growth.

Resources

The Algebra 2 curriculum is supported by a blend of digital tools, instructional resources, and assessment platforms that enhance learning and engagement. Tools like Desmos and GeoGebra help students visualize complex concepts, while platforms such as Google Classroom, Khan Academy, and IXL provide organization, practice, and immediate feedback. In addition, McGraw Hill Reveal Math offers integrated resources such as interactive lessons, dynamic visual models, formative and summative

assessments, and differentiated instruction. Together, these resources support conceptual understanding, promote student engagement, and prepare learners for advanced mathematics and real-world applications

Assessments

The Algebra 2 assessment process incorporates a continuous cycle of formative and summative measures to ensure mastery of advanced functions and their properties. Formative assessment occurs daily through collaborative "Math Talk" routines, notice and wonder observations recorded in graphic organizers, and Think-Pair-Share tasks where students orally describe function features and share assumptions. Students also participate in evidence-based writing to explain mathematical choices and provide formal written justifications for solution steps, which allows for ongoing monitoring of their conceptual understanding. Summative assessment is structured through mid-unit quizzes and comprehensive unit tests following dedicated review periods for each of the eight instructional units. This evaluative process culminates in major benchmarks, including a Midterm Exam at the end of the second quarter and a Final Exam at the conclusion of the 160-day program

CTECS Mathematics Department Philosophy

The Mathematics Department at the Connecticut Technical Education and Career System (CTECS) is committed to delivering a rigorous and relevant math education that prepares students for both their technical trade programs and postsecondary opportunities. The department emphasizes real-world application, helping students connect mathematical concepts to industry practices while building strong problem-solving and critical thinking skills.

The department fosters an inclusive learning environment that supports all students through vertically aligned curricula, differentiated instruction, and data-informed practices. By prioritizing both conceptual understanding and procedural fluency, and integrating technology and industry-aligned resources, CTECS aims to develop confident, mathematically literate graduates ready for college, careers, and lifelong learning.

Quarter 1: Relations, Functions, and Systems (39 Days)

Unit 1: Functions & Relations (19 Days)

CTECS Mathematics Curriculum

Algebra II Unit 1 (Functions & Relations)

Name of the Unit: Functions & Relations Reveal Module 1	Length of the Unit: 19 Days
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Purpose of the Unit:

1. Students determine if functions are one to one or onto.
2. Students determine the linearity, intercepts, and symmetry of functions.
3. Students identify extrema and end behavior of functions.
4. Students analyze and compare graphs.
5. Students graph functions and inequalities in two variables.
6. Students identify and use transformations of functions.

Interdisciplinary Knowledge Transfer (from prior to future courses):

Learners will become effective collaborators, technology users, critical thinkers, and problem solvers. They will develop these skills through the application of argumentative discourse and reasoning to model and solve expressions in contextual situations.

Next: Students will solve equations and inequalities in one and two variables algebraically and by graphing.

Big Ideas: (can be broad [interdisciplinary], topical [content focused] or both)
(Big ideas help students make connections among disciplines or units of study within a content area)
(What is the value or benefit of learning the concepts in this goal)

- A function is a special kind of relation where each member of the domain of the function is associated with exactly one member of the range of the function.
- We can study a very wide range of phenomena by starting with a very small group of “parent” functions and applying transformations to those functions.

Essential Questions: (engaging, open-ended questions to spark student interest and sharply focus instruction and assessment)

- What is a function?
- What are the different ways in which functions may be represented?
- What is the meaning of the domain and range of functions?
- What is a family of functions?
- How do different families of functions grow?
- What is the effect of a transformation of an independent variable? What is the effect of a transformation of a dependent variable?
- How can functions be used to model real world situations, make predictions, and solve problems?

Key vocabulary/terms:

x-coordinate, y-coordinate, intercept, solution, family of graphs, algebraic notation, constant function, continuous function, discontinuous function, discrete function, domain, end behavior, even function, dilation, interval notation, line of reflection, line of symmetry, linear equation, linear function, odd functions, one to one functions, parent functions, range, reflection, dilation, transformation

CELP (Emphasize standards in bold)	Standards for Mathematical Practice (Emphasize practices in bold)
<p>1, 2, 3, 4, 5, 6, 7, 8, 9, 10</p> <p>CELP 1- 10 (see the full description of each standard here)</p>	<ul style="list-style-type: none"> • Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning. <p>MP1, MP2, MP3, MP4, MP5, MP6 (see the full description of each standard here)</p>

Common Core State Standards Addressed in this unit:

PRIORITY STANDARDS

CCSS.MATH.CONTENT.HSA.CED.A.3

Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For*

example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

CCSS.MATH.CONTENT.HSF.BF.B.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.

CCSS.Math.Content.HSF.IF.A.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 $y = f(x)$.

CCSS.Math.Content.HSF.IF.A.2

Use function notation, evaluate functions, and interpret statements that use function notation in terms of a context.

CCSS.Math.Content.HSF.IF.B.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.* *

CCSS.Math.Content.HSF.IF.B.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.* *

CCSS.MATH.CONTENT.HSF.IF.C.7

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

CCSS.MATH.CONTENT.HSF.IF.C.7.C

Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

CCSS.Math.Content.HSF.IF.C.8

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.*

Key Concepts	Skills (Students are skilled at)
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Nouns or noun phrases (Need to know)	Verbs (Able to do at the desired) Align with I know and I can statements
<ul style="list-style-type: none"> • Function • Domain • Range • One-to-one function • Onto function • Discrete • Continuous • Set-builder notation • Interval notation 	<ul style="list-style-type: none"> • Classify a relation as a function or not a function • Relate the domain of a function to its graph • Relate the range of a function to its graph • Identify functions as on-to-one or onto functions • Determine continuity of functions • Write domain and range in set-builder notation • Write domain and range in interval notation
<ul style="list-style-type: none"> • Function Notation • Linear function • Nonlinear function • Parabola • Intercepts • Symmetry • Line of symmetry • Even and odd functions 	<ul style="list-style-type: none"> • Identify linear functions from equations, graphs, and tables • Find x- and y- intercepts from functions • Interpret meaning of intercepts • Determine symmetry of functions • Classify functions as even or odd
<ul style="list-style-type: none"> • Extrema • Maximum/minimum • Relative maximum/minimum • Increasing • Decreasing • Positive • Negative • End Behavior 	<ul style="list-style-type: none"> • Identify the maximum and minimum points of a function if they exist • Find and interpret extrema from graphs • Use $x \rightarrow \pm \infty$ to describe end behavior of functions • Find intervals where the graph is increasing or decreasing
<ul style="list-style-type: none"> • Scales • Axes • Domain and range • Intercepts • Symmetry • End behavior • Extrema • Increasing/decreasing positive/negative • Key features • Linear/nonlinear functions 	<ul style="list-style-type: none"> • Use key features such as intercepts, increasing/decreasing intervals, positive/negative intervals, extrema, end behavior, continuity, etc to sketch functions. • Compare properties of two functions each represented in different ways. • Can apply real world data to a graph.
<ul style="list-style-type: none"> • Linear functions • Table of values • Standard form • Intercepts • Slope • Y-intercept 	<ul style="list-style-type: none"> • Graph linear equations using a table of values • Graph linear equations by finding intercepts • Graph linear equations using slope and y-intercept • Graph linear inequalities • Identify the variables and quantities represented in a real-world problem.

<ul style="list-style-type: none"> • Slope-intercept form • Linear inequality • Boundary line • Closed half-plane • Open half-plane • Viable solutions • Constraint 	<ul style="list-style-type: none"> • Determine the best models for the real-world problem. • Interpret solutions in the context of the situation modeled and decide if they are reasonable.
<ul style="list-style-type: none"> • Parent Function • Transformations <ul style="list-style-type: none"> ○ Vertical Translation ○ Horizontal Translation ○ Dilation ○ Vertical Stretch/Compression ○ Horizontal Stretch/Compression ○ Reflection over y axis/x axis 	<ul style="list-style-type: none"> • Graph a relationship between two quantities using a table • Identify and graph parent functions. • Describe transformations as it relates to the parent function from a graph. • Apply translations to parent functions. • Apply dilations to parent functions. • Apply reflections to parent functions. • Apply multiple transformations to parent functions. • Identify equations from a graph using transformations. • Can apply real world data to a graph and an equation. • Identify the effect on the graph of replacing $f(x)$ by $f(x)+k$, $k \cdot f(x)$, $f(kx)$, and $f(x+k)$. • Find K given a graph and knowing the original $f(x)$. • Analyze similarities and differences between functions with different k values
<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science</p>	<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science Algebra 2 Unpacked Standards-CCSS</p>

<p>Evidence of Teaching and Learning</p>
<p><i>- How will we know when students are learning?</i></p>
<ul style="list-style-type: none"> • Oral participation in "Math Talk" routines where students describe and compare function features using academic vocabulary. • Creation of reference charts, such as picture and word webs, to visualize function properties. • Evidence-based writing produced during math workstations to test mathematical hypotheses. • Completion of written argumentative reflections that evaluate initial predictions and hypotheses. • Daily exit tickets used to gauge student understanding of relations and continuity. • Sketches and comparisons of functions that identify key features like intercepts, symmetry, and extrema. • Use of formal notation ($x \rightarrow \pm\infty$) to accurately describe end behavior.

- Successful application of transformations (translations, dilations, reflections) to "parent" functions.
- Performance data from a mid-unit quiz covering foundations such as linearity and symmetry.
- Results from a comprehensive unit test assessing the ability to analyze and transform advanced functions.

Evidence of Teaching and Learning

- **Facilitating Collaborative Routines:** Teachers engage students in "Math Talk or BTCM" routines during the Launch phase to elicit predictions and hypotheses about function families. Students provide oral evidence of learning by using academic vocabulary—such as one-to-one, onto, and discrete vs. continuous—to describe and compare function features.
- **Utilizing Visual and Organizational Tools:** Instruction includes the use of reference charts, specifically picture and word webs, which help students visualize and relate domain and range to their respective graphs.
- **Scaffolding Evidence-Based Writing:** Teachers guide students through math workstations where they generate evidence-based writing to test hypotheses about function behavior. This process culminates in written argumentative reflections where students evaluate their initial predictions based on their findings.
- **Direct Instruction of Skills:** Teaching is evidenced by students' ability to perform specific "Able to Do" tasks, such as sketching and comparing functions, identifying intercepts, and using formal notation ($x \rightarrow \pm\infty$) to describe end behavior.
- **Modeling Transformations:** A core component of the teaching process involves demonstrating how to apply transformations (translations, dilations, and reflections) to a group of "parent" functions to represent real-world constraints.
- **Systematic Assessment:** The teacher monitors progress through a structured cycle of daily exit tickets, a mid-unit quiz following a two-day review, and a comprehensive unit test at the end of the 19-day period

What strategies/interventions/modifications/ will be applied for non-mastery?

- **Visual and Organizational Supports:** Students use reference charts, such as picture and word webs, to visualize and compare function features. Graphic organizers are provided to help students record "notice and wonder" observations and provide structured scaffolding for constructing viable mathematical arguments.
- **Linguistic Modifications:** To ensure students master the necessary academic language, the curriculum incorporates increased repetition of academic terms and daily vocabulary reviews. Students also use visual aids during small group

discussions to better understand connections, such as the relationship between Pascal's Triangle and binomial expansion.

- **Math Workstations:** During the "Exploration and Development" phase, students work in math workstations where they can test hypotheses and develop evidence-based writing in a more focused setting.

Collaborative Strategies

- **"Math Talk" or BTCM Routines:** These collaborative sessions allow students to orally describe features and make predictions before attempting independent work, providing a low-stakes environment for identifying misconceptions.
- **Think-Pair-Share Tasks:** This strategy is utilized for students to **orally share assumptions** and observations, allowing peer-to-peer support in clarifying concepts like quadratic representations.

Systematic Review and Assessment

- **Dedicated Review Cycles:** Every unit in the pacing guide includes substantial time for review. Most units allocate **two days for a Mid-Unit Quiz and review**, followed by a **three-day Review and Test cycle** at the end of the unit.
- **Formative Feedback:** The "Practice and Reflection" phase of each lesson utilizes **exit tickets** and **written argumentative reflections**. These tools allow teachers to identify non-mastery immediately and address it before students move on to subsequent topics.
- **Major Exam Reviews:** The curriculum includes a **four-day review** period for the **Midterm Exam** and a separate **four-day final review** before the **Final Exam** to consolidate learning from previous quarters.

Unit Assessments, Performance Indicators, and Scoring Rubrics /Proficiency Scales

The unit performance indicators are taught and formatively assessed through all units

	Unit 1
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Code	Learning Events (Engaging students)
<u>Launch:</u>	<p>Provide an opportunity for students to focus on the big concept. Explore patterns, what do they observe and wonder, make predictions and hypotheses. Math talks routines/</p> <p>(Collaborative grouping and sharing out)</p> <p>Formative assessment check- (warm-up check, observations, student discourse and engagement, anecdotal notes)</p>
<u>Exploration and Development:</u>	<p>Apply guided questions and activities for students to dive deep into exploration of their hypothesis. Collaborative or whole class grouping/direct instruction/math workstations are applied. Testing, providing evidence-based writing, and sharing out can be incorporated here as well.</p> <p>Formative assessment check (observations, student discourse and engagement, anecdotal notes, conferencing).</p>
<u>Practice and Reflection:</u>	<p>Group or independent practice opportunities. Can include student reflection on initial question/hypothesis and lesson reflection.</p> <p>Formative assessment check (Exit ticket, observations, student discourse and engagement, anecdotal notes, written argumentative reflection)</p>

<u>FRAME Learning Intention (at the end):</u>	
Success Criteria: I know I am successful because...	Significant Tasks/Learning Progressions
<ul style="list-style-type: none"> • Define and Classify Functions: Students can distinguish between a general relation and a function, ensuring each input relates to exactly one output. • Identify Function Types: Students can correctly apply terms such as one-to-one, onto, and discrete vs. continuous to describe various relations. • Understand Families of Functions: Students can explain the concept of a "parent" function and describe how complex real-world phenomena can 	<p>Significant Tasks Students demonstrate their learning through several high-level mathematical and literacy tasks:</p> <ul style="list-style-type: none"> • Classifying and Analyzing Relations: Students must classify relations as functions and use set-builder and interval notation to identify domain and range. • Describing Behavior with Formal Notation: A critical task involves using $x \rightarrow \pm\infty$ to accurately describe the end behavior of various function graphs.

be modeled by applying transformations to these base functions.

- **Interpret Modeling Contexts:** Students can represent real-world constraints using equations or inequalities and determine if solutions are **viable or non-viable** within that context.

- **Graphing and Interpreting Functions:** Students graph polynomial and rational functions, identifying **zeros, intercepts, and asymptotes** while showing intervals of increase or decrease.
- **Applying Transformations:** Students identify the effect of replacing $f(x)$ with $f(x)+k$, $k \cdot f(x)$, $f(k \cdot x)$, and $f(x+k)$ and must find the value of k when given a graph.

Learning Progression

The unit is structured into the following chronological sequence to build mastery:

- **Foundation (Days 1–4):** The progression begins with defining **functions and continuity**, followed by an analysis of **linearity and symmetry**. Students establish the core "Big Idea" that functions are special relations where each domain member has exactly one range member.
- **Feature Analysis (Days 5–6):** Students move into identifying advanced graphical features, specifically **extrema** (relative maximums and minimums) and **end behavior**.
- **Mid-Unit Assessment (Days 7–8):** A dedicated two-day period for review and a quiz ensures students have grasped foundational concepts before moving to complex applications.
- **Advanced Application (Days 9–13):** Students engage in **sketching and comparing** polynomial and rational functions and practicing **linear graphing**.
- **Transformational Modeling (Days 14–16):** The progression culminates in the study of **"parent" functions** and the application of **transformations** (dilations, reflections, and translations) to represent real-world constraints.
- **Summative Evaluation (Days 17–19):** The unit concludes with a three-day review and comprehensive test cycle.

Teacher notes:

- identify specific content or skills which often are misunderstood, confusing, or incorrect assumptions students might have with the content of the course/unit
- explicitly targeted to significant tasks/assessments
- include process standards to reinforce/foster in the instructional practice of the course/unit
- suggested resources/activities to support the course/unit

Differentiation/Intervention Strategies		
<u>Non-mastery</u> (Provide items for struggling learners)	<u>Enrichment</u> (Provide items for high performing students)	<u>ELL</u> (Provide items to support ELL students)
<ul style="list-style-type: none"> • Reteach addressing multiple intelligence • Scaffolding • Graphic organizers • Small group or independent direct study • Varied guided questions • Tiered assignments • Daily math review 	<ul style="list-style-type: none"> • Tiered assignments • Extend or deepen concept learning • Increased rigor • More argumentative writing 	<ul style="list-style-type: none"> • Scaffolding (simplify task with structured guidance) • Connect to primary language and culture • Create reference charts (picture or word web) • Increase processing time • Daily vocabulary review • Varied guided questions • Increase repetition

Unit 2: Equations, Inequalities, and Functions (20 Days)

CTECS Mathematics Curriculum

Algebra II Unit 2 (Equations, Inequalities and Functions)

Name of the Unit: Equations, Inequalities and Functions Reveal Module 2.1 - 2.6	Length of the Unit: 20 Days
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Purpose of the Unit:

1. Students solve linear equations and inequalities.
2. Students solve equations and inequalities involving absolute value.
3. Students write linear equations in standard, slope-intercept, and point-slope forms.
4. Students solve systems of equations by graphing, substitution and/or elimination.
5. Students solve systems of inequalities in two variables.

Interdisciplinary Knowledge Transfer (from prior to future courses):

Learners will become effective collaborators, technology users, critical thinkers, and problem solvers. They will develop these skills through the application of argumentative discourse and reasoning to model and solve expressions in contextual situations.

Previous: Students graphed and identified key features of linear functions and inequalities.

Next: Students will perform operations on polynomials and factor polynomials.

Big Ideas:(can be broad [interdisciplinary], topical [content focused] or both)

(Big ideas helps students make connections among disciplines or units of study within a content area)

(What is the value or benefit of learning the concepts in this goal)

- Creating and graphing equations, inequalities, systems of equations, and systems of inequalities can be used to represent constraints in a real-world context and find viable solutions. Learners can rewrite formulas to solve for a specific variable.

Essential Questions: (engaging, open-ended questions to spark student interest and sharply focus instruction and assessment)

- How are equations, and systems of equations best used to model real-world situations?
- How are inequalities, and systems of inequalities best used to model real-world situations?

Key vocabulary/terms:

absolute value, bounded, consistent, dependent, elimination, empty set, equation, extraneous solution, feasible region, inconsistent, independent, inequality, point-slope form, root, slope-intercept form, solution, standard form of a linear equation, substitution, system of equations, system of inequalities, unbounded, zero

CELP

(Emphasize standards in **bold**)

Standards for Mathematical Practice

(Emphasize practices in **bold**)

1, 2, 3, 4, 5, 6, 7, 8, 9, 10

[CELP 1- 10](#)
(see the full description of each standard here)

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

[MP1, MP2, MP3, MP4, MP5, MP6](#) (see the full description of each standard here)

Common Core State Standards Addressed in this unit:

PRIORITY STANDARDS

CCSS.MATH.CONTENT.HSA.CED.A.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.*

CCSS.MATH.CONTENT.HSA.CED.A.2

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CCSS.MATH.CONTENT.HSA.CED.A.3

Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

CCSS.MATH.CONTENT.HSA.REI.A.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.

CCSS.MATH.CONTENT.HSA.REI.C.8

Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

CCSS.MATH.CONTENT.HSA.REI.D.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, polynomial, rational, absolute value, exponential, and logarithmic functions.*

CCSS MATH CONTENT.HSF.IF.B.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.

Key Concepts	Skills (Students are skilled at)
<p>Nouns or noun phrases (Need to know)</p>	<p>Verbs (Able to do at the desired) Align with I know and I can statements</p>
<ul style="list-style-type: none"> • Equations • Inequalities • Linear graph • Inverse operations • Roots, zeros, and intercepts • Related function 	<ul style="list-style-type: none"> • Justify each step of solving linear equations and inequalities using mathematical properties. • Recognize and use correct inverse operations • Demonstrate or prove why an answer is correct • Given an equation, write a scenario to represent it. • Identify the variables and quantities represented in a real-world problem. • Determine the appropriate model for the real-world problem (linear equation, linear inequality, quadratic equation, Quadratic inequality, rational equation, exponential equation). • Write the equation or inequality that best models the problem. • Solve an equation or inequality and interpret the solution in the context. • Graph equations on coordinate axes with appropriate labels and scales. • Explain the relationship between the equation and graph of an equation
<ul style="list-style-type: none"> • Absolute value equations • Absolute value inequalities • Extraneous solutions • Empty set 	<ul style="list-style-type: none"> • Write and solve absolute value equations and inequalities • Graph solutions on a number line • Interpret solutions determining if they are reasonable • Identify the variables and quantities represented in a real-world problem. • Determine the appropriate model for the real-world problem. • Write the equation or inequality that best models the problem. • Solve an equation or inequality and interpret the solution in the context.
<ul style="list-style-type: none"> • Standard form • Slope-intercept form • Point-slope form • Y-intercept • Slope 	<ul style="list-style-type: none"> • Identify the variables and quantities represented in a real-world problem. • Determine the appropriate model for the real-world problem • Write the equation or inequality that best models the problem. • Find the rate of change (slope) • Determine and explain when a linear function rises or falls, has a positive, negative or zero slope, or has no slope • Convert between various forms of equations

<ul style="list-style-type: none"> • System of linear equations • Graphing • Consistent and inconsistent • Independent and dependent • One solution • No solution • Infinite solutions • Intersection of two functions 	<ul style="list-style-type: none"> • Identify the variables and quantities represented in a real-world problem. • Write the system of equations that best model the problem. • Graph the system on coordinate axes with appropriate labels and scales. • Finding the intersection both by hand and using technology. • Interpret solutions in the context of the situation modeled and decide if they are reasonable. • Explain why the x-value is the solution to $f(x) = g(x)$ • Infer that if $y = f(x)$ and $y = g(x)$, then (x, y) is a solution to $f(x) = g(x)$ • Solve a system of equations using technology • Prove if a particular answer is correct
<ul style="list-style-type: none"> • System of equations • Substitution Method • Elimination Method • One solution • No solution • Infinite solutions • Intersection of two functions 	<ul style="list-style-type: none"> • Identify the variables and quantities represented in a real-world problem. • Determine the best models for the real-world problem. • Write the system of equations that best models the problem. • Solve systems of equations using the substitution method. • Solve systems of equations using the elimination (linear combination) method. • Solve and interpret solutions in the context of the situation modeled and decide if they are reasonable. • Infer that if $y = f(x)$ and $y = g(x)$, then (x, y) is a solution to $f(x) = g(x)$ • Explain why the x-value is the solution to $f(x) = g(x)$
<ul style="list-style-type: none"> • System of Inequalities • Intersection of two functions • Feasible region • Bounded region • Unbounded region • Boundary lines • Related equation 	<ul style="list-style-type: none"> • Identify the variables and quantities represented in a real-world problem. • Determine the best models for the real-world problem. • Write the system of inequalities that best models the problem. • Graph the system on coordinate axes with appropriate labels and scales. • Find the intersection (if it exists) of a system of inequalities; this intersection may be regions • Feasible regions for systems of inequalities may be bounded or unbounded • Interpret solutions in the context of the situation modeled and decide if they are reasonable. • Solve a system of inequalities using technology
<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science</p>	<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science Algebra 2 Unpacked Standards-CCSS</p>

Evidence of Teaching and Learning

Evidence of Teaching and Learning - *How will we know when students are learning?*

- **Written formal justifications** for each step taken to solve an equation, citing specific mathematical properties.
- **Original scenarios** authored by students that accurately model mathematical equations in real-world contexts.
- **Interpretations of solutions** that distinguish between viable and non-viable options within a specific modeling context.
- **Algebraic solutions** to systems of equations demonstrated through the correct application of substitution and elimination methods.
- **Graphical representations** of systems of inequalities that correctly identify **feasible regions** as either bounded or unbounded.
- **Identification of extraneous solutions**, specifically within the context of solving absolute value equations.
- **Calculations of the average rate of change** for various functions over specified intervals.
- **Constructed viable arguments** shared during collaborative sessions, supported by the use of graphic organizers and structured scaffolding.
- **Evidence-based writing** produced in math workstations to test hypotheses regarding systems and constraints.
- **Written argumentative reflections** where students evaluate their initial hypotheses and justify their final mathematical conclusions.
- **Daily exit tickets** and results from the **mid-unit quiz** and **comprehensive unit test**.

What strategies/interventions/modifications/ will be applied for non-mastery?

- **Structured Scaffolding and Graphic Organizers:** To meet the unit's language objective, students use **structured scaffolding** and **graphic organizers** to help them construct viable mathematical arguments and record "notice and wonder" observations.
- **Written Justifications:** Students are required to **write formal justifications** for each step of their solutions using mathematical properties, which helps identify specific procedural misunderstandings.
- **Math Workstations:** During the "Exploration and Development" phase, students work in **math workstations** where they can test hypotheses and produce **evidence-based writing** in a focused environment.
- **Math Talk" Routines:** During the "Launch" phase, teachers use these routines to allow students to orally make predictions and explore patterns before moving to independent work.
- **Collaborative Sharing:** Unit 2 emphasizes **collaborative sharing** sessions where students can defend their mathematical choices and receive peer feedback.
- **Think-Pair-Share:** This routine is used to help students **orally share assumptions** and observations, which serves as a low-stakes intervention for students struggling with conceptual definitions like consistent vs. inconsistent systems

How will we enrich students who are proficient?

- **Complex Modeling and Scenario Creation:** Rather than simply solving given problems, proficient students can be tasked with **writing original, complex scenarios** that model multi-layered real-world constraints using systems of equations or inequalities.
- **Advanced Formal Justification:** Proficient students can move beyond procedural accuracy to master the "Language Objective" of **writing formal justifications** for every single step of a solution, citing specific mathematical properties as evidence.
- **Constructing and Defending Arguments:** During collaborative sharing, these students can focus on **constructing viable arguments** to explain why certain solutions are viable or non-viable in a modeling context, particularly when dealing with **bounded vs. unbounded feasible regions**.
- **Depth of Interpretation:** Students who have mastered the basics can explore the **average rate of change** across various function types with greater depth, interpreting how these rates reflect shifts in real-world data.
- **Leadership in Collaborative Routines:** Proficient students can take a lead role in "**Math Talk**" routines and **Think-Pair-Share tasks**, using specialized academic vocabulary—such as *consistent, inconsistent, dependent, and independent*—to mentor peers and facilitate deeper group analysis

Unit Assessments, Performance Indicators, and Scoring Rubrics /Proficiency Scales
The unit performance indicators are taught and formatively assessed through all units

	Unit 2
Assessment Links:	<p>Module 2: Summative Assessments (See: Reveal Math, Algebra 2, Mod/Unit 2)</p> <p align="center">Module Test Equations On Level Assessments (Form A) Differentiated Assessments (Form B=AL “Approaching Level”) Differentiated Assessments (Form C=BL “Beyond Level”)</p> <p align="center">Answers: Module Test *Teachers Only On Level Assessments (Form A) Differentiated Assessments (Form B=AL “Approaching Level”) Differentiated Assessments (Form C=BL “Beyond Level”)</p> <p align="center">See: Proficiency Scale Alignment</p>
Rubric Links:	

Performance Task (PT) Links:	Module 2: Performance Task (See: Reveal Math , Algebra 2, Mod/Unit 2)
PT Rubric Links:	Module 2: Performance Task Rubric *Teachers Only (See: Reveal Math , Algebra 2, Mod/Unit 2)
	See: Proficiency Scale Alignment

Learning Plan	
<p>Students' success at acquisition, meaning, and transfer depends on...</p> <p>Leveraging instructional lesson plan elements that engage students in interesting and rigorous learning activities that centers on collaboration and argumentative discourse. The latter aligns with an instructional plan that includes the phases of (1) Launching, Exploring and Developing, and Practice and Reflection. Formative evaluations are embedded throughout all three of these phases.</p> <p><u>Tech. resources to consider:</u> Reveal Math, IXL, Smart Board, PowerPoints, Google Suite, , CK-Math, Gizmos, Khan Academy, Desmos, TI-84 Calculator,</p>	
Code	Learning Events (Engaging students)
<u>Launch:</u>	<p>Provide an opportunity for students to focus on the big concept. Explore patterns, what do they observe and wonder, make predictions and hypotheses. Math talks routines/</p> <p>(collaborative grouping and sharing out)</p> <p>Formative assessment check- (warm-up check, observations, student discourse and engagement, anecdotal notes)</p>
<u>Exploration and Development:</u>	<p>Apply guided questions and activities for students to dive deep into exploration of their hypothesis. Collaborative or whole class grouping/direct instruction/math workstations are applied. Testing, providing evidence-based writing, and sharing out can be incorporated here as well.</p> <p>Formative assessment check (observations, student discourse and engagement, anecdotal notes, conferencing).</p>

<u>Practice and Reflection:</u>	<p>Group or independent practice opportunities. Can include student reflection on initial question/hypothesis and lesson reflection.</p> <p>Formative assessment check (Exit ticket, observations, student discourse and engagement, anecdotal notes, written argumentative reflection)</p> <p>Tech. resources to consider: Reveal Math, , IXL EdPuzzle.com, Smart Board, PowerPoints, Google Suite, Gizmos, Khan Academy</p>
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<u>FRAME Learning Intention (at the end):</u>	
Success Criteria: I know I am successful because...	Significant Tasks/Learning Progressions
<ul style="list-style-type: none"> • Solve and Justify: I am able to solve linear and absolute value equations and provide formal written justifications for each step of my solution using specific mathematical properties. • Analyze Systems: I can solve systems of equations both graphically and algebraically (using substitution and elimination) and correctly use academic vocabulary like consistent, inconsistent, dependent, and independent to describe them. • Identify Regions: I can graph systems of inequalities to identify feasible regions and determine if those regions are bounded or unbounded. • Model Real-World Scenarios: I can write original scenarios for equations and interpret my mathematical solutions to determine if they are viable or non-viable options within a real-world modeling context. • Determine Complex Solutions: I am able to identify extraneous solutions in absolute value problems and calculate the average rate of change for various functions over specific intervals. • Construct Arguments: I can construct viable mathematical arguments during collaborative sharing sessions, utilizing 	<ul style="list-style-type: none"> • Formal Written Justifications: A primary task is for students to justify each step of a mathematical solution by citing specific properties. This is a core part of the unit's language objective, requiring the use of structured scaffolding and graphic organizers to construct viable arguments. • Scenario Authoring: Students are tasked with writing original scenarios for equations, demonstrating their ability to translate real-world contexts into mathematical models. • Identifying Extraneous Solutions: Particularly during the study of absolute value, students must perform the significant task of identifying and explaining extraneous solutions that do not fit the original context. • Analyzing Feasible Regions: Students must determine if a feasible region is bounded or unbounded and interpret what those regions represent in terms of viable vs. non-viable solutions to a problem. • Collaborative Analysis: During the "Launch" phase, students participate in "Math Talk" routines to orally describe features like consistency and independence in systems,. They further refine these observations through evidence-based writing produced in math workstations.

<p>structured scaffolding and graphic organizers to defend my reasoning.</p> <ul style="list-style-type: none"> Evaluate Progress: I have demonstrated mastery through successful completion of daily exit tickets, the mid-unit quiz, and the comprehensive unit test. 	

<p><u>Teacher notes:</u></p>
<ul style="list-style-type: none"> identify specific content or skills which often are misunderstood, confusing, or incorrect assumptions students might have with the content of the course/unit explicitly targeted to significant tasks/assessments include process standards to reinforce/foster in the instructional practice of the course/unit suggested resources/activities to support the course/unit

<p>Differentiation/Intervention Strategies</p>		
<p><u>Non-mastery</u> (Provide items for struggling learners)</p>	<p><u>Enrichment</u> (Provide items for high performing students)</p>	<p><u>ELL</u> (Provide items to support ELL students)</p>
<ul style="list-style-type: none"> Reteach addressing multiple intelligence Scaffolding Graphic organizers Small group or independent direct study Varied guided questions Tiered assignments Daily math review 	<ul style="list-style-type: none"> Tiered assignments Extend or deepen concept learning Increased rigor More argumentative writing 	<ul style="list-style-type: none"> Scaffolding (simplify task with structured guidance) Connect to primary language and culture Create reference charts (picture or word web) Increase processing time Daily vocabulary review Varied guided questions Increase repetition

Quarter 2: Polynomials and Quadratics (42 Days)
Unit 3: Polynomials (15 Days)

CTECS Mathematics Curriculum

Algebra 2 Unit 3 (Polynomials)

Name of the Unit: Polynomials Algebra 1 Module10	Length of the Unit: 15 Days
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Purpose of the Unit:

1. Students will be able to add and subtract polynomials.
2. Students will be able to multiply polynomials.
3. Students will be able to factor polynomials, including in the case of special products.
4. Students understand how polynomials are related to special products.

Interdisciplinary Knowledge Transfer (from prior to future courses):

Learners will become effective collaborators, technology users, critical thinkers, and problem solvers. They will develop these skills through the application of argumentative discourse and reasoning to model and solve expressions in contextual situations.

Previous: Students solve linear equations and inequalities in one and two variables both algebraically and by graphing.

Next: Students will graph and solve quadratic equations and inequalities.

Big Ideas: (can be broad [interdisciplinary], topical [content focused] or both)

(Big ideas help students make connections among disciplines or units of study within a content area)
(What is the value or benefit of learning the concepts in this goal)

- Mathematical situations and structures can be translated and represented abstractly using variables, expressions, and equations.
- Any number, measure, numerical expression, algebraic expression, or equation can be represented in an infinite number of ways that have the same value.
- Polynomials form a system analogous to the system of integers that is closed under addition, subtraction, and multiplication.

Essential Questions: (engaging, open-ended questions to spark student interest and sharply focus instruction and assessment)

- How can you perform operations on polynomials and use them to represent real-world situations?
- How can polynomials be simplified in order to solve problems?
- Can two algebraic expressions that appear to be different be equivalent?
- How are the properties of real numbers related to polynomials?

Key vocabulary/terms:

binomial, degree of a monomial, degree of a polynomial, difference of two squares, factoring, factoring by grouping, leading coefficient, perfect square trinomials, polynomial, prime polynomial, quadratic expression, standard form of a polynomial, trinomial

CELP (Emphasize standards in bold)	Standards for Mathematical Practice (Emphasize practices in bold)
<p>1, 2, 3, 4, 5, 6, 7, 8, 9, 10</p> <p>CELP 1- 10 (see the full description of each standard here)</p>	<ul style="list-style-type: none"> • Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Common Core State Standards Addressed in this unit: CCSS (Priority and Supporting Standards)

PRIORITY STANDARDS

CCSS.MATH.CONTENT.HSA.APR.A.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.

CCSS.MATH.CONTENT.HSA.SSE.A.1.A

Interpret parts of an expression, such as terms, factors, and coefficients.

CCSS.MATH.CONTENT.HSA.SSE.A.2

Use the structure of an expression to identify ways to rewrite it. *For example, see $x^2 - y^2$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*

CCSS.MATH.CONTENT.HSA.APR.C.5

(+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n , where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

Key Concepts	Skills (Students are skilled at)
<p>Nouns or noun phrases (Need to know)</p>	<p>Verbs (Able to do at the desired) Align with I know and I can statements</p>
<ul style="list-style-type: none"> • Polynomial • Monomial • Binomial • Trinomial • Degree • Leading coefficient • Standard form 	<ul style="list-style-type: none"> • Identify the coefficient of a variable in an expression • Identify polynomials by type and degree • Give an example of an equivalent expression • Define expression, term, factor, and coefficient and rewrite it in another way • Polynomials can be added and subtracted. • Write polynomials in standard form • Determine the degree of a polynomial • Simplify polynomials • Apply the definition of polynomial to explain why adding or subtracting two polynomials always produces a polynomial.
<ul style="list-style-type: none"> • Distributive property • Square of sum or difference • Product of sum or difference 	<ul style="list-style-type: none"> • Multiply polynomials by a monomial • Multiply polynomials by a binomial • Multiply polynomials by a trinomial • Understand the relationship between multiplying polynomials and the distributive property • Finding the square of a sum or difference • Finding the product between a sum or difference
<ul style="list-style-type: none"> • Factor • Greatest common factor • Factor by grouping • Ac method • Prime polynomials 	<ul style="list-style-type: none"> • Finding a greatest common factor • Factor out a monomial • Factor by grouping • Factor using the ac method • Recognizing prime polynomials • Look for and identify clues in the structure of expressions in order to rewrite it another way. • Explain why equivalent expressions are equivalent. • Apply models for factoring and multiplying polynomials to rewrite expressions.
<ul style="list-style-type: none"> • Difference of squares • Perfect square trinomial • Sum or difference of cubes 	<ul style="list-style-type: none"> • Factor a difference of squares • Recognize a perfect square trinomial • Factor a perfect square trinomial • Factor a sum or difference of cubes • Factor using more than one method

- Look for and identify clues in the structure of expressions in order to rewrite it another way.
- Explain why equivalent expressions are equivalent.
- Apply models for factoring and multiplying polynomials to rewrite expressions.

Evidence of Teaching and Learning

- How will we know when students are learning?

- **Operations on Polynomials:** Students demonstrate learning by correctly adding, subtracting, and multiplying polynomials, showing an understanding that these expressions form a system **analogous to integers**.
- **Advanced Factoring Methods:** Mastery is shown through the successful application of various factoring techniques, including the **ac method, grouping, and identifying special products** like the sum and difference of cubes or perfect square trinomials.
- **Simplification and Equivalence:** Students provide evidence of conceptual depth by **simplifying complex polynomials** and explaining how two different-looking algebraic expressions can be equivalent.
- **Identification and Classification:** Learning is verified when students can accurately **identify polynomials by their type** (monomial, binomial, trinomial) and their **degree**

What strategies/interventions/modifications/ will be applied for non-mastery?

- **Increased Repetition:** Teachers use increased repetition of academic terms to ensure students can correctly identify and classify polynomials by degree and type.
- **Daily Vocabulary Reviews:** Every lesson includes a review of specialized vocabulary, such as **perfect square trinomial, difference of squares, and leading coefficient**.
- **Structured Oral Practice:** During the **Launch phase**, students participate in "**Math Talk**" **routines** to orally define and classify polynomials before attempting complex algebraic operations
- **Daily Formative Assessment:** Teachers use **exit tickets** at the conclusion of each lesson to gauge student understanding of polynomial operations and equivalence.
- **Argumentative Reflections:** Students complete **written argumentative reflections** to evaluate their initial hypotheses, helping them self-correct misconceptions about how different-looking expressions can be equivalent.
- **Dedicated Review Period:** The unit concludes with a **three-day Review and Test cycle**, providing a structured window for students to consolidate their learning and for teachers to remediate priority standards (HSA.APR.A.1 and HSA.SSE.A.2) before the summative exam

How will we enrich students who are proficient?

- **Exploring Mathematical Analogies:** Proficient students can delve deeper into the "Big Idea" that **polynomials form a system analogous to integers**, investigating what it means for a system to be "closed" under addition, subtraction, and multiplication.
- **Advanced Factoring and Identification:** These students can focus on the most complex factoring skills in the unit, such as mastering the **sum and difference of cubes** and identifying **prime polynomials** that cannot be factored further.
- **Proving Equivalence:** Beyond simply simplifying expressions, advanced students can be tasked with providing **formal explanations and justifications** for why two different-looking algebraic expressions are mathematically equivalent.
- **Applying the Binomial Theorem:** While the unit introduces the **Binomial Theorem** (standard HSA.APR.C.5), proficient students can explore more complex expansions or look ahead to how these expansions connect to Pascal's Triangle, a topic expanded upon in later units.
- **Instructional Leadership:** In the **Launch phase** of the Ainsworth Learning Plan, proficient students can lead "**Math Talk**" routines, using their mastery of academic vocabulary—like *leading coefficient* and *perfect square trinomial*—to facilitate peer discussions and classify polynomials by degree and type.
- **Evidence-Based Writing:** During the **Exploration and Development phase**, these students can produce more sophisticated **evidence-based writing** in math workstations, testing complex hypotheses about polynomial behavior and equivalence.

Unit Assessments, Performance Indicators, and Scoring Rubrics /Proficiency Scales
The unit performance indicators are taught and formatively assessed through all units

	Unit 3
Assessment Links:	<p>Module 10: Summative Assessments (See: Reveal Math, Algebra 1, Mod/Unit 10)</p> <p>Module Test Equations On Level Assessments (Form A) Differentiated Assessments (Form B=AL "Approaching Level") Differentiated Assessments (Form C=BL "Beyond Level")</p> <p>Answers: Module Test *Teachers Only On Level Assessments (Form A) Differentiated Assessments (Form B=AL "Approaching Level") Differentiated Assessments (Form C=BL "Beyond Level")</p> <p>See: Proficiency Scale Alignment</p>
Rubric Links:	

Performance Task (PT) Links:	Module 10: Performance Task (See: Reveal Math, Algebra 1, Mod/Unit 10)
PT Rubric Links:	Module 10: Performance Task Rubric *Teachers Only (See: Reveal Math, Algebra 1, Mod/Unit 10)
	See: Proficiency Scale Alignment

Learning Plan	
<p>Students' success at acquisition, meaning, and transfer depends on...</p> <p>Leveraging instructional lesson plan elements that engage students in interesting and rigorous learning activities that centers on collaboration and argumentative discourse. The latter aligns with an instructional plan that includes the phases of (1) Launching, Exploring and Developing, and Practice and Reflection. Formative evaluations are embedded throughout all three of these phases.</p> <p><u>Tech. resources to consider:</u> Reveal Math, IXL, Smart Board, PowerPoints, , Nearpod, Google Suite, Gizmos, Khan Academy, Desmos, TI-84 Calculator, OneNote Class Notebook,.</p>	
Code	Learning Events (Engaging students)
<u>Launch:</u>	<p>Provide an opportunity for students to focus on the big concept. Explore patterns, what do they observe and wonder, make predictions and hypotheses. Math talks routines/</p> <p>(collaborative grouping and sharing out)</p> <p>Formative assessment check- (warm-up check, observations, student discourse and engagement, anecdotal notes)</p>
<u>Exploration and Development:</u>	<p>Apply guided questions and activities for students to dive deep into exploration of their hypothesis. Collaborative or whole class grouping/direct instruction/math workstations are applied. Testing, providing evidence-based writing, and sharing out can be incorporated here as well.</p>

	Formative assessment check (observations, student discourse and engagement, anecdotal notes, conferencing).
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<u>FRAME Learning Intention (at the end):</u>	
Success Criteria: I know I am successful because...	Significant Tasks/Learning Progressions
<ul style="list-style-type: none"> • Classify Polynomials: I am able to identify and name polynomials by their type (monomial, binomial, or trinomial) and by their degree, • Perform Operations: I can simplify polynomials by correctly performing addition, subtraction, and multiplication, demonstrating an understanding that polynomials form a system analogous to integers. • Master Factoring Techniques: I can factor complex algebraic expressions using multiple methods, including the GCF, grouping, and the ac method,. • Identify Special Products: I am successful at recognizing and factoring special products, specifically the difference of squares, perfect square trinomials, and the sum and difference of cubes. • Determine Equivalence: I can explain and justify why two algebraic expressions that appear different are mathematically equivalent. 	<ul style="list-style-type: none"> • Polynomial Foundations (Days 1–3): The progression begins with adding and subtracting polynomials (1 day), followed by multiplying polynomials (2 days). Students establish the "Big Idea" that polynomials form a system analogous to integers, meaning they are closed under these operations. • Factoring Methodologies (Days 4–9): Students advance to complex factoring techniques, beginning with factoring by grouping (3 days) and moving to the ac method (3 days). This stage focuses on identifying the Greatest Common Factor (GCF) and simplifying expressions. • Special Products (Days 10–12): The progression concludes with three days dedicated to Factor Special Products, where students learn to handle specific patterns like the sum and difference of cubes. • Summative Evaluation (Days 13–15): The unit ends with a three-day Review and Test cycle to assess mastery of priority standards regarding polynomial structure and equivalence. <p>Significant Tasks Throughout the 15-day unit, students must complete the following high-level tasks:</p>

<ul style="list-style-type: none"> • Recognize Constraints: I am able to identify prime polynomials that cannot be factored using standard methods,. • Apply Theorems: I can apply the Binomial Theorem to expand algebraic expressions. • Utilize Academic Language: I can accurately use specialized vocabulary—such as standard form, leading coefficient, and quadratic expression—to define and orally classify polynomials during collaborative routines. • Reflect on Learning: I have demonstrated mastery through the completion of daily exit tickets and written argumentative reflections where I evaluate my initial hypotheses about polynomial behavior 	<ul style="list-style-type: none"> • Classify and Identify: Students are tasked with identifying polynomials by their specific type (monomial, binomial, trinomial) and their degree. • Demonstrate Equivalence: A critical conceptual task is for students to explain and justify why two algebraic expressions that appear different are mathematically equivalent. • Apply Factoring Skills: Students must successfully factor expressions using various methods, including grouping, the ac method, and special products such as the difference of squares and perfect square trinomials. • Recognize Prime Polynomials: Students must be able to recognize prime polynomials that cannot be factored using standard algebraic methods. • Utilize the Binomial Theorem: Students apply the Binomial Theorem to expand powers of algebraic expressions. • Collaborative Literacy Tasks: Following the Ainsworth Learning Plan, students engage in "Math Talk" routines to orally define and classify polynomials and produce evidence-based writing in math workstations to test hypotheses about polynomial behavior

Teacher notes:

- identify specific content or skills which often are misunderstood, confusing, or incorrect assumptions students might have with the content of the course/unit
- explicitly targeted to significant tasks/assessments
- include process standards to reinforce/foster in the instructional practice of the course/unit
- suggested resources/activities to support the course/unit

Differentiation/Intervention Strategies

<u>Non-mastery</u> (Provide items for struggling learners)	<u>Enrichment</u> (Provide items for high performing students)	<u>ELL</u> (Provide items to support ELL students)
<ul style="list-style-type: none"> • Reteach addressing multiple intelligence • Scaffolding • Graphic organizers • Small group or independent direct study • Varied guided questions • Tiered assignments • Daily math review 	<ul style="list-style-type: none"> • Tiered assignments • Extend or deepen concept learning • Increased rigor • More argumentative writing 	<ul style="list-style-type: none"> • Scaffolding (simplify task with structured guidance) • Connect to primary language and culture • Create reference charts (picture or word web) • Increase processing time • Daily vocabulary review • Varied guided questions • Increase repetition

Unit 4: Quadratic Functions (27 Days)

CTECS Mathematics Curriculum

Algebra 2 Unit 4 (Quadratic Functions)

Name of the Unit: Quadratic Functions Reveal Module 3.1 - 3.7	Length of the Unit: 23 Days
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Purpose of the Unit:
<ol style="list-style-type: none"> 1. Students will graph quadratic functions. 2. Students will solve quadratic equations by graphing. 3. Students will perform operations involving Complex Numbers. 4. Students will solve quadratic equations by factoring. 5. Students will solve quadratic equations by using the Square Root Property and completing the square. 6. Students will use the quadratic formula and discriminant to solve quadratic equations and determine the number of real roots. 7. Students will graph and solve quadratic inequalities. (Enrichment if time)

Interdisciplinary Knowledge Transfer (from prior to future courses):

Learners will become effective collaborators, technology users, critical thinkers, and problem solvers. They will develop these skills through the application of argumentative discourse and reasoning to model and solve expressions in contextual situations.

Previous: Students performed operations on polynomial functions and factored polynomials.

Next: Students will graph and identify key features of polynomial functions.

Big Ideas: (can be broad [interdisciplinary], topical [content focused] or both)
 (Big ideas help students make connections among disciplines or units of study within a content area)
 (What is the value or benefit of learning the concepts in this goal)

- Quadratic function can determine the longest and shortest values of a quantity and apply medians to maximize outcomes in context.
- Multiple methods can be used to find solutions.
- Quadratic functions can be used to model real world relationships and the key points in quadratic functions have meaning in the real world context.

Essential Questions: (engaging, open-ended questions to spark student interest and sharply focus instruction and assessment)

- What are important characteristics of a quadratic function, and what real-world situations can be modeled by quadratic functions and equations?
- Why is it important to learn multiple representations of quadratic equations?
- Why is it important to understand, interpret and model contextual situations with quadratic equations?

Key vocabulary/terms:

average rate of change, axis of symmetry, completing the square, complex conjugates, complex number, difference of squares, discriminant, factored form, imaginary unit i , maximum, minimum, perfect square trinomials, projectile motion problems, pure imaginary number, quadratic equation, quadratic function, quadratic inequality, rate of change, rationalizing the denominator, standard form of a quadratic equation, vertex, vertex form

<p><u>CELP</u> (Emphasize standards in bold)</p>	<p><u>Standards for Mathematical Practice</u> (Emphasize practices in bold)</p>
<p>1, 2, 3, 4, 5, 6, 7, 8, 9, 10</p> <p>CELP 1-10 (see the full description of each standard here)</p>	<ul style="list-style-type: none"> • Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

- Look for and express regularity in repeated reasoning.

[MP1, MP2, MP3, MP4, MP5, MP6](#) (see the full description of each standard here)

Common Core State Standards Addressed in this unit:

PRIORITY STANDARDS

CCSS.MATH.CONTENT.HSA.CED.A.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.*

CCSS.MATH.CONTENT.HSA.CED.A.2

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CCSS.MATH.CONTENT.HSA.CED.A.3

Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

CCSS.MATH.CONTENT.HSA.SSE.A.1.B

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 .*

CCSS.MATH.CONTENT.HSA.SSE.B.3.A

Factor a quadratic expression to reveal the zeros of the function it defines.

CCSS.MATH.CONTENT.HSA.SSE.B.3.B

Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

CCSS.MATH.CONTENT.HSF.IF.B.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.**

CCSS.MATH.CONTENT.HSF.IF.B.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.*

CCSS.MATH.CONTENT.HSF.IF.C.7

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

CCSS.MATH.CONTENT.HSF.IF.C.7.A

Graph linear and quadratic functions and show intercepts, maxima, and minima.

CCSS.MATH.CONTENT.HSF.IF.C.8.A

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.

CCSS.MATH.CONTENT.HSN.CN.A.1

Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.

CCSS.MATH.CONTENT.HSN.CN.A.2

Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

CCSS.MATH.CONTENT.HSN.CN.C.7

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

CCSS.MATH.CONTENT.HSN.CN.C.8

(+) Extend polynomial identities to the complex numbers. *For example, rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$.*

CCSS.MATH.CONTENT.HSA.REI.B.4

Solve quadratic equations in one variable.

CCSS.MATH.CONTENT.HSA.REI.B.4.b

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 and write them as $a \pm bi$ for real numbers a and b .

Key Concepts	Skills (Students are skilled at)
Nouns or noun phrases (Need to know)	Verbs (Able to do at the desired) Align with I know and I can statements
<ul style="list-style-type: none"> • Quadratic function • Axis of symmetry • Vertex • Maximum and minimum • Rate of change 	<ul style="list-style-type: none"> • Graph a relationship between two quantities using a table • Interpret the graph of a quadratic function and explain how the vertex is a maximum or minimum value • Locate the maximum and minimum points of a graph • Find the intercepts of a graph • Give equations of the lines of symmetries • Identify the vertex

<ul style="list-style-type: none"> • Domain and range • Vertex form • Intervals 	<ul style="list-style-type: none"> • Compare key features of quadratic functions - Determine and interpret the intercepts, line of symmetry, maximum and minimum points of the relationship between two quantities, and explain the relevance. • Write a quadratic function given a contextual situation. • Interpret all of the key features of the graph given a real-world situation (i.e. - path of a thrown ball) • Find the domain and range of quadratic function • Identify the intervals where the function is either positive or negative • Identify the intervals where the function is either increasing or decreasing • Interpret the meaning of average rate of change for any given function • Calculate the average rate of change of a function over a specified interval • Determine and interpret the end behavior of the relationship between two quantities
<ul style="list-style-type: none"> • Zeros of a function (x-intercepts) • Roots 	<ul style="list-style-type: none"> • Find the x-intercepts for the equation and determine the zeros of the function • Explain why the function has zero, one, or two zeros of the function • Use technology to graph a quadratic function and interpret key features of the graph. • Find the solutions of a quadratic equation using technology
<ul style="list-style-type: none"> • Imaginary numbers, i • Complex numbers • Square root method • Complex solution • Complex conjugate 	<ul style="list-style-type: none"> • Give an example of a complex number • Identify the real part of a complex number • Identify the imaginary part of a complex number • Write a complex number defined as $a + bi$ • Simplify negative radicals • Solve equations using the square root method • Perform operations with complex numbers • Write the conjugate of a complex number • Determine when a quadratic equation has complex roots by graphing
<ul style="list-style-type: none"> • Factored form • Zero product principle • Extraneous solution 	<ul style="list-style-type: none"> • Solve quadratic equations by factoring • Factor a polynomial using complex numbers • Identify the complex root from a factor • Factor a quadratic expression with the use of technology • Use the factors of the expression to determine the zeros of the function • Generate a quadratic model given the zeros of the function • Write a quadratic function, given a contextual situation, and determine the “zeros” to find the values of the function • Identify an extraneous solution • Give an example of when an extraneous solution may arise. • Write a quadratic function given the zeros of the function

	<ul style="list-style-type: none"> • Explain why the function has zero, one, or two zeros of the function
<ul style="list-style-type: none"> • Square root property • Complete the square • Vertex form 	<ul style="list-style-type: none"> • Demonstrate how to solve an equation by using the method of completing the square • Complete the square to factor a quadratic function to determine the maximum or minimum value • Apply completing the square to a projectile in motion problem • Write a function defined by an expression in different but equivalent forms
<ul style="list-style-type: none"> • Quadratic formula • Discriminant • Complex solutions 	<ul style="list-style-type: none"> • Find the solution of a quadratic equation using the quadratic formula • Express the solution of a quadratic equation as a complex number $a + bi$ • Use $b^2 - 4ac$ to determine number of real solutions • Demonstrate how using the quadratic function might yield an imaginary number and, when it does, write the solution in the form of $a \pm bi$
<ul style="list-style-type: none"> • Quadratic inequality • Constraints • Viable solutions 	<ul style="list-style-type: none"> • Graph quadratic inequalities • Determine constraints of a quadratic inequality • Interpret solutions as viable or nonviable in a modeling context • Identify the variables and quantities represented in a real-world problem. • Determine the appropriate model for the real-world problem (linear equation, linear inequality, quadratic equation, Quadratic inequality, rational equation, exponential equation). • Write the equation or inequality that best models the problem. • Solve an equation or inequality and interpret the solution in the context.
<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science</p>	<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science Algebra 2 Unpacked Standards-CCSS</p>

Evidence of Teaching and Learning
<i>- How will we know when students are learning?</i>
<ul style="list-style-type: none"> • Solving through Multiple Representations: Students can solve quadratic equations using factoring, the Square Root Property, and the Quadratic Formula.

- **Graphing and Identifying Features:** Mastery is shown when students can accurately graph quadratic functions and identify the vertex, axis of symmetry, zeros, and roots.
- **Completing the Square:** Students demonstrate advanced understanding by completing the square to transform equations and reveal maximum or minimum values (extrema).
- **Complex Number Operations:** Evidence includes the ability to simplify negative radicals and perform arithmetic operations with complex numbers and imaginary units (i).
- **Analysis of Roots:** Students use the discriminant to determine the nature of roots and can successfully rationalize the denominator when necessary.

In alignment with the unit's **Language Objective**, learning is documented through collaborative and written routines:

- **"Notice and Wonder" Observations:** Students provide written evidence of their initial engagement by recording observations in graphic organizers.
- **Think-Pair-Share Tasks:** Learning is evidenced orally as students share assumptions and predictions with peers during collaborative tasks.
- **Evidence-Based Writing:** During the "Exploration and Development" phase, students produce writing in math workstations to test hypotheses about quadratic behavior and projectile motion.
- **Argumentative Reflections:** Students complete written reflections to evaluate their initial hypotheses and justify their mathematical conclusions.

What strategies/interventions/modifications/ will be applied for non-mastery?

- **Visual and Organizational Support:** Students use **graphic organizers** to record "notice and wonder" observations, which provides a structured way to engage with new quadratic concepts before moving to complex algebraic work.
- **Multiple Representations:** A core instructional strategy is teaching **multiple representations** (vertex, standard, and factored form). This allows students who struggle with one algebraic method to find success through alternative graphical or structural representations.
- **Math Workstations:** During the "Exploration and Development" phase, students work in **math workstations** where they can test hypotheses and receive more targeted support while producing **evidence-based writing**.

Collaborative Interventions

- **Think-Pair-Share Tasks:** This routine is used specifically in Unit 4 to allow students to **orally share assumptions** and predictions with peers, serving as a low-stakes intervention to clarify misconceptions about quadratic behavior.

- **Math Talks:** During the "Launch" phase, students participate in collaborative routines to explore patterns and make predictions, helping to build conceptual understanding before formal direct instruction.

How will we enrich students who are proficient?

- **Advanced Modeling of Projectile Motion:** Proficient students can move beyond basic graphing to solve complex projectile motion problems, using quadratic functions to calculate specific time-of-flight, maximum height (extrema), and impact points in various real-world scenarios.
- **Mastery of Multiple Representations:** These students can be tasked with demonstrating the fluidity between vertex, standard, and factored forms of quadratic equations. They can prove the importance of each representation by explaining which form is most efficient for identifying specific features like the axis of symmetry or zeros in a given context.
- **Deep Analysis of the Discriminant:** Students can explore how the discriminant predicts the nature of roots (real, rational, or complex) and create their own quadratic equations that result in specific types of solutions, including those involving complex conjugates.
- **Complex Number Theory:** Proficient students can engage in more rigorous operations with complex numbers and imaginary units (i), such as investigating the powers of i or solving higher-level equations that require rationalizing the denominator with complex conjugates.
- **Optimization Problems:** Using the concept of extrema, students can solve optimization tasks—such as maximizing area or minimizing costs—to see how quadratic functions are used to "maximize outcomes in context".
- **Instructional Leadership in Collaborative Routines:** During the "Launch" and "Exploration" phases, proficient students can lead Think-Pair-Share tasks. They can focus on the unit's Language Objective by orally defending their assumptions and using advanced academic vocabulary, such as pure imaginary number and zero product principle, to mentor their peers.
- **Sophisticated Argumentative Reflection:** In the "Practice and Reflection" phase, these students can produce more in-depth written reflections that not only justify their own mathematical steps but also critique alternative solution methods for efficiency and accuracy

Unit Assessments, Performance Indicators, and Scoring Rubrics /Proficiency Scales

The unit performance indicators are taught and formatively assessed through all units

	Unit 4
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Code	Learning Events (Engaging students)
<u>Launch:</u>	<p>Provide an opportunity for students to focus on the big concept. Explore patterns, what do they observe and wonder, make predictions and hypotheses. Math talks routines/</p> <p>(Collaborative grouping and sharing out)</p> <p>Formative assessment check- (warm-up check, observations, student discourse and engagement, anecdotal notes)</p>
<u>Exploration and Development:</u>	<p>Apply guided questions and activities for students to dive deep into exploration of their hypothesis. Collaborative or whole class grouping/direct instruction/math workstations are applied. Testing, providing evidence-based writing, and sharing out can be incorporated here as well.</p> <p>Formative assessment check (observations, student discourse and engagement, anecdotal notes, conferencing).</p>
<u>Practice and Reflection:</u>	<p>Group or independent practice opportunities. Can include student reflection on initial question/hypothesis and lesson reflection.</p> <p>Formative assessment check (Exit ticket, observations, student discourse and engagement, anecdotal notes, written argumentative reflection)</p>

FRAME Learning Intention (at the end):

I can identify and interpret the important characteristics of a quadratic function, and model and solve real-world situations that involves these functions.

Success Criteria: I know I am successful because...	Significant Tasks/Learning Progressions
<ul style="list-style-type: none"> • Model Real-World Situations: Students can identify and model real-world contexts, such as projectile motion, using quadratic functions. • Utilize Multiple Representations: Students can explain the importance of and transition between different forms of quadratic equations, 	<ul style="list-style-type: none"> • Graphical Foundations (Days 1–4): The progression begins with two days of graphing quadratic functions, followed by two days of solving by graphing. This establishes the visual connection between a function's form and its x-intercepts. • The Complex Number System (Days 5–9): Students spend three days exploring complex numbers, learning to simplify negative radicals and

<p>specifically vertex, standard, and factored form.</p> <ul style="list-style-type: none"> • Identify Key Features: Students can define and locate the vertex, axis of symmetry, zeros, and roots of a quadratic function. • Understand Extrema: Students understand that quadratic functions are used to determine maximum or minimum values (extrema) to maximize outcomes in a given context. • Solve via Multiple Methods: Students can solve quadratic equations using various algebraic methods, including factoring, the Square Root Property, and the Quadratic Formula. • Complete the Square: Students can successfully complete the square to transform an equation and reveal its maximum or minimum values. • Master Complex Numbers: Students can simplify negative radicals and perform operations with complex numbers, utilizing the imaginary unit i and complex conjugates. • Apply the Discriminant: Students can use the discriminant to determine the number and nature of the roots of a quadratic equation. • Graph and Analyze: Students can graph quadratic functions and identify their intercepts and symmetry. • Refine Solutions: Students can rationalize the denominator 	<p>perform operations with imaginary units (i). This stage concludes with a two-day Review and Quiz.</p> <ul style="list-style-type: none"> • Algebraic Solving Methods (Days 10–17): The progression advances through various algebraic techniques: <ul style="list-style-type: none"> ◦ Solving by Factoring (3 days): Utilizing the zero-product principle to find roots. ◦ Completing the Square (3 days): Learning to transform equations into vertex form to reveal maximum or minimum values (extrema). ◦ Quadratic Formula and Discriminant (2 days): Using the formula to find solutions and the discriminant to determine the nature of those roots. • Inequalities and Evaluation (Days 18–23): The final instructional phase focuses on solving and graphing quadratic inequalities, followed by a three-day Review and Unit Test cycle. • Cumulative Review (Days 24–27): Because Unit 4 concludes the second quarter, the progression ends with a four-day Midterm Review and Exam covering all material from Units 1 through 4. <p>Significant Tasks Students demonstrate their learning through several high-level mathematical and literacy tasks:</p> <ul style="list-style-type: none"> • Analyzing Features and Extrema: A primary task is to identify key features of quadratic graphs, including the vertex, axis of symmetry, and zeros. Students must use these features to determine extrema to maximize outcomes in specific contexts. • Performing Complex Operations: Students are tasked with simplifying negative radicals and performing
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and identify extraneous solutions when solving quadratic problems.

- Solve Inequalities: Students can solve and graph quadratic inequalities
- I can use the quadratic formula and discriminant to solve quadratic equations in contextual situations

Refer to the following links below:

[FRAME Template Example](#)
[FRAME model Infographic](#)

arithmetic operations with complex numbers and conjugates.

- Mastering Multiple Representations: Students must demonstrate the ability to solve quadratic equations using factoring, the Square Root Property, and the Quadratic Formula.
- Modeling with Quadratics: A significant application task involves using quadratic functions to model and solve problems related to projectile motion.
- Collaborative Literacy Tasks: Following the unit's Language Objective, students must record "notice and wonder" observations in graphic organizers and orally share assumptions and predictions during Think-Pair-Share tasks.
- Reflective Writing: As part of the instructional framework, students produce evidence-based writing in math workstations and complete written argumentative reflections to evaluate their initial hypotheses.
- Students will work to study and compare what is given, known and assumed. They will use a graphic organizer to write their observations and what they wonder before sharing with peers in their partner or group.
- **Question?**
What do you observe/wonder? What questions can you ask? What do you notice about the questions/observations between you and your peer(s)?
- **Whole Class discussion**
Using an organizer, generate class questions to address and assumptions to explore.
- **Group discussion and written response to the following**
How can you answer your question?
What strategies can you use?
What assumptions, if any, will you make?
Why are you making these assumptions?

	<p>Why are assumptions important in this context?</p> <ul style="list-style-type: none"> • <u>Work independently</u> Apply a strategy to answer the question and explain your reasoning in the provided organizer. • <u>Group discussion</u> Share your strategy and answer with others in your group pair of students, or the entire class. Did each pair of students use correct mathematical reasoning to answer their question? How are the strategies similar and different? <p>EXTENSION (Differentiation):</p> <p>Explore and share different models to solve the problem, and compare how these models impact the floor size. Encourage students to realize they cannot automatically believe data presented graphically.</p> <ul style="list-style-type: none"> • Use these questions to guide you: What do you notice? What questions can you ask? How can you answer your questions? What assumptions will you make? <p>Assessment: Observations, Student Responses, Exit-Ticket, Journal Entry. What did you like/did not like about today's lesson? What experience(s) did you gain about making observations and generating strategies to answer questions.</p>
	<p>Significant task 3: Quadratic Functions Approaching Level: Home Run Ball 1A On Level: Home Run Ball Beyond Level: Historic Hotels</p> <p>Timeline: 1 day DOK 2-3</p> <p>Note 1: "Approaching Level" tasks are for students who are performing below the desired performance level. Note 2: "On Level" tasks are for students who are performing at the desired performance level.</p>

Note 3: "Beyond Level" tasks are for students who are performing above the desired performance level.

WHY:

- **CCSS Content**
Standard(s): HSA/SSE/B/3/a/,
HSA/SSE/B/3/b/, HSA.REI.B.4

HOW:

- **Group discussion**
Students will discuss and assign group members as leader, scribe, time-keeper,)
- **Think-pair-share**
Students will think creatively to create and compare expressions that represent relationships. They can use a graphic organizer to write down their plan, answers to questions, and any challenges they may encounter. They will share and discuss this information with their peers. The group will decide on a plan to move forward.
- **Question?**
Which plan works best for accomplishing your task and why?
- **Group discussion and written response to the following**
Did you discuss ideas together?
How did you agree on which strategies to apply?
How do you know your answers are correct?
- **Cooperative Group work**
Work together in your group and use your questions to construct your table.
- **Whole class sharing and peer evaluation**
Share your presentation with the class and collect feedback. (provide a proficiency scale to support feedback)
- **Question?**
Did the mathematical model accurately represent the situation?
Is the table accurate and correctly aligned with correct domains and ranges?
Based on the proficiency scale rating, what rating level would you give to this project.

EXTENSION (Differentiation):

Dive deeper in understanding with the *Historical Hotel*

	<p>activity by having students Apply similar questions from above to guide student responses.</p> <ul style="list-style-type: none"> • <u>(Group discussion and write response to the following)</u> How did you answer your questions? What strategies did you use? How do you know your answers are correct? <p>Assessment: Observations, Student Responses, Peer Evaluations, Exit-Ticket, Journal Entry. What did you like/did not like about the performance task? What experience(s) did you gain about collecting, organizing, and representing linear relationships? How would you evaluate your contribution to the group?</p> <p>Material/Resources:</p> <ul style="list-style-type: none"> • Computer/Internet Access/Desmos • (OneNote Notebook or Hard Copy activity form) • SmartBoard • Calculators • Proficiency Scale Level Rubric <p>CSDE -Algebra 2 Curriculum</p>
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<u>Teacher notes:</u>	
	<ul style="list-style-type: none"> • identify specific content or skills which often are misunderstood, confusing, or incorrect assumptions students might have with the content of the course/unit • explicitly targeted to significant tasks/assessments • include process standards to reinforce/foster in the instructional practice of the course/unit • suggested resources/activities to support the course/unit

Differentiation/Intervention Strategies		
<u>Non-mastery</u> (Provide items for struggling learners)	<u>Enrichment</u> (Provide items for high performing students)	<u>ELL</u> (Provide items to support ELL students)
<ul style="list-style-type: none"> • Reteach addressing multiple intelligence • Scaffolding • Graphic organizers • Small group or independent direct study • Varied guided questions • Tiered assignments • Daily math review 	<ul style="list-style-type: none"> • Tiered assignments • Extend or deepen concept learning • Increased rigor • More argumentative writing 	<ul style="list-style-type: none"> • Scaffolding (simplify task with structured guidance) • Connect to primary language and culture • Create reference charts (picture or word web) • Increase processing time • Daily vocabulary review • Varied guided questions • Increase repetition

Quarter 3: Polynomial Functions and Equations (34 Days)

Unit 5: Polynomial Functions (17 Days)

CTECS Mathematics Curriculum

Algebra 2 Unit 5 (Polynomial Functions)

Name of the Unit: Polynomial Functions Reveal Module 4	Length of the Unit: 17 Days
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Purpose of the Unit:
<ol style="list-style-type: none"> 1. Students analyze polynomial functions by examining key features and graphing. 2. Students analyze the graphs of polynomial functions by identifying key features. 3. Students will add, subtract, and multiply polynomials. 4. Students divide polynomials by using long division and synthetic division. 5. Students expand powers of binomials.

Interdisciplinary Knowledge Transfer (from prior to future courses):

Learners will become effective collaborators, technology users, critical thinkers, and problem solvers. They will develop these skills through the application of argumentative discourse and reasoning to model and solve expressions in contextual situations.

Previous: Students studied linear and quadratic functions.

Next: Students will write and solve polynomial equations and identify zeros of polynomial functions.

Big Ideas:(can be broad [interdisciplinary], topical [content focused] or both)
 (Big ideas helps students make connections among disciplines or units of study within a content area)
 (What is the value or benefit of learning the concepts in this goal)

- The end behavior of a polynomial is determined by its degree, even or odd, and the sign of its leading coefficient.
- Long division by the binomial $x-a$ can be used to factor a polynomial and the Remainder = $P(a)$.

Essential Questions: (engaging, open-ended questions to spark student interest and sharply focus instruction and assessment)

- What are the basic features of a polynomial function based on the degree of the polynomial?
- How is the division of a polynomial, $P(x)$, by a binomial of the form $x - a$ connected to the polynomial function, $y = P(x)$, when evaluated at $x=a$?
- How can long division by the binomial $x-a$ be used to factor a polynomial?
- What is the connection between the zeros of a polynomial function, the x-intercepts of the graph of the polynomial function, and the factors of the polynomial?
- How is the expansion of the binomial $(a+b)^n$ connected to Pascal's Triangle?

Key vocabulary/terms:

binomial, binomial theorem, closed, degree, degree of a polynomial, end behavior, extrema, intervals, leading coefficient, maximum, minimum, monomial function, Pascal's triangle, polynomial in one variable, polynomial function, power function, quartic function, quintic function, standard form of a polynomial, synthetic division, trinomial

<p>CELP (Emphasize standards in bold)</p>	<p>Standards for Mathematical Practice (Emphasize practices in bold)</p>
<p>1, 2, 3, 4, 5, 6, 7, 8, 9, 10</p> <p>CELP 1- 10 (see the full description of each standard here)</p>	<ul style="list-style-type: none"> • Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically.

- **Attend to precision.**
- **Look for and make use of structure.**
- **Look for and express regularity in repeated reasoning.**

[MP1, MP2, MP3, MP4, MP5, MP6](#) (see the full description of each standard here)

Common Core State Standards Addressed in this unit: CCSS (Priority and Supporting Standards)

PRIORITY STANDARDS

CCSS.MATH.CONTENT.HSF.IF.B.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 end behavior; and periodicity.*

CCSS.MATH.CONTENT.HSF.IF.C.7.C

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

CCSS.MATH.CONTENT.HSF.IF.C.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.*

CCSS.MATH.CONTENT.HSA.APR.A.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.

CCSS.MATH.CONTENT.HSA.APR.C.5

(+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n , where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

CCSS.MATH.CONTENT.HSA.APR.D.6

Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.

CCSS.MATH.CONTENT.HSA.SSE.A.2

Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.

Key Concepts	Skills (Students are skilled at)
<p>Nouns or noun phrases (Need to know)</p>	<p>Verbs (Able to do at the desired) Align with I know and I can statements</p>
<ul style="list-style-type: none"> • Polynomial function • Degree of polynomials • Leading coefficient • Shapes of polynomial functions • End behavior of polynomials • Domain and Range • Tables of polynomials • Graphs of polynomials • Intercepts of a graph • Zeros of a polynomial • Key features of graphs • Maximum and minimum of functions • Extrema 	<ul style="list-style-type: none"> • Use $x \rightarrow \pm \infty$ to describe end behavior • Graph polynomial functions • Evaluate polynomial functions • Find intercepts of a function • Identify the vertex • Locate and identify the maximum and minimum points of a function if they exist • Find and compare other key features of a function
<ul style="list-style-type: none"> • Increasing or decreasing intervals • Line of symmetry • Verbal description • Graphs of real-world problems • Labels and scales of graphs • Relationships between quantities • Equations of real-world problems 	<ul style="list-style-type: none"> • Use technology to find maximum/minimum • Locate and identify the maximum and minimum points of a graph if they exist • Find the intercepts of a graph • Can apply real world data to a graph and an equation • Find intervals where the graph is increasing or decreasing • Find intervals where the graph is positive or negative • Give equations of the lines of symmetries • Determine the best model for the real-world problem (linear, quadratic). • Write the equation that best fits the model's problem. • Create coordinate axes using an appropriate scale and label the axes. • Graph equations on coordinate axes with appropriate labels and scales • Identify the variables and quantities represented in a real-world problem. • Use $x \rightarrow \pm \infty$ to describe end behavior
<ul style="list-style-type: none"> • Function notation • Binomial • Trinomial 	<ul style="list-style-type: none"> • Find sum and differences of functions • Find products of functions functions • Write polynomials in standard form

<ul style="list-style-type: none"> Polynomial Addition, subtraction, multiplication of polynomials Standard form of polynomials Like terms Degree of polynomials Definition of polynomial Distributive property FOIL Method 	<ul style="list-style-type: none"> Determine the degree of a polynomial Simplify polynomials Apply the definition of polynomial to explain why adding, subtracting or multiplying two polynomials always produces a polynomial
<ul style="list-style-type: none"> Long division Synthetic division Remainder of polynomial 	<ul style="list-style-type: none"> Perform long division on polynomials Perform synthetic division on some polynomials Determine when to use synthetic or long division Find the remainder from polynomial division. Apply the remainder theorem. Prove $x-a$ is a factor of $p(x)$ by getting a remainder of zero. Write the result of polynomial division in $Q(x)D(x) + R(x)$.
<ul style="list-style-type: none"> Binomial expansion Binomial Theorem Pascal's Triangle 	<ul style="list-style-type: none"> Expand $(x+y)^n$ for any n value Expand $(x+y)^n$ for any x and y value Calculate any term of the expansion Generate Pascal's Triangle to find the coefficients of binomial expansion.
<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science</p>	<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science Algebra 2 Unpacked Standards-CCSS</p>

Evidence of Teaching and Learning

- How will we know when students are learning?

- Mastery of Division:** Students provide evidence of learning by accurately performing **long and synthetic division** to factor polynomials.
- Application of the Remainder Theorem:** Mastery is shown when students use the **Remainder Theorem** to evaluate a polynomial $P(a)$ by identifying the remainder of the division by $(x-a)$.
- Binomial Expansion:** A significant indicator of progress is the student's ability to **expand powers of binomials** by identifying and utilizing the connection to **Pascal's Triangle**.
- Analysis of End Behavior:** Students demonstrate conceptual depth by using **formal notation** $(x \rightarrow \pm\infty)$ to describe how the degree (even vs. odd) and the leading coefficient determine the direction of a graph.

- **Graphing and Sketching:** Evidence includes the ability to **sketch rough graphs** of polynomial functions, identifying **relative extrema** and end behavior features.

Academic Literacy and Communication

In alignment with the unit's **Language Objective**, learning is documented through specific collaborative routines:

- **Collaborative Explanations:** Students provide verbal evidence of learning in small group discussions by **explaining the connection** between Pascal's Triangle and expansion using visual aids.
- **Use of Specialized Vocabulary:** We will know students are learning when they correctly apply academic terms such as **power function, quartic, quintic, and synthetic division** during "Math Talk" routines.
- **Evidence-Based Writing:** During the "Exploration and Development" phase, students produce **writing in math workstations** to test hypotheses about polynomial properties and division.

What strategies/interventions/modifications/ will be applied for non-mastery?

How will we enrich students who are proficient?

Unit Assessments, Performance Indicators, and Scoring Rubrics /Proficiency Scales The unit performance indicators are taught and formatively assessed through all units

	Unit 5
Assessment Links:	<p>Module 4: Summative Assessments (See: Reveal Math, Algebra 2, Mod/Unit 4)</p> <p>Module Test Equations On Level Assessments (Form A) Differentiated Assessments (Form B=AL "Approaching Level") Differentiated Assessments (Form C=BL "Beyond Level")</p>
Rubric Links:	<p>Answers: Module Test *Teachers Only On Level Assessments (Form A) Differentiated Assessments (Form B=AL "Approaching Level") Differentiated Assessments (Form C=BL "Beyond Level")</p> <p>See: Proficiency Scale Alignment</p>

Performance Task (PT) Links:	Module 4: Performance Task (See: Reveal Math , Algebra 2, Mod/Unit 4)
PT Rubric Links:	Module 4: Performance Task Rubric (Relations and Functions) *Teachers Only (See: Reveal Math , Algebra 2, Mod/Unit 4)
	See: Proficiency Scale Alignment

Learning Plan	
<p>Students' success at acquisition, meaning, and transfer depends on...</p> <p>Leveraging instructional lesson plan elements that engage students in interesting and rigorous learning activities that centers on collaboration and argumentative discourse. The latter aligns with an instructional plan that includes the phases of (1) Launching, Exploring and Developing, and Practice and Reflection. Formative evaluations are embedded throughout all three of these phases.</p> <p><u>Tech. resources to consider:</u> Reveal Math, IXL , Padlet, Smart Board, PowerPoints, Google Suite, CK-Math, Gizmos, Khan Academy, Desmos, TI-84 Calculator</p>	
Code	Learning Events (Engaging students)
<u>Launch:</u>	<p>Provide an opportunity for students to focus on the big concept. Explore patterns, what do they observe and wonder, make predictions and hypotheses. Math talks routines/</p> <p>(collaborative grouping and sharing out)</p> <p>Formative assessment check- (warm-up check, observations, student discourse and engagement, anecdotal notes)</p>
<u>Exploration and Development:</u>	<p>Apply guided questions and activities for students to dive deep into exploration of their hypothesis. Collaborative or whole class grouping/direct instruction/math workstations are applied. Testing, providing evidence-based writing, and sharing out can be incorporated here as well.</p> <p>Formative assessment check (observations, student discourse and engagement, anecdotal notes, conferencing).</p>

<p><u>Practice and Reflection:</u></p>	<p>Group or independent practice opportunities. Can include student reflection on initial question/hypothesis and lesson reflection.</p> <p>Formative assessment check (Exit ticket, observations, student discourse and engagement, anecdotal notes, written argumentative reflection)</p> <p>Tech. resources to consider: Reveal Math, EdPuzzle.com, Smart Board, PowerPoints, Google Suite, Gizmos,</p>
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<p><u>FRAME Learning Intention (at the end):</u></p>	
<p>I can identify and interpret the important characteristics of a quadratic function, and model and solve real-world situations that involves these functions.</p>	
<p>Success Criteria: I know I am successful because...</p>	<p>Significant Tasks/Learning Progressions</p>

- **Analyze End Behavior:** Use formal notation ($x \rightarrow \pm\infty$) to describe how the degree of a function (even or odd) and its leading coefficient determine the graph's direction.
- **Perform Polynomial Division:** Accurately execute both **long division** and **synthetic division** to factor polynomials.
- **Apply the Remainder Theorem:** Demonstrate that long division of a polynomial by $(x-a)$ results in a remainder equal to $P(a)$.
- **Master Binomial Expansion:** Successfully **expand powers of binomials** and explain the mathematical connection between these expansions and **Pascal's Triangle**.
- **Identify Function Features:** Classify and describe the characteristics of **monomial, power, quartic, and quintic functions**, including identifying their **relative extrema**.
- **Sketch Polynomial Graphs:** Create rough sketches of polynomial functions by utilizing your understanding of zeros and end behavior.
- **Communicate Using Academic Vocabulary:** Accurately use specialized terms—such as **synthetic division, power function, and binomial theorem**—during collaborative "Math Talk" routines and small group discussions.
- **Justify and Reflect:** Provide **evidence-based writing** to explain polynomial properties and complete **written argumentative reflections** to evaluate your initial hypotheses about function behavior

- **Function Analysis and Graphing (Days 1–7):** The progression begins with a three-day introduction to **Polynomial Functions**, followed by two days of **Analyzing Graphs** to identify relative extrema and end behavior. This phase concludes with a **two-day Review and Quiz**.
- **Algebraic Operations and Division (Days 8–11):** Students move into procedural mastery, spending two days on **polynomial operations** and two days specifically on **Dividing polynomials** using both long and synthetic division.
- **Binomial Expansion (Days 12–14):** The instructional sequence shifts to **Powers of Binomials**, where students explore the connection between algebraic expansion and **Pascal's Triangle**.
- **Summative Assessment (Days 15–17):** The unit concludes with a **three-day Review and Test cycle** focusing on priority standards such as graphing polynomial functions and performing division of polynomials.

Significant Tasks

Students demonstrate their learning through high-level mathematical and literacy tasks integrated into the **Ainsworth Learning Plan**:

- **Describing End Behavior:** A critical task is using **formal notation** ($x \rightarrow \pm\infty$) to describe how the degree (even vs. odd) and the leading coefficient determine the direction of a graph.
- **Performing Division and Evaluation:** Students must perform **long and synthetic division** and apply the **Remainder Theorem** to demonstrate that dividing a polynomial by $(x-a)$ results in a remainder equal to $P(a)$.
- **Expanding Binomials:** Students are tasked with expanding powers of binomials using the **Binomial Theorem** and explaining its connection to the rows of **Pascal's Triangle**.

Refer to the following links below:

[FRAME Template Example](#)

[FRAME model Infographic](#)

- **Sketching Functions:** Based on their analysis of zeros and end behavior, students must **sketch rough graphs** of quartic and quintic functions,.
- **Collaborative Literacy Tasks:** In alignment with the **Language Objective**, students must **explain the connection** between Pascal's Triangle and expansion in small group discussions using visual aids.
- **Evidence-Based Writing:** During the "Exploration and Development" phase, students produce writing in **math workstations** to test hypotheses about polynomial behavior. The unit concludes with students providing **written argumentative reflections** on their initial mathematical hypotheses

Teacher notes:

- identify specific content or skills which often are misunderstood, confusing, or incorrect assumptions students might have with the content of the course/unit
- explicitly targeted to significant tasks/assessments
- include process standards to reinforce/foster in the instructional practice of the course/unit
- suggested resources/activities to support the course/unit

Differentiation/Intervention Strategies		
<u>Non-mastery</u> (Provide items for struggling learners)	<u>Enrichment</u> (Provide items for high performing students)	<u>ELL</u> (Provide items to support ELL students)
<ul style="list-style-type: none"> • Reteach addressing multiple intelligence • Scaffolding • Graphic organizers • Small group or independent direct study • Varied guided questions • Tiered assignments • Daily math review 	<ul style="list-style-type: none"> • Tiered assignments • Extend or deepen concept learning • Increased rigor • More argumentative writing 	<ul style="list-style-type: none"> • Scaffolding (simplify task with structured guidance) • Connect to primary language and culture • Create reference charts (picture or word web) • Increase processing time • Daily vocabulary review • Varied guided questions • Increase repetition

Unit 6: Polynomial Equations (17 Days)

CTECS Mathematics Curriculum

Algebra 2 Unit 6 (Polynomial Equations)

Name of the Unit: Polynomial Equations
Reveal Module 5.1, 5.2, 5.4, 5.5

Length of the Unit: 17 Days

Purpose of the Unit:

1. Students solve polynomial equations by graphing
2. Students will solve polynomial equations by factoring and writing in quadratic form.
3. Students evaluate and factor equations using the Remainder and Factor Theorems.
4. Students determine the numbers and types of roots of polynomial equations, find zeros, and use zeros to graph polynomial functions.

Interdisciplinary Knowledge Transfer (from prior to future courses):

Learners will become effective collaborators, technology users, critical thinkers, and problem solvers. They will develop these skills through the application of argumentative discourse and reasoning to model and solve expressions in contextual situations.

Previous: Students graphed and analyzed polynomial functions and divided/expanded polynomial functions.

Next: Students will simplify and solve radical expressions and equations.

Big Ideas:(can be broad [interdisciplinary], topical [content focused] or both)

(Big ideas helps students make connections among disciplines or units of study within a content area)

(What is the value or benefit of learning the concepts in this goal)

- The solutions or roots of the polynomial equation $y = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$ are the x coordinates of the x-intercepts of $f(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$ and are the zeros of the function $f(x)$.
- Every polynomial equation with a degree n has n roots in the set of complex numbers.

Essential Questions: (engaging, open-ended questions to spark student interest and sharply focus instruction and assessment)

- What is the Fundamental Theorem of Algebra?
- What is the connection between the zeros of a polynomial function, the x-intercepts of the graph of the polynomial function, and the factors of the polynomial?

Key vocabulary/terms:

prime polynomial, quadratic form, identity, polynomial identity, synthetic substitution, depressed polynomial, multiplicity, factor theorem, fundamental theorem of algebra, remainder theorem

CELP

(Emphasize standards in **bold**)

1, 2, 3, 4, 5, 6, 7, 8, 9, 10

[CELP 1- 10](#)

(see the full description of each standard here)

Standards for Mathematical Practice

(Emphasize practices in **bold**)

- **Make sense of problems and persevere in solving them.**
- **Reason abstractly and quantitatively.**
- **Construct viable arguments and critique the reasoning of others.**
- **Model with mathematics.**
- **Use appropriate tools strategically.**
- **Attend to precision.**
- **Look for and make use of structure.**
- **Look for and express regularity in repeated reasoning.**

[MP1, MP2, MP3, MP4, MP5, MP6](#) (see the full description of each standard here)

**Common Core State Standards Addressed in this unit:
CCSS (Priority and Supporting Standards)**

PRIORITY STANDARDS

CCSS.MATH.CONTENT.HSA.CED.A.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.*

CCSS.MATH.CONTENT.HSA.APR.B.2

Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a , the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.

CCSS.MATH.CONTENT.HSA.APR.B.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.

CCSS.MATH.CONTENT.HSA.REI.D.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, polynomial, rational, absolute value, exponential, and logarithmic functions.*

CCSS.MATH.CONTENT.HSF.IF.C.7.C

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

CCSS.MATH.CONTENT.HSN.CN.C.9

(+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Key Concepts	Skills (Students are skilled at)
<p>Nouns or noun phrases (Need to know)</p>	<p>Verbs (Able to do at the desired) Align with I know and I can statements</p>
<ul style="list-style-type: none"> • X-intercepts • Related function • Zeros • System • Intersection 	<ul style="list-style-type: none"> • Solve a polynomial equation by graphing • Explain why the x-value is the solution to $f(x) = g(x)$ • Solve a system of equations graphically • Solve a system of equations that model real world situations and interpret the solution in the context of the problem. • Infer that if $y = f(x)$ and $y = g(x)$, then (x, y) is a solution to $f(x) = g(x)$ • Identify the variables and quantities represented in a real-world problem.

	<ul style="list-style-type: none"> • Determine the appropriate model for the real-world problem (linear equation, linear inequality, quadratic equation, Quadratic inequality, rational equation, exponential equation). • Write the equation that best models the problem.
<ul style="list-style-type: none"> • Prime polynomial • Quadratic form • Factored form • Factoring methods • Zero product principle 	<ul style="list-style-type: none"> • Solve polynomial equations by factoring • Identify the variables and quantities represented in a real-world problem. • Write the equation that best models the problem. • Solve an equation and interpret the solution in the context of the problem. • Write and solve equations in quadratic form.
<ul style="list-style-type: none"> • Division Algorithm • Remainder Theorem • Synthetic substitution • Direct substitution • Depressed polynomial • Factor Theorem 	<ul style="list-style-type: none"> • Find the remainder from polynomial division. • Evaluate a function using synthetic and direct substitution. • Apply the remainder theorem. • Prove $x-a$ is a factor of $p(x)$ using the Factor Theorem by getting a remainder of zero.
<ul style="list-style-type: none"> • Fundamental Theorem of algebra • Multiplicity • Descartes' rule of signs • Synthetic substitution • Zeros • Quadratic formula • Depressed polynomial • End behavior • Multiply polynomials 	<ul style="list-style-type: none"> • Factor a polynomial to identify the zeros of a polynomial • Determine number and types of roots. • Find the number of positive and negative zeros. • Identify zeros of a function using synthetic substitution. • Find the solution of a quadratic equation using the quadratic formula. • Sketch a rough graph by finding the zeros. • Create a polynomial equation from solutions that are given. • Predict the shape of a function given all the zeros, degree, leading coefficient of polynomial • Use $x \rightarrow \pm \infty$ to describe end behavior
<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science</p>	<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science Algebra 2 Unpacked Standards-CCSS</p>

Evidence of Teaching and Learning

How will we know when students are learning?

- Applying the Fundamental Theorem of Algebra: Students provide evidence of learning by proving that a polynomial of degree n has exactly n roots within the complex number system,.
- Solving and Sketching: Mastery is shown when students can solve polynomial equations both graphically and algebraically and use those results to sketch rough graphs using zeros and multiplicity.
- Utilizing Theorems: Students demonstrate progress by applying the Remainder and Factor Theorems to identify factors and using Descartes' Rule of Signs to determine the possible number and types of roots,.
- Evaluating Functions: Evidence includes the ability to perform synthetic substitution to evaluate functions and create depressed polynomials through division.
- Equation Creation: Learning is verified when students can create polynomial equations from a given set of solutions or zeros.
- Comparative Analysis: Students provide evidence of learning by evaluating and comparing the results of synthetic versus direct substitution.
- Evidence-Based Writing: We will know students are learning when they produce written explanations, supported by mathematical evidence, to justify why specific values are zeros of a function.
- Use of Specialized Vocabulary: Students accurately apply academic terms—such as multiplicity, polynomial identity, and synthetic substitution—during mathematical discussions and reflections.

What strategies/interventions/modifications/ will be applied for non-mastery?

- Math Workstations: During the "Exploration and Development" phase, students who have not yet mastered solving polynomial equations work in math workstations. This allows for targeted direct instruction and the opportunity to test mathematical hypotheses in a smaller, more focused setting.
- "Math Talk" Routines: During the "Launch" phase, students engage in patterns and predictions. These routines allow teachers to identify misconceptions early—such as confusion between zeros, x-intercepts, and factors—before moving into complex algebraic solving.
- Evidence-Based Writing: To support conceptual understanding, students are required to produce evidence-based writing to explain why specific values are zeros of a function. This helps move students beyond procedural errors to a deeper understanding of the Factor Theorem

How will we enrich students who are proficient?

- **Advanced Application of the Fundamental Theorem of Algebra:** Proficient students can move beyond merely identifying the number of roots to exploring the relationship between complex and irrational root pairs, proving why certain roots must exist in conjugates based on the theorem.
- **Exhaustive Root Analysis:** Using Descartes' Rule of Signs, these students can be tasked with performing exhaustive analyses of high-degree polynomials to determine all possible combinations of positive real, negative real, and imaginary roots.
- **Complex Equation Synthesis:** Rather than solving given equations, proficient students can create original polynomial equations from complex sets of solutions, including those with specific multiplicities and complex or radical roots.
- **Deep Analysis of Multiplicity:** These students can investigate how different degrees of multiplicity (e.g., even vs. odd powers of a factor) impact the behavior of a graph at the x-axis—analyzing whether the graph crosses, touches, or flattens at a zero.
- **High-Level Comparative Analysis:** In alignment with the unit's Language Objective, proficient students can lead comparisons between synthetic and direct substitution. They can be challenged to provide formal mathematical justifications or proofs for why these methods are equivalent and in which specific scenarios one is more efficient than the other.
- **Instructional Leadership in Math Workstations:** During the Exploration and Development phase, these students can act as "peer consultants," reviewing the evidence-based writing of others to ensure that arguments for why a value is a zero are mathematically sound and utilize correct academic vocabulary like *depressed polynomial* or *multiplicity*.
- **Sophisticated Argumentative Reflection:** Proficient students can produce more complex written argumentative reflections, critiquing the limitations of graphical solving versus algebraic solving for finding exact values of irrational or imaginary roots

Unit Assessments, Performance Indicators, and Scoring Rubrics /Proficiency Scales
The unit performance indicators are taught and formatively assessed through all units

	Unit 6
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Code	Learning Events (Engaging students)
<u>Launch:</u>	<p>Provide an opportunity for students to focus on the big concept. Explore patterns, what do they observe and wonder, make predictions and hypotheses. Math talks routines/</p> <p>(collaborative grouping and sharing out)</p> <p>Formative assessment check- (warm-up check, observations, student discourse and engagement, anecdotal notes)</p>
<u>Exploration and Development:</u>	<p>Apply guided questions and activities for students to dive deep into exploration of their hypothesis. Collaborative or whole class grouping/direct instruction/math workstations are applied. Testing, providing evidence-based writing, and sharing out can be incorporated here as well.</p> <p>Formative assessment check (observations, student discourse and engagement, anecdotal notes, conferencing).</p>
<u>Practice and Reflection:</u>	<p>Group or independent practice opportunities. Can include student reflection on initial question/hypothesis and lesson reflection.</p> <p>Formative assessment check (Exit ticket, observations, student discourse and engagement, anecdotal notes, written argumentative reflection)</p> <p>Tech. resources to consider: Reveal Math, JamBoard, Padlet, EdPuzzle.com, SmartBoard, PowerPoints, Pear Deck, Nearpod, Google Suite, Gizmos, (Quizizz.com), (Kahoot.com), (Vocabulary.com), (Flocabulary.com).</p>

<u>FRAME Learning Intention (at the end):</u>	
I can identify and interpret the important characteristics of a quadratic function, and model and solve real-world situations that involves these functions.	
Success Criteria: I know I am successful because...	Significant Tasks/Learning Progressions
<ul style="list-style-type: none"> Apply the Fundamental Theorem of Algebra: I can prove that every polynomial of degree n has exactly n roots within the set of complex numbers,. 	<ul style="list-style-type: none"> Initial Solving Methods (Days 1–5): The progression begins with two days of solving polynomial equations by graphing, followed by three days of solving algebraically.

<ul style="list-style-type: none"> • Connect Key Concepts: I can explain the mathematical connection between the zeros of a function, its x-intercepts, and its factors. • Analyze Multiplicity: I understand how the multiplicity of a root affects the behavior of a polynomial's graph. • Utilize Predictive Rules: I can use Descartes' Rule of Signs to determine the possible number and types of roots for a given polynomial equation,. • Solve Equations Multiple Ways: I can solve polynomial equations both graphically and algebraically. • Evaluate Functions: I can use synthetic substitution to evaluate functions and create depressed polynomials through division,. • Apply Theorems: I am able to use the Remainder and Factor Theorems to identify factors of a polynomial. • Create Equations: I can create original polynomial equations when given a specific set of solutions or zeros. • Sketch Graphs: I can use my knowledge of zeros to sketch rough graphs of polynomial functions. <p>Refer to the following links below: FRAME Template Example FRAME model Infographic</p>	<ul style="list-style-type: none"> • Mid-Unit Evaluation (Days 6–7): Students participate in a two-day Review and Quiz period to assess their initial mastery of solving techniques. • Theorems and Division (Days 8–10): The sequence advances to a three-day study of the Remainder and Factor Theorems, where students learn the relationship between polynomial division and identifying zeros. • Root Analysis (Days 11–14): Over four days, students focus on Roots and Zeros, exploring concepts such as multiplicity and Descartes' Rule of Signs to determine the possible number and types of roots. • Summative Assessment (Days 15–17): The unit concludes with a three-day Review and Test cycle.
<p>Refer to the following links below: FRAME Template Example FRAME model Infographic</p>	<p>CSDE -Algebra 2 Curriculum</p>

Teacher notes:

- identify specific content or skills which often are misunderstood, confusing, or incorrect assumptions students might have with the content of the course/unit
- explicitly targeted to significant tasks/assessments
- include process standards to reinforce/foster in the instructional practice of the course/unit
- suggested resources/activities to support the course/unit

Differentiation/Intervention Strategies		
<u>Non-mastery</u> (Provide items for struggling learners)	<u>Enrichment</u> (Provide items for high performing students)	<u>ELL</u> (Provide items to support ELL students)
<ul style="list-style-type: none">• Reteach addressing multiple intelligence• Scaffolding• Graphic organizers• Small group or independent direct study• Varied guided questions• Tiered assignments• Daily math review	<ul style="list-style-type: none">• Tiered assignments• Extend or deepen concept learning• Increased rigor• More argumentative writing	<ul style="list-style-type: none">• Scaffolding (simplify task with structured guidance)• Connect to primary language and culture• Create reference charts (picture or word web)• Increase processing time• Daily vocabulary review• Varied guided questions• Increase repetition

Quarter 4: Radical and Exponential Functions (45 Days)

Unit 7: Radical Functions (22 Days)

CTECS Mathematics Curriculum

Algebra II Unit 7 (Radical Functions)

Name of the Unit: Radical Functions

Length of the Unit: 22 Days

Purpose of the Unit:

1. Students will perform operations (Compositions) of functions
2. Students graph and verify inverse functions.
3. Students graph and analyze square and cube root functions.
4. Students simplify expressions involving radicals and rational exponents.
5. Students simplify and perform operations with radical expressions.
6. Students solve radical equations algebraically and by graphing.

Interdisciplinary Knowledge Transfer (from prior to future courses):

Learners will become effective collaborators, technology users, critical thinkers, and problem solvers. They will develop these skills through the application of argumentative discourse and reasoning to model and solve expressions in contextual situations.

Previous: Students solved polynomial equations and identified the zeros of polynomial functions.

Next: Students will graph and solve exponential functions.

Big Ideas:(can be broad [interdisciplinary], topical [content focused] or both)

(Big ideas helps students make connections among disciplines or units of study within a content area)
(What is the value or benefit of learning the concepts in this goal)

- Like radicals have the same radicand and same index.
- Radicals can be rewritten as rational exponents and rational exponents can be rewritten as radicals.
- The rules for rational exponents are the same as rules for exponents.
- In solving radical equations it is possible that nonequivalent equations may be generated making the check essential.

Essential Questions: (engaging, open-ended questions to spark student interest and sharply focus instruction and assessment)

- How are a function and its inverse related?
- What are some of the characteristics of the graph of square and cube root functions?
- How can you use inverse operations to solve radical equations?
- How can the inverse of a function be used to help interpret a real-world event or solve a problem.

Key vocabulary/terms:

Composition of functions, horizontal line test, inverse relations, inverse functions, n th root, index, radicand, principal root, exponential form, extraneous solutions, radical form, rational

exponent, radical function, square root function, square root inequality, cube root function, like radical expressions, conjugates, radical equation, restricted domain

CELP (Emphasize standards in bold)	Standards for Mathematical Practice (Emphasize practices in bold)
<p>1, 2, 3, 4, 5, 6, 7, 8, 9, 10</p> <p>CELP 1- 10 (see the full description of each standard here)</p>	<ul style="list-style-type: none"> • Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning. <p style="text-align: center;"> MP1, MP2, MP3, MP4, MP5, MP6 (see the full description of each standard here) </p>

Common Core State Standards Addressed in this unit:
CCSS (Priority and Supporting Standards)

STANDARDS

CCSS.MATH.CONTENT.HSA.SSE.A.2

Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*

CCSS.MATH.CONTENT.HSA.REI.A.2

Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

CCSS.MATH.CONTENT.HSF.IF.B.5

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

CCSS.MATH.CONTENT.HSF.IF.C.7

Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

CCSS.MATH.CONTENT.HSF.IF.C.7.B

Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

CCSS.MATH.CONTENT.HSF.BF.A.1.E

Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*

CCSS.MATH.CONTENT.HSF.BF.B.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.

CCSS.MATH.CONTENT.HSF.BF.B.4

Find inverse functions.

CCSS.MATH.CONTENT.HSF.BF.B.4.A

Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. *For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.*

Key Concepts	Skills (Students are skilled at)
<p>Nouns or noun phrases (Need to know)</p>	<p>Verbs (Able to do at the desired) Align with I know and I can statements</p>
<ul style="list-style-type: none"> • Operations on functions • Composition of functions • Composition notation • Domain and range of functions 	<ul style="list-style-type: none"> • Combine standard function types using addition and subtraction. • Combine standard function types using multiplication and division. • Write a function that describes a relationship between two quantities. • Identify the quantities. • Compose functions
<ul style="list-style-type: none"> • Inverse functions • Inverse relations • Restricted domain • Composition of functions • Horizontal line test 	<ul style="list-style-type: none"> • Find inverse relations and functions. • Interpret inverse functions • State the appropriate domain and defend my choice • Explain why other choices may be excluded • Write an expression for the inverse function • Graph an inverse function given a function • Determine if the inverse of a function is also a function • Prove two functions are inverses by composition of functions
<ul style="list-style-type: none"> • Square root function 	<ul style="list-style-type: none"> • Graph square and cube root functions

<ul style="list-style-type: none"> • Cube root function • Parent function • Transformations of functions • Key features of radical functions • Domain and range • Index 	<ul style="list-style-type: none"> • Use $x \rightarrow \pm \infty$ to describe the end behavior of square root and cube root functions. • Identify domain and range of radical functions. • Find intercepts of a radical function. • Find other key features of radical functions. • Identify the effect on the graph of replacing $f(x)$ by $f(x)+k$, $k \cdot f(x)$, $f(kx)$, and $f(x+k)$ • Compare key features of radical functions. • Write a radical function given a graph
<ul style="list-style-type: none"> • Index • Radicand • Rational Exponent • n^{th} roots • Radical form • Exponential form 	<ul style="list-style-type: none"> • Find roots of radical expressions • Convert between radical and exponential form • Look for and identify clues in the structure of expressions in order to rewrite it another way. • Explain why equivalent expressions are equivalent. • Evaluate and simplify expressions with rational exponents. • Recognize when expressions with rational exponents are in simplest form.
<ul style="list-style-type: none"> • Simplest form of radicals • Rationalize denominator • Properties of radicals • Like radicals • Conjugates 	<ul style="list-style-type: none"> • Simplify radicals • Rationalize the denominator • Add and subtract radical expressions • Multiply radical expressions
<ul style="list-style-type: none"> • Radical equations • X-intercepts • Index • Extraneous solutions 	<ul style="list-style-type: none"> • Determine which numbers cannot be solutions of a radical equation and explain why they cannot be solutions • Identify an extraneous solution • Solve a radical equation in one variable algebraically • Solve a radical equation by graphing using technology • Give an example on when an extraneous solution may arise. • Generate examples of radical equations with extraneous solutions
<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science</p>	<p>Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science Algebra 2 Unpacked Standards-CCSS</p>

Evidence of Teaching and Learning
<i>How will we know when students are learning?</i>

- **Managing Inverses and Compositions:** Students can compose functions and successfully verify inverse relations, identifying when a restricted domain is necessary.
- **Fluency Between Forms:** Mastery is shown when students can fluidly convert between radical and exponential forms, demonstrating that radicals follow the same rules as rational exponents.
- **Algebraic Solving:** Students demonstrate progress by solving radical equations algebraically and, crucially, identifying and justifying extraneous solutions.
- **Simplifying Expressions:** Evidence includes the ability to rationalize denominators using conjugates and performing operations with n th roots.
- **Oral Defense:** We will know students are learning when they can orally defend their choice of restricted domains during collaborative discussions.
- **Specialized Vocabulary:** Students accurately apply academic terms—such as radicand, index, principal root, and horizontal line test—to justify their mathematical reasoning.
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What strategies/interventions/modifications/ will be applied for non-mastery?

- **Launch Phase Interventions:** During the initial phase, students engage in "Math Talk" routines to explore patterns and make predictions. This allows teachers to identify and address conceptual misconceptions early, such as confusion between a function and its inverse.
- **Math Workstations:** In the "Exploration and Development" phase, students work in workstations to test hypotheses. This setting provides an opportunity for more targeted instruction and allows students to use evidence-based writing to clarify their understanding of complex radical operations.
- **Graphic Organizers and Scaffolding:** As part of the general curriculum model, students use graphic organizers and structured scaffolding to help them construct viable arguments and process new information.
- **Oral Defense of Domains:** A key intervention in this unit requires students to orally defend their choice of restricted domains. This verbal justification helps students internalize when and why certain inputs must be limited to ensure a relation remains a function.
- **Extraneous Solution Analysis:** Students are tasked with generating written examples of extraneous solutions. This targeted practice ensures they understand why certain algebraic results may not be viable in the original context of a radical equation.
- **Repetition of Academic Vocabulary:** To support language development and conceptual clarity, students practice specialized terms—such as radicand, index, and conjugates—through increased repetition and written exercises

What strategies/interventions/modifications/ will be applied for non-mastery?

- **Launch Phase Interventions:** Teachers use "Math Talks" routines and pattern exploration to identify misconceptions early in the 22-day unit, particularly regarding the relationship between functions and their inverses.
- **Math Workstations:** During the Exploration and Development phase, students who struggle with procedural skills—such as rationalizing denominators or converting between radical and exponential forms—work in workstations. This setting allows for testing hypotheses and receiving more targeted support while producing evidence-based writing.
- **Reflective Practices:** Students complete written argumentative reflections on their initial hypotheses, which encourages self-correction and helps them process why certain algebraic operations are necessary for solving radical equations.
- **Oral Defense of Domains:** A key strategy for addressing conceptual non-mastery is requiring students to orally defend their choice of restricted domains. This verbal justification helps students internalize the constraints required for a relation's inverse to be a function.
- **Targeted Practice with Extraneous Solutions:** Because checking for extraneous solutions is a "Big Idea" of the unit, students are tasked with generating original written examples of these solutions to demonstrate they understand why they occur.
- **Vocabulary Support:** To reinforce complex concepts, students practice specialized terms like radicand, index, and principal root through increased repetition during collaborative tasks.

How will we enrich students who are proficient?

- **Formal Verification of Inverses:** Proficient students can move beyond basic verification to prove that two functions are inverses using the formal composition of functions ($f(g(x))=x$ and $g(f(x))=x$) for more complex radical and power functions.
- **Deep Analysis of Restricted Domains:** These students can be tasked with providing formal mathematical justifications for why a specific restricted domain is required for a function's inverse to exist, utilizing concepts like the horizontal line test to ensure the original function is one-to-one.
- **The Theory of Extraneous Solutions:** Rather than just identifying them, proficient students can investigate the algebraic "why" behind extraneous solutions, analyzing how the process of raising both sides of an equation to a power can introduce non-viable roots.
- **Higher-Order Rationalization:** Challenge these students to rationalize denominators for expressions involving n th roots higher than a square root, or expressions with multiple radical terms in the denominator requiring advanced use of conjugates.

- Fluency Between Radical and Exponential Forms: Students can explore complex expressions that require multiple steps of converting between radical and exponential forms to simplify, demonstrating mastery of the idea that radicals follow the same rules as integer exponents.
- Peer Mentorship in Math Workstations: During the "Exploration and Development" phase, proficient students can act as "peer consultants" in math workstations, reviewing the evidence-based writing of their classmates to ensure their arguments for radical solutions are mathematically sound.
- Advanced Oral Defense: Following the unit's Language Objective, these students can be challenged to orally defend their solutions to complex radical inequalities, using a full range of academic vocabulary such as *radicand*, *index*, and *principal root* to justify their steps.
- Sophisticated Argumentative Reflection: In the "Practice and Reflection" phase, proficient students can produce more in-depth written argumentative reflections that critique different solving strategies (e.g., algebraic vs. graphical) for efficiency and accuracy when dealing with radical equations.

Unit Assessments, Performance Indicators, and Scoring Rubrics /Proficiency Scales

The unit performance indicators are taught and formatively assessed through all units

	Unit 7
Assessment Links:	<p>Module 6: Summative Assessments (See: Reveal Math, Algebra 2, Mod/Unit 6)</p> <p>Module Test Equations On Level Assessments (Form A) Differentiated Assessments (Form B=AL “Approaching Level”) Differentiated Assessments (Form C=BL “Beyond Level”)</p> <p>Answers: Module Test *Teachers Only On Level Assessments (Form A) Differentiated Assessments (Form B=AL “Approaching Level”) Differentiated Assessments (Form C=BL “Beyond Level”)</p> <p>See: Proficiency Scale Alignment</p>
Rubric Links:	

Performance Task (PT) Links:	Module 6: Performance Task (See: Reveal Math , Algebra 2, Mod/Unit 6)
PT Rubric Links:	Module 6: Performance Task Rubric (Relations and Functions) *Teachers Only (See: Reveal Math , Algebra 2, Mod/Unit 6)
	See: Proficiency Scale Alignment

Learning Plan

Students' success at acquisition, meaning, and transfer depends on...

Leveraging instructional lesson plan elements that engage students in interesting and rigorous learning activities that centers on collaboration and argumentative discourse. The latter aligns with an instructional plan that includes the phases of (1) Launching, Exploring and Developing, and Practice and Reflection. Formative evaluations are embedded throughout all three of these phases.

Tech. resources to consider:

Reveal Math, IXL, Smart Board, Power Points, Google Suite, Gizmos, Khan Academy, Desmos, TI-84 Calculator

Code	Learning Events (Engaging students)
<u>Launch:</u>	Provide an opportunity for students to focus on the big concept. Explore patterns, what do they observe and wonder, make predictions and hypotheses. Math talks routines/ (collaborative grouping and sharing out) Formative assessment check- (warm-up check, observations, student discourse and engagement, anecdotal notes)
<u>Exploration and Development:</u>	Apply guided questions and activities for students to dive deep into exploration of their hypothesis. Collaborative or whole class grouping/direct instruction/math workstations are applied. Testing, providing evidence-based writing, and sharing out can be incorporated here as well. Formative assessment check (observations, student discourse and engagement, anecdotal notes, conferencing).

<u>Practice and Reflection:</u>	<p>Group or independent practice opportunities. Can include student reflection on initial question/hypothesis and lesson reflection.</p> <p>Formative assessment check (Exit ticket, observations, student discourse and engagement, anecdotal notes, written argumentative reflection)</p> <p>Tech. resources to consider: Reveal Math, Padlet, EdPuzzle.com, Smart Board, PowerPoints, Pear Deck, Nearpod, Google Suite.</p>
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<u>FRAME Learning Intention (at the end):</u>	
I can identify and interpret the important characteristics of a quadratic function, and model and solve real-world situations that involves these functions.	
Success Criteria: I know I am successful because...	Significant Tasks/Learning Progressions
<ul style="list-style-type: none"> • Explain Inverse Relationships: I can describe how a function and its inverse are related and explain how inverse operations are used to solve radical equations. • Identify Domain Constraints: I understand the concept of a restricted domain and can identify when it is necessary for a relation's inverse to be a function. • Relate Radicals and Exponents: I can demonstrate that radicals follow the same mathematical rules as rational and integer exponents. • Understand Extraneous Solutions: I recognize that solving radical equations requires checking for extraneous Manipulate Functions: I can successfully compose functions and verify inverse relations through composition. • Convert Forms: I can fluidly convert expressions between radical and exponential forms. 	<ul style="list-style-type: none"> • Foundations of Inverses (Days 1–4): The progression begins with two days on operations and compositions of functions, followed by two days on inverse relations. Students learn to identify when a restricted domain is necessary for an inverse to be a function. • Graphical Analysis (Days 5–7): Students spend three days graphing radical functions, such as square root and cube root functions, and utilizing the horizontal line test to determine if an inverse exists. • Mid-Unit Assessment (Days 8–9): A two-day Review and Quiz period allows for the consolidation of these foundational concepts. • Advanced Radical Operations (Days 10–16): The instructional sequence moves into rational exponents (2 days) and radical operations (5 days). Students

- Rationalize Denominators: I can rationalize denominators in radical expressions, specifically utilizing conjugates when necessary.
- Solve Algebraically: I am able to solve radical equations algebraically while accurately identifying any non-viable solutions.
- Graph and Analyze: I can graph square root and cube root functions and apply the horizontal line test to determine if an inverse exists.
- solutions and can explain why they occur

Refer to the following links below:

[FRAME Template Example](#)
[FRAME model Infographic](#)

learn to fluidly convert between radical and exponential forms and perform complex arithmetic with n th roots.

- Algebraic Solving (Days 17–19): Students spend three days solving radical equations algebraically, with a specific focus on identifying and justifying extraneous solutions.
- Summative Evaluation (Days 20–22): The unit concludes with a three-day Review and Unit Test cycle.
- Proving Inverses: A core task is using the composition of functions to formally prove that two functions are inverses of each other.
- Rationalizing Denominators: Students must be able to rationalize denominators in radical expressions, specifically utilizing conjugates.
- Analyzing Extraneous Solutions: A critical task involves generating written examples of extraneous solutions to explain why certain algebraic results are not viable in the context of the original equation.
- Oral Defense of Domains: In alignment with the unit's Language Objective, students are required to orally defend their choice of restricted domains during collaborative discussions.
- Instructional Framework Routines: Following the Ainsworth Learning Plan, students participate in "Math Talk" routines to make predictions during the Launch phase and produce written argumentative reflections on their initial hypotheses during the Practice and Reflection phase.

	<ul style="list-style-type: none"> Fluency in Notation: Students are tasked with using formal notation to relate radicands and indices while converting expressions into exponential form.
<p>Refer to the following links below: FRAME Template Example FRAME model Infographic</p>	<p>CSDE -Algebra 2 Curriculum</p>

Teacher notes:
<ul style="list-style-type: none"> identify specific content or skills which often are misunderstood, confusing, or incorrect assumptions students might have with the content of the course/unit explicitly targeted to significant tasks/assessments include process standards to reinforce/foster in the instructional practice of the course/unit suggested resources/activities to support the course/unit

Differentiation/Intervention Strategies		
<u>Non-mastery</u> (Provide items for struggling learners)	<u>Enrichment</u> (Provide items for high performing students)	<u>ELL</u> (Provide items to support ELL students)
<ul style="list-style-type: none"> Reteach addressing multiple intelligence Scaffolding Graphic organizers Small group or independent direct study Varied guided questions Tiered assignments Daily math review 	<ul style="list-style-type: none"> Tiered assignments Extend or deepen concept learning Increased rigor More argumentative writing 	<ul style="list-style-type: none"> Scaffolding (simplify task with structured guidance) Connect to primary language and culture Create reference charts (picture or word web) Increase processing time Daily vocabulary review Varied guided questions Increase repetition

Unit 8: Exponential Functions (19 Days)

CTECS Mathematics Curriculum

Algebra II Unit 8 (Exponential Functions)

Name of the Unit: Exponential Functions Reveal Module 7	Length of the Unit: 19 Days
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Purpose of the Unit:

1. Students graph exponential growth and decay functions.
2. Students solve exponential equations and inequalities algebraically and by graphing.
3. Students analyze expressions and functions involving the natural base e .
4. Students generate geometric series.
5. Students choose the best function type to model sets of data by using technology.

Interdisciplinary Knowledge Transfer (from prior to future courses):

Learners will become effective collaborators, technology users, critical thinkers, and problem solvers. They will develop these skills through the application of argumentative discourse and reasoning to model and solve expressions in contextual situations.

Previous: Students solved radical equations.

Big Ideas: (can be broad [interdisciplinary], topical [content focused] or both)

(Big ideas helps students make connections among disciplines or units of study within a content area)

(What is the value or benefit of learning the concepts in this goal)

- Exponential Functions are useful in real world situations. Exponential functions are used to model populations, carbon date artifacts, help coroners determine time of death, compute investments, as well as many other applications.
- The exponential growth family will always overtake the polynomial family no matter how large the degree or how large the leading coefficient.
- When comparing an exponential model with a linear model, the question is not *if* the exponential model will generate very large or very small inputs, but rather *when*.

Essential Questions: (engaging, open-ended questions to spark student interest and sharply focus instruction and assessment)

- What characterizes exponential growth and decay?
- What are real world models of exponential and logarithmic growth and decay?

- What are the limitations of exponential growth models?
- How can one differentiate an exponential model from a linear model given a real world data set?
- How does polynomial growth compare to exponential growth?

Key vocabulary/terms:

exponential function, exponential growth, asymptote, percent rate of change, growth factor, exponential decay, decay factor, exponential equation, compound interest, exponential inequality, e , sequence, term of a sequence, finite sequence, infinite sequence, geometric sequence, common ratio, geometric means, series, geometric series, sigma notation

<p>CELP (Emphasize standards in bold)</p>	<p>Standards for Mathematical Practice (Emphasize practices in bold)</p>
<p>1, 2, 3, 4, 5, 6, 7, 8, 9, 10</p> <p>CELP 1- 10 (see the full description of each standard here)</p>	<ul style="list-style-type: none"> • Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning. <p>MP1, MP2, MP3, MP4, MP5, MP6 (see the full description of each standard here)</p>

Common Core State Standards Addressed in this unit:
CCSS (Priority and Supporting Standards)

STANDARDS

CCSS.MATH.CONTENT.HSF.IF.B.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.**

CCSS.MATH.CONTENT.HSF.IF.B.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.*

CCSS.MATH.CONTENT.HSF.IF.C.7.E

Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

CCSS.MATH.CONTENT.HSA.CED.A.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.*

CCSS.MATH.CONTENT.HSA.CED.A.2

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CCSS.MATH.CONTENT.HSA.REI.D.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, polynomial, rational, absolute value, exponential, and logarithmic functions.*

CCSS.MATH.CONTENT.HSA.SSE.B.4

Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.**

Key Concepts	Skills (Students are skilled at)
<p>Nouns or noun phrases (Need to know)</p>	<p>Verbs (Able to do at the desired) Align with I know and I can statements</p>
<ul style="list-style-type: none"> • Graphs of Exponential Functions • Asymptotes • Key features of graphs of exponential functions • End Behavior of Exponential Functions • Domain and Range of Exponential Functions • Exponential Growth and Decay • Transformations of functions 	<ul style="list-style-type: none"> • Graph an exponential function • Understand the key features of exponential functions. • Apply transformations to exponential functions • Determine domain and range of an exponential function • Classify exponential functions as growth or decay • Use $x \rightarrow \pm \infty$ to describe end behavior

<ul style="list-style-type: none"> • Exponential equation • Exponential inequality • Graphic solutions to exponential equations • Compound interest formula 	<ul style="list-style-type: none"> • Identify the variables and quantities represented in a real-world problem. • Determine the appropriate model for the real-world problem (linear equation, linear inequality, quadratic equation, Quadratic inequality, rational equation, exponential equation). • Write the equation or inequality that best models the problem. • Solve an equation or inequality and interpret the solution in the context. • Solve exponential equations and inequalities by finding common bases • Solve exponential equations graphically • Use the compound interest formula solving for various criteria • Explain why the x-value is the solution to $f(x) = g(x)$ • If a solution exists, solve a system of equations (linear, polynomial, rational, absolute value, exponential, and logarithmic) by a table of values or graphically • Infer that if $y = f(x)$ and $y = g(x)$, then (x, y) is a solution to $f(x) = g(x)$
<ul style="list-style-type: none"> • Base e • Continuous compounding • Transformations of functions 	<ul style="list-style-type: none"> • Identify the variables and quantities represented in a real-world problem. • Determine the appropriate model for the real-world problem (linear equation, linear inequality, quadratic equation, Quadratic inequality, rational equation, exponential equation). • Write the equation or inequality that best models the problem. • Solve an equation or inequality and interpret the solution in the context. • Graph functions with base e by hand and using technology • Apply functions with base e
<ul style="list-style-type: none"> • Common ratio • Finite sequence • Infinite sequence • Geometric sequence • Explicit formula 	<ul style="list-style-type: none"> • Define a finite geometric series and common ratio. • Recognize real-world scenarios that are modeled by geometric series. • Use the formula for geometric sequences to find nth terms • Write an explicit formula for a geometric sequence
<ul style="list-style-type: none"> • Verbal expressions • Symbolic expressions. • Linear functions • Quadratic functions, • Exponential functions • Rational Functions • Exponential patterns 	<ul style="list-style-type: none"> • identify the variables and quantities represented in a real-world problem. • Determine the best model for the real-world problem (linear, quadratic). • Write the equation that best fits the model's problem. • Create coordinate axes using an appropriate scale and label the axes. • Graph equations on coordinate axes with appropriate labels and scales.

Refer to the links below:

[Depth of Knowledge LA](#)
[Depth of Knowledge Math/Science](#)

Refer to the links below:

[Depth of Knowledge LA](#)
[Depth of Knowledge Math/Science](#)
[Algebra 2 Unpacked Standards-CCSS](#)

Evidence of Teaching and Learning

How will we know when students are learning?

- Graphing and Classifying: Students can accurately graph growth and decay functions and classify them based on their behavior.
- Solving Equations: Evidence of learning includes the ability to solve exponential equations by finding common bases.
- Financial Modeling: Students demonstrate progress by using the compound interest formula and modeling data using the natural base e (continuous compounding).
- Advanced Sequences: Mastery is shown when students can derive the sum of a finite geometric series and use sigma notation
- Model Differentiation: We will know students are learning when they collaborate to differentiate between various mathematical models (e.g., linear vs. exponential).
- Argumentative Reflection: A key indicator of success is the student's ability to use argumentative reflection to explain, both orally and in writing, why exponential growth will eventually overtake polynomial growth regardless of the degree.
- Use of Specialized Vocabulary: Students accurately apply academic terms—such as asymptote, common ratio, and percent rate of change—during "Math Talk" routines

What strategies/interventions/modifications/ will be applied for non-mastery?

- "Math Talk" Routines: During the Launch phase, students engage in these routines to explore patterns and make predictions. This allows teachers to identify early misconceptions regarding the difference between exponential growth and decay before moving into complex solving.
- Math Workstations: In the Exploration and Development phase, students who struggle with skills—such as solving equations by finding common bases—work in math workstations. This setting provides opportunities for direct instruction and allows students to test hypotheses through evidence-based writing.
- Argumentative Reflections: Students use written argumentative reflections to evaluate their initial hypotheses. In Unit 8, this specifically includes explaining why exponential growth will eventually overtake polynomial growth regardless of the degree

- Collaborative Differentiation: A key intervention strategy for this unit is having students collaborate to differentiate between various mathematical models, such as linear versus exponential growth.
- Scaffolded Vocabulary: Students receive support for specialized academic terms—such as asymptote, common ratio, and sigma notation—to help them construct viable arguments during collaborative sharing.
- Model Analysis: Students are tasked with using argumentative reflection to explain the limitations of exponential models in real-world contexts, helping them move from procedural steps to conceptual mastery.

How will we enrich students who are proficient?

- Theoretical Proofs: Students can be tasked with providing rigorous mathematical justifications for the "Big Idea" that exponential growth will eventually overtake polynomial growth, regardless of the polynomial's degree.
- Deriving Formulas: Rather than simply applying formulas, proficient students can focus on the skill of deriving the sum of a finite geometric series and exploring the mathematical transition from finite to infinite sequences.
- Complex Modeling: These students can apply the compound interest formula and the natural base e to more intricate, multi-variable real-world scenarios, such as advanced investment strategies or the specific mathematics behind carbon dating.
- Leading "Math Talks": During the Launch phase, proficient students can lead "Math Talk" routines, facilitating the exploration of complex patterns and guiding the class in making predictions about exponential behavior.
- Facilitating Differentiation: In alignment with the Language Objective, these students can act as group leaders to help their peers collaborate to differentiate between various mathematical models, such as linear versus exponential functions.
- Peer Review in Workstations: During the Exploration and Development phase, proficient students can use their evidence-based writing skills to critique the mathematical hypotheses of their peers in math workstations, ensuring logical consistency in arguments.
- Mastery of Sigma Notation: Proficient students can be challenged to represent and solve highly complex series and sums using sigma notation and explicit formulas beyond the standard requirements.
- In-Depth Argumentative Reflection: During the Practice and Reflection phase, these students can produce sophisticated written argumentative reflections that analyze the specific limitations of exponential models in various context-specific real-world situations.

Tech. resources to consider:

Reveal Math, , Smart Board, PowerPoints, Google Suite, Gizmos, Khan Academy, Desmos, TI-84 Calculator, IXL

Code	Learning Events (Engaging students)
<u>Launch:</u>	<p>Provide an opportunity for students to focus on the big concept. Explore patterns, what do they observe and wonder, make predictions and hypotheses. Math talks routines/</p> <p>(Collaborative grouping and sharing out)</p> <p>Formative assessment check- (warm-up check, observations, student discourse and engagement, anecdotal notes)</p>
<u>Exploration and Development:</u>	<p>Apply guided questions and activities for students to dive deep into exploration of their hypothesis. Collaborative or whole class grouping/direct instruction/math workstations are applied. Testing, providing evidence-based writing, and sharing out can be incorporated here as well.</p> <p>Formative assessment check (observations, student discourse and engagement, anecdotal notes, conferencing).</p>
<u>Practice and Reflection:</u>	<p>Group or independent practice opportunities. Can include student reflection on initial question/hypothesis and lesson reflection.</p> <p>Formative assessment check (Exit ticket, observations, student discourse and engagement, anecdotal notes, written argumentative reflection)</p> <p>Tech. resources to consider: Reveal Math, Padlet, EdPuzzle.com, Smart Board, PowerPoints, , Google Suite, Gizmos, IXL. Khan Academy</p>

FRAME Learning Intention (at the end):

I can identify and interpret the important characteristics of a quadratic function, and model and solve real-world situations that involves these functions.

Success Criteria: I know I am successful because...	Significant Tasks/Learning Progressions
<ul style="list-style-type: none">Explain Growth Trends: I understand the "Big Idea" that exponential growth will eventually overtake polynomial	<ul style="list-style-type: none">Foundational Review and Graphing (Days 1-5): The progression begins with a two-day Exponents Review, followed

growth, regardless of the degree of the polynomial.

- **Analyze Function Features:** I can identify and describe the characteristics that distinguish **exponential growth from exponential decay**.
- **Evaluate Model Limitations:** I can identify and discuss the **limitations of exponential models** when applied to real-world scenarios.
- **Recognize Real-World Applications:** I understand how these functions are used to model critical phenomena such as **population growth, investments, and carbon dating**.
- **Graph and Classify:** I can accurately **graph growth and decay functions** and identify their **asymptotes**.
- **Solve Equations:** I am able to **solve exponential equations and inequalities** by finding and utilizing common bases.
- **Apply Financial Formulas:** I can use the **compound interest formula** and model data using the **natural base e** for continuous compounding.
- **Master Sequences and Series:** I can work with **geometric sequences and series**, which includes the ability to **derive the sum of a finite geometric series**.
- **Utilize Advanced Notation:** I can correctly use **sigma notation** and **explicit formulas** to represent mathematical patterns
- **Collaborate and Differentiate:** I can **collaborate with peers to differentiate** between various mathematical models during instructional tasks.
- **Provide Argumentative Justification:** I use **argumentative reflection** to explain complex concepts, such as why exponential functions eventually exceed the growth of the polynomial family.
- **Master Academic Vocabulary:** I accurately use specialized terms—including **percent rate of change, common ratio, and geometric means**—in my oral and written work
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by three days of **Graphing** growth and decay functions.

- **Solving and Special Functions (Days 6–9):** Students spend two days **solving exponential equations and inequalities** by finding common bases, followed by two days exploring **special functions** using the **natural base e** .
- **Mid-Unit Assessment (Days 10–11):** A **two-day Review and Quiz** period allows students to consolidate their understanding of exponential behavior and solving techniques.
- **Sequences and Series (Days 12–14):** The instructional sequence shifts to **Geometric Sequences and Series** for three days, where students work with common ratios and summation.
- **Data Modeling and Summative Evaluation (Days 15–19):** The unit concludes with two days of **Modeling Data**, followed by a **three-day Review and Unit Test** cycle.
- **Course Conclusion:** As this is the final unit, an additional **four-day Final Review and Exam** period follows the unit test.
- **Graphing and Classifying:** A significant task involves accurately
- **Graphing growth and decay functions** and identifying their **asymptotes**.
- **Deriving Series Formulas:** Students are tasked with **deriving the sum of a finite geometric series** and utilizing **sigma notation**.
- **Financial Modeling:** Students must apply the **compound interest formula** and model continuous compounding using the **natural base e** .
- **Model Differentiation:** In alignment with the unit's **Language Objective**, students **collaborate to differentiate** between various mathematical models (e.g., linear vs. exponential).
- **Evidence-Based Argumentation:** Using **argumentative reflection**, students must explain—orally and in writing—why **exponential growth will eventually overtake polynomial growth** regardless of the degree.

	<ul style="list-style-type: none"> • Instructional Routines: Following the three-phase framework, students engage in "Math Talk" routines to make predictions during the Launch phase and produce written argumentative
<p>Refer to the following links below: FRAME Template Example FRAME model Infographic</p>	<p>CSDE -Algebra 2 Curriculum</p>

<p><u>Teacher notes:</u></p>
<ul style="list-style-type: none"> • identify specific content or skills which often are misunderstood, confusing, or incorrect assumptions students might have with the content of the course/unit • explicitly targeted to significant tasks/assessments • include process standards to reinforce/foster in the instructional practice of the course/unit • suggested resources/activities to support the course/unit

Differentiation/Intervention Strategies		
<u>Non-mastery</u> (Provide items for struggling learners)	<u>Enrichment</u> (Provide items for high performing students)	<u>ELL</u> (Provide items to support ELL students)
<ul style="list-style-type: none"> • Reteach addressing multiple intelligence • Scaffolding • Graphic organizers • Small group or independent direct study • Varied guided questions • Tiered assignments 	<ul style="list-style-type: none"> • Tiered assignments • Extend or deepen concept learning • Increased rigor • More argumentative writing 	<ul style="list-style-type: none"> • Scaffolding (simplify task with structured guidance) • Connect to primary language and culture • Create reference charts (picture or word web) • Increase processing time • Daily vocabulary review

<ul style="list-style-type: none">• Daily math review		<ul style="list-style-type: none">• Varied guided questions• Increase repetition
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