

TOPIC 2

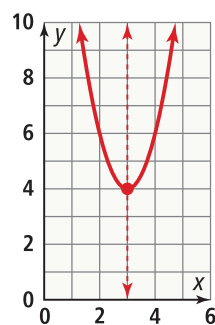
Quadratic Functions and Equations

MATH BACKGROUND KEY CONCEPTS

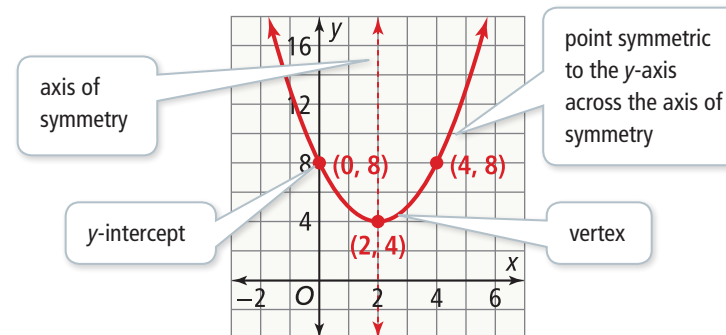
Topic 2 focuses on extending previous understanding of quadratic functions. Students identify different forms of quadratic functions and their key features, including the focus and directrix. Students explore complex numbers and solve problems with complex numbers. Students learn different methods for solving quadratic equations and inequalities.

Forms of Quadratic Functions

Vertex Form of a Quadratic Function In Lesson 2-1, students learn to write quadratic functions in vertex form, graph them, and use the graph to identify key features of the function.



Standard Form of a Quadratic Function Students learn to write quadratic functions in standard form, graph them, and use the graph to identify key features of the function in Lesson 2-2.

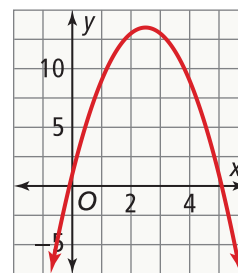


Factored Form of Quadratic Function Students, in Lesson 2-3, write quadratic functions in factored form and relate factors to the zeros of the function.

Solving Quadratic Equations and Inequalities

Factoring In Lesson 2-4, students rewrite quadratic equations in factored form and use the Zero Product Property to find solutions of the equation.

Completing the Square Students learn to solve quadratic equations by completing the square in Lesson 2-5. Students complete the square to write a quadratic equation in vertex form and graph it to determine the maximum or minimum value of the function.



Quadratic Formula In Lesson 2-6, students learn to derive the Quadratic Formula and use it to solve quadratic equations. Students learn that they can use the Quadratic Formula to solve any quadratic equation, including equations with complex solutions.

Modeling with Quadratic Functions Students explain how to create quadratic models and use them to make predictions about real-world data. In Lesson 2-7, students choose a model for a set of data, fit a quadratic function to data, and use quadratic models to make predictions.

Quadratic Inequalities Students write two-variable quadratic inequalities in Lesson 2-8. They represent them with graphs and in words, and then graph the solution set of a two-variable quadratic inequality that represents a real-world problem.

Parabolas Students, in Lesson 2-9, derive the equation of a parabola. Exploring the properties of parabolas, students relate a parabola's focal length to its equation and rewrite an expression by completing the square and then use it to find the focus and directrix of a parabola.

TOPIC 2

Quadratic Functions and Equations

MATH BACKGROUND COHERENCE

Students learn best when concepts are connected through the curriculum. This coherence is achieved within topics, across topics, across domains, and across grade levels.

MAKING MATHEMATICAL CONNECTIONS Looking Back

How does Topic 2 connect to what students learned earlier?

ALGEBRA 1

- **Solutions of Quadratic Equations** Students learned to find the real solutions of quadratic equations. (A.7A) In Topic 2, students discover that quadratic equations can also have complex solutions and discover that the Quadratic Formula always works, regardless of whether the quadratic function has real or imaginary roots.

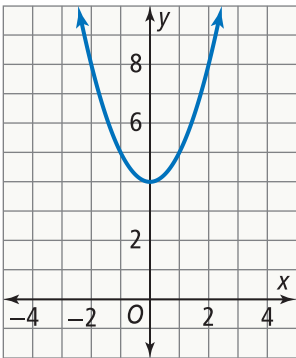
TOPIC 1

- **Key Features of Functions** Students learned the key features of linear functions. (2A.7I) In Topic 2, students build on this knowledge as they explore the key features of quadratic functions.
- **Absolute Value Functions** Students learned to solve absolute value equations and inequalities. (2A.6D) In Topic 2, students extend this knowledge to solve linear-quadratic systems of equations and inequalities.

IN THIS TOPIC

How is content connected within Topic 2?

- **Forms of Quadratic Functions** In Lessons 2-1, 2-2, and 2-3, students write quadratic functions in vertex, standard, and factored forms. Students use these different forms to identify key features and find the zeros of quadratic functions. (2A.4B)
- **Solving Quadratic Equations** In Lessons 2-4, 2-5, and 2-6, students solve quadratic equations using factoring, completing the square, and the Quadratic Formula. (2A.4F) Students learn about complex numbers and solve quadratic equations with complex solutions. They go on to model with quadratic functions in Lesson 2-7. (2A.8A, 2A.8B)



MAKING MATHEMATICAL CONNECTIONS Looking Ahead

How does Topic 2 connect to what students will learn later?

TOPIC 6

- **Rational Exponents and Radical Functions** Students represent and solve square root and cube root functions. (2A.2A) They graph radical functions and solve radical equations. (2A.4F)

PRECALCULUS

- **Minimum and Maximum Values** Students find the maximum and minimum values of a quadratic function by completing the square. In Calculus, students will find minimum and maximum values of functions using differentiation. (P.2I)

TOPIC 2

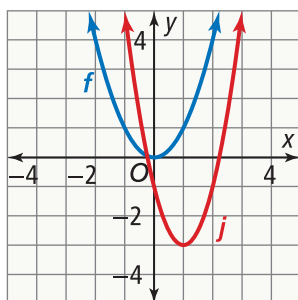
Quadratic Functions and Equations

MATH BACKGROUND BALANCE

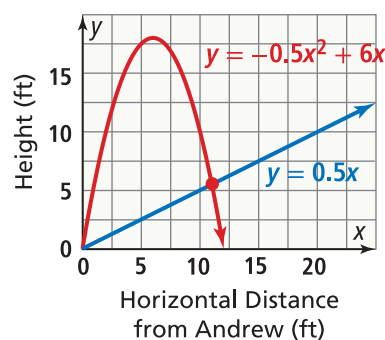
A rigorous curriculum emphasizes conceptual understanding, procedural skill and fluency, and applications.

Conceptual Understanding

- **Vertex Form of a Quadratic Function** Students understand that all quadratic functions are transformations of the parent function $f(x) = x^2$. Students use a quadratic function written in vertex form to identify the key features of its graph.



- **Complex Solutions to Quadratic Equations** Students recognize complex solutions when solving a quadratic equation using the Quadratic Formula. Students know to write the solutions of the equation in the form $a + bi$.
- **Solutions of Linear-Quadratic Systems** Students understand that the x -values of the points of intersection of the graphs of linear and quadratic functions represent solutions of the system of equations.



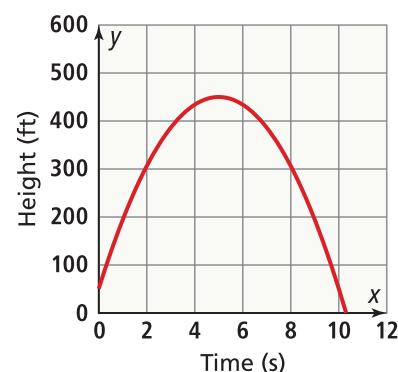
- **Focus and Directrix of Parabolas** Students develop an understanding of the relationship between the geometric concept of a parabola as the set of points equidistant from a point, the focus, and a line, the directrix and the algebraic concept of a quadratic function by using the distance formula to derive the equation for a parabola given its focus and directrix.

Procedural Skill

- **Factoring Quadratic Expressions** Students use the Distributive Property and the Zero Product Property to factor quadratic expressions and to solve quadratic equations by factoring.
- **Operations with Complex Numbers** Students use combining like terms to add and subtract complex numbers. Students use the Distributive Property to multiply complex numbers.
- **Completing the Square** Students determine the value needed to complete the square and the steps that must be taken to maintain equality for completing the square and solving a quadratic equation.
- **Quadratic Inequalities** Students graph the solutions of quadratic inequalities using their knowledge of the key features of quadratic functions and by reasoning about the values of the coordinates in different regions of the resulting graph.

Applications

- **Modeling with Quadratic Functions** Students encounter many different application problems that require writing and solving quadratic functions. Students model area problems and the paths of objects. Students model and solve projectile motion problems.



TOPIC 2

Quadratic Functions and Equations

MATHEMATICAL PROCESS STANDARDS

Math Processes Within Topic 2 Lessons

The mathematical process standards describe the behaviors and habits of mind that mathematically proficient students demonstrate when actively engaged in mathematics work. Opportunities to develop expertise with the important behaviors and thinking habits of all the math processes exist throughout the topic and the program.

In this topic, you may choose to focus on developing and assessing proficiency with process standards 2A.1B and 2A.1F. As students graph and solve quadratic functions and equations, look for the following behaviors to assess and identify students who demonstrate proficiency with these math processes.

Highlighted Math Processes Within Topic 2 Lessons	
The student is expected to use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. (2A.1B)	The student is expected to analyze mathematical relationships to connect and communicate mathematical ideas. (2A.1F)
Mathematically proficient students:	Mathematically proficient students:
See relationships between quadratic functions in vertex, standard, and factored forms.	Look for relationships between a quadratic function and its graph.
Identify factoring, completing the square, and the Quadratic Formula as starting points and apply the Zero Product Property as a solution pathway for solving a quadratic equation.	Use the structure of a quadratic function written in vertex form to rewrite it in its equivalent standard form, $y = ax^2 + bx + c$.
Relate the concept of solving linear-quadratic systems to their understanding of solving systems of linear equations.	Find relationships involving a, h, and k by converting from vertex form to standard form and then use those relationships to identify the key features of the function's graph, including the vertex, axis of symmetry, maximum or minimum, domain, and range
Plan a solution pathway for problems that can be solved using quadratic functions.	Recognize the pattern that the sign of the y-value of a test point will be the same as the y-value of any other point within an interval between zeros that they are testing.
Understand the various methods of solving quadratic equations and determine which one to use.	Apply the structure used to solve systems of linear equations to solve linear-quadratic systems by substitution and elimination.

Help students become more proficient with using a problem-solving model and analyzing mathematical relationships.

If students do not understand how to identify and use appropriate strategies for understanding and solving problems involving quadratic functions and equations, then use these questioning strategies to help them develop their proficiency with the problem-solving process and connecting ideas as they solve problems throughout the topic.

- Q: What do you notice about functions written in vertex form?
- Q: How do you determine which method you will use to solve a quadratic equation?

- Q: What do you notice about the graph of a linear-quadratic system and the number of solutions of the system?

TOPIC 2

Linguistic Accommodations

Quadratic Functions and Equations

Language Accommodations and Oral/Written Discourse

There are many opportunities to interact with the topic’s vocabulary words: by using the Vocabulary Builder activity, the Language Routines, as you Talk About Math Ideas, and review of vocabulary learned in the topic in the Topic Review, the Math Literacy and Vocabulary activity, the student prompts in the margins, the math games, and more.

Activities in this topic offer diverse and engaging experiences with math vocabulary to build confidence and support for all, but particularly for Emergent Bilingual (EB) students in developing both their academic and language skills.

Topic Vocabulary Support

Topic Vocabulary			
Parabola	Complex Conjugates	Discriminant	Directrix
Quadratic Function	Complex Number	Quadratic Formula	Focal Length
Vertex Form of a Quadratic Function	Imaginary Number	Coefficient of Determination	Focus of a Parabola
Standard Form of a Quadratic Function	Imaginary Unit i	Quadratic Regression	General Form of a Second-Degree Equation
Zero Product Property	Completing the Square	Conic Section	
Prior Terms			
Average Rate of Change	Minimum	Inequality Notation	Set-Builder Notation
Interval Notation	Zero of the Function	Maximum	
Upcoming Terms			
Inconsistent System	Solution of a System of Linear Equations	System of Linear Equations	System of Linear Inequalities
Reduced Row Echelon Form			
Vocabulary in Context			
Word	Math Meaning	Other Meaning(s)	
Function	A rule that assigns exactly one output to each input in a set	A social event or official ceremony	
Value	The result of a calculation or the worth of a number in an equation	Belief about what is right and wrong and what is important in life	
Factor	A number that divides another number exactly or is multiplied to get a product	A substance in the blood that helps the clotting process	
Context Setting Vocabulary			
Students will encounter the following terms in this topic, be sure they understand their meaning to make sense of the problem situation.			
Lesson 1 vertex, parent function, alfajores`		Lesson 6 quadratic equation, in-state, radicand	
Lesson 2 coefficients, discus throw, souvenir		Lesson 7 variables, linear regression, fundraiser	
Lesson 3 zero of a function, multilevel driving range, snorkeler		Lesson 8 parabola, pole vault, boundary, strict	
Lesson 4 denominator, voltage, in parallel		Lesson 9 solar cooker, bracket, focus, parabolic mirror	
Lesson 5 perfect square trinomial, principal root, absolute value, trap plot			

Metalinguistic Transfer to Spanish

Transferrable Skills
In both English and Spanish languages commas are used to separate introductory phrases from the main clause. In a pole vault, a successful vault requires the crossbar to remain in place. <i>En el salto con pértiga, un salto exitoso requiere que la barra transversal permanezca en su lugar.</i>
Non-Transferrable Skills
In Spanish, most nouns have a grammatical gender (masculine or feminine) and require articles (<i>el, la, un, una</i>) that match this gender. In contrast, English nouns are often gender-neutral, and gender is determined later through pronouns. A farmer is planting a trap plot around her main crop to prevent pests. <i>Una agricultora está plantando una parcela trampa alrededor de su cultivo principal para prevenir plagas.</i>

Cognates

Cognates in this Topic		
Symmetry : Simetría	Maximum : Máximo	Catapults : Catapulta
Domain : Dominio	Determine : Determinar	
False Cognates		
Pan A flat container made of metal, used for cooking.		
Pan Bread. A type of food made from flour, water and usually yeast mixed together and baked.		

Academic Vocabulary

Recommended Terms
Although the academic vocabulary can be used anytime during the year, you may emphasize the terms below in written and oral opportunities:
Factor To break down a mathematical expression into simpler parts (factors) that, when multiplied together, give the original expression.
Derive To obtain or develop a mathematical equation or expression from a set of principles or formulas.

English Language Proficiency Standards (ELPS)				
Lesson	(1) Listening	(2) Speaking	(3) Reading	(4) Writing
Lesson 1				4E
Lesson 2		2F	3D	
Lesson 3			3F	
Lesson 4				4E
Lesson 5			3E	
Lesson 6		2E		
Lesson 7		2A		
Lesson 8		2E		
Lesson 9			3G	4D

TOPIC 2

Quadratic Functions and Equations

TOPIC OVERVIEW

Lesson	2-1 Vertex Form of a Quadratic Function	2-2 Standard Form of a Quadratic Function	2-3 Factored Form of a Quadratic Function	2-4 Complex Numbers and Operations
	3 DAYS	2 DAYS	2 DAYS	2 DAYS
Essential Understanding	All quadratic functions are transformations of the parent function $f(x) = x^2$. The vertex form of a quadratic function highlights the key features of the function's graph and shows how the graph of the parent function can be transformed.	A quadratic function in vertex form can be rewritten in standard form to highlight different features of the function's graph. The key features are used to interpret values in context.	The factored form of a quadratic function is used to find the zeros of the function by identifying the values that make one or both of the factors equal to zero.	A complex number contains both real and imaginary parts. The four basic operations can be applied to complex numbers.
Mathematics Objectives	• Create quadratic functions in vertex form to represent relationships between variables as shown in their graphs. • Graph functions on coordinate axes using their key features. • Interpret key features of the graph of a quadratic function.	• Create quadratic functions written in standard form. • Identify key features of quadratic functions and graph a quadratic function written in standard form.	• Write a quadratic equation in factored form and use it to identify the zeros of the function it defines. • Determine the intervals over which a quadratic function is positive or negative.	• Add, subtract, and multiply complex numbers using the properties of operations and the relation $i^2 = -1$. • Use complex numbers to represent numbers that are not on the real number line.
Language Objective	• Listen to instruction and discussion with peers with a goal of identifying connections between the vertex form of a quadratic function and the graph of the function.	• Describe key features of a graph of a polynomial function and explain how they are related to the equation of the function.	• Identify principles and procedures for identifying the zeros of a quadratic function.	• Explain how to add, subtract, and multiply complex numbers.
Vocabulary	New Vocabulary parabola, quadratic function, vertex form of a quadratic function	New Vocabulary standard form of a quadratic function	New Vocabulary Zero Product Property	New Vocabulary complex conjugates, complex number, imaginary number, imaginary unit i
TEKS & ELPS	TEKS 2A.4B, 2A.4D, 2A.7I Mathematical Process Standards 2A.1A, 2A.1B, 2A.1D, 2A.1E, 2A.1F, 2A.1G ELPS Writing 4E	TEKS 2A.4A, 2A.4B, 2A.4E Mathematical Process Standards 2A.1A, 2A.1D, 2A.1E, 2A.1F, 2A.1G ELPS Speaking 2F, Reading 3D	TEKS 2A.4B Mathematical Process Standards 2A.1A, 2A.1B, 2A.1C, 2A.1D, 2A.1E, 2A.1F, 2A.1G ELPS Reading 3F	TEKS 2A.7A Mathematical Process Standards 2A.1A, 2A.1D, 2A.1E, 2A.1F, 2A.1G ELPS Writing 4E

The suggested pacing for each lesson is shown for a 45-minute class. In addition, allow 1 day for the Topic Review and 1 day for the Topic Assessment.
For planning information such as timing of the lesson components and student materials required, find an editable LESSON PLAN for each lesson on SavvasRealize.com

Topic Assessment Options

• Topic Readiness Assessment

• Topic Assessment

• Topic Performance Task

• Benchmark Assessment Topics 1–2

in Assessment Sourcebook and Online

TOPIC OVERVIEW

Lesson	Math Modeling in 3 Acts	2-5 Completing the Square	2-6 The Quadratic Formula	2-7 Modeling with Quadratic Functions
	1 DAY	2 DAYS	2 DAYS	3 DAYS
Essential Understanding	Many real-world problem situations can be represented with a mathematical model, but that model might not represent the real-world situation exactly.	A quadratic equation can be solved by completing the square to transform the equation to an equivalent equation, $(x - p)^2 = q$.	The Quadratic Formula can be used to solve any quadratic equation, including those with complex solutions.	Regression equations are useful quadratic models for making predictions about real-world situations.
Mathematics Objectives	• Use mathematical modeling to represent a problem situation and to propose a solution. • Test and verify the appropriateness of their mathematical models. • Explain why the results from their mathematical models might not align exactly with the problem situation.	• Transform a quadratic equation into the form $(x - p)^2 = q$ by completing the square. • Complete the square to reveal the minimum or maximum value of a quadratic expression.	• Use the Quadratic Formula to solve quadratic equations that have complex solutions.	• Analyze data to select an appropriate quadratic model. • Use regression methods to write a quadratic function. • Make predictions using a quadratic model.
Language Objective	• Use precise mathematical language with peers to discuss strategies and identify problem-solving methods.	• Describe how to transform a quadratic equation by completing the square, then identify the minimum or maximum value of the corresponding expression.	• Explain how to use the Quadratic Formula to solve quadratic equations that have complex solutions.	• Communicate fluently using mathematical vocabulary.
Vocabulary	Reinforce Vocabulary model, quadratic function	New Vocabulary completing the square	New Vocabulary discriminant, Quadratic Formula	New Vocabulary quadratic regression
TEKS & ELPS	TEKS 2A.4A, 2A.8C Mathematical Process Standards 2A.1A, 2A.1B, 2A.1E, 2A.1G	TEKS 2A.4F Mathematical Process Standards 2A.1A, 2A.1B, 2A.1C, 2A.1D, 2A.1E, 2A.1F, 2A.1G ELPS Reading 3E, Reading 3D	TEKS 2A.4F Mathematical Process Standards 2A.1B, 2A.1C, 2A.1E, 2A.1F, 2A.1G ELPS Speaking 2E	TEKS 2A.8B, 2A.8A, 2A.8C Mathematical Process Standards 2A.1A, 2A.1D, 2A.1F, 2A.1G ELPS Speaking 2A

TOPIC OVERVIEW

Lesson	2-8 Quadratic Inequalities 2 DAYS	2-9 Focus and Directrix of Parabolas 3 DAYS
Essential Understanding	To solve a quadratic inequality by graphing, graph the equality and test points on either side of the line of equality.	A parabola is the set of all points on a plane that are equidistant from the focus and the directrix. This definition is used to derive the equation of a parabola and apply the geometric properties of a parabola.
Mathematics Objectives	- Write two-variable quadratic inequalities and represent them with graphs and in words. - Graph the solution set of a two-variable quadratic inequality that represents a real-world problem.	- Derive the equation of a parabola. - Relate a parabola’s focal length to its equation. - Rewrite an expression by completing the square and then use it to find the focus and directrix of a parabola.
Language Objective	Clearly describe how to determine whether a solution set to a quadratic inequality lies above or below the curve, and whether the curve is part of the solution.	Explain how to complete the square to rewrite the expression and then use it to find the focus and directrix.
Vocabulary	New Vocabulary parabola	New Vocabulary conic section, directrix, focal length, focus of a parabola, general form of a second-degree equation
TEKS & ELPS	TEKS 2A.4H Mathematical Process Standards 2A.1A, 2A.1B, 2A.1C, 2A.1D, 2A.1E, 2A.1F, 2A.1G ELPS Speaking 2E	TEKS 2A.4B Mathematical Process Standards 2A.1A, 2A.1B, 2A.1C, 2A.1D, 2A.1E, 2A.1F, 2A.1G ELPS Reading 3G, Writing 4D

Notes

TOPIC 2

Quadratic Functions and Equations

TOPIC RESOURCES

DIGITAL	Print and Digital Resources	LESSON	TOPIC	PROGRAM
	Student and Teacher's Edition			
	• Math Walk and Video		•	
	• Pick a Project		•	
	• Math Modeling in 3 Acts		•	
	• Practice & Problem Solving	•		
	• Concept Summary	•		
	• Topic Review		•	
	• Visual Glossary (English and Spanish)			•
	Resource Originals			
	• Reteach to Build Understanding	•		
	• Additional Practice	•		
	• Mathematical Literacy and Vocabulary	•		
	• Enrichment	•		
	• Pick a Project		•	
	• Amazing Contributions	•	•	•
	• Math Walk		•	
	• Game Cards and Instructions for Hands-On Games	•	•	
	Assessment Sourcebook			
	• Course Readiness Assessment			•
	• Progress Monitoring Assessments A, B, C			•
	• Topic Readiness Assessment		•	
	• Exit Ticket	•		
	• Quick Check	•		
	• Topic Assessment		•	
	• Topic Performance Tasks		•	
	• Cumulative/Benchmark Assessments			•
	• Item Analysis Charts and Scoring Guides	•	•	•

DIGITAL	Digital-only Resources	LESSON	TOPIC	PROGRAM
	Savvas Realize			
	Interactive Student Edition	•	•	•
	Student Edition eBook	•	•	•
	Teacher's Edition eBook	•	•	•
	Program Overview			•
	Student Companion	•		
	Lesson Plans	•		
	Math Talks	•		
	Vocabulary Builder Activities	•		
	Interactives powered by Desmos® Calculators and Tools	•		
	Lesson Presentation Slides	•		
	Interactive Practice	•		
	Spiral Review	•		
	Skills Review & Practice	•	•	•
	Digital Math Games		•	
	Student Tutorial Videos	•		
	Interactive Answers & Solutions	•	•	
	Adaptive Practice	•		
	Test Generator	•	•	•
	Family Engagement	•	•	•
	Classroom Videos			•
	Topic Overview Teacher Support Video		•	
	Multilingual Handbook			•
	Problem Solving Model			•
	Scope and Sequence	•	•	•
	Pacing Guide		•	•
	Internalization Protocols			•
	Student and Teacher Progress Trackers	•	•	•
	Editable Assessments and Resource Originals	•	•	•

TOPIC 2

Quadratic Functions and Equations

TOPIC OPENER

TOPIC ESSENTIAL QUESTION

What general strategies can you use to solve simple equations?

Revisit the Topic Essential Question throughout the topic. See the Teacher’s Edition Topic Review for notes about answering the Topic Essential Question.

Math Walk

 **Math Walk Video** Generate excitement about the topic by having students watch the Math Walk video.

Question in the Video

How do outdoor acoustics work?

Questions for Students

You might give students copies of these Math Walk questions or project them and have students turn and talk to a partner followed by a whole-class discussion.

What did you notice?

What did you wonder?

What question in the video is the person trying to answer?

What did you see in the video that would help you answer the question?

What other information do you need to answer the question?

What math do you already know that can help you answer the question?

What math questions do you have about what you saw in the video?

Later in the Topic

Any time after Lesson 2-6, show the video again.

Ask: What math did you learn that could help you answer the question or find the answer in a different way?

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TOPIC ESSENTIAL QUESTION

How do you use quadratic functions to
model situations and solve problems?



MATH WALK

Sound Quality

Watch the video to see where you might find quadratic functions and
equations while on a math walk. How does the shape of a concert hall
enhance a musical performance?


Math Walk

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SavvasRealize.com

Activity

TOPIC 2

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Pick a Project

Overview

A variety of rich projects is provided for each topic. Students may select the project that is most interesting to them.

Project	Different Engaging Contexts	Different Activity Modalities	Different Final Products
2A	Real World	Create	Math Walk
2B	Ball Parks	Design	Drawing
2C	Pizza	Analyze	Model
2D	Square Root of -1	Write	Biography

Selecting a Project

Introduce each project option with the students. Sharing the resource masters with students might help them choose.

During the Project

Pacing Projects will be completed over a number of lessons. The amount of time students spend on each project will vary. You may wish to let early finishers choose an additional project.

Grouping You might have students work independently, with a partner, or in small groups.

Content Projects are related to the content of this topic. As students continue their work on projects throughout the topic, new math ideas should be incorporated.

Project Sharing Invite students to share their completed projects with a partner, a small group, or with the whole class. Encourage students to discuss how they demonstrated math processes during the project. Provide students an opportunity for reflection by asking what interesting information they learned and what math they used in the project.

Extension Suggestions are included for each project.

Scoring Guide

Provide a scoring rubric to students as they begin work on the project. A full and editable version can be found online. For students who score Emerging on any goal, review the rubric score with them in detail. Encourage them to update their project, or select a different project, to demonstrate their understanding of the mathematics in this topic.

Sample Scoring Rubric

Emerging (1 point)	Developing (2 points)	Proficient (3 points)	Advanced (4 points)
		Mathematical Concepts Demonstrates understanding of a key mathematical concept from the topic with minimal or no errors.	
		Context Connects mathematical concepts to the project context in a logical and natural way.	
		Presentation Presentation is clear and coherent.	

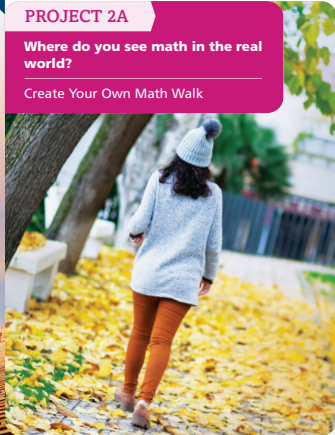
AVAILABLE ONLINE

PICK A PROJECT

PROJECT 2A

Where do you see math in the real world?

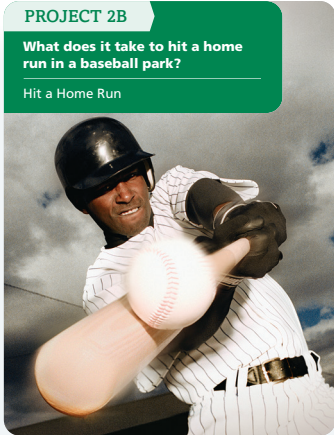
Create Your Own Math Walk



PROJECT 2B

What does it take to hit a home run in a baseball park?

Hit a Home Run



PROJECT 2C

How would you determine the cost of a pizza?

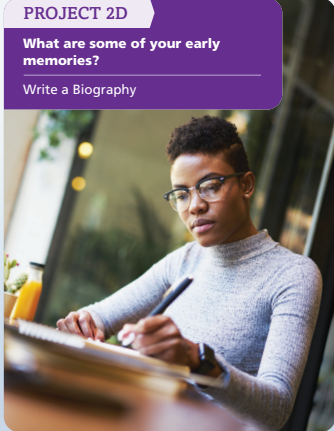
Analyze a Pepperoni Pizza



PROJECT 2D

What are some of your early memories?

Write a Biography



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TOPIC 2

Quadratic Functions and Equations



Pick a Project

Project 2A 2A.1A, 2A.4D

Materials video recording device

Guidelines Students may brainstorm locations and objects for their Math Walk throughout the topic.

Extension Ask students to explore other questions inspired by their Math Walk.

Project 2B 2A.1C, 2A.8C

Materials calculator, graphing software (optional)

Guidelines Students may begin the project at any point during the topic. Encourage them to incorporate new information as they work through the topic.

Extension Have students compare their design to an existing ballpark of their choosing. How are the ballparks alike? How are the different? In which ballpark is a player more likely to hit a home run? Include any supporting mathematics.

Project 2C 2A.1C, 2A.8A

Materials cardboard; 1 inch-diameter discs; graphing software (optional)

Guidelines Students may begin their projects at any point in the topic.

Extension Research at least three local pizzerias to see how closely they adhere to the quadratic model.

Project 2D 2A.1C, 2A.7A

Materials none

Guidelines Students should begin their project after learning about complex numbers.

Extension Choose a scene from the biography and enhance it with dialogue. Perform the scene.

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Topic 2 Pick a Project A
Create Your Own Math Walk

To find math all around you, just take a walk!
Math Walks can focus on many different themes, including nature, art, design, computation, community, or careers.
There are a few criteria for a successful Math Walk.

- It prompts a question that can be solved using math.
- It is a real-world situation or spot.
- You can observe important information during your math walk.

Plan Your Math Walk
What's your question?

What location will you include in your Math Walk?

Answer Your Question
Use math you know to answer your question.

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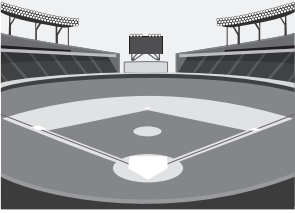
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Topic 2 Pick a Project B
Take Me Out to the Ball Game

Cameras and RADAR precisely track everything that happens in a professional baseball game, including the speed and launch angle of every batted ball. If a baseball player hits a 90-mile per hour pitch with more than 8,000 pounds of force, the ball leaves the bat at 110 miles per hour. You can model the flight of a hit baseball with a parabola. The initial vertical and horizontal speed of the ball can be found using trigonometry and the launch angle of the hit.



Your Project Hit a Home Run
When a baseball is hit, how high and how far the ball travels depend on the ball's exit velocity. The average exit velocity of a ball after being hit by a wooden bat is 98 mi/h. The ball also has a vertical velocity, v_y , and a horizontal velocity, h_y , that depend on the angle of the hit.
Design a ballpark. The infield is a square with side lengths of 90 feet. Decide on the shape of the outfield of your ballpark. Decide how high the walls will be. Complete the *Baseball Trajectories and Velocities* and *Hitting a Home Run* worksheets and use your calculations to describe a home run at your ballpark. Draw a plan of your ballpark, including dimensions. Include your plan and completed worksheets in your final presentation.

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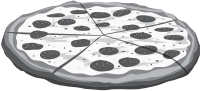
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Topic 2 Pick a Project C
Slice by Slice

Most people have an opinion on what does and does not belong on a pizza. Whether it's a classic pepperoni or a polarizing combination of pineapple and ham, pizza toppings are a personal choice. According to a survey conducted by a national pizza restaurant chain, 42% of ordered pizzas have pepperoni, and 23% of people said they would ban fish as a topping. In 2023, the global pizza market was valued at over 148 billion dollars, and the pizza industry is expected to continually grow. The average American eats pizza three times every month.

Your Project Analyze a Pepperoni Pizza
Knowing the cost of producing a 9-inch diameter pizza, predict the cost of producing pizzas with diameters of 12 and 18 inches. Create cardboard models of the pizzas and fill them with small circles to represent pepperoni slices. Each pizza should have the same relative density of pepperoni per slice.
Graph the number of pepperoni slices that fit on the pizza as a function of the diameter. Write an equation for the graph in the form $C = k \cdot d^2$. Explain why this form is expected. Explain why the same should be true for all ingredients (crust, cheese, mushrooms, etc.).
Suppose it costs \$3 to make the 9-inch pepperoni pizza. What would be the cost for the 12-inch and 18-inch pizzas? What happens when more toppings are added? Some pizza parlors offer a "stuffed crust" pizza. If this adds 50 cents to the cost of the 9-inch pizza, what should it add to the cost of the other sized pizzas?
Make a poster to summarize your analysis. Include your function and graph. What other factors might affect the cost of producing pizzas of different diameters?



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Topic 2 Pick a Project D
Life of i

Imagine your favorite story. It may be an epic adventure among a party of friends or a love story that defies all odds. Whatever the tale, you may believe that they are confined to fiction, but sometimes real lives offer just as much thrill and excitement.
A *biography* is a detailed account of a person's life written by someone else. Biographies bring a person's narratives to life, allowing us to walk in the footsteps of those who have shaped history, made groundbreaking discoveries, or influenced society in profound ways. They offer more than just dates and facts; they provide a tapestry of human emotion, resilience, and inspiration. Through these personal tales, we also gain a deeper understanding of the world in which the subject lived and the legacy they left behind.

Your Project Write a Biography
Research imaginary numbers. Write an introduction to inform and pique the interest of your readers. Make a timeline of significant events in the history of imaginary numbers to help you organize the biography. Answer the questions of who discovered them, what they are, when they were discovered, and why they are important to mathematics and other industries. Explain why you think the information you include is important.



enVision® Algebra 2 • Pick a Project

Quadratic Functions and Equations

TOPIC OPENER

Math Modeling in 3 Acts

Generate excitement about the upcoming Math Modeling in 3 Acts lesson by having students read about the math modeling problem for this topic.

Refer to the Teacher's Edition lesson support for notes about how to use the lesson video in your classroom.

Expand the Learning with Math Games

Encourage students to engage with the math in this topic and further develop their skills in using and applying Quadratic Functions and Equations by taking on the challenge of the Math Games.

There are multiple types of games throughout the program that provide students with more opportunities for playful exploration and skill practice. For guidance on these games, see the Expand the Learning section in Step 4 of the lesson.

Build G.R.I.T.

Confidence will play an important role as students build on what they know as they extend their knowledge of number systems to complex numbers. Understanding the complex system is essential to solving all quadratic equations, and will be revisited when students solve more general polynomial equations.

Grow Confidence

When solving linear-quadratic systems, students are synthesizing quadratic equations and solving systems concepts. Discuss the connections between what students are finding algebraically and the graphs of systems.

Resilience

Students may not land on a model right away. Encourage productive struggle. If one approach is not working, explore with students other approaches.

Self-Efficacy

Complex numbers will likely be unfamiliar to students, and applying the powers of i result in products that do not resemble the products of binomials. Students can be confident in applying their knowledge of polynomial operations to arrive at an initial expression for a complex number operation. Then students can step back to see if there are powers of i they can apply to help simplify the expression.

Time Management

Students have multiple methods to choose from when solving quadratic equations. Have students take a moment to evaluate the equation they are solving, and decide on the method they think will be the most efficient, or most comfortable.

MATH MODELING IN 3 ACTS

A Preview of Swift Kick

Whether you call it soccer, football, or fútbol, it's the most popular sport in the world by far. Even if you don't play soccer, you probably know several people who do.

There are many ways to kick a soccer ball: you can use any part of either foot. If you want the ball to end up in the goal, you also need to try different amounts of spin and power. You'll see one person's effort in the Math Modeling in 3-Acts lesson.

MATH GAMES

Be a Math Gamer

Henry
Sure! We started with the complex plane, plotting complex numbers with real and imaginary parts. That was a new way of seeing numbers.

[Back](#) [Next](#)

Gamify your learning with competitive quiz games, vocabulary games, partner/group hands-on games, and STEAMquests.

You will apply your knowledge and skills in quadratic functions and equations as you play the Topic 2 games.

Family Engagement

Involve family in your learning. Go online with your family to access topic and lesson summaries, objectives, standards, and other supports.

Family

58 TOPIC 2 Quadratic Functions and Equations

Instructional Routines in This Topic

Lesson	Language Routines	Math Talk / Data Talk
1	Compare and Connect	Find a Rule
2	Three Reads	Which One Doesn't Belong
3	Collect and Display	Equation Detective
4	Collect and Display	Equation Detective
5	Compare and Connect	Which One Doesn't Belong
6	Three Reads	Every Picture Tells a Story
7	Information Gap	Slow Reveal Graphs
8	Discussion Supports	Find a Rule
9	Discussion Supports	Equation Detective