

Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 1: The Real Number System

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Key Ideas and Details 1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

- WHST.6-8.6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- 2. Reason abstractly and quantitatively.
- 6. Attend to precision.
- 8. Look for and express regularity in repeated reasoning.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, The Number System

8.NS Know that there are numbers that are not rational, and approximate them by rational numbers.

- 8.NS.1. Understand informally that every number has a decimal expansion; the rational numbers are those with decimal expansions that terminate in 0s or eventually repeat. Know that other numbers are called irrational.
- 8.NS.2. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Expressions & Equations

8.EE Work with radicals and integer exponents.

- 8.EE.1. Know and apply the properties of integer exponents to generate equivalent numerical expressions.
- 8.EE.2. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
- 8.EE.3. Use numbers expressed in the form of a single digit times a whole-number power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.
- 8.EE.4. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

DOC: Mathematics, DOC: Grade 8, Numbers, Number Sense and Operations

A. Number and Number Systems

- 2. Recognize that natural numbers, whole numbers, integers, rational numbers, and irrational numbers are subsets of the real number system.
- 4. Demonstrate an understanding of the properties of the rational number system; e.g., order, and reciprocals.

B. Meaning of Operations

- 1. Apply order of operations to simplify expressions and perform computations involving integer exponents and radicals

C. Computation and Estimation

- 5. Add, subtract, multiply, divide, and compare numbers written in scientific notation.

Essential Questions

- Why is the real number system important in the study of mathematics?
- To what extent can scientific notation be used or found in my life?
- Why should I know how to use numbers and variables?
- How does knowing how to write algebraic expressions and equations enhance my ability to communicate?

Content

The students will know

1. Subsets of the real number system
2. Rational numbers
3. Irrational numbers
4. Square Roots of non-perfect squares
5. Decimal expansion
6. Rational approximations
7. Cube Roots
8. Properties of exponents
9. Operations with scientific notation

Skills

Bloom's Taxonomy

DOK Links

The students will be able to

1. Recognize that every number has a decimal expansion.
2. Identify rational numbers as those with decimal expansions that terminate in 0s or eventually repeat.
3. Differentiate subsets of the real number system.
4. Describe and illustrate the properties of the real number system.
5. Calculate the decimal expansion of rational numbers.
6. Construct decimal expansions into rational numbers.
7. Compare the size of irrational numbers through the use of rational approximations of irrational numbers.
8. Connect physical, verbal, and symbolic representations of irrational numbers.
9. Generate equivalent numerical expressions.
10. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$.
11. Evaluate square roots of small perfect squares and cube roots of small perfect cubes.
12. Know that $\sqrt{2}$ is irrational.
13. Calculate numerical expressions applying the properties of exponents.
14. Utilize numbers written in scientific notation.
15. Interpret scientific notation generated by technology.
16. Add, subtract, multiply, divide, and compare numbers written in scientific notation.
17. Apply order of operations to simplify expressions and perform computations involving integer exponents and radicals.
18. Formulate written explanations using the concepts in the real number system.

Reading/Writing Skills

1. Define, using context clues, specific vocabulary from the Common Core and apply the terms and definitions to solve problems.
2. Justify solutions, either verbally or in written form.

	<ul style="list-style-type: none"> ▪ Explain step-by-step process. ▪ Summarize results using specific and appropriate vocabulary. <p>3. Use technology to produce written explanations and justifications for real-life and mathematical problems.</p>
<p>Common Core Vocabulary</p> <ol style="list-style-type: none"> 1. Rational number 2. Irrational number 3. Decimal expansion 4. Rational approximations 5. Scientific Notation 6. Exponents 	<p>Additional Vocabulary</p> <ol style="list-style-type: none"> 1. Subsets of the real number system 2. Order of Operations
<p>Learning Experiences (Suggested)</p> <ol style="list-style-type: none"> 1. Class activity. Introduce this unit using the video on <i>Real Numbers</i> found in the Links. After viewing the video, have students write a summary of what they learned from the video. Share their summaries with the class. 2. Class activity/Online learning. Engage students in developing an understanding that there are numbers that are not rational, and approximate them by rational numbers. Use the videos for Standards 8.NS.1 & 2 found in the <i>Learn Zillion</i> site or another appropriate site. (See Links) 3. Following the class activity using the video on the standards, have students work with a partner to do the following. <ol style="list-style-type: none"> a. Define irrational numbers and apply the definition to a real-world situation. b. Define rational numbers and apply the definition to a real-world situation. c. Distinguish between rational and irrational numbers and give several examples of each. d. Show several examples of converting repeating decimals into fractions. e. Use a number line to place non-perfect square roots between two integers. <p>In each of the tasks, provide a explanation of the thinking process used.</p> 4. Provide students with 10-20 decimal numbers and have them convert each decimal to a rational number. Ask students to state the steps taken to: <ol style="list-style-type: none"> a. convert a decimal expansion that terminates to a rational number b. convert a decimal expansion that repeats to a rational number <p>And finally have them work with several non-perfect squares and place them between two integers on a number line.</p> 5. Online learning. Have students work with the videos for Standard 8.EE.1 found in the <i>Learn Zillion</i> site to reinforce their understanding of, and ability to apply the properties of integer exponents to generate equivalent numerical expressions. For each of the videos have students provide at least one mathematical expression showing an understanding of the concept developed. Share their work with the class. 6. Class activity/Online learning. Engage students in developing the ability to use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Use the videos for Standard 8.EE.2 found in the <i>Learn Zillion</i> site or another appropriate site. (See Links) After discussing the videos, have 	<p>Assessment (Suggested)</p> <p>Real Numbers ~ What Do I Know? Reflective Writing</p> <p>After viewing and discussing the video on Real Numbers, students will reflect on what they learned and write a summary statement.</p> <p>Real Number System Organizer Summative: Graphic Organizer</p> <p>Students will create a poster illustrating the real number system and all of the subsets of that system of numbers. They will then present their organizer to the class.</p> <p>Rational and Irrational Numbers Formative: Homework</p> <p>Students will work with a partner to do the following.</p> <ol style="list-style-type: none"> a. Define irrational numbers and apply the definition to a real-world situation. b. Define rational numbers and apply the definition to a real-world situation. c. Distinguish between rational and irrational numbers and give several examples of each. d. Show several examples of converting repeating decimals into fractions. e. Use a number line to place non-perfect square roots between two integers. <p>In each of the tasks, they will provide a explanation of the thinking process used.</p> <p>Working With Rational Numbers Formative: Homework</p> <p>Given 10-20 decimal numbers, students will convert each decimal to a rational number. They will state the steps taken to:</p> <ol style="list-style-type: none"> a. convert a decimal expansion that terminates to a rational number b. convert a decimal expansion that repeats to a rational number <p>Non-Perfect Squares Formative: Homework</p> <p>Given 10-15 non-perfect squares, students will place them between two integers on a number line.</p>

students work with a partner to provide at least five examples for each of the following properties:

- a. Product of Powers
 - b. Quotient of Powers
 - c. Power of a Power
 - d. Negative Exponents
 - e. Zero Exponents
7. Online learning. Have students learn how to use exponents and to perform operations with exponents by studying the material presented in the videos for Standards 8.EE.3-4 found at the Learn Zillion site. Follow student work with a class discussion of exponential notation and how it is used in real-world situations.
 8. Have students add, subtract, multiply and divide problems in exponential form that exemplify real-world situations.
 9. Cooperative group work. Have students use the *Alice in Wonderland* learning activity found in the Links to reinforce their understanding of exponential notation. Have each group share their solutions and summarize what they learned about working with exponents.



[Real Number System Game!](#)



[Lessons on Properties of Real Number System!](#)



[Real Numbers!](#)



[Alice in Wonderland Activity!](#)

Working With Exponents

Formative: Online Learning

Students will work with the videos for Standard 8.EE.1 found in the *Learn Zillion* site to reinforce their understanding of, and ability to apply the properties of integer exponents to generate equivalent numerical expressions. For each of the videos they will provide at least one mathematical expression showing an understanding of the concept developed. They will share their work with the class

More on Exponents

Formative: Homework

Students will add, subtract, multiply and divide problems in exponential form that exemplify real-world situations. they will justify the reasoning used to solve the problems.

Alice in Wonderland Activity

Summative: Cooperative Group Work

Working in cooperative groups, students will use the *Alice in Wonderland* learning activity to reinforce their understanding of exponential notation. Each group will share their solutions and summarize what they learned about working with exponents.

Resources (Suggested)

1. iPad Resources
2. Literature Connections
Tuck Everlasting by Natalie Babbitt
Alice in Wonderland by Lewis Carroll
Tuck Everlasting by Natalie Babbitt
3. Internet Resources



[Properties of Numbers!](#)



[Order of Operations!](#)



[Order of Operations!](#)



[Real Number System with descriptions!](#)



[The National Library of Virtual Manipulatives!](#)



[The Khan Academy!](#)

Catholic Identity

Social Justice Teachings

- ✚ Life And Dignity Of The Human Person
- ✚ Call To Family, Community, And Participation
- ✚ Rights And Responsibilities
- ✚ The Dignity Of Work And The Rights Of Workers

Rights of Children

- ✚ THE RIGHT TO A CATHOLIC COMMUNITY that witnesses to Christ and the Gospel by protecting them from child abuse, including sexual abuse and neglect.
- ✚ THE RIGHT TO A SAFE ENVIRONMENT that promotes care, protection and security.
- ✚ THE RIGHT TO BE RESPECTED AS INDIVIDUALS with human dignity.
- ✚ THE RIGHT TO WORK ACTIVELY TOWARD THEIR OWN EMPOWERMENT through the development of their gifts and talents.
- ✚ THE RIGHT TO A LEARNING ENVIRONMENT THAT VALUES COOPERATION, and challenges its members to critical and reflective thinking in their search for truth.
- ✚ THE RIGHT TO DEVELOP POSITIVE, RESPONSIBLE AND CARING ATTITUDES AND BEHAVIORS TOWARD OTHERS and to recognize the rights of others to be safe and free from harassment and abuse.
- ✚ THE RIGHT TO LEARN RESPONSIBILITY for themselves and



[iLearn Ohio](#)



[Ohio Resource Center](#)



[Learn Zillion ~ Common Core Videos](#)



[NCTM Illuminations Site](#)



[IXL ~ Algebra](#)



[Table of Properties of Real Numbers](#)

their actions.

Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 2: Expressions

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Key Ideas and Details 1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

- WHST.6-8.6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- 4. Model with mathematics.
- 6. Attend to precision.
- 7. Look for and make use of structure.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Seeing Structure in Expressions

A-SSE Interpret the structure of expressions.

- A-SSE.1. Interpret expressions that represent a quantity in terms of its context.★
- A-SSE.1a. Interpret parts of an expression, such as terms, factors, and coefficients.
- A-SSE.1b. Interpret complicated expressions by viewing one or more of their parts as a single entity.
- A-SSE.2. Use the structure of an expression to identify ways to rewrite it.

A-SSE Write expressions in equivalent forms to solve problems.

- A-SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Essential Questions

- To what extent are mathematical expressions used throughout the world?
- Why should I know how to use numbers and variables?
- How does knowing how to write algebraic expressions and equations enhance my ability to communicate?
- Why is mathematics considered a universal language?

<p>Content</p> <p>The students will know</p> <ol style="list-style-type: none"> 1. Mathematical expressions in terms of context 2. Parts of an expression <ul style="list-style-type: none"> ▪ terms ▪ factors ▪ coefficients 3. Equivalent expressions 	<p>Skills</p> <p><u>Bloom's Taxonomy</u> <u>DOK Links</u></p> <p>The students will be able to</p> <ol style="list-style-type: none"> 1. Create mathematical expressions from word problems. 2. Translate from a verbal expression to an algebraic expression. 3. Construct models of expressions to represent a quantity in terms of its context. 4. Differentiate and define the parts of an expression. 5. Critique complicated expressions by breaking down into parts. 6. Create an equivalent expression using the given structure. 7. Create an equivalent expression using the given properties. <p>Reading/Writing Skills</p> <ol style="list-style-type: none"> 1. Define, using context clues, specific vocabulary from the Common Core and apply the terms and definitions to solve problems. 2. Justify solutions, either verbally or in written form. <ul style="list-style-type: none"> ▪ Explain step-by-step process. ▪ Summarize results using specific and appropriate vocabulary. 3. Use technology to produce written explanations and justifications for real-life and mathematical problems.
<p>Common Core Vocabulary</p> <ol style="list-style-type: none"> 1. Expression 2. Term 3. Factor 4. Coefficient 5. Equivalent expressions 	<p>Additional Vocabulary</p> <ol style="list-style-type: none"> 1. Like terms 2. Distributive property
<p>Learning Experiences (Suggested)</p> <ol style="list-style-type: none"> 1. Class activity. Discuss the importance of interpreting expressions that represent a quantity in terms of its context. Provide students with several mathematical examples where they will need to: <ol style="list-style-type: none"> a. interpret parts of an expression, such as terms, factors, and coefficients, and b. interpret complicated expressions by viewing one or more of their parts as a single entity. 2. Have students work with a partner to interpret several mathematical quantities in terms of their context. Specifically, have students (a)interpret parts of the expression and (b) interpret complicated expressions by looking at one or more of their parts as a single entity. Have them justify their work. 3. Cooperative group work. Have students use real-world context examples to explore the nature of algebraic expressions. <i>For example, suppose the cost of cell phone service for a month is represented by the expression $0.40s + 12.95$. Students can analyze how the coefficient of 0.40 represents the cost of one minute (40¢), while the constant of 12.95 represents a fixed, monthly fee, and s stands for the number of cell phone minutes used in the month.</i> Provide students with similar real-world 	<p>Assessment (Suggested)</p> <p>Equivalent Expressions Project Summative: Visual Arts Project</p> <p>Students will create a visual representation of equivalent expressions and explain the properties of the expressions as it relates to a real-world situation.</p> <p>Interpreting Mathematical Quantities Formative: Class Work</p> <p>Students will work with a partner to interpret several mathematical quantities in terms of their context. Specifically, students will (a)interpret parts of the expression and (b) interpret complicated expressions by looking at one or more of their parts as a single entity. They will justify their work.</p> <p>Working With Algebraic Expressions Formative: Class Work</p> <p>Students will use real-world context examples to explore the nature of algebraic expressions. They will be provided with real-world examples,</p>

examples, such as tax rates, to explore the meaning of expressions.

4. Class activity. Have students work with a partner to create their own expressions that meet specific criteria (e.g., number of terms factorable, difference of two squares, etc.) and verbalize how they can be written and rewritten in different forms. Have the teams share their expressions and rewrite one another's expressions.
5. As a culminating activity for this unit, have students work in teams to play the Algebraic Expressions Millionaire game. (See Links)



[Equivalent Expressions Bingo](#)



[Algebraic Expressions Millionaire](#)

such as tax rates, to explore the meaning of expressions.

Creating Your Own Expression

Formative: Class Work

Students will work with a partner to create their own expressions that meet specific criteria (e.g., number of terms factorable, difference of two squares, etc.) and verbalize how they can be written and rewritten in different forms. Teams will share their expressions and rewrite one another's expressions.

Algebraic Expression Millionaire

Summative: Teacher Observation

As a culminating activity for this unit, students will work in teams to play the Algebraic Expressions Millionaire game.

Resources (Suggested)

1. iPad Resources
2. Literature Connections
Fraction Action by Loreen Leedy
One Two Three . . . Infinity: Facts and Speculations of Science by George Gamow
A Grain of Rice by Helena Clare Pittman
Uncle Petros and Goldbach's Conjecture by Apostolos Doxiadis
The Unknowns: A Math Mystery by Benedict Carey
3. Internet Resources



[Equivalent Expressions Video](#)



[Equivalent Expressions Video w/ Distributive Property](#)



[The Khan Academy](#)



[The National Library of Virtual Manipulatives](#)



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[IXL ~ Algebra](#)

Catholic Identity

Social Justice Teachings

- ✦ Life And Dignity Of The Human Person
- ✦ Call To Family, Community, And Participation
- ✦ Rights And Responsibilities
- ✦ The Dignity Of Work And The Rights Of Workers

Rights of Children

- ✦ THE RIGHT TO A CATHOLIC COMMUNITY that witnesses to Christ and the Gospel by protecting them from child abuse, including sexual abuse and neglect.
- ✦ THE RIGHT TO A SAFE ENVIRONMENT that promotes care, protection and security.
- ✦ THE RIGHT TO BE RESPECTED AS INDIVIDUALS with human dignity.
- ✦ THE RIGHT TO WORK ACTIVELY TOWARD THEIR OWN EMPOWERMENT through the development of their gifts and talents.
- ✦ THE RIGHT TO A LEARNING ENVIRONMENT THAT VALUES COOPERATION, and challenges its members to critical and reflective thinking in their search for truth.
- ✦ THE RIGHT TO DEVELOP POSITIVE, RESPONSIBLE AND CARING ATTITUDES AND BEHAVIORS TOWARD OTHERS and to recognize the rights of others to be safe and free from harassment and abuse.
- ✦ THE RIGHT TO LEARN RESPONSIBILITY for themselves and their actions.
- ✦ THE RIGHT TO MAKE RESPONSIBLE DECISIONS founded on religious conviction.

Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 3: Linear Functions

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Key Ideas and Details 1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

- WHST.6-8.6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 3. Construct viable arguments and critique the reasoning of others.
- 4. Model with mathematics.
- 6. Attend to precision.
- 7. Look for and make use of structure.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Functions

8.F Define, evaluate, and compare functions.

- 8.F.1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
- 8.F.2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.
- 8.F.3. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

8.F Use functions to model relationships between quantities.

- 8.F.4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
- 8.F.5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing

or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Reasoning with Equations & Inequalities

A-RE I Understand solving equations as a process of reasoning and explain the reasoning.

- A-REI.1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

DOC: Mathematics, DOC: Grade 8, Patterns, Functions, and Algebra

A. Patterns, Relations and Functions

- 1. Describe and represent relations and functions with tables, graphs, words, and symbols.

Essential Questions

- Why do we graph lines?
- How does rate of change relate to the graph of a line?
- To what extent does the relationship between two quantities help me to predict the future?
- How does knowing linear functions help me in other subjects and in the real-world?

Content

The students will know

1. Definition of a function
2. Function rule
3. Properties of functions
4. Functional relationship between two quantities
5. Slope of a line
6. Slope-intercept equation of a line
7. Initial value of a function
8. Rate of change of a linear relationship
9. Equation

Skills

Bloom's Taxonomy

DOK Links

The students will be able to

1. Construct a function as a rule assigning one input (domain) to exactly one output (range).
2. Analyze properties of two functions represented in different ways.
3. Construct a function to model a linear relationship between two quantities.
4. Compute slope given two points on a line.
5. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line.
6. Prove $y = mx + b$ as defining a linear function.
7. Construct a function to model a linear relationship between two quantities.
8. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values.
9. Differentiate between the graphs of linear functions and non-linear functions.
10. Analyze a graph to describe the functional relationship between two quantities.
11. Analyze a graph to determine the rate of change and initial value of a linear function.
12. Analyze a table of values to determine the rate of change and initial value of a linear function.
13. Describe qualitatively the functional relationship between two quantities by analyzing a graph.
14. Design a graph that explains quantitative features of a function.
15. 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.
16. Construct a viable argument to justify a solution method used to solve an equation.
17. Design and explain relations and functions using tables, graphs, words, and symbols.

Reading/Writing Skills

1. Define, using context clues, specific vocabulary from the

	<p>Common Core and apply the terms and definitions to solve problems.</p> <ol style="list-style-type: none"> Justify solutions, either verbally or in written form. <ul style="list-style-type: none"> Explain step-by-step process. Summarize results using specific and appropriate vocabulary. Use technology to produce written explanations and justifications for real-life and mathematical problems.
<p>Common Core Vocabulary</p> <ol style="list-style-type: none"> Function rule Input Output Initial value Rate of change Functional relationship Slope Non-linear function Equation Domain Range 	<p>Additional Vocabulary</p> <ol style="list-style-type: none"> Graph Coordinate plane Ordered pair Corresponding Table of values One-to-one correspondence Equality
<p>Learning Experiences (Suggested)</p> <ol style="list-style-type: none"> Class activity. Introduce students to Standard 8.F.1, 2, and 3 using the <i>Learn Zillion</i> site or another appropriate site. (See Links) After using the videos with the students have them define, in their own words, what a function is and what the domain and range of a function is. Ask them to provide examples to support their definitions. Working with a partner, have students use the <i>Function Machine</i> in the <i>National Library of Virtual Manipulatives</i> to find the rule the Function Machine is using to pair each input with one output. (See Links) Have them copy the table and the function rule and use graph paper to graph the function. Repeat at least three times. In conclusion, ask the students to discuss what is common in each graph. Class activity/Online learning. Engage students to Standard 8.F.4 and 5 using the <i>Learn Zillion</i> site or another appropriate site. (See Links) Have students work out the problems presented in the videos to ensure understanding of the concept presented. discuss in class. Have students work with a partner to find three real-world situations that can be represented by linear functions in which the rate of change is constant. Situations that can be modeled by linear functions may include the following. <ol style="list-style-type: none"> taxi rates rental fees admission fees to sports events ticket prices for movies/concerts, etc. <p>In completing the activity, students should write an equation, identify the rate of change, identify the initial value, and draw a graph of the equations and interpret the slope and the initial value. Share the reasoning used in completing the task with the class.</p> Working with a partner, have students use the <i>Graphing Calculator</i> (see Links) to explore the effects changing the slope and y-intercept will have on the linear equation's orientation on the coordinate plane. Share conclusions with the class. 	<p>Assessment (Suggested)</p> <p>Functions Formative: Cooperative Group Work</p> <p>Students will work in groups to construct and model functions for real-world and mathematical problems. Students will describe and explain their relationships.</p> <p>Function PowerPoint Summative: Technology Project</p> <p>Students will create a PowerPoint presentation that will describe a real-life situation that represents both an equation and an inequality. They will then create the appropriate graphs in their presentations. Students will present their justify their methods and solutions and will present examples to the rest of the class.</p> <p>Function Rule Formative: Class Work</p> <p>Students will use the <i>Function Machine</i> in the <i>National Library of Virtual Manipulatives</i> to find the rule the Function Machine is using to pair each input with one output. (See Links) They will copy the table and the function rule and use graph paper to graph the function. Repeat at least three times. In conclusion, the students will discuss what is common in each graph.</p> <p>Real-World Situations Formative: Cooperative Group Work</p> <p>Students will work with a partner to find three real-world situations that can be represented by linear functions in which the rate of change is constant. Situations that can be modeled by linear functions may include the following.</p> <ol style="list-style-type: none"> taxi rates rental fees



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[The National Library of Virtual Manipulatives](#)

c. admission fees to sports events
d. ticket prices for movies/concerts, etc.
In completing the activity, students will write an equation, identify the rate of change, identify the initial value, and draw a graph of the equations and interpret the slope and the initial value. They will share the reasoning used in completing the task with the class.

Resources (Suggested)

1. iPad Resources
2. Literature Connection
Do the Math #2: The Writing on the Wall by Wendy Lichtman
Do the Math: Secrets, Lies, and Algebra by Wendy Lichtman
The Unknowns: A Math Mystery by Benedict Carey
3. Internet Resources



[Slope Slider Interactive Activity](#)



[The Khan Academy](#)



[The National Library of Virtual Manipulatives](#)



[iLearn Ohio](#)



[Ohio Resource Center](#)



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[Algebra I Activities](#)

Catholic Identity

Social Justice Teachings

- ✚ Life And Dignity Of The Human Person
- ✚ Solidarity
- ✚ Care For God's Creation

Rights of Children

- ✚ THE RIGHT TO A CATHOLIC COMMUNITY that witnesses to Christ and the Gospel by protecting them from child abuse, including sexual abuse and neglect.
- ✚ THE RIGHT TO A SAFE ENVIRONMENT that promotes care, protection and security.
- ✚ THE RIGHT TO BE RESPECTED AS INDIVIDUALS with human dignity.
- ✚ THE RIGHT TO WORK ACTIVELY TOWARD THEIR OWN EMPOWERMENT through the development of their gifts and talents.
- ✚ THE RIGHT TO A LEARNING ENVIRONMENT THAT VALUES COOPERATION, and challenges its members to critical and reflective thinking in their search for truth.
- ✚ THE RIGHT TO LEARN RESPONSIBILITY for themselves and their actions.
- ✚ THE RIGHT TO MAKE RESPONSIBLE DECISIONS founded on religious conviction.

Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 4: Solving Equations and Inequalities

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Key Ideas and Details 1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

- WHST.6-8.6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 3. Construct viable arguments and critique the reasoning of others.
- 5. Use appropriate tools strategically.
- . Attend to precision.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Expressions & Equations

8.EE Analyze and solve linear equations and pairs of simultaneous linear equations.

- 8.EE.7. Solve linear equations in one variable.
- 8.EE.7a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers).
- 8.EE.7b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Creating Equations

A-CED Create equations that describe numbers or relationships.

- A-CED.1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
- A-CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- A-CED.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.

- A-CED.4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

DOC: Mathematics, DOC: Grade 8, Patterns, Functions, and Algebra

C. Analyze Change

- 4. Use calculators or computers to analyze change; e.g., interest compounded over time as a nonlinear growth pattern.

Essential Questions

- How can the natural world and real-life situations be represented symbolically and graphically?
- How does knowing how to solve equations and inequalities help me to solve real-world problems?
- How does using equations and inequalities help me to succeed in the real-world?
- How do I decide what strategy will work best in a given situation?
- Why is the ability to solve problems the heart of mathematics?

Content

The students will know

1. One variable linear equations
2. One variable linear inequalities
3. Solutions for one variable linear equations
 - one solution
 - no solution
 - infinite number of solutions
4. Multi-step linear equations
5. Multi-step linear inequalities
6. Compound inequalities
7. Absolute value equations

Skills

Bloom's Taxonomy

DOK Links

The students will be able to

1. Solve linear equations in one variable using one or more steps.
2. Differentiate and explain the type of solution for the linear equation in one variable.
3. Prove each step in solving a simple equation as following from the equality of numbers.
4. Identify linear equations in one variable with one solution, infinitely many solutions, or no solutions.
5. Solve linear equations with rational number coefficients.
6. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
7. Solve equations whose solutions require expanding expressions using the distributive property and collecting like terms.
8. Solve equations in two or more variables to represent relationships between quantities.
9. Graph equations on coordinate axes with labels and scales.
10. Formulate solution sets using an algebraic equation or inequality and graph on a number line.
11. Use concepts to solve unions and intersections to determine solution sets of absolute value and compound inequalities.
12. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
13. Use technology to analyze change.

Reading/Writing Skills

1. Define, using context clues, specific vocabulary from the Common Core and apply the terms and definitions to solve problems.
2. Justify solutions, either verbally or in written form.
 - Explain step-by-step process.
 - Summarize results using specific and appropriate vocabulary.
3. Use technology to produce written explanations and justifications for real-life and mathematical problems.

Common Core Vocabulary

1. Quadratic functions
2. Exponential functions

Additional Vocabulary

1. Coefficient
2. Linear equations

<p>3. Rational functions</p>	<p>3. Rational number 4. Distributive property 5. Like terms 6. Solution 7. Linear inequalities 8. Coordinate Plane 9. Interest formula</p>
<p>Learning Experiences (Suggested)</p> <ol style="list-style-type: none"> Class activity/Online learning. Review the order of operations (PEMDAS) with the students using the video addressing order of operations in the series of videos for Standard 7.EE.3 found at the <i>Learn Zillion</i> site. (See Links) Following the review of order of operations, have the students solve several mathematical problems to reinforce their understanding of the order of operations. Have them write a sentence explaining each step used to solve the problem. Class activity/Online learning. Engage students in the explanation of solving multi-step problems using the videos in the series of videos for 7.EE.3 found in the <i>Learn Zillion</i> site or another appropriate site. (See Links) While using the videos, have students work similar problems to reinforce the concepts presented. Have students work with a partner to solve a number of linear equations with one variable. Have them justify the reasonableness of solutions using mental computations and estimation and ask them to share their justifications with the class. Working in cooperative groups, have students create equations and inequalities in one variable and use them to solve problems. They should include equations arising from linear and quadratic functions, and simple rational and exponential functions. Use the videos for Standards A-CED.1, 2, and 3 found at the <i>Learn Zillion</i> site to provide students background in creating such equations and inequalities. As a follow-up to the group activity, have groups exchange their equations and inequalities with another group and solve. Have students justify the reasoning used in solving the problem. Class activity. Have students examine real-world graphs in terms of constraints that are necessary to balance a mathematical model with the real-world context. <i>For example, a student writing an equation to model the maximum area when the perimeter of a rectangle is 12 inches should recognize that $y = x(6 - x)$ only makes sense when $0 < x < 6$. This restriction on the domain is necessary because the side of a rectangle under these conditions cannot be less than or equal to 0, but must be less than 6.</i> Have the students discuss the difference between the parabola that models the problem and the portion of the parabola that applies to the context. Working with a partner, have students explore examples illustrating when it is useful to rewrite a formula by solving for one of the variables in the formula. For example, the formula for the area of a trapezoid ($A = 1/2h(b_1+b_2)$) can be solved for h if the area and lengths of the bases are known but the height needs to be calculated. Have teams exchange their examples and solve the equation by rewriting the formula and solving for one of the variables. Justify the thinking used to solve the problem. Class activity/discussion. Provide students with examples of real-world problems that can be solved by writing an equation, and have them explore the graphs of the equations on a 	<p>Assessment (Suggested)</p> <p>Graphing Lab Formative: Lab Assignment</p> <p>Students will graphing linear equations and linear inequalities on a coordinate plane with technology. They will then analyze the graphs to find all linear properties. Students will then apply this knowledge to a real-life situation.</p> <p>Order of Operations ~ Review Formative: Class Work</p> <p>Students will solve several mathematical problems to reinforce their understanding of the order of operations. They will write a sentence explaining each step used to solve the problem.</p> <p>Solving Linear Equations Formative: Cooperative Group Work</p> <p>Students will work with a partner to solve a number of linear equations with one variable. They will justify the reasonableness of solutions using mental computations and estimation and share their justifications with the class.</p> <p>Creating Equations and Inequalities Formative: Online Learning</p> <p>Students will create equations and inequalities in one variable and use them to solve problems. They will include equations arising from linear and quadratic functions, and simple rational and exponential functions. they will use the videos for Standards A-CED.1, 2, and 3 found at the <i>Learn Zillion</i> site to gain background in creating such equations and inequalities.</p> <p>Solving By Rewriting Formative: Cooperative Group Work</p> <p>Students will create examples illustrating when it is useful to rewrite a formula by solving for one of the variables in the formula. For example, the formula for the area of a trapezoid ($A = 1/2h(b_1+b_2)$) can be solved for h if the area and lengths of the bases are known but the height needs to be calculated. Teams will exchange their examples and solve the equation by rewriting the formula and solving for one of the variables. Justify the thinking used to solve the problem.</p> <p>Solving Equations Formative: Homework</p> <p>Given formulas, such as area and volume (or from science or business), students will solve the equations for each of the different variables in the formulas. Students will explain the reasoning used in solving the problem.</p>

graphing calculator to determine which parts of the graph are relevant to the problem context. Discuss their findings.

10. Give students formulas, such as area and volume (or from science or business), and have students solve the equations for each of the different variables in the formula. Have them explain the reasoning used in solving the problem



[Learn Zillion ~ Common Core Videos](#)



[The Khan Academy](#)

Resources (Suggested)

1. iPad Resources
2. Literature Connection
Do the Math: Secrets, Lies, and Algebra by Wendy Lichtman
5-Minute Math Problem of the Day: 250 Fun, Multi-Step Problems That Sharpen Math Reasoning, Number Sense, and Computation Skills by Marcia Miller and Martin Lee
More Sideways Arithmetic From Wayside School by Louis Sachar
Do the Math #2: The Writing on the Wall by Wendy Lichtman
3. Internet Resources



[Linear Equation Solver](#)



[Solve multi-step equations](#)



[Absolute value equation solver](#)



[Solve compound inequalities](#)



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[Algebra I Activities](#)

Catholic Identity

Social Justice Teachings

- ✚ Life And Dignity Of The Human Person
- ✚ Call To Family, Community, And Participation
- ✚ Rights And Responsibilities
- ✚ The Dignity Of Work And The Rights Of Workers
- ✚ Solidarity

Rights of Children

- ✚ THE RIGHT TO A CATHOLIC COMMUNITY that witnesses to Christ and the Gospel by protecting them from child abuse, including sexual abuse and neglect.
- ✚ THE RIGHT TO A SAFE ENVIRONMENT that promotes care, protection and security.
- ✚ THE RIGHT TO BE RESPECTED AS INDIVIDUALS with human dignity.
- ✚ THE RIGHT TO WORK ACTIVELY TOWARD THEIR OWN EMPOWERMENT through the development of their gifts and talents.
- ✚ THE RIGHT TO A LEARNING ENVIRONMENT THAT VALUES COOPERATION, and challenges its members to critical and reflective thinking in their search for truth.
- ✚ THE RIGHT TO DEVELOP POSITIVE, RESPONSIBLE AND CARING ATTITUDES AND BEHAVIORS TOWARD OTHERS and to recognize the rights of others to be safe and free from harassment and abuse.
- ✚ THE RIGHT TO LEARN RESPONSIBILITY for themselves and their actions.
- ✚ THE RIGHT TO MAKE RESPONSIBLE DECISIONS founded on religious conviction.



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Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 5: Graphing Equations and Inequalities

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Key Ideas and Details 1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

- WHST.6-8.6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

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

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Expressions & Equations

8.EE Understand the connections between proportional relationships, lines, and linear equations.

- 8.EE.5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.
- 8.EE.6. Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b .

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Functions

8.F Define, evaluate, and compare functions.

- 8.F.3. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Statistics & Probability

8.SP Investigate patterns of association in bivariate data.

- 8.SP.1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
- 8.SP.2. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
- 8.SP.3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Creating Equations

A-CED Create equations that describe numbers or relationships.

- A-CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Reasoning with Equations & Inequalities

A-RE I Represent and solve equations and inequalities graphically.

- A-REI.10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
- A-REI.11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.★
- A-REI.12. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

DOC: Mathematics, DOC: Grade 8, Patterns, Functions, and Algebra

B. Algebraic Representation

- 3. Describe the relationship between the graph of a line and its equation, including being able to explain the meaning of slope as a constant rate of change.

C. Analyze Change

- 1. Differentiate and explain types of changes in mathematical relationships, such as linear vs. nonlinear, direct variation vs. inverse variation.
- 2. Describe and compare how changes in an equation affect the related graphs; e.g., for a linear equation changing the coefficient of x affects the slope and changing the constant affects the intercepts.
- 4. Use calculators or computers to analyze change; e.g., interest compounded over time as a nonlinear growth pattern.

Essential Questions

- To what extent are patterns present in our everyday world?
- What impact (either positively or negatively) does data collection have on our world?
- How can tables and graphs aid individuals in making everyday decisions?
- How are data collection and statistics used in relevant real-world activities?
- How can the knowledge of scatter plots help you in the decision-making process?

Content

The students will know

- Proportional Relationships
- Types of changes in mathematical relationships and skills
 - Linear functions
 - Nonlinear functions
 - Direct variation

Skills

Bloom's Taxonomy

DOK Links

The students will be able to

- Differentiate and explain types of changes in mathematical relationships.
- Explain how changes in an equation affect the related graph.

<ul style="list-style-type: none"> ▪ Inverse variation 3. Unit rate 4. Slope 5. Slope intercept form of an equation of a line 6. The effect of changes in an equation on the related graph 7. Similar triangles 8. Slopes of parallel lines 9. Scatter plots 10. Trends in scatter plots <ul style="list-style-type: none"> ▪ Positive correlation ▪ Negative correlation ▪ No correlation 11. Trend line 12. Relative frequencies 	<ul style="list-style-type: none"> 3. Analyze change utilizing graphing calculators or computers. 4. Construct graphs of proportional relationships. 5. Prove the unit rate is the slope of the line using concepts such as similar triangles. 6. Compare and contrast proportional relationships represented in different forms. 7. Explain and illustrate why the slope of a line would be the same between any two points on a non-vertical line. 8. Derive the slope-intercept equation for a line through <ul style="list-style-type: none"> ▪ the origin ▪ a point on the vertical axis, the y-intercept 9. Write an equation for a line using point-slope form, graph a line using slope-intercept form, and represent a line with its standard form. 10. Use slope and y-intercept or two points to write an equation for a line. 11. Identify slopes, relationships, and graphs of parallel, perpendicular, horizontal, and vertical lines. 12. Construct and interpret a two-way table. 13. Create scatter plots from the collection of data. 14. Analyze scatter plots to determine the trend. 15. Construct an equation of a linear model to solve problems to interpret data. 16. Construct frequency tables to describe possible associations and patterns between two variables. <p>Reading/Writing Skills</p> <ul style="list-style-type: none"> 1. Define, using context clues, specific vocabulary from the Common Core and apply the terms and definitions to solve problems. 2. Justify solutions, either verbally or in written form. <ul style="list-style-type: none"> ▪ Explain step-by-step process. ▪ Summarize results using specific and appropriate vocabulary. 3. Use technology to produce written explanations and justifications for real-life and mathematical problems.
<p>Common Core Vocabulary</p> <ul style="list-style-type: none"> 1. Proportional relationships 2. Linear functions 3. Nonlinear functions 4. Direct variation 5. Inverse variation 6. Slope 7. Similar triangles 8. Slope-intercept form of an equation of a line 9. Y-intercept 10. Parallel lines (using the definition of slopes) 11. Bivariate 12. Scatter plot 13. Correlation 14. Positive correlation 15. Negative correlation 16. No correlation 17. Trend line 18. Frequency 19. Relative frequency 20. Linear association 21. Non-linear association 	<p>Additional Vocabulary</p> <ul style="list-style-type: none"> 1. Rate of change 2. Constant rate of change 3. Unit rates

<p>22. Quantitative variables 23. Two-way table</p>	
<p>Learning Experiences (Suggested)</p> <ol style="list-style-type: none"> Online learning. Have students prepare for the study of this unit by studying work related to: <ol style="list-style-type: none"> graphing proportional relationships and interpreting the unit rate as the slope of the graph. Have students use the videos for Standards 8.EE.5 & 6 found at the <i>Learn Zillion</i> site or another appropriate site. (See Links) Cooperative group work. Based on what students learned by studying the videos listed above, have the students answer the following questions: <ol style="list-style-type: none"> How can you describe these lines? Why are slope and y-intercept useful? In what forms can these linear relationships be written? How can you write the relationship if you are given information about it? <p>Have groups share their responses and justify their thinking.</p> Class activity/Online learning. Engage students in constructing and interpreting scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. Use the videos for Standard 8.SP.1-2 found at the <i>Learn Zillion</i> site or another appropriate site. (See Links) Working with a partner, have students gather data to determine if there is a relationship between the height of an adult and his or her shoe size. Using the data make two scatter plots – one for the males and one for the females. Investigate, describe and analyze the patterns of association. Share with the class. Have students use the <i>Interactive Regression Activity</i> found in the Links to create a scatter plot, draw the line of best fit, and compare their line of best fit with a computer-generated line of best fit. Have them write an explanation of how a scatter plot and a line of best fit are related. Share with the class. Class activity/Online learning. Engage students in an activity designed to help them understand (a) that straight lines are widely used to model relationships between two quantitative variables, and (b) one uses the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. Use the videos for Standard 8.SP.3-4 found at the <i>Learn Zillion</i> site or another appropriate site. (See Links) Cooperative group work. Have students use the lesson <i>Impact of a Superstar</i> in the Links to (a) use technology tools to plot data, identify lines of best fit, and detect outliers, and (b) compare the lines of best fit when one element is removed from a data set, and interpret the results. Following the activity, engage students in a discussion of the questions provided in the lesson and use the teacher reflection questions as a way of gathering information about the project. Online learning. Working with a partner, have students gain an understanding that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table by using the videos for Standard 8.SP.4 found at the <i>Learn Zillion</i> site or another appropriate site. 	<p>Assessment (Suggested)</p> <p>Graphing Lab Formative: Lab Assignment</p> <p>Students will investigate the relationship between the graph of a line and its equation, including the types of changes in mathematical relationships.</p> <p>Proportional Relationships, Lines, and Linear Equations. Formative: Class Work</p> <p>Based on what students learned by studying the videos, they will work in groups to answer the following questions:</p> <ol style="list-style-type: none"> How can you describe these lines? Why are slope and y-intercept useful? In what forms can these linear relationships be written? How can you write the relationship if you are given information about it? <p>The groups will share their responses and justify their thinking.</p> <p>Creating Scatter Plots Formative: Cooperative Group Work</p> <p>Students will gather data to determine if there is a relationship between the height of an adult and his or her shoe size. Using the data, they will make two scatter plots – one for the males and one for the females in order to investigate, describe and analyze the patterns of association. They will share their work with the class.</p> <p>Impact of a Superstar Formative: Cooperative Group Work</p> <p>Students will use the lesson <i>Impact of a Superstar</i> in the Links to (a) use technology tools to plot data, identify lines of best fit, and detect outliers, and (b) compare the lines of best fit when one element is removed from a data set, and interpret the results. Following the activity, they will engage in a discussion of the questions provided in the lesson and use the teacher reflection questions as a way of gathering information about the project.</p> <p>Two-Way Tables Formative: Cooperative Group Work</p> <p>Students will construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. They will use relative frequencies calculated for rows or columns to describe possible association between two variables.</p> <p>Students will create a situation in which a two-way table will be used to summarize the data and share the results of their investigation with the class and explain the reasoning used to come to their conclusions.</p>

(See Links)

- Group Project. Have students construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Have them use relative frequencies calculated for rows or columns to describe possible association between two variables. Have students create a situation in which a two-way table will be used to summarize the data. Have students share the results of their investigation with the class and explain the reasoning used to come to their conclusions.



[Learn Zillion ~ Common Core Videos](#)



[The Khan Academy](#)



[Exploring Linear Data](#)



[Interactive Regression Activity](#)



[Impact of a Superstar](#)

Resources (Suggested)

- iPad Resources
- Literature Connection
Equal Shmequal by Virginia L. Kroll and Philomena O'Neill
Do the Math: Secrets, Lies, and Algebra by Wendy Lichtman
A Tangled Tale by Lewis Carroll
Do the Math #2: The Writing on the Wall by Wendy Lichtman
The Unknowns: A Math Mystery by Benedict Carey
- Internet Resources



[Slope-Intercept Form Song](#)



[Slope Video](#)



[Online Graphing Calculator](#)



[Slope Games and Activities](#)



[The Khan Academy](#)



[The National Library of Virtual Manipulatives](#)



[Learn Zillion ~ Common Core Videos](#)



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Catholic Identity

Social Justice Teachings

- ✦ Life And Dignity Of The Human Person
- ✦ Call To Family, Community, And Participation
- ✦ Rights And Responsibilities
- ✦ The Dignity Of Work And The Rights Of Workers
- ✦ Solidarity

Rights of Children

- ✦ THE RIGHT TO A CATHOLIC COMMUNITY that witnesses to Christ and the Gospel by protecting them from child abuse, including sexual abuse and neglect.
- ✦ THE RIGHT TO A SAFE ENVIRONMENT that promotes care, protection and security.
- ✦ THE RIGHT TO BE RESPECTED AS INDIVIDUALS with human dignity.
- ✦ THE RIGHT TO WORK ACTIVELY TOWARD THEIR OWN EMPOWERMENT through the development of their gifts and talents.
- ✦ THE RIGHT TO A LEARNING ENVIRONMENT THAT VALUES COOPERATION, and challenges its members to critical and reflective thinking in their search for truth.
- ✦ THE RIGHT TO DEVELOP POSITIVE, RESPONSIBLE AND CARING ATTITUDES AND BEHAVIORS TOWARD OTHERS and to recognize the rights of others to be safe and free from harassment and abuse.
- ✦ THE RIGHT TO LEARN RESPONSIBILITY for themselves and their actions.
- ✦ THE RIGHT TO MAKE RESPONSIBLE DECISIONS founded on religious conviction.



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Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 6: Systems of Linear Equations & Inequalities

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Key Ideas and Details 1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

- WHST.6-8.6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 4. Model with mathematics.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Expressions & Equations

8.EE Analyze and solve linear equations and pairs of simultaneous linear equations.

- 8.EE.8. Analyze and solve pairs of simultaneous linear equations.
- 8.EE.8a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
- 8.EE.8b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.
- 8.EE.8c. Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Creating Equations

A-CED Create equations that describe numbers or relationships.

- A-CED.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.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Reasoning with Equations & Inequalities

A-RE I Solve systems of equations.

- A-REI.5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
- A-REI.6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

DOC: Mathematics, DOC: Grade 8, Patterns, Functions, and Algebra

B. Algebraic Representation

- 8. Solve systems of linear equations graphically and by simple substitution.

Essential Questions

- How can the natural world and real-life situations be represented symbolically and graphically?
- To what extent are systems of equations used in your life?
- Why is it important to know more than one way to solve a problem?

Content

The students will know

1. Systems of two linear equations in two variables
2. Solutions of systems of two linear equations in two variables
 - one solution, no solution, and infinite number of solutions
3. Algebraic and geometric representations of solutions of systems of two linear equations in two variables
4. Real world applications of linear systems of equations

Skills

Bloom's Taxonomy

DOK Links

The students will be able to

1. Analyze and solve pairs of simultaneous linear equations.
2. Solve systems of equations using the methods below with and without technology
 - Graphing
 - Substitution
 - Elimination
3. Recognize that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs
4. Differentiate and explain the type of solution for a system of two linear equations in two variables.
5. Formulate a system of two linear equations in two variables to solve real-world problems.
6. Solve systems of two linear equations in two variables algebraically.
7. Estimate solutions by graphing the equations.
8. Solve simple cases by inspection.
9. Solve real-world and mathematical problems leading to two linear equations in two variables.
10. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities.
11. interpret solutions as viable or nonviable options in a modeling context.
12. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
13. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
14. Construct a graph of the solutions to a linear inequality in two variables as a half-plane, and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
15. Solve systems of linear equations graphically and by simple substitution.

Reading/Writing Skills

1. Define, using context clues, specific vocabulary from the Common Core and apply the terms and definitions to solve problems.
2. Justify solutions, either verbally or in written form.
 - Explain step-by-step process.
 - Summarize results using specific and appropriate vocabulary.
3. Use technology to produce written explanations and justifications for real-life and mathematical problems.

Common Core Vocabulary

1. System of equations
2. Coefficient
3. Intersection of two lines

Additional Vocabulary

1. Linear equations
2. Rational number
3. Distributive property
4. Like terms
5. Solution
6. Two variable equation of a line

Learning Experiences (Suggested)

1. Class activity/Online learning. Engage students in developing an understanding of analyzing and solving linear equations and pairs of simultaneous linear equations. Use the videos for Standards 8.EE.8a-c found at the *Learn Zillion* site or another appropriate site. (See Links)
2. Working with a partner, have students analyze the following problem and share their thinking with the class.

Problem. Plant A and Plant B are on different watering schedules. This affects their rate of growth. Compare the growth of the two plants to determine when their heights will be the same.

Let W = number of weeks
Let H = height of the plant after W weeks

Plant A ~ W = 0, 1, 2, 3
 H = 4, 6, 8, 10

Plant B ~ W = 0, 1, 2, 3
 H = 2, 6, 10, 14

 - a. Identify the coordinates and graph their corresponding lines.
 - b. Write an equation that represent the growth rate of Plant A and Plant B.
 - c. At which week will the plants have the same height?
3. Class activity/Online learning. Engage students in developing skill in representing constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable in a modeling context. Use the videos for Standard A-CED.3 found at the *Learn Zillion* site or another appropriate site. (See Links)
4. Cooperative group work. Have students work together to plan on starting their own business using the activity outlined in *Starting a Skateboard Business* found in the Links (tag down to the bottom of the site for the Skateboard activity).
5. Online learning. Have students develop an understanding of the steps needed to prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. Have them use the videos for Standard A-REI.5 found at the *Learn Zillion* site or another appropriate site. (See

Assessment (Suggested)

Solving Systems Group Problems
Summative: Cooperative Group Work

Working in groups, the students will solve systems of equations using the methods taught. They will discuss and interpret solutions as being realistic or not according to each situation.

Real-World Problem
Formative: Cooperative Group Work

Working with a partner, students will analyze the following problem and share their thinking with the class.

Problem. Plant A and Plant B are on different watering schedules. This affects their rate of growth. Compare the growth of the two plants to determine when their heights will be the same.

Let W = number of weeks
Let H = height of the plant after W weeks

Plant A ~ W = 0, 1, 2, 3
 H = 4, 6, 8, 10

Plant B ~ W = 0, 1, 2, 3
 H = 2, 6, 10, 14

- a. Identify the coordinates and graph their corresponding lines.
- b. Write an equation that represent the growth rate of Plant A and Plant B.
- c. At which week will the plants have the same height?

Starting a Skateboard Business
Summative: Cooperative Group Work

Students will work together to plan on starting their own business using the activity outlined in *Starting a Skateboard Business* found in the Links

Creating Problems
Formative: Cooperative Group Work

Students will create a problem that exemplifies the concept taught in each of the four videos for Standard A-REI.5. Teams will exchange their

Links)

6. Working with a partner, have students create a problem that exemplifies the concept taught in each of the four videos for Standard A-REI.5. Have teams exchange their problems with another team and solve. For each solution, justify the reasoning used.
7. Class activity/Online learning. Engage students in learning to solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. Use the videos for Standard A-REI.6 found at the *Learn Zillion* site or another appropriate site. (See Links)
8. Working with a partner, have students create and solve equations representing each of the following conditions.
 - a. Solve simple systems of equations by linear combination (elimination).
 - b. Solving systems of equations by linear combination (elimination).
 - c. Solving word problems by using systems of equations.
 - d. Approximating the solution to a system by graphing.
 - e. Solving systems of equations by substitution.



[Learn Zillion ~ Common Core Videos](#)



[The Khan Academy](#)



[Common Core Algebra I ~ Starting a Skateboard Business](#)

problems with another team and solve. For each solution, they will justify the reasoning used.

Solving Equations and ...

Formative: Cooperative Group Work

Students will create and solve equations representing each of the following conditions.

- a. Solve simple systems of equations by linear combination (elimination).
- b. Solving systems of equations by linear combination (elimination).
- c. Solving word problems by using systems of equations.
- d. Approximating the solution to a system by graphing.
- e. Solving systems of equations by substitution.

Resources (Suggested)

1. iPad Resources
2. Literature Connection
 - Equal Shmequal* by Virginia L. Kroll and Philomena O'Neill
 - Do the Math: Secrets, Lies, and Algebra* by Wendy Lichtman
 - A Tangled Tale* by Lewis Carrol
 - Do the Math #2: The Writing on the Wall* by Wendy Lichtman
 - The Unknowns: A Math Mystery* by Benedict Carey
3. Internet Resources



[Systems of Equations video](#)



[Systems Solver](#)



[Learn Zillion ~ Common Core Videos](#)



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[The Khan Academy](#)



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Catholic Identity

Social Justice Teachings

- ✚ Life And Dignity Of The Human Person
- ✚ Rights And Responsibilities
- ✚ Solidarity

Rights of Children

- ✚ THE RIGHT TO A CATHOLIC COMMUNITY that witnesses to Christ and the Gospel by protecting them from child abuse, including sexual abuse and neglect.
- ✚ THE RIGHT TO A SAFE ENVIRONMENT that promotes care, protection and security.
- ✚ THE RIGHT TO BE RESPECTED AS INDIVIDUALS with human dignity.
- ✚ THE RIGHT TO WORK ACTIVELY TOWARD THEIR OWN EMPOWERMENT through the development of their gifts and talents.
- ✚ THE RIGHT TO A LEARNING ENVIRONMENT THAT VALUES COOPERATION, and challenges its members to critical and reflective thinking in their search for truth.
- ✚ THE RIGHT TO LEARN RESPONSIBILITY for themselves and their actions.
- ✚ THE RIGHT TO MAKE RESPONSIBLE DECISIONS founded on religious conviction.



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Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 7: Probability

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Key Ideas and Details 1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- 2. Reason abstractly and quantitatively.
- 3. Construct viable arguments and critique the reasoning of others.
- 7. Look for and make use of structure.

CCSS: Mathematics (2011), OH: CCSS: HS: Stats/Prob, Conditional Probability & the Rules of Probability

S-CP Understand independence and conditional probability and use them to interpret data

- S-CP.1. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).
- S-CP.2. Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.

S-CP Use the rules of probability to compute probabilities of compound events in a uniform probability model

- S-CP.9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems.

Essential Questions

- How can the knowledge of probability help you in the decision making process?
- How does the type of data influence the choice of graph?
- How is the probability of an event determined and described?
- How do people use data to influence others?
- How are data collection and statistics used in relevant real-world activities?

Content

The students will know

- Fundamental Counting Principle
- Independent events

Skills

Bloom's Taxonomy

DOK Links

The students will be able to

<ol style="list-style-type: none"> 3. Dependent events 4. Experimental probability 5. Theoretical probability 6. Permutations 7. Combinations 	<ol style="list-style-type: none"> 1. Determine the total number of possible outcomes for mathematical situations using counting techniques and the Fundamental Counting Principle. 2. Identify situations involving independent and dependent events. 3. Explain differences between, and common misconceptions about, probabilities associated with independent and dependent events. 4. Estimate probabilities and solve problems dealing with uncertainty using theoretical and experimental probability. 5. Describe, create, and analyze a sample space and use it to calculate probability. 6. Differentiate and explain the relationship between the probability of an event and the odds of an event, and compute one given the other. 7. Use the concepts of factorial notation and computations to represent and solve problem situations involving arrangements. <p>Reading/Writing Skills</p> <ol style="list-style-type: none"> 1. Define, using context clues, specific vocabulary from the Common Core and apply the terms and definitions to solve problems. 2. Justify solutions, either verbally or in written form. <ul style="list-style-type: none"> ▪ Explain step-by-step process. ▪ Summarize results using specific and appropriate vocabulary. 3. Use technology to produce written explanations and justifications for real-life and mathematical problems.
<p>Common Core Vocabulary</p> <ol style="list-style-type: none"> 1. Fundamental Counting Principle 2. Independent events 3. Dependent events 4. Experimental probability 5. Theoretical probability 6. Permutations 7. Combinations 8. Union 9. Intersection 10. Compound events 	<p>Additional Vocabulary</p> <ol style="list-style-type: none"> 1. Probability 2. Outcomes 3. Events 4. Abstract
<p>Learning Experiences (Suggested)</p> <ol style="list-style-type: none"> 1. All activities for this unit of study on Probability may be found at <i>Conditional Probability and Probability of Simultaneous Events</i> unit/lessons found in the Links. While using this unit/lesson, engage students in all of the activities listed. 2. Culminating activity. Have teams of students engage in one or more of the interactive probability activities found in the Links.  <p>Conditional Probability and Probability of Simultaneous Events</p>	<p>Assessment (Suggested)</p> <p>Probability Game Formative: Cooperative Group Work</p> <p>Students, in a group, will create a game using their knowledge of probability. Other groups will then play the game using permutations and combinations to solve the problems in the game.</p> <p>Conditional Probability and Probability of Simultaneous Events ~ Activities Formative: Class Work</p> <p>Have students complete and respond to all of the problems and activities found in the Conditional Probability and Probability of Simultaneous</p>



[Interactive Activities ~ Scroll Down to Probability](#)

Events site.

Resources (Suggested)

1. iPad Resources
2. Literature Connection
A Million Fish...More or Less by Patricia McKissack
A Wrinkle in Time by Madeleine L'Engle
Do You Wanna Bet?: Your Chance to Find Out About Probability by Jean Cushman and Martha Weston
Jumanji by Chris Van Allsburg
3. Internet Resources



[The Probability Song](#)



[Probability website](#)



[Probability Problems](#)



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[Gapminder ~ Statistical Data Resource](#)

Catholic Identity

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Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 8: Exponents and Exponential Functions

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

- WHST.6-8.6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- 1. Make sense of problems and persevere in solving them.
- 3. Construct viable arguments and critique the reasoning of others.
- 4. Model with mathematics.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Expressions & Equations

8.EE Work with radicals and integer exponents.

- 8.EE.1. Know and apply the properties of integer exponents to generate equivalent numerical expressions.
- 8.EE.2. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
- 8.EE.3. Use numbers expressed in the form of a single digit times a whole-number power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.
- 8.EE.4. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Seeing Structure in Expressions

A-SSE Write expressions in equivalent forms to solve problems.

- A-SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
- A-SSE.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.

Essential Questions

- Why is the real number system important in the study of mathematics?
- To what extent do exponential functions relate to real-world problems?
- To what extent are exponential functions the fuel for technology, progress, invention, discovery, and creativity?
- To what extent can learning about exponential functions be satisfying, enjoyable, and confidence-building?

Content

The students will know

1. Square roots of non-perfect squares
2. Cube roots
3. Properties of exponents
4. Graphs of exponential functions
5. Exponential growth
6. Exponential decay

Skills

Bloom's Taxonomy

DOK Links

The students will be able to

1. Know and apply the properties of integer exponents to generate equivalent numerical expressions.
2. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
3. Calculate numerical expressions applying the properties of exponents.
4. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$.
5. Evaluate square roots of small perfect squares and cube roots of small perfect cubes.
6. Know that $\sqrt{2}$ is irrational.
7. Use numbers expressed in the form of a single digit times a whole-number power of 10 to estimate very large or very small quantities.
8. Formulate written explanations using the concepts in the real number system.
9. Use the concepts of functions or relationships and freely translate among tabular, graphical, and symbolic representations to generalize patterns.
10. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.
11. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities.
12. Solve real-world problems that can be modeled using exponential functions.
13. Interpret scientific notation that has been generated by technology.
14. Use the concepts of formulas to solve problems involving exponential growth and decay.
15. 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.

Reading/Writing Skills

1. Define, using context clues, specific vocabulary from the Common Core and apply the terms and definitions to solve problems.
2. Justify solutions, either verbally or in written form.
 - Explain step-by-step process.
 - Summarize results using specific and appropriate vocabulary.
3. Use technology to produce written explanations and justifications for real-life and mathematical problems.

Common Core Vocabulary

1. Exponential growth

Additional Vocabulary

1. Square root
2. Perfect square

<p>2. Exponential decay</p>	<p>3. Cube root 4. Rational number 5. Irrational number 6. Exponent 7. Scientific notation</p>
<p>Learning Experiences (Suggested)</p> <ol style="list-style-type: none"> Online learning and class discussions. Working with a partner, have students use the videos found in the <i>Learn Zillion</i> site for Standard 8.EE.1 to help them work with radicals and integer exponents. As they work, ask them to provide at least five examples for each of the following properties: <ol style="list-style-type: none"> Product of Powers Quotient of Powers Power of a Power Negative Exponents Zero Exponents Have students find the square root and the cube root of the numbers. Using calculators, ask them to create a table showing the number, the square (or cube), and the square root (cube root) for the numbers 1 through 24. Online learning. Have students review their understanding of (a) using numbers expressed in the form of a single digit times a whole-number power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other, and (b) performing operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use the videos for Standards 8.EE.3-4 found at the Learn Zillion site or another appropriate site for this online learning experience. Cooperative group project. Present students with the following information from the CTIA Advocacy site found in the Links. <ol style="list-style-type: none"> The number of text messages in America in June 2006 was 33,500,000. In June 2011 there were 196,900,000,000 text message sent. Express these numbers in exponential form. Estimate how many more texts were sent and estimate how many times more texts were sent in 2011 than 2006. Convert the information presented in each category for the years 2007 and 2012 to exponential form. Create a chart showing the original number and the number in exponential form. Is there, or is there not an advantage to writing the numbers in exponential form. Justify your response. Have students add, subtract, multiply, and divide numbers expressed in scientific notation. Have them explain the steps taken to solve the problems. Class activity. Use the <i>The X Factor - Trinomials and Algebra Tiles</i> (ORC# 10600) lesson found at the Ohio Resource site (see Links) which focuses on connections between the factors of quadratic polynomials of the form $x^2 + bx + c$, algebra tile representations of the factorization, and roots of the quadratic function to teach the concepts presented in Standard A-SSE.3. Class activity/Online learning. Engage students in a series of discussions designed to teach them how to 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. Use the site <i>Finite Geometric Series</i> found in the Links or another appropriate site. Cooperative group project. To promote student working 	<p>Assessment (Suggested)</p> <p>Knowing Your Exponents Formative: Homework</p> <p>After viewing the videos for Standards , students will provide at least five examples for each of the following properties of exponents.</p> <ol style="list-style-type: none"> Product of Powers Quotient of Powers Power of a Power Negative Exponents Zero Exponents <p>Square Root ~ Cube Root Formative: Homework</p> <p>Students will find the square root and the cube root of the numbers. Using calculators, they will create a table showing the number, the square (or cube), and the square root (cube root) for the numbers 1 through 24.</p> <p>Using Exponential Notation Summative: Cooperative Group Work</p> <p>Cooperative group project. Present students with the following information from the CTIA Advocacy site found in the Links.</p> <ol style="list-style-type: none"> The number of text messages in America in June 2006 was 33,500,000. In June 2011 there were 196,900,000,000 text messages sent. Express these numbers in exponential form. Estimate how many more texts were sent and estimate how many times more texts were sent in 2011 than 2006. Convert the information presented in each category for the years 2007 and 2012 to exponential form. Create a chart showing the original number and the number in exponential form. Is there, or is there not an advantage to writing the numbers in exponential form. Justify your response. <p>The X Factor - Trinomials and Algebra Tiles Formative: Class Work</p> <p>Students will complete all activities presented in the lesson entitled <i>The X Factor - Trinomials and Algebra Tiles</i> (ORC# 10600) lesson found at the Ohio Resource site (see Links) which focuses on connections between the factors of quadratic polynomials of the form $x^2 + bx + c$, algebra tile representations of the factorization, and roots of the quadratic function to teach the concepts presented in Standard A-SSE.3.</p> <p>Incandescent or Fluorescent? Formative: Cooperative Group Work</p> <p>Cooperative group project. To promote student working knowledge of Standard A-SSE.4, they will work in cooperative groups to complete the</p>

knowledge of Standard A-SSE.4, have them work in cooperative groups to complete the task found in the *Incandescent or Fluorescent?* (ORC# 10156) lesson found in the Ohio Resource site. (See Links)



[Paper Folding](#)



[M&M Lab](#)



[Exponential Growth and Decay activities](#)



[CTIA Advocacy ~ Wireless Facts](#)



[Learn Zillion ~ Common Core Videos](#)



[The Khan Academy](#)



[Ohio Resource Center ~ Math Common Core Standards](#)



[Finite Geometric Series ~ A-SSE.4](#)

tasks in the *Incandescent or Fluorescent?* (ORC# 10156) lesson found in the Ohio Resource site.

Resources (Suggested)

1. iPad Resources
2. Literature Connection
Tuck Everlasting by Natalie Babbitt
Alice in Wonderland by Lewis Carroll
The Unknowns: A Math Mystery Benedict Carey
3. Internet Resources



[Laws of Exponents](#)



[Exponent Video](#)



[Exponents song to Wheels on the Bus](#)



[Algebra games including exponents](#)



[Learn Zillion ~ Common Core Videos](#)



[iLearn Ohio](#)



[The Khan Academy](#)

Catholic Identity

Social Justice Teachings

- ✦ Life And Dignity Of The Human Person
- ✦ Call To Family, Community, And Participation
- ✦ The Dignity Of Work And The Rights Of Workers
- ✦ Solidarity

Rights of Children

- ✦ THE RIGHT TO A CATHOLIC COMMUNITY that witnesses to Christ and the Gospel by protecting them from child abuse, including sexual abuse and neglect.
- ✦ THE RIGHT TO A SAFE ENVIRONMENT that promotes care, protection and security.
- ✦ THE RIGHT TO BE RESPECTED AS INDIVIDUALS with human dignity.
- ✦ THE RIGHT TO WORK ACTIVELY TOWARD THEIR OWN EMPOWERMENT through the development of their gifts and talents.
- ✦ THE RIGHT TO A LEARNING ENVIRONMENT THAT VALUES COOPERATION, and challenges its members to critical and reflective thinking in their search for truth.
- ✦ THE RIGHT TO DEVELOP POSITIVE, RESPONSIBLE AND CARING ATTITUDES AND BEHAVIORS TOWARD OTHERS and to recognize the rights of others to be safe and free from harassment and abuse.
- ✦ THE RIGHT TO LEARN RESPONSIBILITY for themselves and their actions.
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[The National Library of Virtual Manipulatives](#)



[Ohio Resource Center](#)



[Math Concepts, Tips, Games and Worksheets](#)



[NCTM Illuminations Site](#)



[Algebra I Activities](#)



[Math for Morons Like Us ~ Exponents](#)

Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 9: Polynomials and Factoring

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Key Ideas and Details 1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 3. Construct viable arguments and critique the reasoning of others.
- 4. Model with mathematics.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Seeing Structure in Expressions

A-SSE Write expressions in equivalent forms to solve problems.

- A-SSE.3a. Factor a quadratic expression to reveal the zeros of the function it defines.
- A-SSE.3b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Arithmetic with Polynomials & Rational Functions

A-APR Perform arithmetic operations on polynomials.

- A-APR.1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

A-APR Understand the relationship between zeros and factors of polynomials.

- A-APR.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 $p(x)$.
- A-APR.3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Essential Questions

- How does the form of an algebraic expression help determine which technique of factoring will work best?
- How do we evaluate and graph polynomial functions?
- How do we add, subtract, and multiply polynomials?
- How do we factor and solve polynomial equations?
- How can simplifying and factoring polynomials help solve real-world problems?
- To what extent will being able to perform arithmetic operations on rational expressions help me?

Content

The students will know

1. Operations on polynomials
2. Factor polynomials
3. Operations with rational expressions
4. Rational equations
5. Quadratic equations
6. Quadratic expressions
7. Remainder theorem

Skills

Bloom's Taxonomy

DOK Links

The students will be able to

1. Describe and compare characteristics of families of functions
 - general shape.
 - number of roots.
 - domain.
 - range.
2. Describe how a change in the value of a constant in a linear or quadratic equation affects the related graphs.
3. Solve real-world problems that can be modeled using appropriate functions.
4. Estimate the solutions for problem situations involving square roots.
5. Demonstrate the relationship among zeros of a function, roots of equations, and solutions of equations graphically and in words.
6. Factor using the following techniques
 - Factor a monomial from a polynomial.
 - Factor binomials by difference of two squares.
 - Factor trinomials.
7. Draw conclusions and patterns using functions or relationships and freely translate among tabular, graphical, and symbolic representations.
8. Use the concepts of operations to calculate monomials and polynomials.

Reading/Writing Skills

1. Define, using context clues, specific vocabulary from the Common Core and apply the terms and definitions to solve problems.
2. Justify solutions, either verbally or in written form.
 - Explain step-by-step process.
 - Summarize results using specific and appropriate vocabulary.
3. Use technology to produce written explanations and justifications for real life and mathematical problems.

Common Core Vocabulary

1. Polynomial
2. Quadratic expression
3. Quadratic equation
4. Rational equation
5. Remainder theorem

Additional Vocabulary

1. Function
2. Closure
3. Domain
4. Range

Learning Experiences (Suggested)

Assessment (Suggested)

1. Class activity/Online learning. Engage students in learning how to factor quadratic equations using the videos for Standard A-SSE.3 and 4 found in the Learn Zillion site or the Khan Academy site. (See Links)
2. Online learning. Have students practice factoring quadratic equations using Chapter 1 and 2 in the *Interactive Mathematics* site. (See Links) Have students write all the problems worked and explain the reasoning used to solve the problems. Share their work with class and discuss the steps used to work with factoring quadratic equations (chapter 1) and completing the square in a quadratic expression (chapter 2).
3. Have students work with a partner to create at least five polynomials. Have them write a story to accompany each polynomial. Finally, have the teams exchange polynomials and solve them. Teams solving the polynomials will explain their reasoning using correct vocabulary.
4. Class activity/Online learning. Engage students in making connections between arithmetic of integers and arithmetic of polynomials (Standards A-APR.1). In order to understand this standard, students need to work toward both understanding and fluency with polynomial arithmetic. Additionally, have students talk about their work using correct vocabulary, such as integer, monomial, polynomial, factor, and term. Use videos found the *Khan Academy* site. (See Links)
5. Working with a partner have students solve the arithmetic of a number of polynomials giving special attention to:
 - a. the use of the distributive property because it is fundamental not only in polynomial multiplication but also in polynomial addition and subtraction
 - b. *closure* - a set is *closed* under an operation if when any two elements are combined with that operation, the result is always another element of the same set.
 - c. the sum (difference or product) of any two polynomials is a polynomial
 Have students justify and explain their work using correct vocabulary.
6. Online learning. Have students practice using and applying the Remainder Theorem using the lesson found in the *Interactive Mathematics* site. (See Links) Have students write all the problems worked and explain the reasoning used to solve the problems. Share their work with class and discuss the steps used in working with the Remainder Theory taking care that correct vocabulary is used.
7. Class activity/Online learning. Engage students in a lesson designed to help them 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. Use the lesson *Rational Zeros of Polynomials* found in the Links or another appropriate site.
8. Have students complete Exercises 1-5 found in the *Rational Zeros of Polynomials* lesson. Have them justify the steps taken in completing the exercise.
9. Culminating activity. Working in teams, or groups of 3-4, have students reinforce their understanding of the concepts learned in this unit by playing FOIL Bingo and the Matching with Polynomials game (See Links).

Factoring Quadratic Equations

Formative: Homework

Students will practice factoring quadratic equations using Chapter 1 and 2 in the *Interactive Mathematics* site. (See Links) They will write all the problems worked and explain the reasoning used to solve the problems. They will share their work with class and discuss the steps used to work with factoring quadratic equations (chapter 1) and completing the square in a quadratic expression (chapter 2).

Creating and Solving Polynomials

Formative: Cooperative Group Work

Students will work with a partner to create at least five polynomials. They will write a story to accompany each polynomial. Finally, teams will exchange polynomials and solve them explaining their reasoning using correct vocabulary.

Arithmetic of Polynomials

Formative: Class Work

Working with a partner students will solve the arithmetic of a number of polynomials giving special attention to:

- a. the use of the distributive property because it is fundamental not only in polynomial multiplication but also in polynomial addition and subtraction
 - b. *closure* - a set is *closed* under an operation if when any two elements are combined with that operation, the result is always another element of the same set.
 - c. the sum (difference or product) of any two polynomials is a polynomial
- Students will justify and explain their work using correct vocabulary.

Remainder Theorem

Formative: Online Learning

Students will practice using and applying the Remainder Theorem using the lesson found in the *Interactive Mathematics* site. (See Links) They will write all the problems worked and explain the reasoning used to solve the problems. They will share their work with class and discuss the steps used in working with the Remainder Theory taking care that correct vocabulary is used.

Rational Zeros of Polynomials

Formative: Homework

Students will complete Exercises 1-5 found in the *Rational Zeros of Polynomials* lesson. They will justify the steps taken in completing the exercise.





[Algebra Help ~ Factoring Completely Lessons](#)



[Learn Zillion ~ Common Core Videos](#)



[The Khan Academy](#)



[Remainder Theorem](#)



[Rational Zeros of Polynomials](#)

Resources (Suggested)

1. iPad Resources
2. Literature Connections
Wilma Unlimited: How Wilma Rudolph Became the World's Fastest Woman by Kathleen Krull
Where the Sidewalk Ends ("Band-Aids," "Eighteen Flavors," "One Inch Tall") by Shel Silverstein
My Little Sister Ate One Hare by Bill Grossman
3. Internet Resources



[Teach Me How to Factor](#)



[Explanation of Polynomials](#)



[Box Method of Factoring Trinomials](#)



[Algebra Games](#)



[iLearn Ohio](#)



[The National Library of Virtual Manipulatives](#)



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[The Khan Academy](#)



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[NCTM Illuminations](#)

Catholic Identity

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Rights of Children

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- ✦ THE RIGHT TO DEVELOP POSITIVE, RESPONSIBLE AND CARING ATTITUDES AND BEHAVIORS TOWARD OTHERS and to recognize the rights of others to be safe and free from harassment and abuse.
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Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 10: Quadratic Functions and Equations

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Key Ideas and Details 1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

- WHST.6-8.6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 4. Model with mathematics.
- 5. Use appropriate tools strategically.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Seeing Structure in Expressions

A-SSE Write expressions in equivalent forms to solve problems.

- A-SSE.3a. Factor a quadratic expression to reveal the zeros of the function it defines.
- A-SSE.3b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Reasoning with Equations & Inequalities

A-RE I Solve equations and inequalities in one variable.

- A-REI.4. Solve quadratic equations in one variable.
- A-REI.4a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
- A-REI.4b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b .

A-RE I Represent and solve equations and inequalities graphically.

- A-REI.10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often

forming a curve (which could be a line).

- A-REI.11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Essential Questions

- Why is it important to know more than one method of solving a quadratic equation?
- What is the relationship among zeros of a function, roots of equations, and solutions of equations?
- In what real-life problems is it appropriate to use a quadratic function?

Content

The students will know

1. Zeros of a quadratic function
2. Roots of a quadratic function
3. Solutions of a quadratic function
4. Quadratic function graphs
5. Quadratic equations in factored form
6. Quadratic formula
7. Discriminant
8. Maximum or minimum value of the function
9. Line of symmetry equation
10. Coordinates of the vertex

Skills

Bloom's Taxonomy

DOK Links

The students will be able to

1. Explain and demonstrate the relationship between zeros of a function, roots of equations, and solutions of equations.
2. Compare characteristics of the quadratic function:
 - general shape
 - number of roots
 - domain
 - range
3. Solve quadratic equations with real roots by:
 - factoring
 - graphing
 - using the quadratic formula
 - with and without technology
4. Explain and describe how a change in the value of a constant in a quadratic equation affects the related graphs.
5. Solve real-world problems that can be modeled using quadratic functions.
6. Use the discriminant to determine the number of solutions of a quadratic function.

Reading/Writing Skills

1. Define, using context clues, specific vocabulary from the Common Core and apply the terms and definitions to solve problems.
2. Justify solutions, either verbally or in written form.
 - Explain step-by-step process.
 - Summarize results using specific and appropriate vocabulary.
3. Use technology to produce written explanations and justifications for real life and mathematical problems.

Common Core Vocabulary

1. Quadratic equation
2. Quadratic formula
3. Standard form of a quadratic equation
4. Line of symmetry
5. Vertex
6. Discriminant

Additional Vocabulary

1. Domain
2. Range
3. Polynomial
4. Rational number
5. Absolute value

Learning Experiences (Suggested)

1. Class activity/Online learning. Engage students in learning how to factor quadratic equations using the videos for Standard A-SSE.3 and 4 found in the Learn Zillion site or the Khan Academy site. (See Links)
2. Online learning. Have students practice factoring quadratic equations using Chapter 1 and 2 in the *Interactive Mathematics* site. (See Links) Have students write all the problems worked and explain the reasoning used to solve the problems. Share their work with class and discuss the steps used to work with factoring quadratic equations (chapter 1) and completing the square in a quadratic expression (chapter 2).
3. Have students work with a partner to create at least five real-world quadratic functions. Have them write a story to accompany each quadratic function. Finally, have the teams exchange the quadratic functions and solve them. Teams solving the problems will explain their reasoning using correct vocabulary.
4. **Cooperative Group Project.** Have groups complete the following task which involves graphing the solutions to a linear inequality in two variables.
Task: In order to raise money, you are planning to work during the summer babysitting and cleaning houses. You earn \$10 per hour while babysitting and \$20 per hour while cleaning houses. You need to earn at least \$1000 during the summer.
 - a. Write an expression to represent the amount of money earned while babysitting. Be sure to choose a variable to represent the number of hours spent babysitting.
 - b. Write an expression to represent the amount of money earned while cleaning houses.
 - c. Write a mathematical model (inequality) representing the total amount of money earned over the summer from babysitting and cleaning houses.
 - d. Graph the mathematical model. Graph the hours babysitting on the x-axis and the hours cleaning houses on the y-axis. (Use the graph to answer the following:
 - 1) Why does the graph only fall in the 1st Quadrant?
 - 2) Is it acceptable to earn exactly \$1000? What are some possible combinations of outcomes that equal exactly \$1000? Where do all of the outcomes that total \$1000 lie on the graph?
 - 3) Is it acceptable to earn more than \$1000? What are some possible combinations of outcomes that total more than \$1000? Where do all of these outcomes fall on the graph?
 - 4) Is it acceptable to work 10 hours babysitting and 10 hours cleaning houses? Why or why not? Where does the combination of 10 hours babysitting and 10 hours cleaning houses fall on the graph? Are combinations that fall in this area a solution to the mathematical model? Why or why not?)
 - e. How would the model change if you could only earn more than \$1000? Write a new model to represent needing to earn more than \$1000. How would this change the graph of the model? Would the line still be part of the solution? How would you change the line to show this? Graph the new model.
(Source: *Mathematics CCGPS Coordinate Algebra Unit 2: Reasoning with Equations and Inequalities*. Georgia Department of Education)

Assessment (Suggested)

Interactive Mathematics

Formative: Class Work

Students will practice factoring quadratic equations using Chapter 1 and 2 in the *Interactive Mathematics* site. (See Links) They will write all the problems worked and explain the reasoning used to solve the problems. They will share their work with class and discuss the steps used to work with factoring quadratic equations (chapter 1) and completing the square in a quadratic expression (chapter 2).

Real-World Quadratic Functions

Formative: Cooperative Group Work

Students will work with a partner to create at least five real-world quadratic functions. They will write a story to accompany each quadratic function. Finally, teams will exchange the quadratic functions and solve them. Teams solving the problems will explain their reasoning using correct vocabulary.

Group Project

Summative: Cooperative Group Work

Cooperative Group Project. Groups will find the solution to all components of the task indicated below which involves graphing the solutions to a linear inequality in two variables. Teams will respond to all questions in the task, draw the graph, justify their reasoning and use correct vocabulary throughout the task.

Task: In order to raise money, you are planning to work during the summer babysitting and cleaning houses. You earn \$10 per hour while babysitting and \$20 per hour while cleaning houses. You need to earn at least \$1000 during the summer. (See Learning Experiences for details.)



[Algebra games!](#)



[Learn Zillion ~ Common Core Videos!](#)



[The Khan Academy!](#)



[Factoring Completely Lessons!](#)



[Solving Equations and Inequalities Graphically!](#)

Resources (Suggested)

1. iPad Resources
2. Literature Connections
Equal Shmequal by Virginia Kroll and Philomena O'Neill
Kiss My Math: Showing Pre-Algebra Who's Boss by Danica McKellar
Do the Math: Secrets, Lies, and Algebra by Wendy Lichtman
Do the Math #2: The Writing on the Wall by Wendy Lichtman
The Unknowns: A Math Mystery by Benedict Carey
3. Internet Resources



[Do the Quad Solve Video!](#)



[Quadratic Formula Song!](#)



[Quadratic Formula Song 2!](#)



[Quadratic Formula Solver!](#)



[Algebra Math Games!](#)



[Graph Sketcher!](#)



[Quadratic Function Explorer!](#)



[Learn Zillion ~ Common Core Videos!](#)



[NCTM Illuminations!](#)



[The National Library of Virtual Manipulatives!](#)

Catholic Identity

Social Justice Teachings

- ✦ Life And Dignity Of The Human Person
- ✦ Call To Family, Community, And Participation
- ✦ Rights And Responsibilities
- ✦ The Dignity Of Work And The Rights Of Workers
- ✦ Solidarity

Rights of Children

- ✦ THE RIGHT TO A CATHOLIC COMMUNITY that witnesses to Christ and the Gospel by protecting them from child abuse, including sexual abuse and neglect.
- ✦ THE RIGHT TO A SAFE ENVIRONMENT that promotes care, protection and security.
- ✦ THE RIGHT TO BE RESPECTED AS INDIVIDUALS with human dignity.
- ✦ THE RIGHT TO WORK ACTIVELY TOWARD THEIR OWN EMPOWERMENT through the development of their gifts and talents.
- ✦ THE RIGHT TO A LEARNING ENVIRONMENT THAT VALUES COOPERATION, and challenges its members to critical and reflective thinking in their search for truth.
- ✦ THE RIGHT TO DEVELOP POSITIVE, RESPONSIBLE AND CARING ATTITUDES AND BEHAVIORS TOWARD OTHERS and to recognize the rights of others to be safe and free from harassment and abuse.
- ✦ THE RIGHT TO LEARN RESPONSIBILITY for themselves and their actions.
- ✦ THE RIGHT TO MAKE RESPONSIBLE DECISIONS founded on religious conviction.



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[The Khan Academy](#)

Mathematics Curriculum ~ Grade 8 Algebra

Diocese of Cleveland



Unit 11: Rational/Radical Expressions and Equations

Standards Assessed

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Reading: Science & Technical Subjects

Craft and Structure 4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12, OH: CCSS: Grades 6-8, Writing

2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

- WHST.6-8.2d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

CCSS: Mathematics (2011), OH: CCSS: Grade 8, Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 3. Construct viable arguments and critique the reasoning of others.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Arithmetic with Polynomials & Rational Functions

A-APR Rewrite rational expressions.

- A-APR.6. Rewrite simple rational expressions in different forms; write $\frac{a(x)}{b(x)}$ in the form $q(x) + \frac{r(x)}{b(x)}$, 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.
- A-APR.7. (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

CCSS: Mathematics (2011), OH: CCSS: HS: Algebra, Reasoning with Equations & Inequalities

A-RE I Understand solving equations as a process of reasoning and explain the reasoning.

- A-REI.2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Essential Questions

- To what extent will being able to perform arithmetic operations on rational expressions help me?
- Why is mathematics considered a universal language?

Content

The students will know

1. Operations on polynomials
2. Operations on rational equations
3. Operations on radical equations
4. Extraneous solutions
5. Dividing polynomials

Skills

Bloom's Taxonomy

DOK Links

The students will be able to

1. Calculate operations on polynomials, including dividing polynomials using long division and synthetic division.
2. Simplify radical expressions by eliminating common factors and

<ul style="list-style-type: none"> ▪ Long division ▪ Synthetic division 	<p>applying properties of integer exponents.</p> <ol style="list-style-type: none"> 3. Differentiate between solutions and extraneous solutions. 4. Calculate on radical expressions. <p>Reading/Writing Skills</p> <ol style="list-style-type: none"> 1. Define, using context clues, specific vocabulary from the Common Core and apply the terms and definitions to solve problems. 2. Justify solutions, either verbally or in written form. <ul style="list-style-type: none"> ▪ Explain step-by-step process. ▪ Summarize results using specific and appropriate vocabulary. 3. Use technology to produce written explanations and justifications for real -ife and mathematical problems.
<p>Common Core Vocabulary</p> <ol style="list-style-type: none"> 1. Radical expression 2. Radical equation 3. Rational expression 4. Rational equation 5. Extraneous solution 6. Synthetic division 	<p>Additional Vocabulary</p> <ol style="list-style-type: none"> 1. Rational number 2. Common factors 3. Properties of integer exponents 4. Solution
<p>Learning Experiences (Suggested)</p> <ol style="list-style-type: none"> 1. Class activity/Online learning. Engage students in learning how to rewrite simple rational expressions in different forms; write $\frac{a(x)}{b(x)}$ in the form $q(x) + \frac{r(x)}{b(x)}$, 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. Use the videos for Standard A-APR.6 found at the <i>Learn Zillion</i> site or another appropriate site. (See Links) 2. Following the lesson using the videos for Standard A-APR.6 have students work with a partner to provide an 3-5 examples for each of the following: <ol style="list-style-type: none"> a. rewriting simple rational expressions using inspection b. rewriting rational expressions using division c. rewriting rational expressions by seeing the expression as division of the numerator by the denominator 3. Class activity/Online learning. Engage students in understanding that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression. Use the videos for Standard A-APR.7 found at the <i>Learn Zillion</i> site or another appropriate site. (See Links) 4. Given a number of rational expressions, have students add, subtract, multiply, and divide them. For each problem, have them justify their work using correct vocabulary. 5. Class activity/Online learning. Engage students in solving simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. Use videos for Standard A-REI.2 found in the <i>Learn Zillion</i> site or another appropriate site. (See Links) 6. Following the lesson using the videos for Standard A-REI.2 have students work with a partner to provide an 3-5 examples for each of the following: <ol style="list-style-type: none"> a. finding extraneous solutions in rational algebraic equations 	<p>Assessment (Suggested)</p> <p>Rewriting Rational Expressions Formative: Class Work</p> <p>Students will work with a partner to provide an 3-5 examples for each of the following:</p> <ol style="list-style-type: none"> a. rewriting simple rational expressions using inspection b. rewriting rational expressions using division c. rewriting rational expressions by seeing the expression as division of the numerator by the denominator <p>Working With Rational Numbers Formative: Homework</p> <p>Given a number of rational expressions, students will add, subtract, multiply, and divide them. For each problem, they will justify their work using correct vocabulary.</p> <p>Rational and Radical Algebraic Expressions Formative: Class Work</p> <p>Students will work with a partner to provide an 3-5 examples for each of the following:</p> <ol style="list-style-type: none"> a. finding extraneous solutions in rational algebraic equations b. solving radical algebraic expressions c. finding extraneous solutions in algebraic radical expressions d. solving rational expressions using additive and multiplicative inverses

- b. solving radical algebraic expressions
 - c. finding extraneous solutions in algebraic radical expressions
 - d. solving rational expressions using additive and multiplicative inverses
7. Culminate the unit having the students work with a partner to reinforce their understanding of the concepts learned by using the *Long Division* and *Synthetic Division* videos found in the Links.



[Long Division Videos](#)



[Synthetic Division examples](#)



[Learn Zillion ~ Common Core Videos](#)

Resources (Suggested)

1. iPad Resources
2. Literature Connection
 - A Gebra Named Al: A Novel* by Wendy Isdell
 - Equal Shmequal* by Virginia Krolland Philomena O'Neill
 - Kiss My Math: Showing Pre-Algebra Who's Boss* by Danica McKellar
 - Do the Math: Secrets, Lies, and Algebra* by Wendy Lichtman
 - Tuck Everlasting* by Natalie Babbitt
3. Internet Resources



[Simplifying Rational Expressions Tutorial](#)



[Simplifying Rational Expressions Calculator](#)



[Simplifying Radicals problems with step by step solutions](#)



[iLearn Ohio](#)



[The Khan Academy](#)



[Learn Zillion ~ Common Core Videos](#)



[Ohio Resource Center ~ Math Educators](#)



[The National Library of Virtual Manipulatives](#)



[Algebra Basics](#)

Catholic Identity

Social Justice Teachings

- ✚ Life And Dignity Of The Human Person
- ✚ Call To Family, Community, And Participation
- ✚ Rights And Responsibilities
- ✚ The Dignity Of Work And The Rights Of Workers
- ✚ Solidarity

Rights of Children

- ✚ THE RIGHT TO A CATHOLIC COMMUNITY that witnesses to Christ and the Gospel by protecting them from child abuse, including sexual abuse and neglect.
- ✚ THE RIGHT TO A SAFE ENVIRONMENT that promotes care, protection and security.
- ✚ THE RIGHT TO BE RESPECTED AS INDIVIDUALS with human dignity.
- ✚ THE RIGHT TO WORK ACTIVELY TOWARD THEIR OWN EMPOWERMENT through the development of their gifts and talents.
- ✚ THE RIGHT TO A LEARNING ENVIRONMENT THAT VALUES COOPERATION, and challenges its members to critical and reflective thinking in their search for truth.
- ✚ THE RIGHT TO DEVELOP POSITIVE, RESPONSIBLE AND CARING ATTITUDES AND BEHAVIORS TOWARD OTHERS and to recognize the rights of others to be safe and free from harassment and abuse.
- ✚ THE RIGHT TO LEARN RESPONSIBILITY for themselves and their actions.
- ✚ THE RIGHT TO MAKE RESPONSIBLE DECISIONS founded on religious conviction.



[NCTM Illuminations](#)

PARENT GUIDE

GRADE EIGHT ALGEBRA CURRICULUM

DIOCESE OF CLEVELAND

Below is a list of skills your child will be taught in Grade Eight Algebra.

As parents, you are encouraged to support the work of your child's teacher in helping your child acquire each of these skills.

NUMBER SYSTEM	
KNOW THAT THERE ARE NUMBERS THAT ARE NOT RATIONAL, AND APPROXIMATE THEM BY RATIONAL NUMBERS.	
	Understand informally that every number has a decimal expansion; the rational numbers are those with decimal expansions that terminate in 0s or eventually repeat. Know that other numbers are called irrational.
	Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2).
EXPRESSIONS AND EQUATIONS	
EXPRESSIONS AND EQUATIONS WORK WITH RADICALS AND INTEGER EXPONENTS.	
	Know and apply the properties of integer exponents to generate equivalent numerical expressions.
	Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.
	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
ANALYZE AND SOLVE LINEAR EQUATIONS AND PAIRS OF SIMULTANEOUS LINEAR EQUATIONS.	
	Solve linear equations in one variable.
	Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers).
	Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
	Analyze and solve pairs of simultaneous linear equations.
	Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
	Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.
	Solve real-world and mathematical problems leading to two linear equations in two variables.
UNDERSTAND THE CONNECTIONS BETWEEN PROPORTIONAL RELATIONSHIPS, LINES, AND LINEAR EQUATIONS.	
	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.
	Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b .

FUNCTIONS

DEFINE, EVALUATE, AND COMPARE FUNCTIONS.

	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.
	Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

USE FUNCTIONS TO MODEL RELATIONSHIPS BETWEEN QUANTITIES.

	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
	Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

ALGEBRA, SEEING STRUCTURE IN EXPRESSIONS

INTERPRET THE STRUCTURE OF EXPRESSIONS.

	Interpret expressions that represent a quantity in terms of its context.
	Interpret parts of an expression, such as terms, factors, and coefficients.
	Interpret complicated expressions by viewing one or more of their parts as a single entity.
	Use the structure of an expression to identify ways to rewrite it.

WRITE EXPRESSIONS IN EQUIVALENT FORMS TO SOLVE PROBLEMS.

	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
	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.
	Factor a quadratic expression to reveal the zeros of the function it defines.
	Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

ALGEBRA, CREATING EQUATIONS

CREATE EQUATIONS THAT DESCRIBE NUMBERS OR RELATIONSHIPS.

	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.
	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
	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.
	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

ALGEBRA, REASONING WITH EQUATIONS & INEQUALITIES

REPRESENT AND SOLVE EQUATIONS AND INEQUALITIES GRAPHICALLY.

	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
	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.
	Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

SOLVE SYSTEMS OF EQUATIONS.

	Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

UNDERSTAND SOLVING EQUATIONS AS A PROCESS OF REASONING AND EXPLAIN THE REASONING.

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

SOLVE EQUATIONS AND INEQUALITIES IN ONE VARIABLE.

	Solve quadratic equations in one variable.
	Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
	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 .

ALGEBRA, ARITHMETIC WITH POLYNOMIALS & RATIONAL FUNCTIONS

PERFORM ARITHMETIC OPERATIONS ON POLYNOMIALS.

	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.
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UNDERSTAND THE RELATIONSHIP BETWEEN ZEROS AND FACTORS OF POLYNOMIALS.

	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 $p(x)$.
	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.

REWRITE RATIONAL EXPRESSIONS.

	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.
	Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

STATISTICS & PROBABILITY	
INVESTIGATE PATTERNS OF ASSOCIATION IN BIVARIATE DATA.	
	Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
	Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
STATISTICS/PROBABILITY, CONDITIONAL PROBABILITY & THE RULES OF PROBABILITY	
UNDERSTAND INDEPENDENCE AND CONDITIONAL PROBABILITY AND USE THEM TO INTERPRET DATA.	
	Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).
	Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
USE THE RULES OF PROBABILITY TO COMPUTE PROBABILITIES OF COMPOUND EVENTS IN A UNIFORM PROBABILITY MODEL.	
	Use permutations and combinations to compute probabilities of compound events and solve problems.
DOC : Numbers, Number Sense and Operations	
NUMBER AND NUMBER SYSTEMS	
	Recognize that natural numbers, whole numbers, integers, rational numbers, and irrational numbers are subsets of the real number system.
	Demonstrate an understanding of the properties of the rational number system; e.g., order, and reciprocals.
MEANING OF OPERATIONS	
	Apply order of operations to simplify expressions and perform computations involving integer exponents and radicals.
COMPUTATION AND ESTIMATION	
	Add, subtract, multiply, divide, and compare numbers written in scientific notation.
DOC: Patterns, Functions and Algebra	
PATTERNS, RELATIONS, AND FUNCTIONS	
	Describe and represent relations and functions with tables, graphs, words, and symbols.
ALGEBRAIC REPRESENTATION	
	Describe the relationship between the graph of a line and its equation, including being able to explain the meaning of slope as a constant rate of change.
	Solve systems of linear equations graphically and by simple substitution.
ANALYZE CHANGE	
	Differentiate and explain types of changes in mathematical relationships, such as linear vs. nonlinear, direct variation vs. inverse variation.
	Describe and compare how changes in an equation affect the related graphs; e.g., for a linear equation changing the coefficient of x affects the slope and changing the constant affects the intercepts.
	Use calculators or computers to analyze change; e.g., interest compounded over time as a nonlinear growth pattern.

MATHEMATICS CURRICULUM

GRADE EIGHT – ALGEBRA

CHECKLIST FOR COMMON CORE STATE STANDARDS & DIOCESAN CURRICULUM

DATE TAUGHT	
NUMBER SYSTEM	
KNOW THAT THERE ARE NUMBERS THAT ARE NOT RATIONAL, AND APPROXIMATE THEM BY RATIONAL NUMBERS.	
	Understand informally that every number has a decimal expansion; the rational numbers are those with decimal expansions that terminate in 0s or eventually repeat. Know that other numbers are called irrational.
	Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2).
EXPRESSIONS AND EQUATIONS	
EXPRESSIONS AND EQUATIONS WORK WITH RADICALS AND INTEGER EXPONENTS.	
	Know and apply the properties of integer exponents to generate equivalent numerical expressions.
	Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.
	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
ANALYZE AND SOLVE LINEAR EQUATIONS AND PAIRS OF SIMULTANEOUS LINEAR EQUATIONS.	
	Solve linear equations in one variable.
	Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers).
	Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
	Analyze and solve pairs of simultaneous linear equations.
	Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
	Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.
	Solve real-world and mathematical problems leading to two linear equations in two variables.
UNDERSTAND THE CONNECTIONS BETWEEN PROPORTIONAL RELATIONSHIPS, LINES, AND LINEAR EQUATIONS.	
	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.
	Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at b .

DATE TAUGHT	
FUNCTIONS	
DEFINE, EVALUATE, AND COMPARE FUNCTIONS.	
	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.
	Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.
USE FUNCTIONS TO MODEL RELATIONSHIPS BETWEEN QUANTITIES.	
	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
	Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.
ALGEBRA, SEEING STRUCTURE IN EXPRESSIONS	
INTERPRET THE STRUCTURE OF EXPRESSIONS.	
	Interpret expressions that represent a quantity in terms of its context.
	Interpret parts of an expression, such as terms, factors, and coefficients.
	Interpret complicated expressions by viewing one or more of their parts as a single entity.
	Use the structure of an expression to identify ways to rewrite it.
WRITE EXPRESSIONS IN EQUIVALENT FORMS TO SOLVE PROBLEMS.	
	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
	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.
	Factor a quadratic expression to reveal the zeros of the function it defines.
	Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
ALGEBRA, CREATING EQUATIONS	
CREATE EQUATIONS THAT DESCRIBE NUMBERS OR RELATIONSHIPS.	
	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.
	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
	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.
	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

DATE TAUGHT	
ALGEBRA, REASONING WITH EQUATIONS & INEQUALITIES	
REPRESENT AND SOLVE EQUATIONS AND INEQUALITIES GRAPHICALLY.	
	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
	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.
	Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
SOLVE SYSTEMS OF EQUATIONS.	
	Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
UNDERSTAND SOLVING EQUATIONS AS A PROCESS OF REASONING AND EXPLAIN THE REASONING.	
	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.
	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
SOLVE EQUATIONS AND INEQUALITIES IN ONE VARIABLE.	
	Solve quadratic equations in one variable.
	Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
	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 .
ALGEBRA, ARITHMETIC WITH POLYNOMIALS & RATIONAL FUNCTIONS	
PERFORM ARITHMETIC OPERATIONS ON POLYNOMIALS.	
	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.
UNDERSTAND THE RELATIONSHIP BETWEEN ZEROS AND FACTORS OF POLYNOMIALS.	
	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 $p(x)$.
	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.
REWRITE RATIONAL EXPRESSIONS.	
	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.
	Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

DATE TAUGHT	
STATISTICS & PROBABILITY	
INVESTIGATE PATTERNS OF ASSOCIATION IN BIVARIATE DATA.	
	Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
	Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
	Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
STATISTICS/PROBABILITY, CONDITIONAL PROBABILITY & THE RULES OF PROBABILITY	
UNDERSTAND INDEPENDENCE AND CONDITIONAL PROBABILITY AND USE THEM TO INTERPRET DATA.	
	Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).
	Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
USE THE RULES OF PROBABILITY TO COMPUTE PROBABILITIES OF COMPOUND EVENTS IN A UNIFORM PROBABILITY MODEL.	
	Use permutations and combinations to compute probabilities of compound events and solve problems.
DOC : Numbers, Number Sense and Operations	
NUMBER AND NUMBER SYSTEMS	
	Recognize that natural numbers, whole numbers, integers, rational numbers, and irrational numbers are subsets of the real number system.
	Demonstrate an understanding of the properties of the rational number system; e.g., order, and reciprocals.
MEANING OF OPERATIONS	
	Apply order of operations to simplify expressions and perform computations involving integer exponents and radicals.
COMPUTATION AND ESTIMATION	
	Add, subtract, multiply, divide, and compare numbers written in scientific notation.
DOC: Patterns, Functions and Algebra	
PATTERNS, RELATIONS, AND FUNCTIONS	
	Describe and represent relations and functions with tables, graphs, words, and symbols.
ALGEBRAIC REPRESENTATION	
	Describe the relationship between the graph of a line and its equation, including being able to explain the meaning of slope as a constant rate of change.
	Solve systems of linear equations graphically and by simple substitution.
ANALYZE CHANGE	
	Differentiate and explain types of changes in mathematical relationships, such as linear vs. nonlinear, direct variation vs. inverse variation.
	Describe and compare how changes in an equation affect the related graphs; e.g., for a linear equation changing the coefficient of x affects the slope and changing the constant affects the intercepts.
	Use calculators or computers to analyze change; e.g., interest compounded over time as a nonlinear growth pattern.

